

SUPPORTING MATERIALS

for

Deliberative Public Engagement with Science: An Empirical Investigation

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Please note that the data has been checked and cleaned and de-identified and qualitative data is only available by request. Aspects of the data and some of the limitations are included in the detailed methods files associated with each study. For questions or to notify the authors of any issues associated

with the data or methods, contact

Lisa M. PytlikZillig at lpytlikz@nebraska.edu.

Study 2 Detailed Methods¹

1. Study Overview

Study 2, conducted in the spring of 2011, used experimental methods to examine the effects of (1) critical thinking prompts and (2) organization of information (both during reading activities), and (3) peer discussion during group discussion activities. We examined impacts of our manipulations on engagement, knowledge gains, and attitudes toward nanotechnology as well as toward deliberation.

2. Methods

2.1. Participants

Participants were 192 students (52.7% female) enrolled in a freshman-level introductory biology course at the University of Nebraska-Lincoln during the spring semester of 2011. The average age of participants was 19 (SD=2 years), with ages ranging from 17 to 30 years old. Participants included primarily first (58%) and second (28%) year students, and fewer students in their third (10%) or fourth years (or beyond) (4%). The majority of students (76%) came from science-related majors, with Biological Science (25%) having the most representation. Only five of the participants did not answer the political party question. Of those answering, the plurality of participants reported an affiliation with the Republican party (41%), while 24% reported an affiliation with the Democratic party and 35% identified as independent or other.

2.2. Participant Recruitment and Consent

All of the activities described here were part of course requirements. However, students could choose whether or not to allow researchers to use their data in the research. Prior to activities relevant to this study, at approximately mid-semester, students were informed that the researchers wished to examine different methods of engaging people with ethical, legal and social issues (ELSI) topics in

¹ Any statistics reported in this document can be reproduced using the Study 2 Methods SPSS syntax and Study 2 data set. The syntax generally follows the order of this report but may include additional analyses not reported here.

science, and therefore would like to analyze their data from the course activities. Students were assured of their confidentiality and told that allowing the use of their data would provide no immediate benefits to them, and would have no impact on their grade in the course. Further, they were informed that their instructor would not know who consented and who did not.

A total of 198/229 (86%) of the students present at the beginning of the activities gave consent for their data to be used in study analyses. At the end of the activities, students were given an opportunity to revisit their decision to consent to research: 82% (168 of 205) of those present indicated their willingness to participate at that time, including 148 who had given consent at the beginning of the activities, 15 additional persons who had not given consent in Assignment 1, and 5 persons with missing data during Assignment 1. Twenty-six students gave consent during assignment 1 but then retracted that consent during Assignment 4.

The final participants were 192 students out of an estimated 237 students in the course (83%). This included participants who gave consent to use their data in the last assignment (n=168), and those who were missing data at the last assignment but had given consent during the first assignment (n=24).

2.3. Research Design Overview

This study used a 3 (cognitive goal, manipulated during Assignment 2, A2) x 2 (social context, manipulated during Assignment 3, A3) between-groups, repeated measure design.

As with the other studies in this series, this study consisted of multiple assignments completed over time. In this study, there were four assignments similar to those used in other studies, and one final extra credit assignment (Assignment 5, A5) used to explore alternative methods of evoking deliberation. The pre-measures were administered at the beginning of the study (in mid-January) and the other assignments were completed near the end of the semester in April and May. Each of the assignments were completed using an online interface to facilitate data collection. These assignments were designed to simulate a typical public engagement exercise, including background reading on the subject of nanotechnology and opportunities to offer opinions about hypothetical ethical scenarios involving application of nanobiological technologies. Repeated measures were used to assess student knowledge and attitudes throughout the exercises.

Assignments also included experimental manipulations of factors that commonly vary between different public engagement activities. Assignments 1 (A1) and 4 (A4) did not include any engagement-related experimental manipulations.² A1 was designed to measure a variety of existing attitudes, prior knowledge, and demographics. A4 was designed to measure a variety of post-engagement attitudes, knowledge, and outcomes. A5 was a pilot of additional methods for evoking deliberation.

In Assignment 2 (A2), students completed an online assignment in which they read a background document pertaining to applications of nanotechnology with a focus on nanogenetics and nanomedicine. Students were randomly assigned by the online survey software to receive one of three different versions of this background assignment. Specifically, the background document varied in the instructions used. As detailed below, the instructions aimed to either motivate simple engagement by asking students to give feedback on what they found to be interesting or surprising, to motivate information organization which might facilitate memory and understanding of alternative perspectives, or to motivate critical thinking, which might focus students on the quality and relevance of evidence for differing perspectives.

In Assignment 3 (A3), students were asked to consider hypothetical future scenarios involving the ethical implications of nanotechnology. Using a 2-group between-group design, students were randomly assigned either to complete this condition alone or to complete it as part of a small group of

² A4 did manipulate the wording of the request for re-consent. Wording differences are shown in Appendix A, Assignment 4. The wording did not appear to have differential effects.

peers, with each group being homogenous in respect to the conditions used in Assignment 2.

2.4. Procedures and Experimental Manipulations

Students were required to complete the assignments as part of the course, but their responses were not graded. To get credit, at the end of each assignment, the web-based assignment interface provided a confirmation page that students could print or email to their instructors, showing they did the assignment. The online materials/surveys and measures used in each assignment are included as Appendix A.

2.4.1. Assignment 1 (A1): Introduction and Pre-measures

A1 was homework assigned near the beginning of the semester which consisted of questions regarding their own demographic characteristics, their previous *experience* with and *knowledge* of issues related to ELSI and nanotechnology, their *attitudes* towards nanotechnology as well as the scientists who study it and the policymakers who regulate it, and a variety of individual traits such as *need for cognition*, *dispositional trust* and *deliberative values*. See Appendix A for all A1 premeasures.

2.4.2. Assignment 2 (A2): Background Reading (3-group design)

A2 was assigned during approximately week 12 of the 15 week semester. This second assignment presented a background document on nanotechnology and ELSI issues in science. Prior to this assignment participants had received little exposure to nanotechnology in class. The exception was a brief exercise requiring participants to read an article discussing the recent advances in molecular therapy in treating muscular dystrophy as well as a short video about the future possibilities of human enhancement through advances in nanotechnology. As participants were relatively unfamiliar with the topic, during A2 they were provided with a brief background document on nanotechnology and nanogenomics. The background document was designed to be a primer and introduce participants to nanotechnology in general. It also provided participants with information about the specific topic under discussion, nanogenomics, and included peer-reviewed information suggested by the nanoscientists³ on the project as well as information from other resources. Included in this document were a number of ways in which nanotechnology is currently being used as well as its potential future applications. In the document were links to various websites that provided additional information beyond what was covered. All participants received identical background documents, regardless of experimental condition. Participants were told that they needed to read the background document as part of the course requirements, but were free to explore the links to additional information as much or as little as they wished.

Regardless of experimental condition, A2 began with a set of questions that assessed participants' familiarity with nanotechnology and nanogenomics, their opinion about the risk vs. benefit of nanogenomics, and their opinion about the amount of regulation is needed in this field of research and development. Participants were then given three questions (randomly assigned out of six possible questions) that assessed more specific knowledge about nanotechnology and nanogenomics. Examples of questions asked are, "Which of the following are areas of *current* nanogenomic research and

³ The authors would like to thank Professors Joseph A. Turner and Yuris Dzenis (University of Nebraska-Lincoln) for their help in gathering material for the background document.

development?”, “What does RNAi stand for?”, and “For what purpose are DNA ‘scaffolds’ manufactured?” After answering this series of questions, participants engaged in one of three cognitive goals: feedback, learning/information organization, and analyze/critical thinking.

Feedback. In the feedback assignment, participants were instructed to first download and read the background document. After participants had read the document, they were asked to “list five insights, realizations, reactions, or new things that you learned as a result of reading the background document or exploring the additional resources in that document.” Participants in the feedback condition were then asked to explore additional information about nanotechnology and nanogenomics by reading through articles and websites or watching short videos linked to the background document. Participants were then asked if they had viewed the additional information and to what extent, and then to rate each additional resource. The next part of the feedback assignment asked participants to give their feedback on the background document and additional resources. They were asked to comment on what they found most interesting in the sources they had read or viewed, what questions they still had about nanogenomics, and something they did *not* like about the background document or additional resources.

Learning/Information organization. In this assignment, participants again downloaded and read the background document. Next, participants were then asked to list what *some people* claim are positive benefits to nanogenomics research, and then rate to what extent they agree with the claims, or more with an opposing response. Participants repeated this exercise three more times, listing: what *some people* claim are negatives or risks of nanogenomics research, what *some people* claim are reasons for (pro) heavy regulation, and finally what *some people* claim are reasons for not having heavy regulation. Again, each time participants were also asked to rate to what extent they agree with the claims they identified.

Analyze/Critical thinking. In this assignment, after downloading and reading the background document, students were asked to judge the relevancy, accuracy, typicality, and sufficiency (RATS) of claims made in the document, following a common framework for critical thinking (Fulkerson, 1996). To introduce students to critical thinking in a systematic way, students were exposed to examples of critical thinking in an area unrelated to nanotechnology (i.e., judging quality of laundry detergent). Next, they were given some claims about nanotechnology to rate using the RATS framework. Finally, they were asked to choose their own claims about nanotechnology to analyze using the RATS framework.

Final Questions. Following one of the cognitive goals exercises, all participants were asked two overarching questions: one dealing with the risks vs. benefits of nanogenomics research and development, and one asking their opinion on the amount of regulation needed for nanogenomics research and development. In their explanation, participants were asked to be *specific* and *justify* their answers. Finally, all participants evaluated the assignment, the background document, and any additional resources they may have used.

Other procedures: Framing lecture. During the same week as the A2 reading was assigned, one of the project principal investigators and a seasoned instructor gave a 45-minute lecture to the all students in the course about the use of public engagement to inform policies around new technologies, and the importance of considering ethical, legal and social issues (ELSI) during the development of new technologies. The lecture used interactive approaches to enhancing student engagement with the material (e.g., posing multiple choice questions shown on a screen which students could answer) and considered questions such as whether or not regulation of science might stymie innovation and advancement, how science is a reflection of and part of society, and how science should be regulated.

Toward the end of the lecture, the discussion turned specifically to the importance of gathering public input around nanotechnology developments and the importance of studies like ours, which examine *how* to best obtain such public input. (See Appendix B for lecture outline.)

2.4.3. Assignment 3 (A3): Consideration of Ethical Scenarios (2-group design).

A week after receiving the reading assignment, students were asked to consider a series of hypothetical future ethical scenarios. Appendix C provides the full text of the ethical scenarios which focused on memory enhancement, cystic fibrosis preventions, and improving the nutritional value of foods through genetic modification.

Social context conditions. Students were randomly assigned to work on Assignment 3 ethical scenarios either alone or in a group of their peers. Each group was led by an outside moderator trained by the research team. Students who completed the assignment alone simply responded to each of the scenarios without any discussion with other students.

After they were finished considering the scenarios, students completed a survey consisting of items measuring their overall *attitudes* towards nanotechnology and their levels of *engagement* while completing the in-class discussion assignment.

2.4.4. Assignment 4 (A4): “Final” Views (Post-measures)

Assignment 4: Post measures. Assignment 4 (A4) was assigned immediately after the in-class discussions with instructions to students that they should complete it within the next week. This last assignment involved completing a post survey of attitudes and knowledge about nanotechnology. Specific items included questions regarding their *attitudes* about and *knowledge* of nanotechnology generally as well as the scientists who study it and the policymakers who regulate it, a variety of individual traits first recorded in A1, and an overall *evaluation* of all activities included in the study. In addition, measures of *policy acceptance* and *preferences* were administered, as were measures of whether and why students changed their minds on any issues.

2.4.5. Assignment 5 (A5): Pilot Study of other Deliberative Methods

In Assignment 5 (A5), students were asked to complete additional measures of personality traits from the five-factor-model (FFM) and then randomly assigned to a critical thinking or information organization condition that had been revised from the prior conditions. Thus, it is possible that students were in the critical thinking or information organization conditions twice (if they had been in one of them in A2). In the revised version of the critical thinking condition, students were asked to use the RATS framework to rate claims that we had gleaned from prior participants in our research (pilot study 1, data which is not released due to lack of time to fully clean and document for broad use). Meanwhile, the information organization condition was reformulated to emphasize student focus and analysis on “opposing perspectives” and also upon areas of potential agreement as well as disagreement between perspectives.

At the end of the A5 exercises all students were asked to report whether and why their attitudes changed and to rate how they engaged with the assignment and its perceived usefulness and quality.

2.5. Outcome Measures

The next sections present descriptions of all of the measures included throughout this study. A full set of the materials and measures used in each assignment are included as Appendix A.

2.5.1. Knowledge and Experience

Subjective knowledge. At Assignment 2 (pre), two questions were asked and averaged ($\alpha = .82$) to assess participants' subjective knowledge regarding nanotechnology. These included: "How familiar are you with nanotechnology?" as well as "How familiar are you with how nanotechnology is used in genetics research and development?" These items were created for the present study to reference the background information that students would read about. Response options to these three items fell along a five-point scale ranging from "not at all familiar" to "extremely familiar."

Subjective learning. In A4, students were also asked to assess whether and how much they learned about nanotechnology from completing the assignments. They were asked: "How much do you feel you learned about nanotechnology and drug delivery as a result of working on the public engagement module last week and this week?" with a scale of five responses ranging from "nothing that I didn't know before" to "a great deal."

Objective knowledge. A series of objective knowledge questions were used to measure knowledge and learning throughout the study. These items bear resemblance to items used in other studies of public knowledge of nanotechnology (e.g., Cobb & Macoubrie, 2004; Lee, Scheufele, & Lewenstein, 2005; Xenos, Becker, Anderson, Brossard, & Scheufele, 2011), with some items created based on the background information presented to the students.

No objective knowledge questions were asked in A1.

In A2, knowledge questions included six questions, but students only completed a randomly selected subset of three of the questions. Examples of multiple choice questions include "Which of the following are areas of current nanogenomic research and development?" and "Which of the following activities are current examples of "human enhancement"? Check all that apply."

In A4, students were asked to revisit the questions used in A1 as well as some additional questions. The methods and scales syntax available in the supplementary documentation examines the quality of the questions used in A4.

2.5.2. Attitudes toward Nanotechnology and Attitude Change

Repeated single item measures. Two attitude questions were asked repeatedly across assignments. The first question asked students whether they felt the risks outweighed the benefits of nanotechnology research and development or vice versa (e.g., "Based on what you know right now: Do you think the risks of nanogenomics research and development outweigh the benefits? Alternatively, do you think the benefits outweigh the risks?" A2post_riskben). Students selected responses from a five-point (in A1) or seven-point (in other assignments) scale ranging from "the risks greatly outweigh the benefits" to "the benefits greatly outweigh the risks". Risk versus benefit items have been commonly used in prior research on public attitudes toward nanotechnology (e.g., see review by Satterfield, Kandlikar, Beaudrie, Conti, & Harthorn, 2009).

The second item (administered in A2 and after, but not in A1) asked students "In your opinion, how much regulation is needed with respect to nano-biological research and development?" Students indicated their response on a scale from 0 to 100 with 0 indicating that no regulation is needed and 100 indicating that every aspect of such research should be highly regulated.

Self-reports of opinion change. In Assignment 4, students were asked "Overall, from the time

you began these exercises, until now, to what extent did you change your mind about the risk/benefits question above?” and whether they changed their mind “about the regulation question” (1= not at all, 5 = a great deal). Using the same response scale, they also were asked “To what extent did the following influence the final views that you gave above?” with items including “Talking about the issue with others” as well as the background information, their own research, and other factors.

General attitudes toward nanotechnology. In Assignments 1 and 4, students were presented with various general goals of nano-biological research and development and asked to assess each on a five-point scale ranging from “unimportant” to “incredibly important.” Examples of these items included the statements “minimizing potential risks for humans,” “minimizing potential environmental risks,” and “studying the social and ethical impacts and implications of future developments and regulations.” If the items were combined into a single scale, the reliability of the scale decreased slightly from A1 to A4 ($\alpha = .83$ to $.74$).

In both A1 and A4, after these rating items, students were then asked to consider the finite resources that are available for such goals, and asked to ascribe to each some percentage of resources dedicated to nanotechnology regulation and development to each goal (with the sum of all goals equaling 100%). They were instructed to give their top priorities the largest share of resources.

Students also were asked whether they agreed or disagreed with six statements concerning nanotechnology research and regulation. These items were obtained or adapted from prior research (Hamlett & Cobb, 2006; Scheufele & Lewenstein, 2005). These were divided into three subscales. Responses fell on a six-point Likert scale ranging from “strongly disagree” to “strongly agree.” To create the *Risks/Concerns subscale*, three items were averaged to measure the extent to which students felt the risks associated with nanotechnology were significant ($\alpha = .72, .74$, in A1 and A4 respectively). These included “The risk of nanotechnology directly affecting physical things like human health, wildlife, or the environment in general is currently too high;” “The risk of nanotechnology affecting social systems like the economy, trade, and sustainable food supply is currently too high;” and “Due to the fact that some have expressed strong concern about nanotechnology's risks, we should have a world ban on new nanotechnology products.” To create the *support/pro-nanotechnology subscale*, two items were averaged to measure the extent to which students felt the benefits associated with nanotechnology were more significant than potential risks ($\alpha = .41, .39$). These included “We should develop nanotechnology at full speed despite its possible risks, in order to keep the U.S. from falling behind other countries” and “There are serious ethical problems associated with not quickly developing nanotechnologies.” Finally, one item assessed the extent to which students trusted certain authorities to effectively manage the risks and promote the benefits associated with nanotechnology: “The government will effectively manage any risks associated with nanotechnology.”

Likelihood/Importance of specific risks and benefits. In Assignments 1 and 4, students were asked to consider a list of potential risks and benefits from nanotechnology research and to rate them according to both their relative importance and likelihood to be realized. These items were taken or adapted from prior research on public attitudes toward nanotechnology (Cobb & Macoubrie, 2004; Lee et al., 2005). Examples of potential risks/benefits include “The extension of human life expectancy” and “Unforeseen side-effects.” Responses fell on two different scales. The first, concerning likelihood, was a five-point scale ranging from “not at all likely” to “extremely likely.” The second, concerning importance, was a five-point scale ranging from “Unimportant” to “Extremely important.”

2.5.3. Familiarity with and Trust and Confidence in Nanoscientists and Policymakers.

Important note: Students were assigned to report their trust in policymakers OR nanoscientists

(randomly assigned) at A1 and A4 such that approximately one-half the sample responded about nanoscientists, and one-half responded about policymakers, at each time point. The random assignment at A4 was independent of assignment at A1.

Familiarity with nanoscientists or policymakers. In A1 and A4, students were asked three questions designed to assess their familiarity with nanoscientists (A1, $\alpha = .76$; A4, $\alpha = .70$) or policy makers (A1, $\alpha = .84$; A4, $\alpha = .86$). Examples of these items include “How much do you know about nanoscientists (policymakers)?”; “To what extent have you had more experiences or interactions with nanoscientists (policymakers)?” and “To what extent do you feel certain in your views about nanoscientists (policymakers)?” Responses were recorded on a five-point scale ranging from “not at all” to “a great deal” (although no participants chose ‘a great deal’).

Confidence and perceived trustworthiness/distrustworthiness of nanoscientists and policy makers. In A1 and A4 students were asked a series of five questions to determine their level of confidence in nanoscientists, or five questions to determine their level of confidence in policymakers. Some questions began with the phrase “To what extent do you have confidence in nanoscientists to...”. Examples of these items include “do their jobs well?” and “meet their professional responsibilities?” Responses fell on a five-point scale ranging from “not at all” to “a great deal.”

In A1 and A4, students were also asked a series of additional questions to determine their specific perceptions of nanoscientists’ or policymakers’ trustworthiness, distrustworthiness, competence, and specific trustworthiness related to nanotechnology. The stem for these items was “To what extent do you feel nanoscientists [policymakers] probably...” Responses were recorded on a five-point scale ranging from “not at all” to “a great deal.”

2.5.4. Process and policy acceptance

To assess acceptability of policies resulting from experimentally varied public engagement procedures, in A4, students were randomly assigned to read one of two hypothetical scenarios wherein the government used a public engagement process similar to the one they just participated in to help determine the shape of new nanotechnology regulations. In the first scenario, the *pro-nanotechnology* scenario, it was reported that most Americans involved in a public engagement identical to the one the students had engaged in were enthusiastic about nanotechnology, and the government decided to dramatically increase its investment in related research and development. In the second, the *pro-regulation* scenario, it was reported that most people were skeptical of nanotechnology, and the government decided to dramatically increase its regulation of related research and development. Because participants had been randomly assigned to the scenario, they were approximately equally likely to receive a scenario consistent with or against their personal views.

Students were then asked after each scenario whether they agreed or disagreed with five statements evaluating the government’s decision-making process (5 items with negative items reversed scored, $\alpha = .89$). Examples of these items include the statements “The process used by the government to make decisions about this issue was fair,” “The government should have used a different process to get public input about this issue” (reversed) and “The government made the right choices with regard to this issue.” Responses fell on a six-point scale ranging from “strongly disagree” to “strongly agree.”

Finally, so that we would know whether the randomly assigned policy/decision scenario was consistent with their preferences or not, participants were asked whether they would favor or be opposed one of two randomly assigned specific policies related to nanotechnology. Use of two similar but different questions was designed to help assess how question wording might be impacting

participant responses. The first read “If legislation were being considered that would slow down nanogenomics research and development in the area of human enhancement by decreasing funding and increasing restrictions...” and the second read “If legislation were being considered that would speed up nanogenomics research and development in the area of human enhancement by increasing funding and decreasing restrictions...” After each, students were asked “Would you be FOR or AGAINST such legislation?” Responses fell on a six-point scale ranging from “strongly AGAINST” to “strongly FOR.”

2.6. Predictor and Control Variables

2.6.1. Demographics

Demographic questions were assessed in A1 and included reports of participant age, gender, year in school, and major. Students were also asked to identify whether, on average, they consider themselves an “A, B, C, or D” student, and were asked the highest level of education achieved by both their mother and father.

2.6.2. Individual Differences, Personality and Motivation

Experience with ELSI. To control for any effects related to previous exposure to ELSI, students were asked in Assignment 1 two questions to identify how often ELSI had been incorporated into previous coursework. The first of these asked students to identify, on a five-point scale, “About how much previous academic work have you done that covered ethics (human, animal, environmental)?” Response options included none, a little, some, a moderate amount, and a great deal. The second question simply asked “How many courses have you taken in the past that touched on ethics (human, animal, environmental)?”

A variety of scales were used to assess student individual differences and personality characteristics during A1. Unless otherwise noted, items were accompanied by a six-point Likert scale ranging from “strongly disagree” to “strongly agree.” Each measure is described in greater detail below (for a full list of items contained in each, see Appendix A). In A4, students were asked to complete short versions of several of the scales. In A5, additional personality measures were administered.

Need for cognition. In A1, a set of seven items were averaged to measure the extent to which students were inclined to invest effort in cognitive activities ($\alpha = .83$). Examples of these items include the statements “The notion of thinking abstractly is appealing to me” and “Thinking is not my idea of fun.” These items were taken from Cacioppo and Petty (1982); and Cacioppo, Petty, Feinstein, and Jarvis (1996).

Right-wing Authoritarianism. Right wing authoritarianism (Adorno, Frenkel-Brunswik, Levinson, & Stanford, 1950; Altemeyer, 1981) was assessed with four items (e.g., “Obedience and respect for authority are the most important virtues children should learn”) and had a Cronbach’s alpha of .47.

Disposition to trust. In A1, eight items assessed a student’s general inclination to trust others ($\alpha = .85$). Items included five from the International Personality Identity Pool (<http://ipip.ori.org>) (e.g., “I believe that others have good intentions,” “I trust what people say,” and “I believe most people try to be fair”). Three other items were bi-polar items accompanied by a 10-point scale instead of the usual 6-point scale and taken from the National Opinion Research Center (1994) (e.g., “Generally speaking, on a scale of 1 to 10, would you say that most people can be trusted, or that you can’t be too careful in dealing with people?”)

Other Five-Factor Model (FFM) Personality Traits. Items from the International Personality Identity Pool (<http://ipip.ori.org>) were also used to assess FFM traits in A5. Each trait was assessed with 10 items, including trait openness ($\alpha = .76$), extraversion ($\alpha = .84$), emotional stability ($\alpha = .83$), agreeableness ($\alpha = .79$), and conscientiousness ($\alpha = .81$).

Political efficacy. In A1 and A4, a set of six items, was averaged to measure a student's evaluation of their own ability to meaningfully participate in the political process ($\alpha = .78, .80$). Examples of these items include the statements "Sometimes politics and government seem so complicated that a person like me can't really understand what's going on" and "I consider myself well-qualified to participate in politics." These statements were adapted from similar items used in the American National Election Study (2000).

Political motivation. Three types of political motivation were assessed in both A1 and A4: intrinsic, introjected, and extrinsic. The items used for these measures were adapted from Koestner, Losier, Vallerand, and Carducci (1996) and Losier and Koestner (1999). Koestner and colleagues' items were similar except that they asked participants to select from a range of responses to a general question (e.g. "Why do you follow current events?" with potential responses including "Because I am supposed to" and "For the pleasure of doing it). Our items also differed in that they explicitly identified social issues in addition to political issues and current events. Specifically, three items in A1 and A4 were averaged to measure the extent to which a student felt motivated to be politically engaged by factors that are *intrinsic* to their concept of self (A1, A4, $\alpha s = .84, .88$). These included the statements "I follow political [social] issues because I want to learn more things" and "I follow political [social] issues because I think it's important."⁴ The extent to which a student felt motivated to be politically engaged by factors they had internalized from outside sources (*introjected motivation*) was assessed with two items (A1, A4, $\alpha s = .78, .74$). These included items such as "I follow political [social] issues because it bothers me when I don't." The extent to which a student felt motivated to be politically engaged by external factors (*extrinsic motivation*) was assessed with two items (A1, A4, $\alpha s = .88, .89$).

Deliberative values. In A1 and A4, a set of five items was averaged to measure the extent to which a student valued deliberation as an element of active citizenship ($\alpha s = .81, .80$). These included the statements "A good citizen should listen to people who disagree with them politically" and "A good citizen should be willing to justify their political views." These items were taken from Muhlberger and Weber (2006).

2.6.3. Political attitudes

The remainder of the individual difference variables were administered only in A1.

Interest in politics. Two items ($\alpha = .58$ when averaged) were used to measure the extent of a student's interest in political issues. These included the questions "How interested are you in *national* politics and *national* affairs?" and "Thinking about your community, how interested are you in *local* community politics and *local* community affairs?" Answers were recorded on a seven-point scale ranging from "not interested" to "extremely interested." These questions were based on similar items used in the Citizen Participation Study (1990).

⁴ Note that in A4 the items referred only to following social issues and A2 referred only to following political issues.

Political ideology. Students were asked to assess their political ideology in three general areas: “overall,” “when it comes to ECONOMIC issues” and “when it comes to SOCIAL issues.” Responses were recorded on a seven-point scale ranging from “strongly liberal” to “strongly conservative”. “Prefer not to answer” was also provided as a possible response and treated as missing. These items were based on similar self-assessments used in Rosenstone, Behr, and Lazarus (1996).

Political affiliation. Students were asked to identify themselves on a seven-point scale ranging from “strong Democrat” to “strong Republican,” with “Independent/Other” in the middle. This item was based on a similar assessment included in the American National Election Study (2000).

Trust (Confidence) in institutions. Confidence in institutions generally was assessed using items following the stem “Consider the following institutions. Please indicate how much confidence you have in each of the following institutions.” Nineteen institutions ranging from local to national were listed (e.g., Congress, Office of the Nebraska Governor). The response scale ranged on a five-point scale from “no confidence” to “complete confidence.”

2.7. Process Measures

2.7.1. Engagement

Engagement. Because participant engagement is believed to be an important element of either public education or the solicitation of public policy input, a scale was generated to measure student engagement during the background reading exercise. This consisted of statements beginning with the phrases “As I worked on this assignment, I felt...” (e.g., interested, annoyed) and “As you worked on this assignment, to what extent did you do the following:” (e.g., “Explored topics related to the subject in order to satisfy my own curiosity”). Students were asked to indicate the extent to which they had experiences reflected in each statement on a five-point scale ranging from “not at all” to “a great deal.” Engagement items are discussed in more detail in PytlikZillig et al. (2013). The items were divided into subscales using the method described in that paper. Specific items following each prompt were given in random order by the survey program, so that items for each of the different forms of engagement were intermixed. These items were presented at the end of Assignments 2, 3 and 5. The Study 2 methods and scales contains syntax identifying possible combinations of items to form subscales.

2.7.2. Evaluation measures

Background document and Assignment evaluation. After completing this background reading in A2, participants were asked to evaluate the document by indicating how strongly they agreed or disagreed with a series of descriptive statements beginning with the stem “Overall, to what extent did the BACKGROUND DOCUMENT and ASSIGNMENT, used together, help to...” (e.g., “Compare the positives and negatives related to nanogenomics”). These items were administered also at the end of A5. Responses were recorded on a five-point scale ranging from “not at all” to “a great deal.”

After A2, students were also asked to “Complete the statements below regarding the BACKGROUND document and your ASSIGNMENT” separately on the same five-point scale. The stem for these items was “The BACKGROUND DOCUMENT [ASSIGNMENT] was...” (e.g., interesting, biased, boring).

After completing the exercises associated with each of the hypothetical scenarios in A3, students were asked to rate “Overall, how useful were the activities today for helping you to think more about Nanogenomics and preparing you to answer the two overarching questions?” The same question

was asked at the end of A5. Students answered using a five-point scale ranging from “not at all” to “extremely.”

2.8. Open-ended Questions

The main open-ended questions asked throughout the assignments were as follows. These may be considered process or outcome variables depending on how the answers are used.

Open-ended expression of nanotechnology attitudes: At the end of Assignments 2 and 4 students were asked to write two short answer outlining their perspective on nanotechnology risk/benefits and regulations. The essays focused on the students’ own perspective, and asked them to “a. Be specific about what you think are the most important benefits and drawbacks/risks of nanogenomics especially in the areas of human enhancement. Please especially consider the social, legal and ethical benefits and drawbacks (or issues) that you see as relevant to nanogenomics, particularly in the area of human enhancement. b. Justify WHY you think either the risks or benefits outweigh the other.” Meanwhile, the regulation question asked them to “a. Be specific about what guidelines, rules, regulations, or other means should be established and which ones should not be established, in order to help ensure that important benefits of nanogenomics are achieved and that harms/drawbacks are avoided, especially in the area of nanogenomics and human enhancement. b. Justify WHY you think those regulations should or should not be in place.” In Assignment 5, students were also asked to explain their answers to the risk/benefit and/or the regulations questions with the added instruction to “MOST IMPORTANTLY: If your opinions have changed as a result of doing this assignment, please explain how and why they changed.”

2.9. Data Quality Measures

We also included in our measures questions related to data quality. In A2, A4, and A5 we directly asked participants if they answered the questions honestly (vs. randomly, without reading, or felt they should answer in a certain way that differed from their honest response). In all, about 90% of respondents indicated giving honest answers to each assignment.

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4. Appendices

4.1. Appendix A – All Assignments

APPENDIX A: Study 2 Survey Questions and materials

4.1.1. Study 2 Assignment 1

Note that in many/most cases the order of the items and answer options (e.g., on multiple choice questions) were administered by the survey software in random order to reduce order effects.

Q184 *Are changes needed in biology education? to ensure that biology majors are equipped to work across traditional subdisciplinary boundaries? to provide biology curricula that equip physical scientists and engineers to take advantage of advances in biological science? and to provide nonscientists with a level of biological understanding that gives them an informed voice regarding relevant policy proposals?* --From "A New Biology for the 21st Century: Ensuring the United States Leads the Coming Biology Revolution"

Q211 PLEASE NOTE

This assignment should take less time than a single recitation period, and is best done in one sitting.

If you leave it and come back, you will need to use the same computer and browser, and have browser cookies enabled, in order to continue where you left off. Otherwise you will have to start over.

[Certain information, highlighted, is removed from the data file for purposes of de-identification.]

a1_RECI Please indicate which Bio 102 recitation you are enrolled in (see list below if you aren't sure):

☐ Recitation section number (151-157) (1)

Recitation instructor name (4)

Q4 **About the "New Biology Issues" Assignments** If you did not yet read the description of the New Biology assignments on Blackboard, please read it now here (it will open in a new window or tab). You will be asked some questions about what you read when you are finished. When you are done reading, click continue.

TA1_2 Timing

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A1purp **What will be the main purpose of the "New Biology Issues" activities you will be completing this semester?**

- ☐ To practice thinking about the social implications of science (e.g., of new technologies in biology) (1)
- ☐ To learn about "new" biological organisms that have been discovered (2)
- ☐ To make new discoveries in cell biology (e.g., work with classmates to discover new biological mechanisms) (3)

A1activ **Which of the following are the four New Biology activities that will be used this semester? (check four)**

- ☐ The current online assignment you are completing right now (1)
- ☐ A lecture (2)
- ☐ An analysis of a New Biology Issue (3)
- ☐ An extra credit opportunity (4)
- ☐ A lab experiment (5)
- ☐ A group presentation on New Biology (6)

A1trfal **Indicate whether each of the following are True or False:**

	True (1)	False (2)
Allowing researchers to use my New Biology assignment data will NOT improve my grade in this course, and refusing to allow them to use it will NOT hurt my grade. (1)	☐	☐
The New Biology Assignments are required parts of the course regardless of whether or not a student gives consent to let researchers conduct research on their assignments. (2)	☐	☐
My data will be kept confidential (i.e., my name will be removed) if I	☐	☐

give consent for researchers to analyze it. (3)		
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Q186 Please note... All of the above T/F questions should have been answered "True." If you did not answer one or more of them "True," please re-read the information here as well as the consent form on the next page. :-)

TA1-3 Timing

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[consent language was included here, in original survey]

a1CONSENT Do you consent to participate in the research by allowing us to use your coursework-related data as indicated above?

☐ Yes (1)

☐ No (2)

a1OPTIONAL Please also check next to any of the following optional activities you might be willing to participate in:

☐ I would be willing to be part of a videotaped discussion group (during recitation) (1)

☐ I would be willing to take part in a 30-minute interview (outside of class) (2)

☐ I would be willing to have my interview audiotaped or videotaped (3)

TA1-4 Timing

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Q189 **SOCIETY & YOU (Section 1 of 5)**

The next questions ask you to think about your place in larger society, and what you think about other social actors.

a1PARTYID In politics today, do you consider yourself a Republican, Democrat, or Independent?

- ☐ Strong Democrat (1)
- ☐ Democrat (2)
- ☐ Weak and Leaning Democrat (3)
- ☐ Independent / Other (4)
- ☐ Weak and Leaning Republican (5)
- ☐ Republican (6)
- ☐ Strong Republican (7)

a1IDEOLOGY Ideologically, which of the following best describes you...

	Strongly Liberal (1)	Moderately Liberal (2)	Weakly Liberal (3)	Centrist / Middle of the Road (4)	Weakly Conservative (5)	Moderately Conservative (6)	Strongly Conservative (7)
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- Overall (1)
- When it comes to ECONOMIC issues (2)
- When it comes to SOCIAL issues (6)

a1intrtloc Thinking about your local community, how interested are you in local community politics and local community affairs?

- ☐ Not Interested 0
- ☐ 1
- ☐ 2
- ☐ Moderately Interested 3
- ☐ 4
- ☐ 5
- ☐ Extremely Interested 6

a1intrtnat How interested are you in national politics and national affairs?

- ☐ Not Interested 0
- ☐ 1

- ☐ 2
☐ Moderately Interested 3
☐ 4
☐ 5
☐ Extremely Interested 6

TA1-5 Timing

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a1instconf **Consider the following institutions. Please indicate how much confidence you have in each of the following institutions.**

No confidence (1)	Very little confidence (2)	Some confidence (3)	A lot of confidence (4)	Complete confidence (5)
----------------------	-------------------------------	------------------------	----------------------------	----------------------------

Executive branch of the federal government (i.e., the President) (5)

United States Supreme Court (9)

Congress (11)

The United States military (12)

Office of the Nebraska Governor (13)

Nebraska Legislature (14)

Nebraska State Courts (15)

Lincoln City government (16)

The Nebraska Department of Natural Resources (18)

University of Nebraska (19)

Banks and financial services (1)

Major companies (2)

Organized religion (3)

Education (4)

Organized labor (6)

Press (7)

Water regulatory agencies (17)

The scientific community (10)

TV news (8)

Q153 ABOUT NEW BIOLOGY & NANOTECHNOLOGY (Section 2 of 5)

The "New Biology" issues that you think about later in the semester will involve thinking about biological applications of nanotechnology.

Most of you probably do not know much about nanotechnology -- that is OK! You will have a chance to change your answers at the end of the semester once you know more. For now, just do the best you can to answer all of the questions, even if you have to guess.

a1Nanorate **First, when it comes to nanotechnology, how important are the following to you?**

	Unimportant (1)	Slightly important (2)	Important (3)	Very important (4)	Incredibly important (5)
--	-----------------	------------------------	---------------	--------------------	--------------------------

Making decisions about the most important directions for nanotechnology development (1)

Minimizing potential risks for humans (2)

Minimizing potential environmental risks (4)

Studying the social and ethical impacts and implications of nanotechnology (3)

Maximizing potential benefits (5)

a1Nano_sum **There are, of course, only a limited number of resources (time, effort, money) that can be spent on each of the things that you rated above.**

So, please consider what percentage of the U.S. resources (i.e., total time, effort, and money) should be spent on each. Make sure that your percentages sum to 100%, and make sure that you give the items you rated the most important the greatest percentage of resources.

Making decisions about the most important directions for nanotechnology development : _____ (1)

Minimizing potential risks for humans : _____ (2)

Minimizing potential environmental risks : _____ (4)

Studying the social and ethical impacts and implications of nanotechnology : _____ (3)

Maximizing potential benefits : _____ (5)

Total : _____

TA1_7 Timing

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a1riskben **Which of the statements below best expresses your present belief about nanotechnology applied to biology?**

- ☐ The risks will probably SIGNIFICANTLY exceed the benefits. (1)
- ☐ The risks will probably SLIGHTLY exceed the benefits. (2)
- ☐ The risks and benefits will probably be about EQUAL. (3)
- ☐ The benefits will probably SLIGHTLY exceed the risks. (4)
- ☐ The benefits will probably SIGNIFICANTLY exceed the risks. (5)

a1ATTPRE04 **Read each of the following statements, and then indicate to what degree you agree or disagree.**

Do your best to answer -- it's OK if you feel uncertain about your answers, because you will have a chance to change your mind at the end of the semester.

Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Slightly Agree (4)	Agree (5)	Strongly Agree (6)
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Nanotechnology is one of the more important issues confronting government. (5)

The risk of nanotechnology directly affecting physical things like human health, wildlife, or the environment in general is currently too high. (6)

The risk of nanotechnology affecting social systems like the economy, trade, and sustainable food supply is currently too high. (4)

The government will effectively manage any risks associated with nanotechnology. (3)

We should develop nanotechnology at full speed despite its possible risks, in order to keep the U.S. from falling

behind other countries. (2)

Due to the fact that some have expressed strong concern about nanotechnology's risks, we should have a world ban on new nanotechnology products. (1)

a1ATTPRE02 Below are seven benefits of nanotechnology that some say are possible.

Drag and drop the items to rank them in order of importance such that

1 = most important benefit, and

7 = least important benefit.

Just give your personal opinion. There is no right or wrong answer.

- _____ New and better ways to clean up the environment (1)
- _____ The ability to improve humans through genetic manipulation (2)
- _____ Increased national security and defense capabilities (3)
- _____ Cheaper, longer lasting consumer products (4)
- _____ New and better ways to treat and detect human diseases (5)
- _____ A greater utilization of renewable energy (6)
- _____ The ability to use nanomedicines to improve human mental capacities (7)

a1ATTPRE03 Below are seven risks of nanotechnology that some say are possible.

Drag and drop the items to rank them in order of importance such that

1 = most worrisome risk, and

7 = least worrisome risk.

Just give your personal opinion. There is no right or wrong answer.

- _____ Economic disruption caused by the loss of traditional jobs (1)
- _____ Losing your personal privacy to tiny new surveillance devices (2)
- _____ A nanotechnology inspired arms race between the U.S. and other nations (3)
- _____ New health problems for people due to the use of nanomedicine (4)
- _____ Unexpected problems due to the use of nanogenomics to alter genetic code (5)
- _____ Pollution of the environment by nanomaterials (6)
- _____ Breathing tiny nano-sized particles that accumulate in your body (7)

First Click (1)
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Q207 NANOMEDICINE & NANOGENOMICS (Section 3 of 5)

The two topics you will talk most about later in the semester will be nanomedicine (e.g., drug delivery) and nanogenomics (genetics and nanotechnology). Please answer the following questions regarding these specific topics.

a1ATTPRE05 NANOMEDICINE

By being able to deliver medicines and other substances at the nanoscale, some people say that the benefits in the chart below would be within reach.

Based on what you know right now, how *likely* do you think it is that each of these potential benefits will become a reality?

And how *important* do you think each potential benefit is to achieve?

Likelihood (1)					How important do you think this benefit is? (2)				
Not at all likely (1)	Slightly likely (2)	Somewhat likely (3)	Very likely (4)	Extremely likely (5)	Unimportant (1)	Slightly Important (2)	Somewhat Important (3)	Very Important (4)	Extremely important (5)

The extension of human life expectancy (1)
 Cheap and more universal healthcare (2)
 Fewer side effects (3)
 Higher rate of terminal illness (e.g. cancer) survival (4)
 Improvement of individuals' physical abilities and muscle function (5)
 Improvement of individuals' mental abilities and brain function (6)

a1ATTPRE06 NANOGENOMICS

By funding and advancing research on nanotechnology and GENETICS, some people say that the effects in the chart below eventually would be incurred.

Based on what you know right now, how *likely* do you think it is that each of these potential effects will become a reality as a result of nanogenomics research?

And how important do you think it is to either achieve the benefits or avoid the drawback?

Likelihood (1)					Do you see this effect as a benefit or drawback? (2)		In your opinion, how <u>important</u> is this benefit or drawback to achieve or avoid? (3)				
Not at all likely (1)	Slightly likely (2)	Somewhat likely (3)	Very likely (4)	Extremely likely (5)	Benefit (1)	Drawback (2)	Not at all (1)	Slightly (2)	Some what (3)	Very (4)	Extremely (5)

Drastic reductions in the effects of aging (1)
 The creation of "designer babies" (aka, "super babies") (2)
 No more passing on of genetic diseases to one's offspring (3)
 A new eugenics movement (4)
 Unforeseen side-effects (5)
 The eradication of genetic inheritance of disease (6)
 Economic development through investment and research (7)
 Siphoning of US funds away from more important purposes related to the immediate economic crisis (8)

TA1-9 Timing

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A1confsci1 **NANOSCIENTISTS** (Section 4 of 5)

Next indicated how you feel about the nanoscientists responsible for researching and making discoveries involving nanotechnology.

Not at all (1)	Just a little	Some (3)	Quite a bit	A great deal
----------------	---------------	----------	-------------	--------------

		(2)		(4)	(5)
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- How much do you know about nanoscientists? (1)
- To what extent have you had experiences or interactions with nanoscientists? (2)
- To what extent do you feel certain in your views about nanoscientists? (3)

Q117 Please make the following judgments based on whatever knowledge or experience you have right now. Don't worry if you don't have much knowledge and experience yet, just indicate your gut-level feelings and impressions.

It's ok if you have to guess -- at the end of the semester you'll have a chance to indicate if you have changed your mind.

A1confsci2 Right now, to what extent do you have confidence in nanoscientists to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
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- Do their jobs well (1)
- Meet their professional responsibilities (2)
- Meet their ethical responsibilities (3)
- Go above and beyond what is expected of them professionally in order to better society (4)
- Go above and beyond what is expected of them professionally in order to protect society from risks (5)

A1confsci3 To what extent do you feel nanoscientists probably...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
--	-------------------	----------------------	----------	-----------------	---------------------

- Are trustworthy (1)
- Are untrustworthy (2)
- Are honest (3)
- Are ethical (4)
- Are dishonest (5)
- Are fair (6)
- Are competent to do their jobs (7)
- Are incompetent to do their jobs (8)

- Have the knowledge needed to do their jobs well (9)
- Have the skills needed to do their jobs well (10)
- Have the training needed to do their jobs well (11)
- Use fair procedures when making decisions (12)
- Listen to everyone's opinion (13)
- Treat people fairly (14)
- Care about the community they serve (15)
- Are impartial to their findings (16)
- Reach the correct conclusions (17)
- Reach conclusions that are best for everyone (18)
- Care about people like you, your friends, and your family (19)
- Are concerned with how their work impacts everyday people (20)
- Care about how their work affects culture (21)
- Care about the long-term impacts of their work (22)
- Are motivated to "do the right thing" (23)
- Are likely to do the right thing because they see themselves as "good" (24)
- Would feel bad about themselves if their work put others at risk (25)
- Need oversight (26)
- Are primarily motivated by self-interest (27)
- Are primarily motivated by what will profit them (28)
- Are primarily motivated by what will benefit them personally (29)
- Will do the right thing only if they are punished for doing the wrong thing (30)
- Don't really care about the long-term risks of their work (31)

TA1_9b Timing

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Click Count (4)

A1confsci4

When it comes to nanotechnology, to what extent do you feel nanoscientists can be trusted to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
--	-------------------	----------------------	----------	-----------------	---------------------

- Make decisions about the most important directions for nanotechnology development (1)
- Minimize potential risks for humans (2)
- Minimize potential environmental risks (4)

- Think about the social and ethical impacts and implications of nanotechnology (3)
- Maximize potential benefits (5)

A1confsci5 **When it comes to nanotechnology, to what extent do you feel nanoscientists are capable of...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
• Making decisions about the most important directions for nanotechnology development (1) • Minimizing potential risks for humans (2) • Minimizing potential environmental risks (4) • Thinking about the social and ethical impacts and implications of nanotechnology (3) • Maximizing potential benefits (5)					

A1confsci6 **When it comes to nanotechnology, to what extent do you feel nanoscientists are motivated to...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
• Make decisions about the most important directions for nanotechnology development (1) • Minimize potential risks for humans (2) • Minimize potential environmental risks (4) • Think about the social and ethical impacts and implications of nanotechnology (3) • Maximize potential benefits (5)					

TA1_10 Timing

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A1confpol1 **POLICY MAKERS (Section 4 of 5)**

Next, please indicate how you feel about the policy makers responsible for regulating and making laws involving nanotechnology.

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
--	----------------	-------------------	----------	-----------------	------------------

- How much do you know about policy makers who regulate nanotechnology? (1)
- To what extent have you had experiences or interactions with these policy makers? (2)
- To what extent do you feel certain in your views about these policy makers? (3)

Q169 Please make the following judgments based on whatever knowledge or experience you have right now. Don't worry if you don't have much knowledge and experience yet, just indicate your gut-level feelings and impressions.

It's ok if you have to guess -- at the end of the semester you'll have a chance to indicate if you have changed your mind.

A1confpol2 To what extent do you have confidence in policy makers who help regulate nanotechnology to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
--	----------------	-------------------	----------	-----------------	------------------

- Do their jobs well (1)
- Meet their professional responsibilities (2)
- Meet their ethical responsibilities (3)
- Go above and beyond what is expected of them professionally in order to better society (4)
- Go above and beyond what is expected of them professionally in order to protect society from risks (5)

A1confpol3 To what extent do you feel policy makers who help regulate nanotechnology...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Are trustworthy (1) Are untrustworthy (2) Are honest (3) Are ethical (4)					

Are dishonest (5)

Are fair (6)

Are competent to do their jobs (7)

Are incompetent to do their jobs (8)

Have the knowledge needed to do their jobs well (9)

Have the skills needed to do their jobs well (10)

Have the training needed to do their jobs well (11)

Use fair procedures when making decisions (12)

Listen to everyone's opinion (13)

Treat people fairly (14)

Care about the community they serve (15)

Are impartial to their findings (16)

Reach the correct conclusions (17)

Reach conclusions that are best for everyone (18)

Care about people like you, your friends, and your family (19)

Are concerned with how their decisions impact everyday people (20)

Care about how their decisions affect culture (21)

Care about the long-term impacts of their work (22)

Are motivated to "do the right thing" (23)

Are likely to do the right thing because they see themselves as "good" (24)

Would feel bad about themselves if their decisions put others at risk (25)

Need oversight (26)

Are primarily motivated by self-interest (27)

Are primarily motivated by what will profit them (28)

Are primarily motivated by what will benefit them personally (29)

Will do the right thing only if they are punished for doing the wrong thing (30)

Don't really care about the long-term risks of their decisions (31)

TA1-11 Timing

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A1confpol4

When it comes to nanotechnology, to what extent do you feel policy makers can be trusted to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Make decisions about the most important directions for nanotechnology development (1)					
Minimize potential risks for humans (2)					
Minimize potential environmental risks (4)					
Think about the social and ethical impacts and implications of nanotechnology (3)					
Maximize potential benefits (5)					

A1confpol5 **When it comes to nanotechnology, to what extent do you feel policy makers are capable of...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Making decisions about the most important directions for nanotechnology development (1)					
Minimizing potential risks for humans (2)					
Minimizing potential environmental risks (4)					
Thinking about the social and ethical impacts and implications of nanotechnology (3)					
Maximizing potential benefits (5)					

A1confpol6 **When it comes to nanotechnology, to what extent do you feel policy makers are motivated to...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Make decisions about the most important directions for nanotechnology development (1)					
Minimize potential risks for humans (2)					
Minimize potential environmental risks (4)					
Think about the social and ethical impacts and implications of nanotechnology (3)					
Maximize potential benefits (5)					

TA1_12 Timing

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Click Count (4)

Demographics

Q187 DEMOGRAPHICS & BACKGROUND (Section 5 of 5) If you gave consent for your assignment data to be used for research and evaluation, then the next questions will help the researchers as they analyze the data for patterns. Also, they will report averages of these (e.g., average age) in any published reports, without identifying any individuals -- but your data will only be included in these summaries if you gave consent for them to be included.

[Note that some variables only administered at one time point, and not expected to change, may not have the 'a1' designation.]

Age

What is your age? (1)

gender

What is your gender?

- ☐ Male (1)
- ☐ Female (2)

Year

What is your year in school?

- ☐ Freshman (1)
- ☐ Sophomore (2)
- ☐ Junior (3)
- ☐ Senior (4)
- ☐ Graduate student (5)
- ☐ Other (6)

A1MAJOR What is your major?

	Biochemistry (3)	Biological science	Biological Science	Chemistry (5)	Pre- Med (6)	Pre-Vet (4)	Psychology (8)	Other (7)
--	---------------------	-----------------------	-----------------------	------------------	-----------------	----------------	-------------------	--------------

		(1)	Engineering (2)					
(1)								

A1MajorTxt **If you answered "Other" to the above question, or if you have more than one major, please type in your other or additional major here.**

grades

On average, would you say you are you an A, B, C, or D student?

- ☐ an "A" student (1)
- ☐ a "B" student (2)
- ☐ a "C" student (3)
- ☐ a "D" student (4)

A1_momedu **What is the highest level of education of your mother?**

- ☐ I don't know (9)
- ☐ Did not complete high school (1)
- ☐ Completed high school (2)
- ☐ Completed some post-secondary education, but no degree (3)
- ☐ Received a 2-year degree, e.g., associate's degree (4)
- ☐ Received a 4-year college degree, e.g., B.A., B.S., etc. (5)
- ☐ Completed some post-graduate courses, but no additional degree (6)
- ☐ Received a 2-year post-graduate degree (e.g., M.A., M.S., etc) (7)
- ☐ Received a 4-year post-graduate degree (e.g., Phd, D.Ed, etc) (8)

a1_dadedu **What is the highest level of education of your father?**

- ☐ I don't know (9)
- ☐ Did not complete high school (1)

- ☐ Completed high school (2)
- ☐ Completed some post-secondary education, but no degree (3)
- ☐ Received a 2-year degree, e.g., associate's degree (4)
- ☐ Received a 4-year college degree, e.g., B.A., B.S., etc. (5)
- ☐ Completed some post-graduate courses, but no additional degree (6)
- ☐ Received a 2-year post-graduate degree (e.g., M.A., M.S., etc) (7)
- ☐ Received a 4-year post-graduate degree (e.g., Phd, D.Ed, etc) (8)

a1_ethcla **About how much previous academic work have you done that covered ethics (human, animal, or environmental)?**

- ☐ None (1)
- ☐ A little (2)
- ☐ Some (3)
- ☐ A moderate amount (4)
- ☐ A great deal (5)

a1_ethcla2 **How many courses have you taken in the past that touched on ethics (human, animal, or environmental)?**

- ☐ 0 (1)
- ☐ 1 (2)
- ☐ 2 (3)
- ☐ 3 (4)
- ☐ 4 (5)
- ☐ 5 (6)
- ☐ More than 5 (7)

TA1_13 Timing

First Click (1)

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Q209 This is the last page of questions! Because people with different personalities and likes and dislikes react differently to different tasks, the next questions ask about your beliefs, preferences, and personality.

a1DISPT1 Generally speaking, on a scale of 1 to 10, would you say that most people can be trusted, or that you can't be too careful in dealing with people?

- ☐ You can't be too careful. (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ Most people can be trusted. (10)

a1DISPT2 On a scale of 1 to 10, do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair?

- ☐ Most people would try to take advantage of me. (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)

- ☐ Most people would try to be fair. (10)

a1DISPT3 On a scale of 1 to 10, would you say that most of the time people try to be helpful or that they are mostly looking out for themselves?

- ☐ Most of the time, people look out for themselves. (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ 6 (6)
- ☐ 7 (7)
- ☐ 8 (8)
- ☐ 9 (9)
- ☐ Most of the time, people try to be helpful. (10)

a1TRAITS Please indicate your level of agreement with the following statements. Please answer these as honestly as you can. Also, the questions are meant to be easy and are most accurate if you give your first "gut reaction" rather than thinking too hard about them.

	Extent of Agreement					
	Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Slightly Agree (4)	Agree (5)	Strongly Agree (6)
I distrust people (1)						
I trust what people say (2)						
I believe that others have good intentions (3)						
I suspect hidden motives in others (4)						
I believe most people try to be fair (5)						
The notion of thinking abstractly is appealing to me (6)						
I like to have the responsibility of handling a situation that requires a lot of thinking. (7)						
Thinking is not my idea of fun. (8)						
I try to anticipate and avoid situations where there is likely a chance I will have to think in depth about something (9)						
I really enjoy a task that involves coming up with new solutions to problems. (10)						
Learning new ways to think doesn't excite me very much (11)						
I usually end up deliberating about issues even when they do not affect me personally (12)						

A good citizen should listen to people who disagree with them politically (13)

A good citizen should allow others to challenge their political beliefs (14)

A good citizen should discuss politics with those who disagree with them (15)

A good citizen should be willing to justify their political views (16)

If a citizen is dissatisfied with the policies of government, he or she has a duty to do something about it. (17)

I follow political issues because I want to learn new things. (18)

I follow political issues because that's what I'm expected to do. (19)

I follow political issues because it bothers me when I don't. (20)

Being politically conscious is important to who I am. (21)

I follow political issues because that's what I'm supposed to do. (22)

I follow political issues because I will feel bad about myself if I don't. (23)

I follow political issues because I think it's important. (24)

I consider myself well-qualified to participate in politics. (25)

People like me don't have any say about what the government does. (26)

Sometimes politics and government seem so complicated that a person like me can't really understand what's going on. (27)

I think that I am better informed about social issues than other students. (28)

I feel I have a pretty good understanding of current social issues facing my world. (29)

I consider myself well qualified to provide input on social issues. (30)

Obedience and respect for authority are the most important virtues children should learn. (31)

In these troubled times laws have to be enforced without mercy, especially when dealing with the agitators and revolutionaries who are stirring things up. (32)

The self-righteous "forces of law and order" threaten freedom in our country a lot more than most of the groups they claim are "radical" and "godless". (33)

Atheists and others who have rebelled against the established religions are no doubt every bit as good and virtuous as those who attend church regularly. (34)

TA1_14 Timing

First Click (1)

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Q213 New Biology Assignment 1 -- Completion Certificate -- That's it! You are done!
Please print this page for your records, or write down the information below, as evidence that you completed the assignment. Your Validation Code is: Q214-[\\$ {q://QID227/ChoiceNumericEntryValue/3}](#)
 The information for Assignment 1 that you entered, in order to get credit, was as follows: **Your name:**

[\\${q://QID80/ChoiceTextEntryValue/1}](#) [\\${q://QID80/ChoiceTextEntryValue/2}](#) **Blackboard username:**
[\\${q://QID80/ChoiceTextEntryValue/3}](#) **Recitation number and Instructor name:**
[\\${q://QID82/ChoiceTextEntryValue/1}](#), [\\${q://QID82/ChoiceTextEntryValue/4}](#)

a1COMMENT_txt **Final Feedback?** As you know, the New Biology assignments are being evaluated by your instructor with the help of researchers from the Public Policy Center. So, if you have any feedback, comments, or questions about this first New Biology Assignment, please write them below.

Q210 When you are done, click continue to submit your assignment. THANK YOU!

4.1.2. Study 2 Assignment 2

In the 3-condition design, this is the version of assignment that encourages Information Organization as students read the material. See Appendix B for Manipulations of these conditions.

Q1 Considering "New Biology"... Issues in Nanotechnology & Genetics

The purposes of the "New Biology" assignments in this course are **to help students to begin thinking about the social implications of scientific discoveries and methods, and to learn to articulate and evaluate the social, legal, ethical, and future implications of science discoveries and new scientific technologies.**

PLEASE NOTE: This assignment will take approximately **one-half to one hour to complete**. If you think you will need to leave it and come back, you should be sure that you come back to the same computer and that your browser is **set to save cookies** so that you can resume the assignment where you left off. If cookies are not enabled, you may have to start the assignment over if you leave and come back.

[Certain information will be removed from the data file for purposes of deidentification.]

NAME To receive credit for this assignment, the following information is required:

- ☐ First Name (1) _____
- ☐ Last Name (2) _____
- ☐ Blackboard user name (e.g., s-name2) (3) _____

a2RECI Please indicate which Bio 102 recitation you are enrolled in (see list below if you aren't sure):

☐ Recitation section number (151-157) (1)

☐ Recitation instructor name (4)

Q203 **What do you think?** Before getting started, please indicate what you think right NOW about the following questions. Don't worry if you do not know much about nanogenomics yet--just make your "best guess." As a result of this assignment you may change your opinions regarding nanogenomics; you will have ample opportunity to indicate this later.

a2NTfam **How familiar are you with nanotechnology?**

- ☐ Not at all familiar (1)
- ☐ Slightly familiar (2)
- ☐ Somewhat familiar (3)
- ☐ Very Familiar (4)
- ☐ Extremely familiar (5)

a2NGfam **How familiar are you with how nanotechnology is used in genetics research and development?**

- ☐ Not at all familiar (1)
- ☐ Slightly familiar (2)
- ☐ Somewhat familiar (3)
- ☐ Very Familiar (4)
- ☐ Extremely familiar (5)

a2pre_riskben **Based on your present knowledge: Do you think the risks of nanogenomics research and development probably outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks? (It is ok to guess).**

- ☐ The risks greatly outweigh the benefits (1)
- ☐ The risks somewhat outweigh the benefits (2)
- ☐ The risks slightly outweigh the benefits (3)
- ☐ The risks and benefits are equal (4)

- ☐ The benefits slightly outweigh the risks (5)
- ☐ The benefits somewhat outweigh the risks (6)
- ☐ The benefits greatly outweigh the risks (7)

a2pre_regslide **In your opinion right now, how much regulation is needed with respect to nanogenomics research and development?** Slide the slider to reflect your view. Zero means that you believe there should be NO regulation of nanogenomics. 100 means that you believe EVERY ASPECT of nanogenomic research and development should be HIGHLY regulated.

No regulation at all (1)	
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Q311 Timing

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Q257 **Current Knowledge** How much do you already know about nanotechnology? See if you can answer the questions below. If you don't know an answer, just make your best guess. Note: You are not expected to know these yet! So please don't "google" the answers!!

a2kq01 **Some people say that nanogenomics may lead to "greater human enhancement." Which of the following activities are current examples of "human enhancement"? Check all that apply.**

- ☐ Education in schools and universities (1)
- ☐ The use performance-enhancing drugs by athletes (2)
- ☐ Use of medicine to combat naturally-contracted or -inherited diseases (3)
- ☐ Use of prosthetic devices to improve how people look (e.g., burn victims) (4)
- ☐ Plastic surgery to improve how people look (5)
- ☐ None of the above (6)

a2kq02 **Which of the following are areas of current nanogenomic research and development?**

- ☐ Use of nano-sequencing to map the human genome (1)
- ☐ Development of better genetic engineering procedures (2)
- ☐ Adapting biological transmodification for medical delivery (3)
- ☐ Synthesizing biochemical reactions more quickly (4)
- ☐ Development of simplified genetic code capable of supporting nanobot reproduction (5)
- ☐ None of the above (6)

a2kq03 **What does RNAi stand for?**

- ☐ RNA interference (1)
- ☐ RNA interceptor (2)
- ☐ RNA integration (3)
- ☐ RNA inception (4)

a2kq04 For what purpose are DNA "scaffolds" manufactured?

- ☐ Making computer chips (1)
- ☐ Making new organisms (2)
- ☐ Making nanobots (3)
- ☐ Making new buildings (4)

a2kq05 **What was the United States eugenics movement?**

- ☐ The movement in the early Twentieth Century supporting the sterilization of humans with undesirable traits (1)
- ☐ The movement in the late Twentieth Century to map the human genome (2)
- ☐ A movement by geneticists to use a new methods involving the compound uracil, first discovered in the Nineteenth Century. (3)
- ☐ There was no United States eugenics movement (4)

a2kq06 **What do some people say is one problem with encouraging research and development in nanogenomics aimed at curing diseases?**

- ☐ People have different opinions about what a disease is. (1)
- ☐ We already know that diseases can not be cured with nanogenomics. (2)
- ☐ Present cures for diseases are cheaper. (3)
- ☐ Nanobots can only cure some diseases, but not all. (4)

Q250 Timing

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Q210 **Now let's get started...**

Q212 In the next pages you will be asked to think about ELSI (ethical, legal and social issues) in an area of New Biology involving nanotechnology applied to genetics research. Because you may not know much about this area, we have created a document with background information. **Please take your time and read it carefully** and consider the potential ethical, legal, and social issues (ELSI) that it may raise.

Download the (.pdf) Background Document Here Click on the link above to download, SAVE, and READ the document before continuing. **Note:** If the document does not appear by clicking on the link, please try "right-clicking" on it and then choose "save target" or "save link" from the menu that appears. It is important to SAVE or PRINT the document, so that you have access while completing this assignment, and to bring it to your next recitation (either saved as a file on your laptop, or in printed form).

Q220 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

[SEE APPENDIX B FOR BACKGROUND DOCUMENTS]

a2BGdI **Did you download the background document, SAVE it, and read it?**

- ☐ Yes (1)
- ☐ No (2)

a2bgdprobs **PROBLEMS?** If you had problems getting or working with the background document (e.g., if you tried links in the document that did not work), please describe those problems here:

Q218 Please do not continue with this assignment until you have downloaded and read the background document. You may email XXXXX if you have trouble getting the document. We will respond as soon as possible.

Feedback (Control) Condition

[NOTE: THE FOLLOWING PROMPTS WERE USED FOR PERSONS ASSIGNED TO THE Feedback (control) CONDITION]

Q247

Assignment Instructions

Q249 As noted in the background document that you just read, at the end of this assignment you will be asked to give your "informed opinion" on the following two questions:

1. *In your opinion, what are the most important benefits and drawbacks of nanogenomics—especially in the areas of human enhancement? Do the benefits outweigh the risks? Or do the risks outweigh the benefits?*
2. *In your opinion, how much should nanogenomic research and development be regulated? What guidelines, rules, regulations, or other means should be established to help ensure that important benefits of nanogenomics are achieved and that risks/drawbacks are avoided – especially in the area of human enhancement?*

One of the most important parts of forming an "informed opinion" involves becoming informed! And the best way to to that is to engage with different information that helps you to learn new things.

a2FB01 Below please list five insights, realizations, reactions, or new things that you learned as a result of reading the background document or exploring the additional resources in that document.

(1)

a2FB02 (2)

a2FB03 (3)

a2FB04 (4)

a2FB05 (5)

Q261 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a2FB06 **Additional Resources**

Below are a number of the "Additional Resources" that were referred to in your Background document. Look at the following (by clicking on them), at least briefly, and give an overall opinion.

Note: You do not have to look at all the resources in their entirety if you do not want to. However, please look at each resource at least briefly, and examine at least TWO of the resources more thoroughly -- looking at "most of it".

You can click on the blue underlined text to view the resource.

	Did you read / view this resource? (1)				Overall, what did you think of this resource? (2)				
	Yes, but only slightly (1)	Yes, some of it (2)	Yes, most of it (3)	Yes, ALL of it (4)	Ick. Get rid of it. (1)	It's So-So, Ho-Hum (2)	It's OK (3)	It's Pretty Good (4)	It's GREAT! Definitely keep it! (5)

- [Nanotechnology, what's that?! This is a video introduction to nanotechnology.](#) (1)
- [Nanotechnology takes off This is a video introduction to nanotechnology in general.](#) (2)
- [Nanotech Now: Your Gateway to Everything Nanotech This is a large website with a huge amount of information about nanotechnology.](#) (3)

- To Upgrade is Human This is the TED video that you saw in recitation--if you saw it in recitation you can rate it without re-watching it. (4)
- National Nanotechnology Initiative This site is an example of how the government is trying to get "input" from people about future research, development, and regulation of nanotechnology. (5)
- Deepening Dialogue: Debating Nanotechnology's Responsible Development This video shows an example of citizens discussing the responsible development of nanotechnology. (6)
- Understanding Nanotechnology: Ethics and Technology This website not only overviews ethics and nanotechnology, it also provides links to numerous others who are working on ethics and nano issues. (7)
- Human Enhancement and Nanotechnology This is a very short text giving an overview of issues pertaining to human enhancement and nanotechnology. (8)

Q267 Finally, write three statements to finish the sentences below:

a2FB07 One of the most interesting things I learned from the background document or the resources was...

a2FB08 A question I still have about nanogenomics is...

a2FB09 Something that I did NOT like about the resources I viewed was...

a2FB10 Feedback / Comments

Do you have any other comments, either about the resources or this assignment? E.g., is there anything about which you have any questions? Do you have any comments? Questions? Things you found interesting or liked? Ways to improve this page?

Q275 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

Information Organization Condition

[NOTE: THE FOLLOWING PROMPTS WERE USED FOR PERSONS ASSIGNED TO THE INFORMATION ORGANIZATION CONDITION]

Q101

Notetaking Tool

As noted in the background document that you just read, at the end of this assignment you will be asked to give your "informed opinion" on the following two questions: 1. In your opinion, what are the most important benefits and drawbacks of nanogenomics –especially in the areas of human enhancement? Do the benefits outweigh the risks? Or do the risks outweigh the benefits? 2. In your opinion, how much should nanogenomic research and development be regulated? What guidelines, rules, regulations, or other means should be established to help ensure that important benefits of nanogenomics are achieved and that risks/drawbacks are avoided – especially in the area of human enhancement? **One of the most important parts of forming an "informed opinion" involves getting lots and lots of information organized.** On any given topic, there is often a large number of ideas and perspectives. Without putting some organization to that information, however, a lot of those ideas get lost or forgotten -- not because they aren't important, only because we only have more new information than we can hold in our brains at one time. On the next page is a tool to help you help you organize your thoughts for answering the questions, and for the activities in recitation next week.

Q315 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

Q314

Notetaking Tool: Benefits and Risks

Note: You do not need to fill in all of the rows, only as many as you wish. However, the more claims you identify, the better prepared you will be to answer the overarching questions. Also, the boxes are short -- but you may still write as much as you wish to explain the benefits and opposing responses.

a2IObens **Benefits** Based on your reading and thinking about nanogenomics, please list **what some people may claim** are the POSITIVE "benefits" of nanogenomics research and development. List as many benefits as you can,

regardless whether you agree with them, and especially consider the ethical, legal and social implications of nanogenomics research and development. Consider this a brainstorm, where you try to think of as many claims as possible. In addition, you should think about claims people may make about potentially positive "second order" effects mentioned in your background document. Next, in the far right column, write what you think might be an "opposing claim" that you think someone on the "opposing side" (someone who sees nanotechnology as quite risky) might say in response to the claim in the left hand column. Again, consider the ELSI issues they might raise, and think about potential "second order" effects. Finally, rate the extent to which you agree with the "benefit" claims that you listed or the "opposing response."

	To what extent do you <u>AGREE MORE</u> with the "benefit" claim versus the "opposing response"?					What someone who is "opposed" to the claim might say in response.
	Benefit claim strongly (1)	Benefit claim somewhat (2)	Neither /Both (3)	Opposing response somewhat (4)	Opposing response strongly (5)	Opposing Response (1)
Benefit 1: (1)						
Benefit 2: (2)						
Benefit 3: (3)						
Benefit 4: (4)						
Benefit 5: (5)						

Benefit 6: (6)						
Benefit 7: (7)						
Benefit 8: (8)						

a2lOrisks **Risks** Now list **what some people** (whether you agree or not) **may claim** are the NEGATIVES or risks of nanogenomics research and development. Brainstorm as many negatives or risks as you can, regardless whether you agree with them and especially consider the ethical, legal and social implications of nanogenomics research and development, and potentially negative second-order effects. Next, in the far right column, write what you think might be an "opposing claim" that you think someone on the "opposing side" (someone who sees nanotechnology as quite beneficial) might say in response to the claim in the left hand column. Finally, rate the extent to which you agree with the "benefit" claims that you listed or the "opposing response."

	To what extent do you <u>AGREE MORE</u> with the "risk" claim versus the "opposing response"?					What someone who is "opposed" to the claim might say in response.
	Risk claim strongly (1)	Risk claim somewhat (2)	Neither/Both (3)	Opposing response somewhat (4)	Opposing response strongly (5)	Opposing Response (1)
Risk 1: (1)						

Risk 2: (2)						
Risk 3: (3)						
Risk 4: (4)						
Risk 5: (5)						
Risk 6: (6)						
Risk 7: (7)						
Risk 8: (8)						

Feedback / Comments At the bottom of each page, there will also be an opportunity for you to give us feedback and write comments about the information we presented. For example, on this page, is there anything about which you have any questions? Do you have any comments? Questions? Things you found interesting or liked? Ways to improve this page?

Q255 Timing

First Click (1)

Last Click (2)

Page Submit (3)

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Q109

Notetaking Tool: Regulation of Nanogenomics

Note: You do not need to fill in all of the rows, only as many as you wish. However, the more claims you identify, the better prepared you will be to answer the overarching questions. Also, the boxes are short -- but you may still write as much as you wish to explain the benefits and opposing responses.

a2IOproreg **Pro-Regulation** Please list **what some people** (whether you agree or not) **may claim** are reasons that would argue for **(pro) heavy regulation** of nanogenomics. Consider this a brainstorm, where you try to think of as many claims as possible. In addition, you should think about claims people may make about potentially positive "second order" effects mentioned in your background document. Next, in the far right column, write what you think might be an "opposing claim" that you think someone on the "opposing side" (someone who is more anti-regulation) might say in response to the claim in the left hand column. Again, consider the ELSI issues they might raise, and think about potential second order effects. Finally, rate the extent to which you agree with the "pro-regulation" claims that you listed or the "opposing response." .Skin .SBS .Long { width:200px; }

To what extent do you AGREE MORE with the "pro-regulation" claim versus the "opposing response"?						What someone who is "opposed" to the claim might say in response.
Pro claim strongly (1)	Pro claim somewhat (2)	Neither/Both (3)	Opposing response somewhat (4)	Opposing response strongly (5)		Opposing Response (1)

Pro 1: (1)						
Pro 2: (2)						
Pro 3: (3)						
Pro 4: (4)						
Pro 5: (5)						
Pro 6: (6)						
Pro 7: (7)						
Pro 8: (8)						

a2IOantire **Anti-Regulation** Please list **what some people** (whether you agree or not) **may claim** are reasons that would argue for **NOT having heavy regulation** of nanogenomics -- but who would argue for very light regulations (and be more ANTI-regulation in their views). Next, in the far right column, write what you think might be an "opposing claim" that you think someone on the "opposing side" (someone who is more anti-regulation) might say in response to the claim in the left hand column. Finally, rate the extent to which you agree with the "pro-regulation" claims that you listed or the "opposing response." .Skin .SBS .Long { width:200px; }

	To what extent do you <u>AGREE MORE</u> with the "anti-regulation" claim or the "opposing response"?					What someone who is "opposed" to the claim might say in response.
	Anti claim strongly (1)	Anti claim somewhat (2)	Neither/Both (3)	Opposing response somewhat (4)	Opposing response strongly (5)	Opposing Response (1)
Anti 1: (1)						
Anti 2: (2)						
Anti 3: (3)						
Anti 4: (4)						
Anti 5: (5)						
Anti 6: (6)						

Anti 7: (7)						
Anti 8: (8)						

a2IOregFB **Feedback / Comments:** Do you have any comments? Questions? Things you found interesting or liked? Ways to improve this page?

Q256 Timing
First Click (1)
Last Click (2)
Page Submit (3)
Click Count (4)

Critical Thinking Condition

[NOTE: THE FOLLOWING PROMPTS WERE USED FOR PERSONS ASSIGNED TO THE Critical Thinking CONDITION]

Q149

Critical Thinking Assignment

The following information is essential to completing the assigned activities. Read it carefully. You may want to print a copy of this page to refer back to.

Q146 As noted in the background document that you just read, at the end of this assignment you will be asked to give your "informed opinion" on the following two questions:

1. In your opinion, what are the most important benefits and drawbacks of nanogenomics –especially in the areas of human enhancement? Do the benefits outweigh the risks? Or do the risks outweigh the benefits?
2. In your opinion, how much should nanogenomic research and development be regulated? What guidelines, rules, regulations, or other means should be established to help ensure that important benefits of nanogenomics are achieved and that risks/drawbacks are avoided – especially in the area of human enhancement? **One of the most important parts of forming an informed opinion involves being able to think critically about claims that people make.**

However, many people have never been told what it means to "think critically." Prior research on critical thinking suggests it can be useful to consider a series of questions when evaluating the evidence for a claim.

1. Relevance: Is the evidence presented *relevant* to the conclusion or statement?

Let's consider a very mundane technology: Laundry detergent. If someone made the **claim:** "This

laundry detergent is great!" and their **reason / evidence** was "Because it makes a lot of suds!", you might ask yourself: Is the amount of suds *relevant* to how well it works? Or do non-sudsy detergents work just as well as sudsy ones?

2. Accuracy: Is the evidence presented *accurate*? Or inaccurate?

When it comes to complex scientific technologies, people sometimes hold inaccurate or incomplete knowledge. Thus, it is also important to ask if various claims or reasons are accurate. For example, with regard to the "great" detergent, if someone's **reason / evidence** was that the detergent outperformed all other detergents on the market, you might ask: Is that true? Or is that an exaggeration? Which detergents, exactly, did it outperform? How do we know for sure that it outperformed *all* of the others?

3. Typicality: Is the evidence presented *typical* evidence? Or is it *atypical* evidence?

Typicality refers to how common or representative different pieces of evidence may be. For example, if a laundry detergent outperformed one other detergent, but underperformed six other detergents, then you could argue that the most *typical* finding is that it does *not* outperform other detergents.

4. Sufficiency: Is the evidence presented *sufficient* to draw the conclusion? Or is more evidence needed?

A final question to answer when considering evidence for certain claims, is whether you need more evidence. For example, is it sufficient to know that a laundry detergent outperformed 1, 7, or 20 others? Would you need other *types* of evidence, such as personal experience? At what point do you decide the evidence is *sufficient* for you to believe the claim that the detergent is "great"?

On each of the next pages, you will be asked to practice analyzing "claims" that people make about nanogenomics using the four criteria described here.

First, try the practice example below.

a2CT01 **Claim:** The laundry detergent "Super X" is an utterly horrible laundry detergent.

Evidence / Reason: Because it has a horrible smell that is more similar to toothpaste than to soap.

What do you think of the evidence provided for this claim?

Note: You can roll your cursor over the red bolded text for a reminder of what the terms mean.

	Not at all (1)	Slightly (2)	Somewhat (3)	Quite a bit (4)	Entirely (5)	I don't know (6)
--	----------------	--------------	--------------	-----------------	--------------	------------------

- How **Relevant** is the evidence to the claim? (1)
- How **Accurate** is the evidence? (2)
- How **Typical** is evidence? (3)
- How **Sufficient** is the evidence to support the claim? (4)

Q277 [[See how (fictional) others might answer the above by clicking [HERE](#)]]

[[Click again to hide]]

With regard to the claim that "It smells like toothpaste," Pat says:

--Relevant: Not at all -- I don't care what it smells like, so that is not *relevant* to whether I buy it.

--Accuracy: I don't know -- I've never smelled the detergent, so I really don't know if it is *accurate*

--Typical: Somewhat -- I found a survey that said 8 of 20 people surveyed thought it smelled like toothpaste, so I guess it's not 'atypical' to think that. However, that means that 12 of 20 people did NOT state that it smelled that way. So maybe it is more typical NOT to think that. Before deciding for sure, I'd like to know if, in the survey, they asked people directly or just depended on the people to bring up the topic of smell. Maybe if they asked people

directly then more people would agree that it does smell that way.

--Sufficient: Not at all -- I need evidence that is relevant to how well the detergent cleans before I decide that I believe this claim about it being a "horrible" detergent.

a2CTxt1 Feedback / Comments

At the bottom of each page, there will also be an opportunity for you to give us feedback and write comments about the information we presented.

For example, on this page, is there anything about which you have any questions? Do you have any comments? Questions? Things you found interesting or liked? Ways to improve this page?

Q252 Timing
First Click (1)
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Q201

----- **Critical Thinking: Nanogenomics** -----

Q200 Now try to apply the method to thinking about the following claim and evidence, that relates to Nanogenomics.

a2CTsaRAT **Student A's Claim:** We should speed up our research and development activities related to nanogenomics.

Student A's Evidence / Reason: Because it might help people who are right now suffering from various diseases. For example, the background document points out that some researchers (e.g., Wilson, 2010) have found ways to more effectively treat inflammatory bowel disease. Speeding up research and development related to nanogenomics could help lead to more effective treatments for diseases -- Meanwhile, by making people wait for this research to get done, people are suffering and some are dying from diseases that may someday be cured by nanogenomics.

What do you think of the evidence/reason provided for this claim?

	Not at all (1)	Slightly (2)	Somewhat (3)	Quite a bit (4)	Entirely (5)	I don't know (6)
--	----------------	--------------	--------------	-----------------	--------------	------------------

- How **Relevant** is the evidence to the claim? (1)
- How **Accurately** is the evidence presented? (2)
- How **Typical** is evidence? (3)
- How **Sufficient** is the evidence to support the claim? (4)

a2CTsaExpl **Please explain WHY you gave the ratings that you gave above.**

For example, did you find something in Wilson 2010 (see link in the background document) that suggested the student's description of the evidence was accurate or inaccurate? Or did you find other evidence in the background document or other sources that helped you to decide how to make your ratings?

a2CT02a **Finally, how much do you agree or disagree with the claim that was stated above? (i.e., that we should speed up nanogenomics research and development)**

- ☐ Strongly Disagree (1)
- ☐ Somewhat Disagree (2)
- ☐ Neutral (3)
- ☐ Somewhat Agree (4)
- ☐ Strongly Agree (5)

Q140 Timing
First Click (1)
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Q157 -----
Critical Thinking: Risks and Benefits

a2CT_cl1 **Next, identify a claim pertaining to the question of RISKS/BENEFITS mentioned in the background document that someone might make about either the risks or benefits of nanogenomics research and development. You may wish to think not only about the direct effects of nanogenomics, but also about its potential "second order" effects.**

Note: You can pick a claim that you either agree with OR disagree with, because you'll be asked to think about WHY you agree or disagree with it.

CLAIM 1:

a2CTc1rb **Is this claim supporting the RISKS or BENEFITS of Nanogenomics research and development?**

- ☐ Mostly/Entirely supporting the RISKS (1)
- ☐ Slightly/somewhat more supportive of the RISKS (2)
- ☐ Neither more supportive of the risks or benefits (3)
- ☐ Slightly/somewhat more supportive of the BENEFITS (4)
- ☐ Mostly/Entirely supporting the BENEFITS (5)

a2CTc1ev1 **Next, identify EVIDENCE that people might use to support or challenge this claim.**

EVIDENCE 1 supporting or challenging CLAIM 1:

a2CTc1e1r1 **Does the evidence you offered above support or negate/challenge Claim 1?**

- ☐ Strongly negates/challenges (1)
- ☐ Somewhat negates/challenges (2)
- ☐ Neither/Both (3)
- ☐ Somewhat supports (4)
- ☐ Strongly supports (5)

a2CTc1e1r2 **What do you think of the evidence you presented above?**

	Not at all (1)	Slightly (2)	Somewhat (3)	Quite a bit (4)	Entirely (5)	I don't know or Not Applicable (6)
--	----------------	--------------	--------------	-----------------	--------------	------------------------------------

- How **Relevant** is the evidence to the claim? (1)
- How **Accurate** is the evidence? (2)
- How **Typical** is evidence? (3)
- How **Sufficient** is the evidence to support the claim? (4)

a2CTc1e1ex **Please explain WHY you gave the ratings that you gave above. Especially explain any LOW ratings that you gave.**

a2CTc1e2 Next, identify a second piece of EVIDENCE that people might use to either support or challenge this claim.

EVIDENCE 2 supporting or challenging CLAIM 1:

a2CTc1e2r1 Does the evidence you presented above support or negate/challenge Claim 1?

- ☐ Strongly negates/challenges (1)
- ☐ Somewhat negates/challenges (2)
- ☐ Neither/Both (3)
- ☐ Somewhat supports (4)
- ☐ Strongly supports (5)

a2CTc1e2r2 What do you think of the evidence you presented above?

	Not at all (1)	Slightly (2)	Somewhat (3)	Quite a bit (4)	Entirely (5)	I don't know or Not Applicable (6)
--	----------------	--------------	--------------	-----------------	--------------	------------------------------------

- How **Relevant** is the evidence to the claim? (1)
- How **Accurate** is the evidence? (2)
- How **Typical** is evidence? (3)
- How **Sufficient** is the evidence to support the claim? (4)

a2CTc1e2ex Please explain WHY you gave the ratings that you gave above. Especially explain any LOW ratings that you gave.

a2CTc1agre Finally, how much do you Agree or Disagree with Claim 1?

- ☐ Strongly Disagree (1)
- ☐ Somewhat Disagree (2)
- ☐ Neutral (3)
- ☐ Somewhat Agree (4)
- ☐ Strongly Agree (5)

a2CTc1evim **Did the evidence you found to support or negate/challenge Claim 1 impact your agreement with it?**

- ☐ Yes (1)
- ☐ No (2)

a2CTc1imex **Why or why not?**

a2CT_COM1 **Feedback / Comments:**

Do you have any comments? Questions? Things you found interesting or liked? Ways to improve this page?

Q253 Timing

First Click (1)

Last Click (2)

Page Submit (3)

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Q165

Critical Thinking: Regulation of Nanogenomics

a2CT_cl2 **Next, identify a claim pertaining to the question of REGULATION mentioned in the background document. Identify a claim that someone might make about either the need for HEAVY regulation or the need to only have LITTLE (light, minimal) regulation of nanogenomics research and development. You may wish to think not only about the direct effects of nanogenomics, but also about its potential "second order" effects, and how those might impact the need for regulation.**

Note: You can pick a claim that you either agree with OR disagree with, because you'll be asked to think about WHY you agree or disagree with it.

CLAIM 2:

a2CTc2reg Is this claim supporting the need for HEAVY regulation or LIGHT regulation of Nanogenomics research and development?

- ☐ Mostly/Entirely supporting LIGHT regulation (1)
- ☐ Slightly/somewhat more supportive of LIGHT regulation (2)
- ☐ Neither more supportive of heavy or light regulation (3)
- ☐ Slightly/somewhat more supportive of HEAVY regulation (4)
- ☐ Mostly/Entirely supporting HEAVY regulation (5)

a2CTc2ev1 Next, identify some EVIDENCE that people might use to either support or challenge this claim.

EVIDENCE 1 supporting or challenging CLAIM 2:

a2CTc2e1r1 Does the evidence you presented above support or negate/challenge Claim 2?

- ☐ Strongly negates/challenges (1)
- ☐ Somewhat negates/challenges (2)
- ☐ Neither/Both (3)
- ☐ Somewhat supports (4)
- ☐ Strongly supports (5)

a2CTc2e1r2 What do you think of the evidence you presented above?

	Not at all (1)	Slightly (2)	Somewhat (3)	Quite a bit (4)	Entirely (5)	I don't know or Not Applicable (6)
--	----------------	--------------	--------------	-----------------	--------------	------------------------------------

- How **Relevant** is the evidence to the claim? (1)
- How **Accurate** is the evidence? (2)
- How **Typical** is evidence? (3)
- How **Sufficient** is the evidence to support the claim? (4)

a2CTc2e1ex Please explain WHY you gave the ratings that you gave above. Especially explain any LOW ratings that you gave.

a2CTc2ev2 **Next, identify a second piece of EVIDENCE that people might use to either support or challenge this claim.**

EVIDENCE 2 supporting or challenging CLAIM 2:

a2CTc2e2r1 **Does the evidence you presented above support or negate/challenge Claim 2?**

- ☐ Strongly negates/challenges (1)
- ☐ Somewhat negates/challenges (2)
- ☐ Neither/Both (3)
- ☐ Somewhat supports (4)
- ☐ Strongly supports (5)

a2CTc2e2r2 **What do you think of the evidence you presented above?**

	Not at all (1)	Slightly (2)	Somewhat (3)	Quite a bit (4)	Entirely (5)	I don't know or Not Applicable (6)
--	----------------	--------------	--------------	-----------------	--------------	------------------------------------

- How **Relevant** is the evidence to the claim? (1)
- How **Accurate** is the evidence? (2)
- How **Typical** is evidence? (3)
- How **Sufficient** is the evidence to support the claim? (4)

a2CTc2e2ex **Please explain WHY you gave the ratings that you gave above. Especially explain any LOW ratings that you gave.**

a2CTc2agre **Finally, how much do you Agree or Disagree with Claim 2?**

- ☐ Strongly Disagree (1)
- ☐ Somewhat Disagree (2)
- ☐ Neutral (3)
- ☐ Somewhat Agree (4)
- ☐ Strongly Agree (5)

a2CTc2evim **Did the evidence you found to support or negate Claim 2 impact your agreement with it?**

- ☐ Yes (1)
- ☐ No (2)

a2CTc2imex **Why or why not?**

a2CT_COM2 **Feedback / Comments:**

Do you have any comments? Questions? Things you found interesting or liked? Ways to improve this page?

Q297 Timing

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End of Conditions- Final A2 Questions

Q216 Overarching Questions... Now that you have read the background information and had a chance to think about it and explore some of the additional materials, please answer the following two questions that were identified in your background documents. NOTE: You may use the "back" button to remind yourself how you answered the prior questions. (You may also print those prior pages from your browser if you like). You may also use the background document and any other resources you would like.

Q309 Click here to see a list of resources that were provided within the background document. [[

Click again to hide]]

Nanotechnology, what's that?! This is a video introduction to nanotechnology.

Nanotechnology takes off This is a video introduction to nanotechnology in general.

Nanotech Now: Your Gateway to Everything Nanotech This is a large website with a huge amount of information about nanotechnology.

To Upgrade is Human This is the TED video that you saw in recitation

National Nanotechnology Initiative This site is an example of how the government is trying to get "input" from people about future research, development, and regulation of nanotechnology.

Deepening Dialogue: Debating Nanotechnology's Responsible Development This video shows and example of citizens discussing the responsible development of nanotechnology.

Understanding Nanotechnology: Ethics and Technology This website not only overviews ethics and nanotechnology, it also provides links to numerous others who are working on ethics and nano issues.

Human Enhancement and Nanotechnology This is a very short text giving an overview of issues pertaining to human enhancement and nanotechnology.

a2post_riskben

1. Based on what you now know: Do you think the risks of nanogenomics research and development outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks?

- ☐ The risks greatly outweigh the benefits (1)
- ☐ The risks somewhat outweigh the benefits (2)
- ☐ The risks slightly outweigh the benefits (3)
- ☐ The risks and benefits are equal (4)
- ☐ The benefits slightly outweigh the risks (5)
- ☐ The benefits somewhat outweigh the risks (6)
- ☐ The benefits greatly outweigh the risks (7)

a2rbexpl_txt

Please explain your answer above. As you explain, a. Be specific about what you think are the most important benefits and drawbacks/risks of nanogenomics especially in the areas of human enhancement. Please especially consider the social, legal and ethical benefits and drawbacks (or issues) that you see as relevant to nanogenomics, particularly in the area of human enhancement. b. Justify WHY you think either the risks or benefits outweigh the other. Note that you can use the "back" button at the bottom of this page to see what you wrote in response to the prior questions and to use those responses in your answer below.

a2post_regslid

2. In your opinion, how much regulation is needed with respect to nanogenomics research and development? Slide the slider to reflect your view. Zero means that you believe there should be NO regulation of nanogenomics. 100 means that you believe EVERY ASPECT of nanogenomic research and development should be HIGHLY regulated.

None at all (1)	
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a2regexpl_txt

Please explain your answer above. As you explain, **a. Be specific** about what guidelines, rules, regulations, or other means should be established and which ones should not be established, in order to help ensure that important benefits of nanogenomics are achieved and that harms/drawbacks are avoided, especially in the area of nanogenomics and human enhancement. **b. Justify WHY** you think those regulations should or should not be in place. Note that you can use the "back" button at the bottom of this page to see what you wrote in response to the prior questions and to use those responses in your answer below.

Q226 Timing

First Click (1)

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Q228 Assignment Evaluation

Q245 These "New Biology" assignments are being developed with assistance from the UNL Public Policy Center, which is made possible by a grant from the National Science Foundation. In order to improve the

assignments for future students, please evaluate your experience with this assignment. **NOTE:** Your answers to these questions will not affect your grade in any way; your instructor will only see the data after it has been separated from the assignment (and thus all answers will be anonymous). Also, any written comments made will be compiled into a list of comments without any identifying information.

Overall, how useful was this assignment for helping you to think more about Nanogenomics and preparing you to answer the two overarching questions?

- ☐ Not at all (1)
- ☐ Slightly (2)
- ☐ Somewhat (3)
- ☐ Quite (4)
- ☐ Extremely (5)

As you worked on this assignment, to what extent did you feel each of the following? As I worked on this assignment, I felt...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
• Interested (1)					
• Annoyed (2)					
• Open-minded (3)					
• Bored (4)					
• Focused (5)					
• Frustrated (6)					
• Competitive (7)					
• Closed (8)					
• Creative (9)					
• Like I wished I was doing something else (10)					
• Like working carefully (11)					
• Like my mind was already made up (12)					
• Responsible (13)					
• Engaged (14)					
• Distracted (15)					
• Conscientious (16)					
• Argumentative (17)					
• Like being thorough (18)					

a2manipchk **Overall, to what extent did the BACKGROUND DOCUMENT and ASSIGNMENT, used together, help to...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Understand nanotechnology (1)					
Learn about nanotechnology (2)					
Inspire me to think creatively (3)					
Motivate me to explore nanotechnology in more depth (4)					
More clearly articulate my own perspective (5)					
Gather information that I could use for my answers to the overarching questions (6)					
Get my thoughts organized (7)					
Organize a great deal of information relevant to the overarching questions (8)					
Compare the positives and negatives related to nanogenomics (9)					
See the issues from perspectives I'd not considered before (10)					
Understand perspectives different from my own (11)					
Formulate my arguments better (13)					
Think critically about evidence (12)					
Better understand what it means to think critically (14)					
Motivate me to look at the evidence for different claims, rather than just accepting the claims (15)					

Q249 Timing

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a2BGdocrt **Complete the statements below regarding the BACKGROUND document and your ASSIGNMENT. The BACKGROUND DOCUMENT was...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
• Interesting (1)					
• Boring (2)					
• Biased (3)					
• Balanced (4)					
• Thorough (5)					
• Useful (6)					
• Accurate (7)					

- Fair (8)
- Engaging (9)
- Relevant (10)
- Informative (11)
- Well-organized (12)
- Disorganized (13)
- Too-detailed (14)
- Not detailed enough (15)
- Useless (16)

a2assignr

This online ASSIGNMENT was...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
• Interesting (1) • Boring (2) • Too hard (3) • Too easy (4) • Challenging (5) • Useful (6) • Engaging (7) • Relevant (8) • Informative (9) • Well-organized (10) • Disorganized (11) • Confusing (12) • Easy to understand (13) • Useless (14)					

a2BCeng **Finally, as you worked on this assignment, to what extent did you do the following:**

	Not at all (1)	A little (2)	Somewhat (3)	Quite a bit (4)	A great deal (5)
Discussed my ideas about the topics with others. (1)					
Asked others what they thought about the topics and issues. (15)					
Tried to think about how the topics I was reading about related to other things I know. (2)					
Checked myself to see how well I understood the issues related to the topics I was learning about. (3)					
Took notes about the issues related to the topics. (4)					
Identified questions that I still had about the topics. (5)					
Tried to find answers to my questions about the topics. (6)					

Explored topics related to the subject in order to satisfy my own curiosity. (7)

Did some of my own research on the topics. (11)

Visited the links and other additional resources listed in the background document. (12)

Tried to think creatively about the impacts of this new technology on society. (13)

Tried to identify new second-order effects of nanotechnology that others may not have thought of yet. (20)

Tried to identify what people with different perspectives might think about the topics. (14)

Tried to compare the benefits and drawbacks of the new technology in terms of their importance. (16)

Carefully evaluated the accuracy of the evidence that was available for different claims. (17)

Carefully evaluated the relevance of various arguments about this new technology. (18)

Carefully evaluated how "typical" or common the evidence was, that was presented for different claims about the technology. (19)

Q242 Timing

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Q307 Finally, answer the following question. The reason for the question below is to ensure the accurate evaluation of the assignments.

a2DataQual Did you give an honest evaluation of this assignment? (You will **not** be penalized for your answer. Dr. Morris and your recitation instructor will **not** know how you answered this question.)

- ☐ Yes, my answers reflect my honest evaluation of the assignment (1)
 - ☐ No, I answered the questions randomly (2)
 - ☐ No, I felt like I should answer in a certain way, so I gave those answers instead of my honest responses (3)
 - ☐ Other (Please explain) (4)
-

a2asnCOM **Please make any other comments that you would like, that could help to improve these assignments.**

Q244 Please Print this Page. You will need to hand it in at your next recitation. This is a record of your answers to the two overarching questions. Please print this page from your browser, so that you have the information for recitation, and as a record of having completed this assignment.

Name: [\\${q://QID4/ChoiceGroup/AllChoicesTextEntry}](#) Section: [\\${q://QID5/ChoiceGroup/AllChoicesTextEntry}](#) Your answers to the overarching questions: Based on what you now know: Do you think the risks of nanogenomics research and development outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks? Your written explanation: [\\${q://QID235/ChoiceTextEntryValue}](#) In your opinion, how much regulation is needed with respect to nanogenomics research and development? Your written explanation: [\\${q://QID237/ChoiceTextEntryValue}](#) When you are finished printing this page, click "Next" to submit your assignment

4.1.3. Study 2 Assignment 3

[Certain information will be removed from the data file for purposes of deidentification.]

NAME In order to get credit for completing this assignment, please fill out the following information.

- ☐ First Name (1) _____
- ☐ Last Name (2) _____
- ☐ Blackboard user name (e.g., s-name2) (3) _____

a3RECI Please indicate which Bio 102 recitation you are enrolled in (see list below if you aren't sure):

- ☐ Recitation section number (151-157) (1) _____
- ☐ Recitation instructor name (4) _____

Q9 **Instructions** The following are **FICTIONAL potential FUTURE** scenarios. Please spend the entire time available in recitation, writing your responses to these scenarios. You may not be able to finish responding to all three scenarios (actually, you should not be able to, if you are writing high quality answers) -- this is intentional. **You may choose to answer the following in any order you wish.** The goal

of the assignment is to provide opportunities to think carefully about ELSI (ethical, legal and social issues) in science. So, **it's better to answer one or two of the questions "well" than to come up with mediocre or poor answers to all three.** **IMPORTANT NOTE:** Some of the scenarios include **things commonly said by people** reacting to nanotechnology. These are **NOT necessarily FACTS**. It is your job, as you reflect on what the fictional people say, to determine if it is likely true or false, and the extent to which you agree with it. Use your background document and additional materials and any of your own research you would like to do, to make these determinations. If you finish early, please look at the background information or additional resources that you were provided for additional considerations and things to write about. The background document, if you did not bring it with you, is available here. Note: If the background document fails to load, right click on the link and choose "save link as" or "save target as" and then save to your computer.

Cysticfibr_txt

Possible Scenario: Cystic Fibrosis Prevention Imagine that some time in the future nanotechnology has enabled doctors to be able to screen for and prevent many common genetic disorders. The following scenario reflects this possibility. Mr. and Mrs. Vanderbilt have decided they would like to have a baby. Both Mr. and Mrs. Vanderbilt have the genetic markers for Cystic Fibrosis. Their doctor informs them that for \$250,000, he can, through the use of nanogenetics, ensure that their baby is not born with Cystic Fibrosis. The Vanderbilt family can afford this, but wonder if they should. Mrs. Vanderbilt favors any kind of intervention that may keep their future children healthy, "we have a responsibility to our future children to keep them from suffering," she says. "If there is something that can be done to ensure that our son or daughter is born healthy, then how could we *not* take advantage of it and still call ourselves good parents?" Mr. Vanderbilt is against use of this technology. He thinks that technology that is applied to genetics is always wrong. Sure, this technology may benefit his child, but he worries that the same technology could be misused and that people will engineer children based on physical appearances. "This technology should be outlawed," he says. "It can only lead to no good. For example, people will start to create super-babies," he says, "and future generations will all end up looking and acting the same." "Furthermore," he worries, "what does this say about people alive now who have diseases and disabilities? Does this mean that we think that they are less worthy of life than others? And what if 'mistakes' are made in messing with our human genetic code and these mistakes are passed down from generation to generation?" What ethical, legal and social issues are raised by this scenario? Please write a paragraph or two explaining how you feel. Whenever possible, use evidence that you found in the background resources or your own research, to support your claims.

cysticf_Q_txt

What questions came up as you were answering this scenario, or would you like to have answered in order to be able to write a better response to the scenario above?

Memory_txt

Possible Scenario: Improving Human Memory Development Imagine that many years in the future Supernanotech Labs is trying to apply past nanogenomic research findings to improve human memory development. The head of the Food and Drug Administration is seeking advice from a panel of citizens regarding their opinions on how regulated this research should be. Participant 1: "This research is an abomination. God would not want us messing with his work. I don't even think this research and development should be done -- regulated or not." Participant 2: "Not everyone shares your views on what God wants. This research could help people with memory problems. What if this research could lead to cures for Alzheimer's? Plus, it would be better if we could all remember everything. We would all be so much smarter! I think that this research should be somewhat regulated, but not so much that research and creativity is stifled or delayed." Participant 3: "I'm pretty sure that only rich and important people would have access to this kind of thing. Then they will be even more rich and important, and the poor will be even more poor. The cycle will never end. Assuming this research goes forward, there needs to be regulations in place that ensure that the developments from this research are not only available to the wealthy." Participant 4: "I disagree. We live in a free market economy and if you don't let the rich buy this technology, you will slow its development. Let the rich buy it, and then more developments will occur so that it becomes cheaper for lower-income people. But if you do not let the rich buy it, future research and development won't even occur -- or it will occur very slowly and other countries will beat us to the 'big' findings. Then THEY will have the market, because they got there first." Participant 5: "My concern is that we don't know the consequences of altering DNA. What if memory gets better but people get more aggressive, or crazy, or something? We just don't know. Also, what will be the very long term effects of using this technology? There has to be special regulations in place to make sure that

these things don't happen.” What should the head of the Food and Drug Administration recommend to the FDA about regulation? How do you feel? Why? How would you respond to the participants above? Would you have a different perspective to add that they did not think of? Please write a paragraph or two to explain your answer. Whenever possible, use evidence that you found in the background resources or your own research, to support your claims.

memory_Q_txt

What questions came up as you were answering this scenario, or would you like to have answered in order to be able to write a better response to the scenario above?

Gmfood_txt

Possible Scenario: Improving the Nutritional Value of Foods Imagine that sometime in the future, Abracadabra Food Company develops a new method using nanotechnology to alter the genetic code of their food products to render the food more filling and nutritious. Abracadabra Foods claims that because this means one can eat less of their food and still be full and nourished, millions of starving people can be saved. Additionally, they say, obesity rates will decline as people will feel satisfied after much smaller meals. A vocal group of protesters, however, are arguing that using nanotechnology to genetically engineer food is unsafe. They are afraid that the food that is produced will alter human DNA and harm us in the long run. They believe that mutations could occur as a result of eating the food, and that cancer rates will increase. How do you feel about these claims? Do you think genetically engineered food is risky? If so, do the risks outweigh the benefits? Why or why not? Write your answer below and, whenever possible, use evidence that you found in the background resources or your own

research, to support your claims.

gmfood_Q_txt

What questions came up as you were answering this scenario, or would you like to have answered in order to be able to write a better response to the scenario above?

Q8 NOTICE Do not continue past this page unless your recitation instructor has directed you to do so. Continue writing on the questions until your instructor tells you that it is time to debrief. Use the "back" button below to return to the scenarios if your instructor has not yet said it is time to debrief. If you cannot think of any thing more to write about the scenarios, please revisit the background document (available here) or other resources, or do some additional research on your own that pertains to the questions raised in the scenarios. Use the "continue" button below ONLY if your instructor has said that it is time to do so. Otherwise, use the "back" button below to continue working on the assignment.

Q25 Answers to the Overarching Questions Now that you have considered some scenarios involving nanogenomics, you have a chance to indicate if you changed your mind on the overarching questions. Here are those 2 main questions again.

a3riskben

1. Based on what you now know: Do you think the risks of nanogenomics research and development

outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks?

- ☐ The risks greatly outweigh the benefits (1)
- ☐ The risks somewhat outweigh the benefits (2)
- ☐ The risks slightly outweigh the benefits (3)
- ☐ The risks and benefits are equal (4)
- ☐ The benefits slightly outweigh the risks (5)
- ☐ The benefits somewhat outweigh the risks (6)
- ☐ The benefits greatly outweigh the risks (7)

a3regslide

2. In your opinion, how much regulation is needed with respect to nanogenomics research and development? Slide the slider to reflect your view. Zero means that you believe there should be NO regulation of nanogenomics. 100 means that you believe EVERY ASPECT of nanogenomic research and development should be HIGHLY regulated.

None at all (1)	
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Q26 **Activity Evaluation** And lastly, once again, to assist in improving these activities for future students, please answer this last page of questions.

a3useful **Overall, how useful were the activities today for helping you to think more about Nanogenomics and preparing you to answer the two overarching questions?**

- ☐ Not at all (1)
- ☐ Slightly (2)
- ☐ Somewhat (3)
- ☐ Quite (4)
- ☐ Extremely (5)

a3lscnAeng

As you worked on the activities today, to what extent did you feel each of the following?As I worked

on this assignment, I felt...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
• Interested (1) • Annoyed (2) • Open-minded (3) • Bored (4) • Focused (5) • Frustrated (6) • Competitive (7) • Closed (8) • Creative (9) • Like I wished I was doing something else (10) • Like working carefully (11) • Like my mind was already made up (12) • Responsible (13) • Engaged (14) • Distracted (15) • Conscientious (16) • Argumentative (17) • Like being thorough (18)					

a3lscBCeng Finally, as you worked on this assignment, to what extent did you do the following:

	Not at all (1)	A little (2)	Somewhat (3)	Quite a bit (4)	A great deal (5)
Discussed my ideas about the topics with others. (1)					
Asked others what they thought about the topics and issues. (15)					
Tried to think about how the topics I was reading about related to other things I know. (2)					
Checked myself to see how well I understood the issues related to the topics I was learning about. (3)					
Took notes about the issues related to the topics. (4)					
Identified questions that I still had about the topics. (5)					
Tried to find answers to my questions about the topics. (6)					
Explored topics related to the subject in order to satisfy my own curiosity. (7)					
Did some of my own research on the topics. (11)					
Visited the links and other additional resources listed in the background document. (12)					
Tried to think creatively about the impacts of this new technology on society. (13)					
Tried to identify new second-order effects of nanotechnology that others may not have thought of yet. (20)					
Tried to identify what people with different perspectives might think about the topics. (14)					
Tried to compare the benefits and drawbacks of the new technology in terms of their importance. (16)					

Carefully evaluated the accuracy of the evidence that was available for different claims. (17)
Carefully evaluated the relevance of various arguments about this new technology. (18)
Carefully evaluated how "typical" or common the evidence was, that was presented for different claims about the technology. (19)

a3comments_txt

If you have any other comments you would like to make on the activities today, especially concerning how they might be improved, please write them here.

4.1.5. Study 2 Assignment 4

Q216 **Considering "New Biology"...** **Issues in Nanotechnology & Genetics** **Follow up Assignment** Please think carefully about the questions in following assignment. If you work relatively carefully, it should take approximately 30-40 minutes to complete -- please complete it in one sitting if possible. If you leave the assignment and come back to finish it later, your browser must be set to "save cookies" and you must use the same computer and browser -- otherwise you will need to start over.

[Certain information will be removed from the data file for purposes of deidentification.]

name In order to get credit for completing this assignment, please fill out the following information.

- ☐ First Name (1) _____
- ☐ Last Name (2) _____
- ☐ Blackboard user name (e.g., s-name2) (3) _____

a4reci Please indicate which Bio 102 recitation you are enrolled in (see list below if you aren't sure):

- ☐ Recitation section number (151-157) (1) _____
- ☐ Recitation instructor name (4) _____

Q259 **Overarching Questions...** Now that you have responded to the scenarios in your recitation, you

may have changed your mind about the two central questions. Please answer the central questions again. **Be sure to especially explain if your views on the questions have changed since answering them before.**

Q261 **Click here to see a list of resources that were provided within the background document.** [[Click again to hide]]
Nanotechnology, what's that?! This is a video introduction to nanotechnology.
Nanotechnology takes off This is a video introduction to nanotechnology in general.
Nanotech Now: Your Gateway to Everything Nanotech This is a large website with a huge amount of information about nanotechnology.
To Upgrade is Human This is the TED video that you saw in recitation
National Nanotechnology Initiative This site is an example of how the government is trying to get "input" from people about future research, development, and regulation of nanotechnology.
Deepening Dialogue: Debating Nanotechnology's Responsible Development This video shows an example of citizens discussing the responsible development of nanotechnology.
Understanding Nanotechnology: Ethics and Technology This website not only overviews ethics and nanotechnology, it also provides links to numerous others who are working on ethics and nano issues.
Human Enhancement and Nanotechnology This is a very short text giving an overview of issues pertaining to human enhancement and nanotechnology.

a4_riskben **1. Based on what you now know: Do you think the risks of nanogenomics research and development outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks?**

- ☐ The risks greatly outweigh the benefits (1)
- ☐ The risks somewhat outweigh the benefits (2)
- ☐ The risks slightly outweigh the benefits (3)
- ☐ The risks and benefits are equal (4)
- ☐ The benefits slightly outweigh the risks (5)
- ☐ The benefits somewhat outweigh the risks (6)
- ☐ The benefits greatly outweigh the risks (7)

a4rbwhy_txt

Please explain your answer above. As you explain, **Be specific** about what you think are the most important benefits and drawbacks/risks of nanogenomics especially in the areas of human enhancement. Please especially consider the social, legal and ethical benefits and drawbacks (or issues) that you see as relevant to nanogenomics, particularly in the area of human enhancement.

Justify WHY you think either the risks or benefits outweigh the other. **Be sure to especially explain if your views on the questions have changed since answering them before.**

a4rbchgm **Overall, from the time you began these exercises, until now, to what extent did you change your mind about the risk/benefits question above?**

- ☐ Not at all (1)
- ☐ Just a little (2)
- ☐ Some (3)
- ☐ Quite a bit (4)
- ☐ A great deal (5)

a4_regslide **2. In your opinion, how much regulation is needed with respect to nanogenomics research and development?** Slide the slider to reflect your view. Zero means that you believe there should be NO regulation of nanogenomics. 100 means that you believe EVERY ASPECT of nanogenomic research and development should be HIGHLY regulated.

None at all (1)	
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a4regwhy_txt

Please explain your answer above. As you explain, **Be specific** about what **guidelines, rules, regulations,** or other means **should be** established and which ones **should not** be established, in order to help ensure that important benefits of nanogenomics are achieved and that harms/drawbacks are avoided, especially in the area of nanogenomics and human enhancement.

Justify WHY you think those regulations should or should not be in place. **Be sure to especially explain if your views on the questions have changed since answering them before.**

a4regchgm **Overall, from the time you began these exercises, until now, to what extent did you change your mind about the regulation question above?**

- ☐ Not at all (1)
- ☐ Just a little (2)
- ☐ Some (3)
- ☐ Quite a bit (4)
- ☐ A great deal (5)

a4inflnce **To what extent did the following influence the final views that you gave above?**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Talking about the issue with others (1)					
The background information that I read about the topics (2)					
Learning about new arguments that I'd not thought of before (3)					
My own research on the issue (4)					
Views of people important to me (5)					
The additional resources provided by the background documents (6)					

a4bioinf **To what extent did you feel like your study and knowledge of biology in this course influenced the input that you gave?**

- ☐ Not at all (1)
- ☐ Just a little (2)
- ☐ Some (3)
- ☐ Quite a bit (4)
- ☐ A great deal (5)

a4ppben **Overall, to what extent was the public participation module a beneficial part of your learning in this course?**

- ☐ Not at all (1)
- ☐ Just a little (2)
- ☐ Some (3)

- ☐ Quite a bit (4)
- ☐ A great deal (5)

How much do you feel you learned about nanotechnology and drug delivery as a result of working on the public engagement module last week and this week?

- ☐ Nothing I didn't know before (1)
- ☐ Just a little (2)
- ☐ Some (3)
- ☐ Quite a bit (4)
- ☐ A great deal (5)

If you would like to explain any of your ratings above, or if you were influenced by other factors or specific things, please explain below.

Q271 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

[NOTE: people received only one of the following 2 scenarios, a4fscnHlr OR a4fscnlowr randomly assigned]

In the Future... Imagine that thousands of people across America were invited to go through a process similar to that which you have just gone through, in order to give their input on the future of research and development in nanogenomics. Specifically, they were:

provided with background information and links to additional information
 given an assignment (very similar to the one you completed) to get a sense of their perceptions of the background information asked to respond to some "potential scenarios"

involving possible future developments using nanogenomics, in the same way that you were asked to respond (e.g., if you discussed the issues in a group, they also did; but if you worked alone, they also worked alone) and then were asked their opinions about the risks and benefits of nanogenomics, and the types of regulations that should be imposed on nanogenomics research and development. Next, imagine that, based on this process, it seemed that the majority of U.S. citizens were extremely negative about the potential benefits of nanogenomics research and development, and were in favor of decreasing the pace with which that research and development was conducted. In general, it seemed that people wanted to be sure that there were plenty of regulations in place to ensure that the risks they perceived did not become reality, even if those regulations slowed down innovation and development. In general, people were very concerned about where nanogenomic research would lead, and feared that the risks might greatly outweigh the benefits. Imagine that, as a result, the U.S. government decided to increase its regulation of nanogenomic research and development and to primarily fund studies of the potential risks associated with nanogenomic research and development rather than innovative studies that might explore the frontiers of its development. Research attending to basic safety concerns was emphasized, and the government began to develop a number of special regulations relating to specific concerns that citizens had regarding nanogenomics. **Given this scenario, please rate your agreement with the following statements.**

a4fscnlwr **In the Future...** Imagine that thousands of people across America were invited to go through a process similar to that which you have just gone through, in order to give their input on the future of research and development in nanogenomics. Specifically, they were:

- provided with background information and links to additional information
- given an assignment (very similar to the one you completed) to get a sense of their perceptions of the background information
- asked to respond to some "potential scenarios" involving possible future developments using nanogenomics, in the same way that you were asked to respond (e.g., if you discussed the issues in a group, they also did; but if you worked alone, they also worked alone)
- and then were asked their opinions about the risks and benefits of nanogenomics, and the types of regulations that should be imposed on nanogenomics research and development.

Next, imagine that, based on this process, it seemed that the majority of U.S. citizens were extremely positive about the potential benefits of nanogenomics research and development, and were in favor of increasing the pace with which that research and development was conducted. In general, it seemed that people wanted to be sure that there were just enough regulations in place to ensure basic safety issues, but they did not want those regulations to slow down innovation and development. In general, people believed that nanogenomic research would make the U.S. a leader in the area, and that the benefits would greatly outweigh the risks. Imagine that, as a result, the U.S. government decided to increase its investment in and funding for nanogenomic research and development. Furthermore, regulations on this research and development were fairly minimal and mostly involved attending to basic safety concerns, as is typical of most technologies, but without any special precautions specifically relating to the fact that it is "nanogenomics" per se. **Given this scenario, please rate your agreement with the following statements.**

	Strongly	Disagree (2)	Slightly	Slightly agree	Agree (5)	Strongly
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	disagree (1)		disagree (3)	(4)		agree (6)
The process used by the government to make decisions about this issue was fair. (1)						
The government made the right choices with regard to this issue. (2)						
The government made the same choices you would have made. (3)						
The government should have made different decisions about this issue. (4)						
The government should have used a different process to get public input about this issue. (5)						

a4fscnexpl_txt

If you would like to comment on this scenario, or explain your ratings, please do so here.

[NOTE: people received only one of the following 2 questions, a4slowrsch OR a4fastrsch randomly assigned]

a4slowrsch If legislation were being considered that would slow down nanogenomics research and development in the area of human enhancement by decreasing funding and increasing restrictions...**Would you be FOR or AGAINST such legislation?**

- ☐ Strongly AGAINST (1)
- ☐ Moderately AGAINST (2)
- ☐ Slightly AGAINST (3)
- ☐ Slightly FOR (4)
- ☐ Moderately FOR (5)
- ☐ Strongly FOR (6)

a4fastrsch If legislation were being considered that would speed up nanogenomics research and development in the area of human enhancement by increasing funding and decreasing restrictions...

Would you be FOR or AGAINST such legislation?

- ☐ Strongly AGAINST (1)

- ☐ Moderately AGAINST (2)
- ☐ Slightly AGAINST (3)
- ☐ Slightly FOR (4)
- ☐ Moderately FOR (5)
- ☐ Strongly FOR (6)

Q221 **What do you know now?** Please answer these 15 questions about nanotechnology. **Please don't look up or Google the answers!** The purpose of these questions is to find out what you may have learned as a result of working on these assignments. Some of the questions refer to information that was only available by visiting the additional resources, so don't worry if you don't know all the answers, simply make your "best guess."

a4kq02 **Which of the following are areas of current nanogenomic research and development? Again, check all that apply.**

- ☐ Use of nano-sequencing to map the human genome (1)
- ☐ Development of better genetic engineering procedures (2)
- ☐ Adapting biological transmodification for medical delivery (3)
- ☐ Synthesizing biochemical reactions more quickly (4)
- ☐ Development of simplified genetic code capable of supporting nanobot reproduction (5)
- ☐ None of the above (6)

a4kq01 **Some people say that nanogenomics may lead to "greater human enhancement." Which of the following activities are current examples of "human enhancement"? Check all that apply.**

- ☐ Education in schools and universities (1)
- ☐ The use performance-enhancing drugs by athletes (2)
- ☐ Use of medicine to combat naturally-contracted or -inherited diseases (3)
- ☐ Use of prosthetic devices to improve how people look (e.g., burn victims) (4)
- ☐ Plastic surgery to improve how people look (5)
- ☐ None of the above (6)

a4kq03 **What does RNAi stand for?**

- ☐ RNA interference (1)
- ☐ RNA interceptor (2)

- ☐ RNA integration (3)
- ☐ RNA inception (4)

a4kq04 For what purpose are DNA "scaffolds" manufactured?

- ☐ Making computer chips (1)
- ☐ Making new organisms (2)
- ☐ Making nanobots (3)
- ☐ Making new buildings (4)

a4kq05 **What was the United States eugenics movement?**

- ☐ The movement in the early Twentieth Century supporting the sterilization of humans with undesirable traits (1)
- ☐ The movement in the late Twentieth Century to map the human genome (2)
- ☐ A movement by geneticists to use a new methods involving the compound uracil, first discovered in the Nineteenth Century (3)
- ☐ There was no United States eugenics movement (4)

a4kq06 **What do some people say is one problem with encouraging research and development in nanogenomics aimed at curing diseases?**

- ☐ People have different opinions about what a disease is. (1)
- ☐ We already know that diseases can not be cured with nanogenomics. (2)
- ☐ Present cures for diseases are cheaper. (3)
- ☐ Nanobots can only cure some diseases, but not all. (4)

a4kq07 **What is genetic engineering?**

- ☐ The changing of the structure of genetic material (1)
- ☐ The engineering of new organisms and life forms (2)
- ☐ The engineering of electronic devices using genetic materials (3)
- ☐ The method by which taxonomists edit transgenic traits (4)

a4kq08 **What does the "ELSI" acronym refer to?**

- ☐ Ethical, legal, and social issues (1)

- ☐ Enteric lethal symbiosis in ice (2)
- ☐ Early lysine-saline injection (3)
- ☐ Enteric-lysine sulfur iodine (4)

a4kq09

Which of the following is between 1 and 100 nanometers?

- ☐ DNA (1)
- ☐ The head of a pin (2)
- ☐ A human hair (3)
- ☐ DNA base-pairs (4)

a4kq10

What are “second-order effects?”

- ☐ Indirect consequences of certain actions and developments (1)
- ☐ The second effect of a certain action or development (2)
- ☐ The effects that the second child of a family has on the rest of the family (3)
- ☐ Effects of genetically modified foods that directly affect animals but not people (4)

a4kq11

Which of the following is a known fact that is sometimes used to argue for caution when it comes to research and development in nanotechnology?

- ☐ Materials that are harmless at the macro-level often have different properties at the nano-level (1)
- ☐ Researchers are using advances in nanogenomics to create biological weapons that could fall into the wrong hands (2)
- ☐ Researchers are using nanogenomics to create nano-sized, self-replicating robots (3)
- ☐ DNA “scaffolds” have been shown to be sentient (4)

a4kq12 **RNAi has shown promise as a possible treatment and prevention of what disease?**

- ☐ Cancer (1)
- ☐ Alzheimer’s (2)
- ☐ Inflammatory Bowel Disease (3)
- ☐ All of the above (4)

a4kq13 **Which of the following could be eliminated for future generations through the use of nanogenomic technology?**

- ☐ Cosmetic abnormalities (1)
- ☐ Physical disabilities with which people are born (2)
- ☐ Mental disabilities with which people are born (3)
- ☐ All of the above (4)

a4kq14 **How many nanometers are in one meter?**

- ☐ 1,000,000,000,000 (One trillion) (1)
- ☐ 1,000,000,000 (One billion) (2)
- ☐ 1,000,000 (One million) (3)
- ☐ .000001 (One millionth) (4)

a4kq15 **Which of the following could theoretically be subject to scientific experimentation by way of nanogenomic technologies that will soon be available?**

- ☐ DNA (1)
- ☐ Quarks (2)
- ☐ Neutrinos (3)
- ☐ Creation of human embryos (4)
- ☐ All of the above (5)

Q235 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

Q153 **What do You Think?** At the beginning of the semester, you answered the following questions, but may have felt that you did not have enough information to answer the questions. You were told that you would have a chance to change your answers at the end of the semester once you know more. This is your chance! **** Do the best you can to answer these questions. ** ** After you and all your classmates have answered these questions -- we will let you know, in summary form, what your**

a4Nanorate **When it comes to nanotechnology, how important are the following to you?**

a4Nanosum **There are, of course, only a limited number of resources (time, effort, money) that can be spent on each of the things that you rated above. So, please consider what percentage of the U.S. resources (i.e., total time, effort, and money) should be spent on each. Make sure that your percentages sum to 100%, and make sure that you give the items you rated the most important the greatest percentage of resources.**

- a4ATT04 Read each of the following statements, and then indicate to what degree you agree or disagree.**

	Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Slightly Agree (4)	Agree (5)	Strongly Agree (6)
Nanotechnology is one of the more important issues confronting government. (5)						
The risk of nanotechnology directly affecting physical things like human health, wildlife, or the environment in general is currently too high. (6)						
The risk of nanotechnology affecting social systems like the economy, trade, and sustainable food supply is currently too high. (4)						
The government will effectively manage any risks associated with nanotechnology. (3)						
We should develop nanotechnology at full speed despite its possible risks, in order to keep the U.S. from falling behind other countries. (2)						
Due to the fact that some have expressed strong concern about nanotechnology's risks, we should have a world						

ban on new nanotechnology products. (1)

a4ATT02 **Below are seven benefits of nanotechnology that some say are possible. Drag and drop the items to rank them in order of importance such that 1 = most important benefit, and 7 = least important benefit. Just give your personal opinion. There is no right or wrong answer.**

- _____ New and better ways to clean up the environment (1)
- _____ The ability to improve humans through genetic manipulation (2)
- _____ Increased national security and defense capabilities (3)
- _____ Cheaper, longer lasting consumer products (4)
- _____ New and better ways to treat and detect human diseases (5)
- _____ A greater utilization of renewable energy (6)
- _____ The ability to use nanomedicines to improve human mental capacities (7)

a4ATT03 **Below are seven risks of nanotechnology that some say are possible. Drag and drop the items to rank them in order of importance such that 1 = most worrisome risk, and 7 = least worrisome risk. Just give your personal opinion. There is no right or wrong answer.**

- _____ Economic disruption caused by the loss of traditional jobs (1)
- _____ Losing your personal privacy to tiny new surveillance devices (2)
- _____ A nanotechnology inspired arms race between the U.S. and other nations (3)
- _____ New health problems for people due to the use of nanomedicine (4)
- _____ Unexpected problems due to the use of nanogenomics to alter genetic code (5)
- _____ Pollution of the environment by nanomaterials (6)
- _____ Breathing tiny nano-sized particles that accumulate in your body (7)

Q129 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4ATT06 **NANOGENOMICS** By funding and advancing research on nanotechnology and GENETICS, some people say that the effects in the chart below eventually would be incurred. **Based on what you know right now, how *likely* do you think it is that each of these potential effects will become a reality as a result of nanogenomics research? And how important do you think it is to either achieve the**

benefits or avoid the drawbacks?

Likelihood (1)					Do you see this effect as a benefit or drawback? (2)		In your opinion, how important is this benefit or drawback to achieve or avoid? (3)				
Not at all likely (1)	Slightly likely (2)	Somewhat likely (3)	Very likely (4)	Extremely likely (5)	Benefit (1)	Drawback (2)	Not at all (1)	Slightly (2)	Somewhat (3)	Very (4)	Extremely (5)
Drastic reductions in the effects of aging (1) The creation of "designer babies" (aka, "super babies") (2) No more passing on of genetic diseases to one's offspring (3) A new eugenics movement (4) Unforeseen side-effects (5) The eradication of genetic inheritance of disease (6) Economic development through investment and research (7) Siphoning of US funds away from more important purposes related to the immediate economic crisis (8)											

a4ATT05 **NANOMEDICINE** By being able to deliver medicines and other substances at the nanoscale, some people say that the benefits in the chart below would be within reach. **Based on what you know right now, how likely do you think it is that each of these potential benefits will become a reality? And how important do you think each potential benefit is to achieve?**

Likelihood (1)					How important do you think this benefit is? (2)				
Not at all likely (1)	Slightly likely (2)	Somewhat likely (3)	Very likely (4)	Extremely likely (5)	Unimportant (1)	Slightly Important (2)	Somewhat Important (3)	Very Important (4)	Extremely Important (5)
The extension of human life expectancy (1) Cheap and more universal healthcare (2) Fewer side effects (3) Higher rate of terminal illness (e.g. cancer) survival (4) Improvement of individuals' physical abilities and muscle function (5) Improvement of individuals' mental abilities and brain function (6)									

Q264 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4TCSCI01 **NANOSCIENTISTS** Next indicate how you feel about the nanoscientists responsible for researching and making discoveries involving nanotechnology.

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
How much do you know about nanoscientists? (1)					
To what extent have you had experiences or interactions with nanoscientists? (2)					
To what extent do you feel certain in your views about nanoscientists? (3)					

Q117 Please make the following judgments based on whatever knowledge or experience you have right now. Don't worry if you don't have much knowledge and experience, just indicate your gut-level feelings and impressions.

a4TCSCI02 Right now, to what extent do you have confidence in nanoscientists to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Do their jobs well (1)					
Meet their professional responsibilities (2)					
Meet their ethical responsibilities (3)					
Go above and beyond what is expected of them professionally in order to better society (4)					
Go above and beyond what is expected of them professionally in order to protect society from risks (5)					

a4TCSCI03 To what extent do you feel nanoscientists probably...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Are trustworthy (1)					
Are untrustworthy (2)					
Are honest (3)					
Are ethical (4)					
Are dishonest (5)					
Are fair (6)					
Are competent to do their jobs (7)					
Are incompetent to do their jobs (8)					

Have the knowledge needed to do their jobs well (9)

Have the skills needed to do their jobs well (10)

Have the training needed to do their jobs well (11)

Use fair procedures when making decisions (12)

Listen to everyone's opinion (13)

Treat people fairly (14)

Care about the community they serve (15)

Reach the correct conclusions (17)

Reach conclusions that are best for everyone (18)

Care about people like you, your friends, and your family (19)

Are concerned with how their work impacts everyday people (20)

Care about how their work affects culture (21)

Care about the long-term impacts of their work (22)

Are motivated to "do the right thing" (23)

Are likely to do the right thing because they see themselves as "good" (24)

Would feel bad about themselves if their work put others at risk (25)

Need oversight (26)

Are primarily motivated by self-interest (27)

Are primarily motivated by what will profit them (28)

Are primarily motivated by what will benefit them personally (29)

Will do the right thing only if they are punished for doing the wrong thing (30)

Don't really care about the long-term risks of their work (31)

Interpret the results of their experiments in an unbiased way (16)

Q128 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4TCSCI07

When it comes to nanotechnology, to what extent do you feel nanoscientists can be trusted to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Make decisions about the most important directions for nanotechnology development (1)					
Minimize potential risks for humans (2)					

Minimize potential environmental risks (4)
Think about the social and ethical impacts and implications of nanotechnology (3)
Maximize potential benefits (5)

a4TCSCI08 **When it comes to nanotechnology, to what extent do you feel
nanoscientists are capable of...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Making decisions about the most important directions for nanotechnology development (1)					
Minimizing potential risks for humans (2)					
Minimizing potential environmental risks (4)					
Thinking about the social and ethical impacts and implications of nanotechnology (3)					
Maximizing potential benefits (5)					

a4TCSCI09 **When it comes to nanotechnology, to what extent do you feel
nanoscientists are motivated to...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Make decisions about the most important directions for nanotechnology development (1)					
Minimize potential risks for humans (2)					
Minimize potential environmental risks (4)					
Think about the social and ethical impacts and implications of nanotechnology (3)					
Maximize potential benefits (5)					

Q102 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4TCREG01 **POLICY MAKERS** Next, please indicate how you feel about the policy makers responsible
for regulating and making laws involving nanotechnology.

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
--	----------------	-------------------	----------	-----------------	------------------

- How much do you know about policy makers who regulate nanotechnology? (1)
- To what extent have you had experiences or interactions with these policy makers? (2)
- To what extent do you feel certain in your views about these policy makers? (3)

Q169 Please make the following judgments based on whatever knowledge or experience you have right now. Don't worry if you don't have much knowledge and experience, just indicate your gut-level feelings and impressions.

a4TCREG02 To what extent do you have confidence in policy makers who help regulate nanotechnology to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Do their jobs well (1)					
Meet their professional responsibilities (2)					
Meet their ethical responsibilities (3)					
Go above and beyond what is expected of them professionally in order to better society (4)					
Go above and beyond what is expected of them professionally in order to protect society from risks (5)					

a4TCREG03 To what extent do you feel policy makers who help regulate nanotechnology...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Are trustworthy (1)					
Are untrustworthy (2)					
Are honest (3)					
Are ethical (4)					
Are dishonest (5)					
Are fair (6)					
Are competent to do their jobs (7)					
Are incompetent to do their jobs (8)					
Have the knowledge needed to do their jobs well (9)					
Have the skills needed to do their jobs well (10)					
Have the training needed to do their jobs well (11)					
Use fair procedures when making decisions (12)					
Listen to everyone's opinion (13)					
Treat people fairly (14)					

Care about the community they serve (15)
Are not biased when it comes to interpreting science that is relevant to policy (16)
Reach the correct conclusions (17)
Reach conclusions that are best for everyone (18)
Care about people like you, your friends, and your family (19)
Are concerned with how their decisions impact everyday people (20)
Care about how their decisions affect culture (21)
Care about the long-term impacts of their work (22)
Are motivated to "do the right thing" (23)
Are likely to do the right thing because they see themselves as "good" (24)
Would feel bad about themselves if their decisions put others at risk (25)
Need oversight (26)
Are primarily motivated by self-interest (27)
Are primarily motivated by what will profit them (28)
Are primarily motivated by what will benefit them personally (29)
Will do the right thing only if they are punished for doing the wrong thing (30)
Don't really care about the long-term risks of their decisions (31)

Q172 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4TCREG07

When it comes to nanotechnology, to what extent do you feel policy makers can be trusted to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Make decisions about the most important directions for nanotechnology development (1)					
Minimize potential risks for humans (2)					
Minimize potential environmental risks (4)					
Think about the social and ethical impacts and implications of nanotechnology (3)					
Maximize potential benefits (5)					

a4TCREG08

When it comes to nanotechnology, to what extent do you feel policy makers are capable of...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Make decisions about the most important directions for nanotechnology development (1)					
Minimize potential risks for humans (2)					
Minimize potential environmental risks (4)					
Think about the social and ethical impacts and implications of nanotechnology (3)					
Maximize potential benefits (5)					

a4TCREG09

When it comes to nanotechnology, to what extent do you feel policy makers are motivated to...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
Make decisions about the most important directions for nanotechnology development (1)					
Minimize potential risks for humans (2)					
Minimize potential environmental risks (4)					
Think about the social and ethical impacts and implications of nanotechnology (3)					
Maximize potential benefits (5)					

Q181 Timing

First Click (1)

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a4traits **Finally, on this last page, please complete the following questions about your general views about citizenship and social issues.**

	<i>Extent of Agreement</i>					
	Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Slightly Agree (4)	Agree (5)	Strongly Agree (6)
A good citizen should listen to people who disagree with them politically (1)						
A good citizen should allow others to challenge their political beliefs (2)						

A good citizen should discuss politics with those who disagree with them (3)

A good citizen should be willing to justify their political views (4)

If a citizen is dissatisfied with the policies of government, he or she has a duty to do something about it. (5)

I follow social issues because I want to learn new things. (6)

I follow social issues because that's what I'm expected to do. (7)

I follow social issues because it bothers me when I don't. (8)

Being socially conscious is important to who I am. (9)

I follow social issues because that's what I'm supposed to do. (10)

I follow social issues because I will feel bad about myself if I don't. (11)

I follow social issues because I think it's important. (12)

I consider myself well-qualified to participate in politics. (13)

People like me don't have any say about what the government does. (14)

Sometimes politics and government seem so complicated that a person like me can't really understand what's going on. (15)

I think that I am better informed about social issues than other students. (16)

I feel I have a pretty good understanding of current social issues facing my world. (17)

I consider myself well qualified to provide input on social issues. (18)

a4intrloc **Thinking about your local community, how interested are you in local community politics and local community affairs?**

- ☐ Not Interested 0 (0)
- ☐ 1 (1)
- ☐ 2 (2)
- ☐ Moderately Interested 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ Extremely Interested 6 (6)

a4intrnat **How interested are you in national politics and national affairs?**

- ☐ Not Interested 0 (0)
- ☐ 1 (1)
- ☐ 2 (2)
- ☐ Moderately Interested 3 (3)
- ☐ 4 (4)

- ☐ 5 (5)
- ☐ Extremely Interested 6 (6)

a4futinput **How interested would you be in participating in future activities like this one, where you have the opportunity to give your input on future developments and regulation of science and technology?**

- ☐ Not Interested 0 (0)
- ☐ 1 (1)
- ☐ 2 (2)
- ☐ Moderately Interested 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ Extremely Interested 6 (6)

Q263 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

[NOTE: students only receive one of the following 2 instructions, randomly assigned]

consentpj **Consent - revisited** Below is the official consent form, the same consent form that you saw at the beginning of the semester (if you did the assignment at the beginning of the semester). At this time, we would like to give everyone a chance to change their consent if they would like. The reason we give this second opportunity is because when you gave your consent at the beginning of the semester you had not yet completed all of the assignments, and so did not know what all they entailed. As it notes below, the decision to allow your work on the New Biology assignments to be used in research (to improve the assignments and current knowledge about input to science regulation) **is entirely up to you**. Your instructor will not know if you participated or not, your participation will not affect your grade, and there are no benefits to you directly. However, if you give consent, then you will influence the improvement of these assignments and your viewpoints will be included in published summaries regarding what the public feels are important issues related to nanogenomics research and development. Note that your viewpoints would only be included in anonymous form, after removing your name and any other identifying information. Your identity (and whether you participated) will be confidential and not be associated with the data in any way.

consentrc **Consent - revisited** Below is the official consent form, the same consent form that you saw at the beginning of the semester (if you did the assignment at the beginning of the semester). At this time, we would like to ask those of you who did not consent before to reconsider whether you would allow us to access your work on the New Biology assignments in order to improve the assignments, and our knowledge about input to science regulation. As it notes below, this decision is entirely up to you. There are no benefits to you directly. However, if you give consent, then you will influence the improvement of these assignments and your viewpoints will be included in published summaries regarding what the public feels are important issues related to nanogenomics research and development. Note that your viewpoints would only be included in anonymous form, after removing your name and any other identifying information. Your identity (and whether you participated) will be confidential and not be associated with the data in any way.

[Consent materials were shown here]

a4consent Do you consent to participate in the research by allowing us to use your coursework-related data as indicated above?

- ☐ Yes (1)
- ☐ No (2)

a4dataqual Did you give your honest answers in this assignment? (You will **not** be penalized for your answer. Dr. Morris and your recitation instructor will **not** know how you answered this question.) .Skin .QuestionBody .TextEntryBox { width:400px; }

- ☐ Yes, my answers reflect my honest answers to the questions in the assignment (1)
 - ☐ No, I answered the questions randomly (2)
 - ☐ No, I felt like I should answer in a certain way, so I gave those answers instead of my honest responses (3)
 - ☐ Other (Please explain) (4)
-

a4finlfbk **Final Feedback?** As you know, the New Biology assignments are being evaluated by your instructor with the help of researchers from the Public Policy Center. So, if you have any feedback, comments, or questions about the New Biology Assignments, please write them below. **These comments WILL be seen by your instructor, so do not write anything that you do not intend your instructor to see.** However, your name and identity will not be associated in any way with the comment unless you choose to put your name within the comment.

Q210 THANK YOU! Click continue to submit your assignment. A copy of your work will be emailed to you if you entered an email at the beginning of the assignment.

4.1.5. Study 2 Assignment 5

[NOTE: This last assignment was offered for extra credit only]

S2 A5 NG Extra Credit

Start of Block: Introduction

Q1 **Considering "New Biology"...**

Issues in Nanotechnology & Genetics

Extra Credit = 5 points

This assignment will take approximately **one-half to one hour to complete**. If you think you will need to leave it and come back, you should be sure that you come back to the same computer and that your browser is **set to save cookies** so that you can resume the assignment where you left off. If cookies are not enabled, you may have to start the assignment over if you leave and come back.

name **To receive credit for this assignment the following information is required.**

- ☐ First Name (1) _____
- ☐ Last Name (2) _____
- ☐ Blackboard user name (e.g., s-name2) (3) _____

reci Please indicate which Bio 102 recitation you are enrolled in (see list at the bottom of the page if you aren't sure):

- ☐ Recitation section number (151-157) (1) _____
- ☐ Recitation instructor name (4) _____

a5email Finally, to receive your work on this assignment via email, please put your email below.

Be sure to enter your email carefully and double-check that it is correct. A copy of your work and the time that you completed it will then be sent to the email that you enter. That email will be your proof that you completed the assignment, should any questions arise.

○ **Email to which to send a copy of your work -->** (1) _____

Q9 Here is a list of the recitations. Please note the out-of-order numbering.

5ffmtrait **About You**

People differ in the types of activities they like. The following questions will help researchers understand if some of the New Biology activities are preferred by people with different personalities.

Below are phrases describing people's feelings and behaviors. Please read each statement carefully, and then use the rating scale below to describe how accurately each statement describes you.

Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age.

	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
--	------------------------	------------------------------	--	----------------------------	-------------------

- Often feel blue. (4)
- Dislike myself. (5)
- Am often down in the dumps. (6)
- Have frequent mood swings. (7)
- Panic easily. (8)
- Rarely get irritated. (9)
- Seldom feel blue. (10)
- Feel comfortable with myself. (11)
- Am not easily bothered by things. (12)
- Am very pleased with myself. (13)
- Feel comfortable around people. (14)
- Make friends easily. (15)
- Am skilled in handling social situations. (16)
- Am the life of the party. (17)
- Know how to captivate people. (18)
- Have little to say. (19)
- Keep in the background. (20)
- Would describe my experiences as somewhat dull. (21)
- Don't like to draw attention to myself. (22)
- Don't talk a lot. (23)
- Believe in the importance of art. (24)
- Have a vivid imagination. (25)
- Tend to vote for liberal political candidates. (26)

- Carry the conversation to a higher level. (27)
- Enjoy hearing new ideas. (28)
- Am not interested in abstract ideas. (29)
- Do not like art. (30)
- Avoid philosophical discussions. (31)
- Do not enjoy going to art museums. (32)
- Tend to vote for conservative political candidates. (33)
- Have a good word for everyone. (34)
- Believe that others have good intentions. (35)
- Respect others. (36)
- Accept people as they are. (37)
- Make people feel at ease. (38)
- Have a sharp tongue. (39)
- Cut others to pieces. (40)
- Suspect hidden motives in others. (41)
- Get back at others. (42)
- Insult people. (43)
- Am always prepared. (44)
- Pay attention to details. (45)
- Get chores done right away. (46)
- Carry out my plans. (47)
- Make plans and stick to them. (48)
- Waste my time. (49)
- Find it difficult to get down to work. (50)
- Do just enough work to get by. (51)
- Don't see things through. (52)
- Shirk my duties. (53)

Critical Thinking Condition

[Note: half the students were assigned to the critical thinking condition and half to the information organization condition for this assignment]

Q149 ----- **Critical Thinking Instructions**

The goal of this assignment is to get your opinions of some of the "claims" made by students before you.

Before we start, please carefully read the instructions, and complete the critical thinking example below.

Q146 **One of the most important parts of forming an "informed opinion" involves being able to think critically about claims that people make and the evidence for those claims.**

It is of course possible to provide lots of evidence for just about any viewpoint out there. However, that does not mean that all the evidence is of equal quality. Before making your mind up on something, you should ask if the evidence that is presented is relevant, true, and representative of most of the evidence.

1. Relevance: Is the evidence presented *relevant* to the conclusion or statement?

2. Accuracy: Is the evidence presented *accurate*? Or inaccurate? Is it partially accurate? Is it an exaggeration of a fact?

3. Typicality: Is the evidence presented *typical* evidence, that is, is it commonly found? Or is it *atypical* evidence (a single unique and uncommon case)?

4. Sufficiency: Is the evidence presented *sufficient* to draw the conclusion? Or is more evidence needed? Next, you will be asked to analyze some claims about nanogenomics using the four criteria described here.

But first, try the practice example below. This example is intended to illustrate the different dimensions of critical thinking.

a5ctexRAT

Example

Below are some pieces of evidence or reasons that someone might give to support the following claim...

CLAIM: You should NOT buy laundry detergent X.

Please rate each piece of evidence below according to how relevant you think it is to this claim, as well as how accurate and how typical you think it is.

EVIDENCE / REASONS: For why you should NOT buy laundry detergent X...

	How Relevant is the evidence to the claim? (1)	How Accurate is the evidence? (2)	How Typical is evidence? (3)
In a recent survey, 8 out of 20 shoppers commented: It smells like toothpaste, not soap. (1)	▼ Not at all (1) ..I don't know (5)	▼ Not at all (1) ..I don't know (5)	▼ Not at all (1) ..I don't know (5)
Your cousins told you that last week, when they washed their clothes with it, it did not get their socks clean. (2)	▼ Not at all (1) ..I don't know (5)	▼ Not at all (1) ..I don't know (5)	▼ Not at all (1) ..I don't know (5)
When you look at the ads in the paper, you see that it costs about half as much as other detergents. (3)	▼ Not at all (1) ..I don't know (5)	▼ Not at all (1) ..I don't know (5)	▼ Not at all (1) ..I don't know (5)

Q295 Note: Above, you can roll your cursor over the red bolded terms to see a reminder of what the term means.

Q292 **[[See how (fictional) others might answer the above by clicking HERE]]**
[[Click again to hide]]

With regard to Claim 1 ("It smells like toothpaste"), Pat says:

--Relevant: Not at all -- I don't care what it smells like, so that is not *relevant* to whether I buy it.

--Accuracy: I don't know -- I don't know who did the so-called survey, so I really don't know if it is *accurate*

--Typical: Somewhat -- If only 8 of 20 (less than half!) thought it smelled like toothpaste, then it seems like people more *typically* say it does **not** smell like toothpaste!

With regard to Claim 2 ("Dirty socks"), Chris says:

--Relevant: Entirely -- The extent to which it gets clothes clean is very *relevant* to whether I buy it.

--Accurate: Entirely -- I trust my cousins to tell me the truth, so I think it is *accurate* that their clothes were not clean.

--Typical: Somewhat -- On the other hand, if only their socks did not get clean, then maybe it is not too *typical* that it fails to get things clean (my cousins have dirtier-than-average socks anyway).

With regard to Claim 3 ("Low cost"), DJ says:

--Relevance: Not at all -- I'm on a tight budget, so cost is *relevant* to whether I buy it, BUT because the detergent is cheap, it is relevant to my **wanting** to buy it, but not relevant to a claim about **not** buying it.

--Accurate: Mostly -- The ads are usually pretty *accurate* when it comes to prices of things like detergent.

--Typical: Mostly -- I looked at quite a few ads and the detergent IS *typically* half as much as other detergents.

a5ctexsuff

Imagine that the evidence above was the only evidence you had for the claim that you should NOT buy detergent X. In your opinion, how sufficient is the evidence to support the claim?

- ☐ Not at all (1)
 - ☐ Slightly (2)
 - ☐ Somewhat (3)
 - ☐ Mostly (4)
 - ☐ Entirely (5)
-

a5ctex_com_txt

Feedback / Comments

On this page, is there anything about which you have any questions? Do you have any comments? Things you found interesting or liked? Things you did not like? Ways to improve this page?

a5Tp2 Timing

First Click (1)
Last Click (2)
Page Submit (3)
Click Count (4)

Q200 **Thinking Critically about....Nanogenomics**

Q319 Next, you will apply what you learned to think critically, and in greater depth, about the question:

"How much should research and developments in nanogenomics be regulated?"

At the "extremes" two perspectives or answers to this question might be written like this:

Pro-regulation Perspective: We DO need to highly regulate every aspect of research and development involving nanogenomics.

Anti-regulation Perspective: We do NOT need to regulate research and development of nanogenomics at all.

In the last assignment, you may have listed some claims that were "pro-" and/or "anti-regulation." This time, we will list some of the most common claims that students before you have listed, and ask you to think about those claims critically and tell us what you think.

Carry Forward All Choices - Displayed & Hidden from "claims with evidence"



a5ctc_rate **How would you rate these student claims?**

Below are some claims that prior students offered as supportive of a **PRO-regulation Perspective** or an **ANTI-Regulation perspective**.

We used prior student input, and some of our own research, to try to find evidence that might either support or negate these claims. You should feel free to do additional research on your own, using any sources that you trust.

Important: We tried to choose claims that varied in quality -- that is some that we thought were really relevant, and some that are not. Some that are accurate, and some that are not accurate. In addition, the *sources* of the evidence provided vary in quality, and the claims may or may not pertain to typical findings.

If you feel like some of the claims or the evidence provided for them are of low quality, this is to be expected. This exercise is intended to reflect real world situations where the claims made by people, and the evidence they offer, do vary in quality.

With that in mind, please rate the following claims.... In your opinion....

Note: You can roll your cursor over the bolded red text for a reminder of what the terms mean. Clicking on "see evidence" will show some quotes below the claim and provide you a link to sources.

	How Relevant is the claim to the PRO-Regulation perspective? (1)	How Accurately is the claim stated? (2)	How Typical is evidence for the claim? (3)	How Relevant is the claim to the ANTI-Regulation perspective? (4)
	▼ Not at all (1) ... Entirely (4)	▼ Not at all (1) ... Entirely (4)	▼ Not at all (1) ... Entirely (4)	▼ Not at all (1) ... Entirely (4)

- Nanogenomics could someday allow people to change any genetic characteristic (hair, skin, eye color) that they would like. See evidence **Supporting evidence?** • Some note that such procedures are already being considered: "'It's technically feasible and it can be done,' says Mark Hughes, a pioneer of the PGD process and director of Genesis Genetics Institute, a large fertility laboratory in Detroit. However, he adds that 'no legitimate lab would get into it and, if they did, they'd be ostracized.'" See source • Nanotechnology may simply be an additional tool for achieving such aims, as suggested by this author: "Nanorobots could change your physical appearance. They could be programmed to perform cosmetic surgery, rearranging your atoms to change your ears, nose, eye color or any other physical feature you wish to alter." See source **Negating evidence?** • At the end of the article referencing the potential of nanorobots above, the author states that, in general, "Many nanotechnology experts feel that these applications are well outside the realm of possibility, at least for the foreseeable future." See source (x1)
- People already use (and our laws allow them to use) medical technologies to change how they look (through plastic surgery) and even their gender--use of nanogenomics for human enhancement is basically the same thing. See evidence **Supporting evidence?** • Dr. Gregor Wolbring reminds us that "the ever increasing appearance of internal and external enhancements of the human body – driven by lucrative and big business sport disciplines on one hand and the medical technology to deal with injuries on the other – enables a culture of increasing demand for, and acceptance of, improvements to and modifications of the human body (structure, function, abilities) beyond its species-typical boundaries." See source • With regard to the potential of nanotechnology to enhance humans, the President's Council on Bioethics said, "These technologies promise great benefits for humanity—such as increased productivity and creativity, longer lives, more serenity, stronger bodies and minds." See source • In 2000, David Resnick noted that scientists at a conference predicted that "within a few years researchers will develop techniques that can be used to enhance human traits." See source **Negating evidence?** • In light of recent developments in genetic research, scientists have been asked to make changes in things like skin color and muscle mass of patients. While this probably could be accomplished with current technology, Dr. Christopher Evans and Dr. Scott McIvor say, "the possibility of harm would be difficult to justify for a cosmetic procedure and, more important, genetic enhancement of healthy people raises a host of difficult ethical questions." See source • "The American Medical Association's Council on Ethical and Judicial Affairs issued a policy statement in 1994 stating that efforts to enhance "desirable" characteristics through the insertion of a modified or additional gene, or efforts to "improve" complex human traits, are contrary not only to the ethical tradition of medicine but also to the egalitarian values of our society." See source *Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x2)
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hair or a father's brown eyes.**Negating evidence?**• David King of Human Genetics Alert says, "Currently, genetic engineering is only applied to non-reproductive cells (this is known as 'gene therapy') in order to treat diseases in a single patient, rather than in all their descendants. Gene therapy is still very unsuccessful, and we are often told that the prospect of reproductive genetic engineering is remote."See source*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x3)

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- Heavy regulation of nanogenomics will stifle and slow down research and development in nanogenomics.See evidence**Supporting evidence?**• In his 2007 paper, Patrick Lin looks at both sides of the issue: "On one side, experts argue that nanomaterials, which are making their way into the marketplace today, are possibly harmful to consumers and the environment, so stronger and new laws are needed to ensure they are safe. On the other side, different experts argue that more regulation will slow down the pace of business and innovation in nanotechnology."See source• Howard Schachman, Biology Professor at the University of California at Berkeley, posits that, "scientists temperamentally and culturally are skeptical about the legitimacy of rules; instinctively they tend to oppose regulations as an unnecessary burden impeding research." He adds that they "express frustration over those government regulations which are imposed as a result of political pressures, provide very little benefit, appear ill-advised or poorly crafted, are costly and do indeed impede scientific research."**Negating evidence?**• According to an Arizona State University study, "leading U.S. scientists in nanotechnology believe regulations are most urgently needed in the areas of surveillance and privacy, human enhancement, medicine and the environment."See source• Norris Alderson, who was on the FDA task force for nanomedicine says, "We reached a number of conclusions. Perhaps the most important is that, for now, this technology is really no different than any other new technology that would be incorporated into FDA products. So with that in mind, we feel comfortable, if you will, using our present regulatory framework. However, we felt there is need for guidance to help this industry as it moves forward. We recognized a need for additional information in various areas, such as biosafety. FDA and other agencies are working together on that. But for now, we just do not see the need for regulations written specifically for nano-engineered materials in the products FDA regulates."See source*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x5)
- Heavy regulation will prevent the creative work that is necessary for life-saving breakthroughs.See evidence**Supporting evidence?**• Dr Patrick Lin, director of The Nanoethics Group says, "We need to find a reasonable balance that responsibly promotes innovation in nanotechnology while at the same time safeguards EHS [environmental health and safety] interests."See source• Eric Berger, science reporter for the Houston Chronicle, says "by finding areas in which nanotechnology may pose even a theoretical threat, they're also opening the door to more stringent regulation, which at some point may strangle the development of small, cash-strapped companies that are trying to commercialize innovative nano ideas."See source• According to a 2010 article on thescientist.com, "Biomedical science as it is practiced today in the United States in academic institutions is largely an enterprise, and a very large enterprise, supported with public funds from the national government. Due to the real risks for lapses in safety or ethics and the appropriate expectation for some form of accountability, research supported by money from

the National Institutes of Health (NIH) or other federal sources is expected to comply with rules and regulations intended to minimize the chances for breaches in safety or ethics or for inappropriate use of research funding. While many of these regulatory regimes are well-intentioned, collectively, they have come to represent an immense burden that stifles creativity and discourages timely implementation of research ideas resulting from new insights or inspirations."See source**Negating evidence?**• Tim Malloy, of the UCLA School of Law Sustainable Technology and Policy Program says, "Nanotechnology raises substantial scientific and policy issues regarding both risk assessment and standard setting, provoking calls for further study and "soft law" approaches relying upon voluntary action by industry rather than mandatory regulation."See source• In 2006, nanotechweb.org argued that, "The anticipated rapid emergence of nanotechnology brings significant regulatory challenges for environmental protection. A lack of regulation will undermine public confidence in the emerging technology."See source*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x6)

- At the nano-scale, materials change their properties: For example, elements that don't conduct electricity at normal scales may suddenly do so at the nano-level. See evidence**Supporting evidence?**• A National Citizens' Technology Forum Report on Nanotechnology states that "A critically important aspect of manipulating matter at the nanoscale is that a material's properties can...exhibit new properties, such as electrical conductivity, elasticity, enhanced strength, different colors, and different reactivity, when compared to the same material at "normal" scale. This means...that using materials at the nanoscale can mean the creation of new materials that can be beneficial in many ways. It also means that we cannot assume that materials that are safe and harmless at normal scales are necessarily safe and harmless at the nanoscale."See source• Andrew Maynard, head of the University of Michigan Risk Science Center, offers an example: "Gold is an inert, yellowish metal—everyone knows this." He continues, "But form gold into particles just a few nanometers across, and everything changes—the metal does the equivalent of transforming from a cat into a dog. Instead of appearing yellowish in color, the particles now appear red, and become highly chemically active."See source**Negating evidence?**• None found*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x7)
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- Nanogenomics will someday let people choose the genetic make up of their children.See evidence**Supporting evidence?**• As Jeff Steinberg of LA's Fertility Institutes says, "This is cosmetic medicine...Others are frightened by the criticism but we have no problems with it." Trait selection in babies "is a service," says Dr. Steinberg, and "[w]e intend to offer it soon."See source• Stanford University's Cross-cultural Rhetoric Project acknowledges that "PGD (Preimplantation Genetic Diagnosis) has been used to create 'Designer Babies'. 'Designer baby' is a term used to refer to a baby whose genetic makeup has been artificially selected by genetic engineering. The procedure used to create these genetically modified babies ensures the presence or absence of particular genes or characteristics."See source**Negating evidence?**• Geneticist and blogger, Minerva reminds us that "the opportunity to alter a relatively "simple" trait such as height will be available long before we figure out the soup of probable genetic determinants of "empathy", so physical trait enhancement will surely precede character trait enhancement."See source• According to a 2009 Science Daily article, "A new study by researchers at NYU Langone Medical Center found a high desire for additional genetic testing among consumers for life altering and threatening medical conditions including mental retardation, blindness, deafness, cancer, heart disease, dwarfism and shortened lifespan from death by 5 years of age. Consumers, however, are less interested in prenatal genetic testing for traits including tall stature, superior athletic ability and superior intelligence."See source*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x8)
-
- Slowing down nanogenomic research will cost zillions of lives as people waiting for this research will die of their genetic disorders.See evidence**Supporting evidence?**• "Among the long term objectives of the NIH initiative are goals such as being able to use nanoparticles to seek out cancer cells before tumors grow, remove and/ or replace "broken" parts of cells or cell mechanisms with miniature, molecular-sized biological "machines", and use similar "machines" as pumps or robots to deliver medicines when and where needed within the body. All of these ideas are feasible based on present technology." Subsequently, delaying this research is risking the lives of the people who could benefit from these treatments.See source• In 2005, a CNN article said that, "by attaching a chemotherapeutic drug to manmade nanoparticles, the team of researchers at the University of Michigan were able to smuggle it inside cancerous cells,

delaying the growth of tumors in mice by up to 30 days -- the equivalent of three years in a human. Professor of biologic nanotechnology James Baker, who led the research, said that the treatment might eventually turn cancer into a chronic but treatable condition.”See source• According to John Miller, a lawyer specializing in law and technology, “a lack of agency preparation could take the form of unnecessary delays in patient access. Inadequate resources combined with a growing caseload, an inefficient regulatory structure, a lack of expertise, or FDA reviewers exercising extreme caution could all result in the FDA taking excessive amounts of time to review new technologies.”See source**Negating evidence?**• John Miller also points out that “If a lack of agency preparation results in hasty approval of dangerous therapies and a failure to effectively monitor clinical research, patients could be exposed to a significant risk of harm during clinical trials.”See source• In the Australian and New Zealand Journal of Public Health, researchers wrote that the “regulatory regimes do not adequately capture the potential risks associated with this new technology. Concerns have arisen due to preliminary evidence suggesting that some engineered nanoparticles may display undesirable toxicological properties, presenting potential risks to human and environmental health and safety.”See source*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x13)

-
- Nanogenomic technology is being used to diagnose (not just treat) diseases. See evidence**Supporting evidence?**• According to the magazine New Scientist, Dr. Christine Keating and her colleagues at Pennsylvania State University have created a chip consisting of a series of nanowires coated with DNA sequences that match those from disease-causing bacteria or viruses that can be used to diagnose a variety of medical conditions. See source • A National Citizens’ Technology Forum Report on Nanotechnology states that nanotechnology may lead to “dramatic diagnostic improvements”, including using “nanoscale particles to dramatically enhance physicians’ ability to detect very minute amounts of specific disease-related molecules in the body.” See source**Negating evidence?**• None found*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x14)

a5ctc_nts **Critiques, Notes & Explanations:**

In the box below, add notes and explanations that will help explain WHY you rated the above claims as you did.

Whenever possible, use EVIDENCE as the basis for explaining why you rated something as accurate or inaccurate and as typical or not typical. If you found additional evidence (other than that listed above) for the claims, or that negate the claims above, list it here and provide a reference or link to your source.

a5ctc_rev1 **Rephrasings:**

Below, state how you would rephrase at least TWO of the claims that you thought were either not entirely relevant (how would you rephrase them to make them more relevant?), or not entirely accurate (how would you rephrase them to make them more accurate?). Even if you thought the claims were accurate and relevant, please attempt to improve two of the claims.

Rephrased Claim 1:

a5ctc_rev2 **Rephrased Claim 2:**

a5ctc_com **Feedback / Comments**

On this page, is there anything about which you have any questions? Do you have any comments? Questions? Things you found interesting or liked? Ways to improve this page?

a5Tctpg Timing

First Click (1)
Last Click (2)
Page Submit (3)
Click Count (4)

End of Block: CThink block

Start of Block: INFO ORG block

Information Organization Condition

[Note: half the students were assigned to the critical thinking condition and half to the information organization condition for this assignment]

Q101

Information Organization Instructions

following information is essential to completing the assigned activities. Please read it carefully.
The goal of this assignment is to get your input on some of the "claims" made by students before you.

The

As noted before, one of the most important parts of forming an "informed opinion" involves getting lots and lots of information organized. On any given topic, there is often a large number of ideas and perspectives. Without putting some organization to that information, however, a lot of those ideas get lost or forgotten -- not because they aren't important, only because we only have more new information than we can hold in our brains at one time.

When analyzing complex topics like the pros and cons of a new scientific technology, **an especially important form of organizing involves organizing competing claims so that they "answer" one another.**

EXAMPLE:

Below is a list of pros and cons of a simple technology we will call "Laundry Detergent X." Let's say that you are trying to decide whether or not to buy this Detergent. Your friends, Chris and Pat, both have used it, and so you ask them their opinions. Below, the pros were listed by Chris, who loves Laundry Detergent X, and the Cons were listed by Pat, who hates Laundry Detergent X.

<u>Pros</u> <u>(by Chris)</u>	<u>Cons</u> <u>(by Pat)</u>
• It makes a lot of suds! • It out performs all the other laundry detergents. • It costs half as much as most other detergents.	• It smells like toothpaste, not soap • It didnt get my socks clean last time I did laundry. • It doesn't work as well as my favorite brand, Laundry Detergent Z.

While knowing these two perspectives is useful -- it would be even more useful to your decision if you knew how Chris and Pat would "answer" or respond to one another's claims. So, let's say you go back to Chris and Pat and ask them just that. The next table below lists the claims so that "answers" to each other's claims are in the same row. The responses are listed to the right of each original claim. The response is green if they are in agreement, and red if they disagree, and in black if agreement is unknown.

<u>Pros (by Chris)</u>	<u>Pat's response</u>	<u>Cons (by Pat)</u>	<u>Chris' response</u>
It makes a lot of suds!	I agree, it does make a lot of suds (but I don't care about suds)	It smells like toothpaste not soap	I disagree, I've never noticed it smelling like toothpaste.
It outperforms all the other laundry detergents	I disagree, It doesn't work as well as my favorite brand, Laundry Detergent Z.	It didn't get my socks clean last time I did laundry.	That's probably true, but I've seen your socks and probably no detergent could get them clean.
It costs half as much as most other detergents.	That's true -- however, you get what you pay for.	It doesn't work as well as my favorite brand, Laundry Detergent Z.	I've never tried Detergent Z.

By looking at this second table, you can see where the areas of disagreement and agreement are and where you may need to look into the facts more carefully before deciding whether or not to believe a claim. In addition, knowing the way in which and "opposing" perspective might answer a claim can provide some additional context and detail to the original claim.

For example, the difference in Chris' and Pat's judgement of Detergent X is not all about a disagreement in the facts.

Their disagreement can be attributed to:

A disagreement on the INTERPRETATION of the meaning of the facts: Chris believes that the fact that Pat's socks didn't get clean means the socks were really dirty, while Pat thinks that fact means the detergent is not very effective.

A disagreement on VALUES/OPINIONS: Chris really values how sudsy the detergent is, and Pat does not.

A disagreement on FACTS: For example, did Detergent X really outperform all detergents or not?

These different TYPES of disagreements only become clear once one knows how the various perspectives would "answer" the claims of another perspective. They are important because each different type of disagreement implies different actions. Differences in facts require one to re-examine the evidence for the facts. Differences in the interpretation of the facts require one to look at the larger context of the fact. Finally, differences in values and opinions require attention to underlying "interests" and values.

Q333 Example

On the next page, your task will be to identify claims that "answer" one another relating to nanogenomics and human enhancement.

Before that, however, try this practice example below.

a5io_ex

Consider the claims below and

(1) Decide whether the claims are likely to represent a view that is mostly "pro" or "anti" laundry detergent X. That is, if someone were pro-detergent X, would they make the following claims? Which of the following claims might be made by someone who was anti-detergent X?

(2) Indicate whether you think both sides would agree with the claim, or only one side or neither side would agree.

(3) Indicate what you think someone "opposed" to the perspective supported by the claim might say in "answer" or to respond to that claim. .Skin .SBS .Long { width:200px; }

	Which perspective does this claim support? (1)	Opposing perspective's response? (2)	Would the PRO and ANTI detergent perspectives agree or disagree that this claim is probably true? (3)			
	▼ PRO Detergent X (1) ... Neither (4)	What would someone who is "opposed" to the view supported by the claim in the left column, say in response to this claim? (1)	Both would agree with the claim (1)	Both would disagree with the claim (2)	Only PRO would agree, ANTI would disagree (3)	Only ANTI would agree, PRO would disagree (4)

- It costs \$10 a box, and that is too much! (1)
- It does not cost as much as some detergents (2)
- It does not dissolve well in cold water (3)
- It works great in warm water. (4)
- It comes in really ugly packaging (5)
- The packaging is simple and elegant (6)

	Which perspective does this claim support?	Would the PRO and ANTI detergent perspectives agree or disagree that this claim is probably true?				Opposing perspective's response? What would someone who is "opposed" to the view supported by the claim in the left column, say in response to this claim?
		Both would agree with the claim	Both would disagree with the claim	Only PRO would agree, ANTI would disagree	Only ANTI would agree, PRO would disagree	
It costs \$10 a box, and that is too much!		☐	☐	☐	☐	
It does not cost as much as some detergents		☐	☐	☐	☐	
It does not dissolve well in cold water		☐	☐	☐	☐	
It works great in warm water.		☐	☐	☐	☐	
It comes in really ugly packaging		☐	☐	☐	☐	
The packaging is simple and elegant		☐	☐	☐	☐	

Q332 [\[\[See how \(fictional\) others might answer the above by clicking HERE \]\]](#)

[\[\[Click again to hide \]\]](#)

In response to **"It doesn't cost as much as some"**

- This claim supports: PRO perspective
- Both sides would AGREE
- ANTI perspective would respond: True, but it is still too much.

Note: This is a disagreement of Opinion (regarding how much is 'too much').

In response to **"It works great in warm water"**

- This claim supports: PRO perspective
- Only the PRO side would agree
- ANTI perspective might respond: No it does not, it works poorly in both cold and warm water.

Note: This is a disagreement of fact (or opinion about what "works great" means)

In response to **"It comes in ugly packaging"**

- This claim supports: ANTI perspective
- Only the ANTI side would agree
- PRO perspective might respond: The packaging is simple and elegant.

Note: This is a disagreement of opinion about what constitutes attractive packaging.

In response to **"It costs \$10 a box and that is too much"**

- This claim supports: ANTI perspective
- BOTH sides would agree that it costs \$10 because that is a verifiable fact. But PRO might disagree that it is too much.
- PRO perspective might respond: It does not cost as much as some detergents.

Note: This is an agreement about facts, but a disagreement of opinion about what is "too much" to pay.

a5Tioex Timing

First Click (1)

Last Click (2)
Page Submit (3)
Click Count (4)

Q343 Organizing information about....Nanogenomics

Q274 Next, you will apply what you have learned to think about the question:

"How much should research and developments in nanogenomics be regulated?"

At the "extremes" two perspectives or answers to this question might be written like this:

Pro-regulation Perspective: We DO need to highly regulate every aspect of research and development involving nanogenomics. **Anti-regulation Perspective:** We do NOT need to regulate research and development of nanogenomics at all.

In the last assignment, you may have listed some claims that were "pro-" and/or "anti-regulation." This time, we will list some of the most common claims that students before you have listed, and ask you how you would organize them.

Carry Forward All Choices - Displayed & Hidden from "claims with evidence"



a5ioc_org

How would you organize these student claims?

Below are some claims that prior students offered as supportive of a **PRO-regulation Perspective** or an **Anti-Regulation perspective**.

We used prior student input, and some of our own research, to try to find evidence that might either support or negate these claims. You should feel free to do additional research on your own, using any sources that you trust.

Important: This exercise is actually intended to reflect real world discussions where the claims made by people, and the evidence they offer, vary in quality. The claims below were made by students and are *not* necessarily true! (And the evidence is not always the most convincing).

If you feel like some of the claims or the evidence provided for them are of low quality, this is to be expected. This exercise is intended to reflect real world situations where the claims made by people, and the evidence they offer, do vary in quality.

With that in mind, please do the following:

(1) Indicate whether you would categorize the following claims as supportive of a PRO-Regulation or ANTI-Regulation perspective, or supportive of BOTH or NEITHER perspectives. That is, which perspective(s) would the claim (if it were true) be used to support?

(2) Indicate whether both "sides" of the PRO- / ANTI- regulation debate would agree with the claim, both would disagree, or whether only one side would agree with it.

(3) Then, in the last column, please write what you think an "opposing" perspective might say in response to the claim. For example, if the claim in the left column is supportive of a PRO-regulation perspective, how would someone who is ANTI-regulation "answer" or respond to that claim? Would the opposing person agree or disagree with the claim? Or would they say that the claim is not true? Or true but not important?

If you think both PRO and ANTI perspectives would entirely "agree" with the claim, simply enter the words "both would agree" into the third column. But, if you think one side would agree with even part of the claim, use the last column to state what they would disagree with. .Skin .SBS .Long { width:200px; }

	Which perspective does this claim support? (1)	Opposing perspective's response? (2)	Would the PRO and ANTI regulation perspectives agree or disagree with this claim? (3)			
	▼ PRO Regulation (1) ... Neither (4)	What would someone who is "opposed" to the view supported by the claim (in the left column), say in response to this claim? (1)	Both would agree with the claim (1)	Both would disagree with the claim (2)	Only PRO would agree, ANTI would disagree (3)	Only ANTI would agree, PRO would disagree (4)

- Nanogenomics could someday allow people to change any genetic characteristic (hair, skin, eye color) that they would like. See evidence**Supporting evidence?**• Some note that such procedures are already being considered: "'It's technically feasible and it can be done,' says Mark Hughes, a pioneer of the PGD process and director of Genesis Genetics Institute, a large fertility laboratory in Detroit. However, he adds that 'no legitimate lab would get into it and, if they did, they'd be ostracized.'" See source • Nanotechnology may simply be an additional tool for achieving such aims, as suggested by this author: "Nanorobots could change your physical appearance. They could be programmed to perform cosmetic surgery, rearranging your atoms to change your ears, nose, eye color or any other physical feature you wish to alter." See source**Negating evidence?**• At the end of the article referencing the potential of nanorobots above, the author states that, in general, "Many nanotechnology experts feel that these applications are well outside the realm of possibility, at least for the foreseeable future." See source (x1)
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-
- Heavy regulation of nanogenomics will stifle and slow down research and development in nanogenomics. See evidence **Supporting evidence?** • In his 2007 paper, Patrick Lin looks at both sides of the issue: “On one side, experts argue that nanomaterials, which are making their way into the marketplace today, are possibly harmful to consumers and the environment, so stronger and new laws are needed to ensure they are safe. On the other side, different experts argue that more regulation will slow down the pace of business and innovation in nanotechnology.” See source • Howard Schachman, Biology Professor at the University of California at Berkeley, posits that, “scientists temperamentally and culturally are skeptical about the legitimacy of rules; instinctively they tend to oppose regulations as an unnecessary burden impeding research.” He adds that they “express frustration over those government regulations which are imposed as a result of political pressures, provide very little benefit, appear ill-advised or poorly crafted, are costly and do indeed impede scientific research.” **Negating evidence?** • According to an Arizona State University study, “leading U.S. scientists in nanotechnology believe regulations are most urgently needed in the areas of surveillance and privacy, human enhancement, medicine and the environment.” See source • Norris Alderson, who was on the FDA task force for nanomedicine says, “We reached a number of conclusions. Perhaps the most important is that, for now, this technology is really no different than any other new technology that would be incorporated into FDA products. So with that in mind, we feel comfortable, if you will, using our present

regulatory framework. However, we felt there is need for guidance to help this industry as it moves forward. We recognized a need for additional information in various areas, such as biosafety. FDA and other agencies are working together on that. But for now, we just do not see the need for regulations written specifically for nano-engineered materials in the products FDA regulates."See source*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x5)

-
- Heavy regulation will prevent the creative work that is necessary for life-saving breakthroughs. See evidence*Supporting evidence?*• Dr Patrick Lin, director of The Nanoethics Group says, "We need to find a reasonable balance that responsibly promotes innovation in nanotechnology while at the same time safeguards EHS [environmental health and safety] interests."See source• Eric Berger, science reporter for the Houston Chronicle, says "by finding areas in which nanotechnology may pose even a theoretical threat, they're also opening the door to more stringent regulation, which at some point may strangle the development of small, cash-strapped companies that are trying to commercialize innovative nano ideas."See source• According to a 2010 article on thescientist.com, "Biomedical science as it is practiced today in the United States in academic institutions is largely an enterprise, and a very large enterprise, supported with public funds from the national government. Due to the real risks for lapses in safety or ethics and the appropriate expectation for some form of accountability, research supported by money from the National Institutes of Health (NIH) or other federal sources is expected to comply with rules and regulations intended to minimize the chances for breaches in safety or ethics or for inappropriate use of research funding. While many of these regulatory regimes are well-intentioned, collectively, they have come to represent an immense burden that stifles creativity and discourages timely implementation of research ideas resulting from new insights or inspirations."See source*Negating evidence?*• Tim Malloy, of the UCLA School of Law Sustainable Technology and Policy Program says, "Nanotechnology raises substantial scientific and policy issues regarding both risk assessment and standard setting, provoking calls for further study and "soft law" approaches relying upon voluntary action by industry rather than mandatory regulation."See source• In 2006, nanotechweb.org argued that, "The anticipated rapid emergence of nanotechnology brings significant regulatory challenges for environmental protection. A lack of regulation will undermine public confidence in the emerging technology."See source*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x6)
-
- At the nano-scale, materials change their properties: For example, elements that don't conduct electricity at normal scales may suddenly do so at the nano-level. See evidence*Supporting evidence?*• A National Citizens' Technology Forum Report on Nanotechnology states that "A critically important aspect of manipulating matter at the nanoscale is that a material's properties can...exhibit new properties, such as electrical conductivity, elasticity, enhanced strength, different colors, and different reactivity, when compared to the same material at "normal" scale. This means...that using materials at the nanoscale can mean the creation of new materials that can be beneficial in many ways. It also means that we cannot assume that materials that are safe and harmless at normal scales are necessarily safe and harmless at the nanoscale."See source• Andrew Maynard, head of the University of Michigan Risk Science Center, offers an example: "Gold is an inert, yellowish metal—everyone knows this." He continues, "But form gold into particles just a few nanometers across, and everything changes—the metal does the equivalent of transforming from a cat into a dog. Instead of appearing yellowish in color, the particles now appear red, and become highly chemically active."See source*Negating evidence?*• None found*Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x7)
-
- Nanogenomics will someday let people choose the genetic make up of their children. See evidence*Supporting evidence?*• As Jeff Steinberg of LA's Fertility Institutes says, "This is cosmetic medicine...Others are frightened by the criticism but we have no problems with it." Trait selection in babies "is a service," says Dr. Steinberg, and "[w]e intend to offer it soon."See source• Stanford University's Cross-cultural Rhetoric Project acknowledges that "PGD (Preimplantation Genetic Diagnosis) has been used to create 'Designer Babies'. 'Designer baby' is a term used to refer to a baby whose genetic makeup has been artificially selected by genetic engineering. The procedure used to create these genetically modified babies ensures the presence or absence of particular genes or characteristics."See source*Negating evidence?*• Geneticist and blogger, Minerva reminds us that "the opportunity to alter a relatively "simple" trait such as height will be available long before we figure out the soup of probable genetic determinants of

"empathy", so physical trait enhancement will surely precede character trait enhancement." See source • According to a 2009 Science Daily article, "A new study by researchers at NYU Langone Medical Center found a high desire for additional genetic testing among consumers for life altering and threatening medical conditions including mental retardation, blindness, deafness, cancer, heart disease, dwarfism and shortened lifespan from death by 5 years of age. Consumers, however, are less interested in prenatal genetic testing for traits including tall stature, superior athletic ability and superior intelligence." See source *Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x8)

-
- Slowing down nanogenomic research will cost zillions of lives as people waiting for this research will die of their genetic disorders. See evidence **Supporting evidence?** • "Among the long term objectives of the NIH initiative are goals such as being able to use nanoparticles to seek out cancer cells before tumors grow, remove and/ or replace "broken" parts of cells or cell mechanisms with miniature, molecular-sized biological "machines", and use similar "machines" as pumps or robots to deliver medicines when and where needed within the body. All of these ideas are feasible based on present technology." Subsequently, delaying this research is risking the lives of the people who could benefit from these treatments. See source • In 2005, a CNN article said that, "by attaching a chemotherapeutic drug to manmade nanoparticles, the team of researchers at the University of Michigan were able to smuggle it inside cancerous cells, delaying the growth of tumors in mice by up to 30 days -- the equivalent of three years in a human. Professor of biologic nanotechnology James Baker, who led the research, said that the treatment might eventually turn cancer into a chronic but treatable condition." See source • According to John Miller, a lawyer specializing in law and technology, "a lack of agency preparation could take the form of unnecessary delays in patient access. Inadequate resources combined with a growing caseload, an inefficient regulatory structure, a lack of expertise, or FDA reviewers exercising extreme caution could all result in the FDA taking excessive amounts of time to review new technologies." See source **Negating evidence?** • John Miller also points out that "If a lack of agency preparation results in hasty approval of dangerous therapies and a failure to effectively monitor clinical research, patients could be exposed to a significant risk of harm during clinical trials." See source • In the Australian and New Zealand Journal of Public Health, researchers wrote that the "regulatory regimes do not adequately capture the potential risks associated with this new technology. Concerns have arisen due to preliminary evidence suggesting that some engineered nanoparticles may display undesirable toxicological properties, presenting potential risks to human and environmental health and safety." See source *Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x13)
-
- Nanogenomic technology is being used to diagnose (not just treat) diseases. See evidence **Supporting evidence?** • According to the magazine New Scientist, Dr. Christine Keating and her colleagues at Pennsylvania State University have created a chip consisting of a series of nanowires coated with DNA sequences that match those from disease-causing bacteria or viruses that can be used to diagnose a variety of medical conditions. See source • A National Citizens' Technology Forum Report on Nanotechnology states that nanotechnology may lead to "dramatic diagnostic improvements", including using "nanoscale particles to dramatically enhance physicians' ability to detect very minute amounts of specific disease-related molecules in the body." See source **Negating evidence?** • None found *Did you find additional evidence to support or negate this claim? Please submit it below under "What's missing?"* (x14)

a5ioc_nts_txt **Critiques, Notes & Explanations:**

In the box below, add notes and explanations that will help explain WHY you rated the above claims as you did.

Please explain here why you categorized certain claims as potentially supportive of the "PRO" or "ANTI" regulation perspectives, or why you chose the agreement/disagreement option that you chose. You do not have to explain all of your choices -- simply explain any choices that you think may not be clear (e.g., where you could imagine someone else making a

different choice, or where you had trouble deciding).

a5ioc_rev1_txt

Rephrasings:

Below, state how you would rephrase at least TWO of the claims that you thought were either not entirely relevant (how would you rephrase them to make them more relevant?), or not entirely accurate (how would you rephrase them to make them more accurate?). Even if you thought the claims were accurate and relevant, please attempt to improve two of the claims.

Rephrased Claim 1:

a5ioc_rev2_txt

Rephrased Claim 2:

a5ioc_com_txt

Feedback / Comments

On this page, is there anything about which you have any questions? Do you have any comments? Questions? Things you found interesting or liked? Ways to improve this page?

a5Tiopg Timing

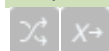
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End of Block: INFO ORG block

Start of Block: Final Questions

Carry Forward All Choices - Displayed & Hidden from "Claims no evidence 1"



a5_clrate1 **Your View vs. Other Students' Views**

Next, consider your views compared to other students' views.

Sometimes people can AGREE with an issue, claim or idea, but feel it is unimportant.
Meanwhile, sometimes people see an issue as IMPORTANT but they disagree with the claims made about that issue.

Consider the claims below that were made by students before you (*note these were not made by experts*), with regard to nanogenomics and human enhancement and **indicate where you stand on each claim in terms of**

(1) your AGREEMENT with the claim and

(2) how IMPORTANT you think the claim is to decisions about the extent to which nanogenomics should be regulated.

	Based on your reading and exploration so far, to what extent do you <u>AGREE</u> with this student's claim? That is, to what extent do you think it is probably <u>TRUE</u> ? (1)					When considering how much to regulate nanogenomics research and development, how <u>IMPORTANT</u> is this claim? That is, how much does it matter whether or not this claim is true? Or how much weight should this claim be given in making decisions about regulation? (2)				
	Not at all (1)	Slightly (2)	Somewhat (3)	Very much (4)	Entirely (5)	Not at all (1)	Slightly (2)	Somewhat (3)	Very (4)	Extremely (5)

- Nanogenomics could someday allow people to change any genetic characteristic (hair, skin, eye color) that they would like. (x1)
- People already use (and our laws allow them to use) medical technologies to change how they look (through plastic surgery) and even their gender--use of nanogenomics for human enhancement is basically the same thing. (x2)
- Nanogenomics differs from prior human enhancement technologies because it involves genetic changes that could be passed on to one's children. (x3)
- When it comes to human enhancement, a "mistake" made using nanogenomic technology is much more serious than mistakes made using other technologies. (x4)
- Heavy regulation of nanogenomics will stifle and slow down research and development in nanogenomics. (x5)



a5clmrate2

	Based on your reading and exploration so far, to what extent do you AGREE with this student's claim? That is, to what extent do you think it is probably TRUE ? (1)					When considering how much to regulate nanogenomics research and development, how IMPORTANT is this claim? That is, how much does it matter whether or not this claim is true? Or how much weight should this claim be given in making decisions about regulation? (2)				
	Not at all (1)	Slightly (2)	Somewhat (3)	Very much (4)	Entirely (5)	Not at all (1)	Slightly (2)	Somewhat (3)	Very (4)	Extremely (5)

- Heavy regulation will prevent the creative work that is necessary for life-saving breakthroughs. (x6)
- At the nano-scale, materials change their properties: For example, elements that don't conduct electricity at normal scales may suddenly do so at the nano-level. (x7)
- Nanogenomics will someday let people choose the genetic make up of their children. (x8)
- Slowing down nanogenomic research will cost zillions of lives as people waiting for this research will die of their genetic disorders. (x13)
- Nanogenomic technology is being used to diagnose (not just treat) diseases. (x14)

a5Tfinrate Timing

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Q159 **Overarching Focus Questions...**

Now that you have had a chance to think more about the various claims other students have provided, and the evidence for those claims, please answer the focus questions again -- and if you changed your mind about any of the questions, please explain why in the open-ended box below.



a5_riskben **Based on what you now know: Do you think the risks of nanogenomics research and development outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks?**

- ☐ The risks greatly outweigh the benefits (1)
- ☐ The risks somewhat outweigh the benefits (2)
- ☐ The risks slightly outweigh the benefits (3)
- ☐ The risks and benefits are equal (4)
- ☐ The benefits slightly outweigh the risks (5)
- ☐ The benefits somewhat outweigh the risks (6)
- ☐ The benefits greatly outweigh the risks (7)

a5rbchgm **To what extent did you change your mind about the risk/benefits question above as a result of completing THIS extra credit assignment?**

- ☐ Not at all (1)
- ☐ Just a little (2)
- ☐ Some (3)
- ☐ Quite a bit (4)
- ☐ A great deal (5)

a5regslid

In your opinion, how much regulation is needed with respect to nanogenomics research and development?

Slide the slider to reflect your view.

Zero means that you believe there should be NO regulation of nanogenomics.

100 means that you believe EVERY ASPECT of nanogenomic research and development should be HIGHLY regulated.

Only a slight amount of regulation A moderate amount of regulation Every aspect highly regulated --> |

0 10 20 30 40 50 60 70 80 90 100

None at all (1)



a5regchgm **To what extent did you change your mind about the regulation question above as a result of completing THIS extra credit assignment?**

- ☐ Not at all (1)
- ☐ Just a little (2)
- ☐ Some (3)
- ☐ Quite a bit (4)
- ☐ A great deal (5)

a5chg_expl_txt

Please explain your answers above.

MOST IMPORTANTLY: If your opinions have changed as a result of doing this assignment, please explain how and why they changed.

a5Tfocusq Timing

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End of Block: Final Questions

Start of Block: assign eval

Q349 **Assignment Evaluation**

Q362 These "New Biology" assignments are being developed with assistance from the UNL Public Policy Center. In order to improve the assignments for future students, please evaluate your experience with the assignment.

Your answers to these questions will not affect your grade in any way; your instructor will only see the data after it has been separated from the assignment (and thus answers will be anonymous).

a5asgnusef

Overall, how useful was this assignment for helping you to think more about Nanogenomics and preparing you to answer the two overarching questions?

- ☐ Not at all (1)
- ☐ Slightly (2)
- ☐ Somewhat (3)
- ☐ Quite (4)
- ☐ Extremely (5)

a5asnAeng **As you worked on this assignment, to what extent did you feel each of the following feelings?**

As I worked on this assignment, I felt...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
--	----------------	-------------------	----------	-----------------	------------------

- Interested (1)
- Annoyed (2)
- Open-minded (3)
- Bored (4)
- Focused (5)
- Frustrated (6)
- Competitive (7)
- Closed (8)
- Creative (9)
- Like I wished I was doing something else (10)
- Like being careful (11)
- Like my mind was already made up (12)
- Responsible (13)
- Engaged (14)
- Distracted (15)
- Conscientious (16)
- Argumentative (17)
- Like being thorough (18)
- Critical (19)
- Judgmental (20)

a5Taffeng Timing

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a5assign **Overall, to what extent did this assignment help to...**

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
• Understand nanotechnology (1) • Learn about nanotechnology (2) • Think critically about evidence (3) • Get my thoughts organized (4) • Give me ideas for my answers to the overarching questions (5) • Inspire me to think creatively (6) • Motivate me to explore nanotechnology in more depth (7) • Compare the benefits and risks related to nanotechnology (8) • Formulate my arguments better (9) • See the issues from a perspective I'd not thought of before (10) • Understand perspectives different from my own (11) • More clearly articulate my own perspective (12)					

a5asnBCeng **As you worked on this assignment, to what extent did you do the following:**

	Not at all (1)	A little (2)	Somewhat (3)	Quite a bit (4)	A great deal (5)
• Thought about how the topics related to other things I know (2) • Checked myself to see how well I understood the issues (3) • Took notes about the issues related to the topics (4) • Identified questions that I still had about the topics (5) • Tried to find answers to my questions about the topics (6) • Explored topics related to the subject in order to satisfy my own curiosity (7) • Did some of my own research on the topics (11) • Read the quotes under "see evidence" (12) • Tried to think creatively about the impacts of this new technology on society. (13) • Tried to identify what others thought about the impacts of this new technology on society. (14) • Carefully evaluated the accuracy of the evidence that was available for different claims. (17) • Visited the actual sources of the quotes listed under "see evidence" (16)					

a5dataqual Did you give your honest answers in this assignment? (You will **not** be penalized for your answer. Dr. Morris and

your recitation instructor will **not** know how you answered this question.) .Skin .QuestionBody .TextEntryBox { width:400px; }

- ☐ Yes, my answers reflect my honest answers to the questions in the assignment (1)
- ☐ No, I answered the questions randomly (2)
- ☐ No, I felt like I should answer in a certain way, so I gave those answers instead of my honest responses (3)
- ☐ Other (Please explain) (4) _____

a5finfdbk That's it! If you have any final comments or feedback, write it here, then click continue to submit your assignment.

a5Tlastpg Timing

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4.1.6. Some of the measures, compiled

Assignment 1

Assignment goals.

- **What will be the main purpose of the "New Biology Issues" activities you will be completing this semester?**
 - To practice thinking about the social implications of science (e.g., of new technologies used in biology); To learn about "new" biological organisms that have been discovered; To make new discoveries in cell biology (e.g., work with classmates to discover new biological mechanisms).
- **Which of the following are the four New Biology activities that will be used this semester? (check four)**
 - The current online assignment you are completing right now; a lecture; an analysis of a New Biology Issue; an extra credit opportunity; a lab experiment; a group presentation on New Biology
- **Indicate whether each of the following are True or False:**
 - Allowing researchers to use my New Biology assignment data will NOT improve my grade in this course, and refusing to allow them to use it will NOT hurt my grade.

- o The New Biology Assignments are required parts of the course regardless of whether or not a student gives consent to let researchers conduct research on their assignments.
- o My data will be kept confidential (i.e., my name will be removed) if I give consent for researchers to analyze it.

Political Affiliation.

- In politics today, do you consider yourself a Republican, Democrat, or Independent/Other?
 - o Strong Democrat; Democrats; Weak and Leaning Democrat; Independent/Other; Weak and Leaning Republican; Republican; Strong Republican

Political Ideology. (3 items) Seven-point scale from “Strongly Liberal” to “Strongly Conservative.” “Prefer not to answer” also provided.

- Overall.
- When it comes to ECONOMIC issues.
- When it comes to SOCIAL issues.

Interest in politics. Seven-point scale from “Not Interested” (0) to “Extremely Interested” (6)

- How interested are you in *national* politics and *national* affairs?
- Thinking about your community, how interested are you in *local* community politics and *local* community affairs?

Institutional confidence. Responses fell on a five-point scale including: No confidence; very little confidence; some confidence; a lot of confidence; complete confidence

- Consider the following institutions. Please indicate how much confidence you have in each of the following institutions.
 - o Executive branch of the federal government (i.e., the Present)
 - o United States Supreme Court
 - o Congress
 - o The United States military
 - o Office of the Nebraska Governor
 - o Nebraska Legislature
 - o Nebraska State Courts
 - o Lincoln City government
 - o The Nebraska Department of Natural Resources
 - o University of Nebraska
 - o Banks and financial services
 - o Major companies
 - o Organized religion
 - o Education
 - o Organized labor

- o Press
- o Water regulatory agencies
- o The scientific community
- o TV news

Nanotechnology Attitudes: General Goals. Each goal was first assessed in terms of importance on a five-point scale ranging from “unimportant” to ‘extremely important.” Students were then asked to complete the following exercise: “There are, of course, only a limited number of resources (time, effort, money) that can be spent on each of the things that you rated above. So, please consider what percentage of the U.S. resources (i.e., total time, effort, and money) should be spent on each. Make sure that your percentages sum to 100%, and make sure that you give the items you rated the most important the greatest percentage of resources.”

- Minimizing potential risks for humans.
- Minimizing potential environmental risks.
- Making decisions about the most important directions for future development.
- Studying the social and ethical impacts and implications of future developments and regulations.
- Maximizing potential benefits.

Attitudes towards Nanotechnology.

- Based on what you know right now: Do you think the risks of nano-biological research and development outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks?
 - o The risks greatly outweigh the benefits, the risks somewhat outweigh the benefits, the risks slightly outweigh the benefits, the risks and benefits are equal, the benefits slightly outweigh the risks, the benefits somewhat outweigh the risks, the benefits greatly outweigh the risks

Nanotechnology Attitudes: Specific Issues. **Responses for all fell of a seven-point Likert scale scale ranging from “strongly disagree” to “strongly agree.”**

- **Risks/Concerns (3 items)**
 - o The risk of nanotechnology directly affecting physical things like human health, wildlife, or the environment in general is currently too high.
 - o The risk of nanotechnology affecting social systems like the economy, trade, and sustainable food supply is currently too high.
 - o Due to the fact that some have expressed strong concern about nanotechnology's risks, we should have a world ban on new nanotechnology products.
- **Support/Pro-nanotechnology (2 items)**
 - o Nanotechnology is one of the more important issues confronting government today.
 - o We should develop nanotechnology at full speed despite its possible risks, in order to keep the U.S. from falling behind other countries.

- Trust authorities
 - The government will effectively manage any risks associated with nanotechnology.

Ranking of benefits. Each of the below were ranked from 1 to 7, with 1 = most important benefit, and 7 = least important benefit.

- New and better ways to clean up the environment
- The ability to improve humans through genetic manipulation
- Increased national security and defense capabilities
- Cheaper, longer lasting consumer products
- New and better ways to treat and detect human diseases
- A greater utilization of renewable energy
- The ability to use nanomedicines to improve human mental capacities

Ranking of risks. Each of the below were ranked from 1 to 7, with 1 = most worrisome risk, and 7 = least worrisome risk.

- Economic disruption caused by the loss of traditional jobs
- Losing your personal privacy to tiny new surveillance devices
- A nanotechnology inspired arms race between the U.S. and other nations
- New health problems for people due to the use of nanomedicine
- Unexpected problems due to the use of nanogenomics to alter genetic code
- Pollution of the environment by nanomaterials
- Breathing tiny nano-sized particles that accumulate in your body

Likelihood/Importance of Nanomedicine Risks and Benefits. Students were asked to assess each of the following specific risks and benefits on two separate scales. The first is a five-point scale measuring the perceived likelihood that each risk/benefit will be realized by nanotechnology research and development, and ranged from “not at all likely” to “extremely likely.” The second is a five-point scale measuring the importance of achieving or avoiding each risk/benefit, and ranging from “unimportant” to “extremely important.”

- The extension of human life expectancy.
- Cheap and more universal healthcare.
- Fewer side effects of medicines.
- Higher rate of terminal illness (e.g., cancer) survival.
- Improvement of individuals' physical abilities and muscle function.
- Improvement of individuals' mental abilities and brain function.

Likelihood/Importance of Nanogenomic Risks and Benefits. Students were asked to assess each of the following specific risks and benefits on three separate scales. The first was a five-point scale measuring the perceived likelihood that each risk/benefit will be realized by nanotechnology research and development, and ranged from “not at all likely” to “extremely likely.” The second was a simple two-

point scale identifying the outcome as either a “benefit” or a “drawback.” The third was a five-point scale measuring the importance of achieving or avoiding each risk/benefit, and ranging from “unimportant” to “extremely important.”

- Drastic reductions in the effects of aging.
- The creation of “designer babies” (aka, “super babies”).
- No more passing on of genetic diseases to one's offspring.
- A new eugenics movement.
- Unforeseen side-effects.
- The eradication of genetic inheritance of disease.
- Economic development through investment and research.
- Siphoning of US funds away from more important purposes related to the immediate economic crisis.

Familiarity with Nanoscientists. (3 items) Answers for all on a five-point scale ranging from “not at all” to “a great deal.”

- Next indicated how you feel about the nanoscientists responsible for researching and making discoveries involving nanotechnology. How much do you know about nanoscientists?
 - How much do you know about nanoscientists?
 - To what extent have you had experiences or interactions with nanoscientists?
 - To what extent do you feel certain in your views about nanoscientists?

Confidence in Nanoscientists. (5 items) Answers for all on a five-point scale ranging from “not at all” to “a great deal.”

- To what extent do you have confidence in nanoscientists to...
 - Do their jobs well.
 - Meet their professional responsibilities.
 - Meet their ethical responsibilities.
 - Go above and beyond what is expected of them professionally in order to better society.
 - Go above and beyond what is expected of them professionally in order to protect society from risks.

Trust in Nanoscientists. (18 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- To what extent do you feel nanoscientists probably...
 - Are trustworthy.
 - Are honest.
 - Are ethical.
 - Are fair.
 - Use fair procedures when making decisions.
 - Listen to everyone's opinion.

- ☐ Treat people fairly.
- ☐ Are impartial to their findings
- ☐ Care about the community they serve.
- ☐ Reach the correct conclusions.
- ☐ Reach conclusions that are best for everyone.
- ☐ Care about people like you, your friends, and your family.
- ☐ Are concerned with how their work impacts everyday people.
- ☐ Care about how their work affects culture.
- ☐ Care about the long-term impacts of their work.
- ☐ Are motivated to “do the right thing.”
- ☐ Are likely to do the right thing because they see themselves as “good.”
- ☐ Would feel bad about themselves if their work put others at risk.

Perceived Competence of Nanoscientists. (5 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- ☐ Are competent to do their jobs.
- ☐ Are incompetent to do their jobs. (reverse coded)
- ☐ Have the knowledge needed to do their jobs well.
- ☐ Have the skills needed to do their jobs well.
- ☐ Have the training needed to do their jobs well.

Distrust in Nanoscientists. (8 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- To what extent do you feel nanoscientists probably...
 - ☐ Are untrustworthy.
 - ☐ Are dishonest.
 - ☐ Need oversight
 - ☐ Are primarily motivated by self-interest.
 - ☐ Are primarily motivated by what will profit them.
 - ☐ Are primarily motivated by what will benefit them personally.
 - ☐ Will do the right thing only if they are punished for doing the wrong thing.
 - ☐ Don't really care about the long-term risks of their work.

Familiarity with Policymakers. (3 items) Answers for all on a five-point scale ranging from “not at all” to “a great deal.”

- Next, please indicate how you feel about the policy makers responsible for regulating and making laws involving nanotechnology.
 - ☐ How much do you know about policy makers who regulate nanotechnology?
 - ☐ To what extent have you had experiences or interactions with these policy makers?
 - ☐ To what extent do you feel certain in your views about these policy makers?

Confidence in Nanoscientists. (5 items) Answers for all on a five-point scale ranging from “not at all” to “a great deal.”

- To what extent do you have confidence in policy makers who help regulate nanotechnology to...
 - Do their jobs well.
 - Meet their professional responsibilities.
 - Meet their ethical responsibilities.
 - Go above and beyond what is expected of them professionally in order to better society.
 - Go above and beyond what is expected of them professionally in order to protect society from risks.

Trust in Policy Makers. (18 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- To what extent do you feel policy makers who help regulate nanotechnology ...
 - Are trustworthy.
 - Are honest.
 - Are ethical.
 - Are fair.
 - Use fair procedures when making decisions.
 - Listen to everyone’s opinion.
 - Treat people fairly.
 - Are impartial to their findings
 - Care about the community they serve.
 - Reach the correct conclusions.
 - Reach conclusions that are best for everyone.
 - Care about people like you, your friends, and your family.
 - Are concerned with how their work impacts everyday people.
 - Care about how their work affects culture.
 - Care about the long-term impacts of their work.
 - Are motivated to “do the right thing.”
 - Are likely to do the right thing because they see themselves as “good.”
 - Would feel bad about themselves if their work put others at risk.

Perceived Competence of Policy Makers. (5 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- Are competent to do their jobs.
- Are incompetent to do their jobs. (reverse coded)
- Have the knowledge needed to do their jobs well.
- Have the skills needed to do their jobs well.
- Have the training needed to do their jobs well.

Distrust in Policy Makers. (8 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- To what extent do you feel policy makers who help regulate nanotechnology ...
 - Are untrustworthy.
 - Are dishonest.
 - Need oversight
 - Are primarily motivated by self-interest.
 - Are primarily motivated by what will profit them.
 - Are primarily motivated by what will benefit them personally.
 - Will do the right thing only if they are punished for doing the wrong thing.
 - Don't really care about the long-term risks of their work.

ELSI Specific Trust of Policy Makers. (5 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- When it comes to nanotechnology, to what extent do you feel policy makers can be trusted to...
 - Make decisions about the most important directions for nanotechnology development
 - Minimize potential risks for humans
 - Minimize potential environmental risks
 - Think about the social and ethical impacts and implications of nanotechnology
 - Maximize potential benefits

ELSI Specific Capability of Policy Makers. (5 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- When it comes to nanotechnology, to what extent do you feel policy makers can be trusted to...
 - Make decisions about the most important directions for nanotechnology development
 - Minimize potential risks for humans
 - Minimize potential environmental risks
 - Think about the social and ethical impacts and implications of nanotechnology
 - Maximize potential benefits

ELSI Specific Motivation of Policy Makers. (5 items) Answers for all on a five-point scale ranging from “not at all probably” to “very probable.”

- When it comes to nanotechnology, to what extent do you feel policy makers can be trusted to...
 - Make decisions about the most important directions for nanotechnology development
 - Minimize potential risks for humans
 - Minimize potential environmental risks
 - Think about the social and ethical impacts and implications of nanotechnology
 - Maximize potential benefits

Demographics.

- What is your age?
- What is your gender?
- What is your year in school?
- What is your major?
 - Biochemistry, Biological science, Biological Science Engineering, Chemistry, Pre-Med, Pre-Vet, Psychology, or Other (Please specify)
- On average, would you say you are an A, B, C or D student?

Parental Education. Answers on a nine-point scale including: I don't know; did not complete high school; completed high school; completed some post-secondary education, but no degree; received a 2-year degree, e.g. associate's degree; received a 4-year college degree, e.g. B.A., B.S., etc.; completed some post-graduate courses, but no additional degree; received a 2-year post-graduate degree (e.g. M.A., M.S., etc.); received a 4-year post-graduate degree (e.g. PhD, D.Ed, etc.)

- What is the highest level of education of your mother?
- What is the highest level of education of your father?

Experience with ELSI.

- About how much previous academic work have you done that covered ethics (human, animal, environmental?)
 - None, a little, some, a moderate amount, a great deal
- How many course have you taken in the past that touched on ethics (human, animal, environmental?)

Personal Traits. Answers for all, unless otherwise noted, fell on a six-point scale ranging from "strongly disagree" to "strongly agree."

Disposition to trust (8 items)

- Please indicate your level of agreement with the following statements.
 - I distrust people. (reverse coded)
 - I believe that others have good intentions.
 - I trust what people say.
 - I suspect hidden motives in others. (reverse coded)
 - I believe most people try to be fair.
- Generally speaking, on a scale of 1 to 10, would you say that most people can be trusted, or that you can't be too careful in dealing with people?
 - 1=You can't be too careful; 10=Most people can be trusted
- On a scale of 1 to 10, do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair?
 - 1=Most people would try to take advantage of me; 10=Most people would try to be fair
- On a scale of 1 to 10, would you say that most of the time people try to be helpful or that they are mostly looking out for themselves?

- o 1=Most of the time, people look out for themselves; 10=Most of the time, people try to be helpful

Need for Cognition. (7 items)

- The notion of thinking abstractly is appealing to me.
- I like to have the responsibility of handling a situation that requires a lot of thinking.
- Thinking is not my idea of fun.
- I try to anticipate and avoid situations where there is likely a chance I will have to think in depth about something.
- I really enjoy a task that involves coming up with new solutions to problems.
- Learning new ways to think doesn't excite me very much.
- I usually end up deliberating about issues even when they do not affect me personally.

Deliberative values (5 items)

- A good citizen should listen to people who disagree with them politically.
- A good citizen should allow others to challenge their political beliefs.
- A good citizen should discuss politics with those who disagree with them.
- A good citizen should be willing to justify their political views.
- If a citizen is dissatisfied with the policies of government, he or she has a duty to do something about it.

Extrinsic political motivation (2 items)

- I follow political and social issues because that's what I'm expected to do.
- I follow political and social issues because that's what I'm supposed to do.

Intrinsic political motivation (3 items)

- I follow political and social issues because I want to learn new things.
- Being politically and socially conscious is important to who I am.
- I follow political and social issues because I think it's important.

Introjected political motivation (2 items)

- I follow political issues because I will feel bad about myself if I don't.
- I follow political and social issues because it bothers me when I don't.

Political efficacy (6 items) – Note compare to (Morrell, 2005)

- People like me don't have any say about what the government does.
- Sometimes politics and government seem so complicated that a person like me can't really understand what's going on.(reverse coded)
- I consider myself well-qualified to participate in politics.

- I consider myself well-qualified to provide input on political and social issues.
- I think that I am better informed about political and social issues than other students.
- I feel I have a pretty good understanding of current political and social issues facing my world.

Right wing authoritarianism. (4 item $\alpha = .47$)

- Obedience and respect for authority are the most important virtues children should learn.
- In these troubled times laws have to be enforced without mercy, especially when dealing with the agitators and revolutionaries who are stirring things up.
- The self-righteous "forces of law and order" threaten freedom in our country a lot more than most of the groups they claim are "radical" and "godless".
- Atheists and others who have rebelled against the established `ions are no doubt every bit as good and virtuous as those who attend church regularly.

Assignment 2.

Subjective Knowledge. (2 items) Answers on a five-point scale including: Not at all familiar; slightly familiar; somewhat familiar; very familiar; extremely familiar.

- How familiar are you with nanotechnology?
- How familiar are you with how nanotechnology is used in genetics research and development?

Attitudes towards Nanotechnology.

- Based on what you know right now: Do you think the risks of nano-biological research and development outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks?
 - The risks greatly outweigh the benefits, the risks somewhat outweigh the benefits, the risks slightly outweigh the benefits, the risks and benefits are equal, the benefits slightly outweigh the risks, the benefits somewhat outweigh the risks, the benefits greatly outweigh the risks
- In your opinion, how much regulation is needed with respect to nano-biological research and development?
 - Move the slider to reflect your view. 0 means that you believe there should be NO regulation of nano-biological developments. 100 means that you believe EVERY ASPECT of nano-biological research and development should be HIGHLY regulated.

Objective Knowledge: Multiple Choice.

- Some people say that nanogenomics may lead to "greater human enhancement." Which of the following activities are current examples of "human enhancement"? Check all that apply.
 - Education in schools and universities; the use of performance-enhancing drugs by athletes; use of medicine to combat naturally-contracted or –inherited diseases; use of a

prosthetic devices to improve how people look (e.g. burn victims); plastic surgery to improve how people look; none of the above

- Which of the following are areas of current nanogenomic research and development? Check all that apply.
 - Use of nano-sequencing to map the human genome; Development of better genetic engineering procedures; Adapting biological transmodification for medical deliver; Synthesizing biochemical reactions more quickly; Development of simplified genetic code capable of supporting nanobot reproduction; None of the above.
- What does RNAi stand for?
 - RNA interference; RNA interceptor; RNA integration; RNA inception
- For what purpose are DNA “scaffolds” manufactured?
 - Making computer chips; making new organisms; making nanobots; making new buildings
- What was the United States eugenics movement?
 - The movement in the early Twentieth Century supporting the sterilization of humans with undesirable traits; the movement in the late Twentieth Century to map the human genome; a movement by geneticists to use new methods involving the compound uracil, first discovered in the Nineteenth Century; there was no United States eugenics movement
- What do some people say is one problem with encouraging research and development in nanogenomics aimed at curing diseases?
 - People have different opinions about what a disease is; ; we already know that diseases can not be cured with nanogenomics; present cures for diseases are cheaper; nanobots can only cure some diseases, but not all

Background Document Technical Problems.

- Did you download the background document, SAVE it, and read it?
- If you had problems getting or working with the background document (e.g., if you tried links in the document that did not work), please describe those problems here:

Critical Thinking Questions. Students assigned to the Critical Thinking Condition were presented with a document presenting explicit instructions on how think critically and then asked the following series of questions to test their understanding of that document. Unless otherwise noted, responses fell on a five point scale including: not at all, slightly, somewhat, quite a bit and entirely. ‘I don’t know’ was also provided as a response.

- **Claim:** The laundry detergent "Super X" is an utterly horrible laundry detergent.
Evidence / Reason: Because it has a horrible smell that is more similar to toothpaste than to soap.
What do you think of the evidence provided for this claim?
 - How relevant is the evidence of this claim?
 - How accurate is the evidence?

- o How typical is the evidence?
 - o How sufficient is the evidence to support the claim?
- **Student A's Claim:** We should speed up our research and development activities related to nanogenomics.

Student A's Evidence / Reason: Because it might help people who are right now suffering from various diseases. For example, the background document points out that some researchers (e.g., Wilson, 2010) have found ways to more effectively treat inflammatory bowel disease. Speeding up research and development related to nanogenomics could help lead to more effective treatments for diseases -- Meanwhile, by making people wait for this research to get done, people are suffering and some are dying from diseases that may someday be cured by nanogenomics.

What do you think of the evidence/reason provided for this claim?

- o How relevant is the evidence of this claim?
 - o How accurate is the evidence?
 - o How typical is the evidence?
 - o How sufficient is the evidence to support the claim?
- Next, identify a claim pertaining to the question of RISKS/BENEFITS mentioned in the background document that someone might make about either the risks or benefits of nanogenomics research and development. You may wish to think not only about the direct effects of nanogenomics, but also about its potential "second order" effects.
Note: You can pick a claim that you either agree with OR disagree with, because you'll be asked to think about WHY you agree or disagree with it.
 - o CLAIM 1: (student provided their own open-ended response)
 - o Is this claim supporting the RISKS or BENEFITS of Nanogenomics research and development?
 - Mostly/entirely supporting the RISKS; slightly/somewhat supporting of the RISKS; Neither more supportive of the risks or benefits; slightly/somewhat more supportive of the BENEFITS; mostly/entirely supporting the BENEFITS
- Next, identify EVIDENCE that people might use to support or challenge this claim.
 - o EVIDENCE 1 supporting or challenging CLAIM 1: (student again provided their own open-ended response concerning their previous claim)
 - o Does the evidence you offered above support or negate/challenge Claim 1?
 - Strongly negates/challenges; somewhat negates/challenges; neither/both; somewhat supports; strongly supports
 - o How relevant is the evidence of this claim?
 - o How accurate is the evidence?
 - o How typical is the evidence?
 - o How sufficient is the evidence to support the claim?
- Next, identify a second piece of EVIDENCE that people might use to support or challenge this claim.

- o EVIDENCE 2 supporting or challenging CLAIM 1: (student again provided their own open-ended response concerning their previous claim)
 - o Does the evidence you offered above support or negate/challenge Claim 1?
 - Strongly negates/challenges; somewhat negates/challenges; neither/both; somewhat supports; strongly supports
 - o How relevant is the evidence of this claim?
 - o How accurate is the evidence?
 - o How typical is the evidence?
 - o How sufficient is the evidence to support the claim?
- Finally, how much do you Agree or Disagree with Claim 1?
 - o Strongly disagree; somewhat disagree; neutral; somewhat agree; strongly agree
- Did the evidence you found to support or negate/challenge Claim 1 impact your agreement with it?
 - o Yes; no
 - o Why or why not? (open-ended response)
- Next, identify a claim pertaining to the question of REGULATION mentioned in the background document. Identify a claim that someone might make about either the need for HEAVY regulation or the need to only have LITTLE (light, minimal) regulation of nanogenomics research and development. You may wish to think not only about the direct effects of nanogenomics, but also about its potential "second order" effects, and how those might impact the need for regulation.

Note: You can pick a claim that you either agree with OR disagree with, because you'll be asked to think about WHY you agree or disagree with it.

 - o CLAIM 2: (student provided their own open-ended response)
 - o Is this claim supporting the need for HEAVY regulation or LIGHT regulation of Nanogenomics research and development?
 - Mostly/entirely supporting LIGHT regulation; slightly/somewhat supporting LIGHT regulation; Neither more supportive of heavy or light regulation; slightly/somewhat more supportive of HEAVY regulation; mostly/entirely supporting HEAVY regulation
- Next, identify EVIDENCE that people might use to support or challenge this claim.
 - o EVIDENCE 1 supporting or challenging CLAIM 2: (student again provided their own open-ended response concerning their previous claim)
 - o Does the evidence you offered above support or negate/challenge Claim 2?
 - Strongly negates/challenges; somewhat negates/challenges; neither/both; somewhat supports; strongly supports
 - o How relevant is the evidence of this claim?
 - o How accurate is the evidence?
 - o How typical is the evidence?
 - o How sufficient is the evidence to support the claim?

- Next, identify a second piece of EVIDENCE that people might use to support or challenge this claim.
 - EVIDENCE 2 supporting or challenging CLAIM 2: (student again provided their own open-ended response concerning their previous claim)
 - Does the evidence you offered above support or negate/challenge Claim 2?
 - Strongly negates/challenges; somewhat negates/challenges; neither/both; somewhat supports; strongly supports
 - How relevant is the evidence of this claim?
 - How accurate is the evidence?
 - How typical is the evidence?
 - How sufficient is the evidence to support the claim?
- Finally, how much do you Agree or Disagree with Claim 2?
 - Strongly disagree; somewhat disagree; neutral; somewhat agree; strongly agree
- Did the evidence you found to support or negate/challenge Claim 2 impact your agreement with it?
 - Yes; no
 - Why or why not? (open-ended response)

Attitudes towards Nanotechnology.

- Based on what you know right now: Do you think the risks of nano-biological research and development outweigh the benefits? Alternatively, do you think that the benefits outweigh the risks?
 - The risks greatly outweigh the benefits, the risks somewhat outweigh the benefits, the risks slightly outweigh the benefits, the risks and benefits are equal, the benefits slightly outweigh the risks, the benefits somewhat outweigh the risks, the benefits greatly outweigh the risks
- **Please explain your answer above.**

As you explain,

a. Be specific about what you think are the most important benefits and drawbacks/risks of nanogenomics especially in the areas of human enhancement. Please especially consider the social, legal and ethical benefits and drawbacks (or issues) that you see as relevant to nanogenomics, particularly in the area of human enhancement.

b. Justify WHY you think either the risks or benefits outweigh the other.

Note that you can use the "back" button at the bottom of this page to see what you wrote in response to the prior questions and to use those responses in your answer below. (student provides open-ended response)
- In your opinion, how much regulation is needed with respect to nano-biological research and development?
 - Move the slider to reflect your view. 0 means that you believe there should be NO regulation of nano-biological developments. 100 means that you believe EVERY ASPECT of nano-biological research and development should be HIGHLY regulated.

- **Please explain your answer above.**

As you explain,

a. Be specific about what you think are the most important benefits and drawbacks/risks of nanogenomics especially in the areas of human enhancement. Please especially consider the social, legal and ethical benefits and drawbacks (or issues) that you see as relevant to nanogenomics, particularly in the area of human enhancement.

b. Justify WHY you think either the risks or benefits outweigh the other.

Note that you can use the "back" button at the bottom of this page to see what you wrote in response to the prior questions and to use those responses in your answer below. (student provides open-ended response)

Assignment Usefulness.

- Overall, how useful was this assignment for helping you to think more about Nanogenomics and preparing you to answer the two overarching questions?
 - Not at all; slightly; somewhat; quite; extremely

Engagement. Answers on a five-point scale from “Not at all” to “A great deal.” Subscales are noted below.

- As I worked on this assignment, I felt/did...
 - Conscientious engagement (5 items)
 - Interested
 - Responsible
 - Engaged
 - Conscientious
 - Focused
 - Disinterested Engagement (2 items)
 - Like I wished I was doing something else
 - Bored
 - Active Learning/Metacognitive Engagement (5 items)
 - Tried to think about how the topics I was reading about related to other things I know.
 - Checked myself to see how well I understood the issues related to the topics I was learning about.
 - Tried to identify what people with different perspectives might think about the topics.
 - Carefully evaluated the relevance of various arguments about this new technology
 - Identified questions that I still had about the topics.
 - Intrinsic Exploratory (3 items)
 - Did some of my own research on the topics.
 - Explored topics related to the subject in order to satisfy my own curiosity.

- Visited the links and other additional resources listed in the background document.
- o Social Engagement (2 items)
 - Discussed my ideas about the topics with others.
 - Asked others what they thought about the topics and issues.
- o Angry Engagement (2 items)
 - Annoyed
 - Frustrated
- o Closed-minded Engagement (2 items)
 - Closed
 - Like my mind was already made up

Assignment Evaluation. Answers to the following questions fell on a five-point scale including: not at all, just a little, some, quite a bit, a great deal.

- Overall, to what extent did the BACKGROUND DOCUMENT and ASSIGNMENT, used together, help to...
 - o Understand nanotechnology.
 - o Learn about nanotechnology.
 - o Inspired me to think creatively
 - o Motivate me to explore nanotechnology in more depth
 - o More clearly articulate my own perspective
 - o Gather information that I could use for my answers to the overarching questions
 - o Get my thoughts organized
 - o Organize a great deal of information relevant to the overarching questions
 - o Compare the positives and negatives related to nanogenomics
 - o See the issues from perspectives I'd not considered before
 - o Understand perspectives different from my own
 - o Formulate my arguments better
 - o Think critically about evidence
 - o Better understand what it means to think critically
 - o Motivate me to look at the evidence for different claims, rather than just accepting the claims

Assignment Evaluation. Answers for all on a five-point scale including strongly disagree, disagree, neither agree nor disagree, agree, strongly agree.

- The BACKGROUND DOCUMENT was...
 - o Interesting
 - o Boring
 - o Biased
 - o Balanced
 - o Thorough

- o Useful
- o Accurate
- o Fair
- o Engaging
- o Relevant
- o Informative
- o Well-organized
- o Disorganized
- o Too-detailed
- o Not detailed enough
- o Useless
- This online ASSIGNMENT was...
 - o Interesting
 - o Boring
 - o Too hard
 - o Too easy
 - o Challenging
 - o Useful
 - o Engaging
 - o Relevant
 - o Informative
 - o Well-organized
 - o Disorganized
 - o Confusing
 - o Easy to understand
 - o Useless

Quality Check.

- Did you read the questions and answer the questions in this assignment honestly? (You will **not** be penalized for your answer. Your instructors will not know how you answers.)
 - o Yes, my answers reflect my honest evaluation of the assignment; No, I answered the questions randomly; No, I felt I should answer in a certain way, so I gave those answers instead of my honest responses; No, I did not even read the questions as I answered them; Other (Please explain).

Assignment 3.

Attitudes towards Nanotechnology. All questions were repeated from Assignment 2.

Change in Attitudes. Unless otherwise noted, responses fell on a five-point scale including: Not at all, just a little, some, quite a bit, a great deal

- Overall, from the time you began these exercises, until now, to what extent did you change your mind about the regulation question above?
- To what extent did the following influence the final views that you gave above?
 - Talking about the issue with others
 - The background information that I read about the topics
 - Learning about new arguments that I'd not thought of before
 - My own research on the issue
 - Views of people important to me
 - The additional resources provided by the background documents
- To what extent did you feel like your study and knowledge of biology in this course influenced the input that you gave?
- Overall, to what extent was the public participation module a beneficial part of your learning in this course?
- How much do you feel you learned about nanotechnology and drug delivery as a result of working on the public engagement module last week and this week?
 - Nothing I didn't know before; just a little; some; quite a bit; a great deal

Regulation Scenarios. Answers for all on a five-point scale including strongly disagree, disagree, neither agree nor disagree, agree, strongly agree.

- The process used by the government to make decisions about this issue was fair.
- The government made the right choices with regard to this issue.
- The government made the same choices you would have made.
- The government should have made different decisions about this issue.
- The government should have used a different process to get public input about this issue.

Legislation. Answers on a six point scale including: Strong AGAINST; Moderately AGAINST; Slightly AGAINST; Slightly FOR; Moderately FOR; Strongly FOR

- If legislation were being considered that would slow down nanogenomics research and development in the area of human enhancement by decreasing funding and increasing restrictions...
Would you be FOR or AGAINST such legislation?
- If legislation were being considered that would speed up nanogenomics research and development in the area of human enhancement by increasing funding and decreasing restrictions...
Would you be FOR or AGAINST such legislation?

Material Evaluation. Both questions were asked after each ELSI scenario.

- To what extent do you feel like the information you explored or reviewed during recitation was helpful as you responded to this scenario?
 - Not helpful at all, slightly helpful, somewhat helpful, very helpful, extremely helpful

- To what extent do you feel like the background document that you were provided with in Assignment 2 (before you came to reci) was helpful as you responded to this scenario?
 - Not helpful at all, slightly helpful, somewhat helpful, very helpful, extremely helpful

Attitudes towards Nanotechnology. Both questions were repeated from Assignment 1.

Engagement. All questions repeated from Assignment 2.

Assignment 4.

Attitudes towards Nanotechnology. Both questions were again repeated from Assignment 1 along with the follow-up questions first introduced in Assignment 2.

Changes in Attitudes. Answers fell on a five-point scale including: not at all, just a little, some, quite a bit, a great deal.

- To what extent did the following influence the final views that you gave about nano-biological technologies and human enhancement?
 - Talking about the issue with others.
 - The background information that I read about the topics.
 - Learning about new arguments that I'd not thought of before.
 - My own research on the issue.
 - Views of people important to me.
 - The additional resources provided by the background documents.
 - My study and knowledge of biology in this course.

Nanotechnology attitudes: general goals. All questions repeated from Assignment 1.

Likelihood/Importance of specific risks and benefits. All questions repeated from Assignment 1.

Nanotechnology attitudes: specific issues. All questions repeated from Assignment 1.

Process Acceptance. (5 items $\alpha = .84$) The following questions were asked after each scenario. Responses fell on a six-point Likert scale.

- The process used by the government to make decisions about this issue was fair.
- The government made the right choices with regard to this issue.
- The government made the same choices you would have made.
- The government should have made different decisions about the issue.
- The government should have used a different process to get public input about this issue.

Nanotechnology attitudes: specific legislation. After both of the following prompts, students were asked "Would you be FOR or AGAINST such legislation?" Responses fell on six-point scale including: strongly AGAINST, moderately AGAINST, slightly AGAINST, slightly FOR, moderately FOR, strongly FOR.

- If legislation were being considered that would slow down nanogenomics research and development in the area of human enhancement by decreasing funding and increasing restrictions...
- If legislation were being considered that would speed up nanogenomics research and development in the area of human enhancement by increasing funding and decreasing restrictions...

Familiarity with Nanoscientists. (3 items $\alpha = .73$) All items repeated from Assignment 1.

Confidence in Nanoscientists. (3 items $\alpha = .87$) A selection of three items were repeated from Assignment 1. Responses fell on a five-point scale ranging including: not at all, just a little, some, quite a bit, a great deal.

- To what extent do you have confidence in nanoscientists to...
 - Do their jobs well.
 - Meet their professional responsibilities.
 - Make decisions about the most important directions for future development.

Trust in Nanoscientists. (3 items $\alpha = .75$) A selection of three items were repeated from Assignment 1. Responses fell on a five-point scale ranging including: not at all, just a little, some, quite a bit, a great deal.

- In general, to what extent do you feel nanoscientists probably...
 - Are trustworthy
 - Listen to everyone's opinion
 - Care about the community they serve

Distrust in Nanoscientists. (3 items $\alpha = .64$) A selection of three items were repeated from Assignment 1. Responses fell on a five-point scale ranging including: not at all, just a little, some, quite a bit, a great deal.

- In general, to what extent do you feel nanoscientists probably...
 - Are primarily motivated by what will benefit them personally
 - Will do the right thing only if they are punished for doing the wrong thing
 - Don't really care about the long-term risks of their work

Familiarity with Policymakers. (3 items $\alpha = .83$) All items repeated from Assignment 1.

Confidence in Policymakers. (3 items $\alpha = .89$) A selection of three items were repeated from Assignment 1. Responses fell on a five-point scale ranging including: not at all, just a little, some, quite a bit, a great deal.

- To what extent do you have confidence in **policy makers who help regulate nanotechnology to...**
 - Do their jobs well.

- Meet their professional responsibilities.
- Make decisions about the most important directions for future development.

Trust in Policymakers. (3 items $\alpha = .82$) A selection of three items were repeated from Assignment 1. Responses fell on a five-point scale ranging including: not at all, just a little, some, quite a bit, a great deal.

- In general, to what extent do you feel **policy makers who help regulate nanotechnology...**
 - Are trustworthy
 - Listen to everyone's opinion
 - Care about the community they serve

Distrust in Policymakers. (3 items $\alpha = .74$) A selection of three items were repeated from Assignment 1. Responses fell on a five-point scale ranging including: not at all, just a little, some, quite a bit, a great deal.

- In general, to what extent do you feel **policy makers who help regulate nanotechnology...**
 - Are primarily motivated by what will benefit them personally
 - Will do the right thing only if they are punished for doing the wrong thing
 - Don't really care about the long-term risks of their work

Changes in Trust/Confidence. Responses fell on a five-point scale including: not at all, just a little, some, quite a bit, a great deal.

- **In your estimation, as you learned more about the development and regulation of nano-biological technologies, how much did you change your feelings and attitudes about ...**
 - The scientists responsible for studying and developing nanotechnologies.
 - The policy makers responsible for making decisions about the funding and regulation of nanotechnologies.

Objective Knowledge: Multiple Choice. All multiple choice knowledge questions from Assignment 1 were repeated.

Objective Knowledge: True/False. After each statement was assessed as either true or false, students were asked to complete the statement "I am _____ confident in my answer" with responses falling on a five-point scale including: not at all, a little bit, moderately, mostly and completely.

- Although they both deal with biological applications of nanotechnology, there is very little overlap in nanogenomic and nanomedicine research.
- Because of their special properties, nanomedicines may be able to reach the brain more effectively than traditional medicines.
- Although more research needs to be done, most experts agree that most of the major risks associated with the use of nanomedicine have now been identified.
- A few companies already offer nanogenomic-based services that allow parents to select particular traits in their children.

- Research and development in nanotechnology is already affecting economic systems.
- Currently, it is really hard to predict the potential second order-effects of nano-technology.
- Second order effects refer to unanticipated impacts of nanogenomic treatments on the offspring of the individual who was treated.
- The government currently uses nano-scale devices to monitor people.
- RNAi is currently being used to effectively treat irritable bowel syndrome.
- One ethical issue that has been considered relating to nanotechnology and human enhancement is whether or not parents should have the right to "enhance" their children.
- Nanotechnology has already been used to develop materials to improve products such as tennis rackets.
- A good example of a "nano"-sized object is a red blood cell.
- Nanotechnology is already being used to map the human genome.
- Due to the increased cost of surgical and diagnostic tools, nanotechnology will inevitably increase the cost of health care.
- One outcome already identified as possible with nanotechnology is innovative diabetes treatments that stimulate insulin production from outside the body.
- Research at the interface of nanotechnology and biology has been used for seemingly non-biological applications such as the creation of faster computer chips.
- Nanotransdermal technology can be used to liquefy coal and turn it into gas.

Individual Differences. All questions repeated from Assignment 1.

Satisfaction with Process.

- **To what extent did you change your mind about the question above over this semester?**
 - Not at all, just a little, some, quite a bit, a great deal
- **Overall, to what extent was the public participation module a beneficial part of your learning in this course?**
 - Not at all, just a little, some, quite a bit, a great deal
- **How much do you feel you learned about nanobiological research for human enhancement as a result of working on the public engagement module last week and this week?**
 - Nothing I didn't know before, just a little, some, quite a bit, a great deal

4.2. Appendix B – Assignment 2 Materials

4.2.1. Lecture Outline

Note: The lecture was given prior to Assignment 2 or at least during the same week as Assignment 2 was assigned. The lecture was approximately the same each semester of the study.

Science and Regulation: History

Presented by Alan Tomkins

I. **Opening Question:**

- Many scientists believe government has no role in overseeing the scientific enterprise. It would stymie innovation and retard advancement. Agree?

Interactive Question#1

Many scientists believe government has no role in overseeing the scientific enterprise. It would stymie innovation and retard advancement.

- a. Agree
- b. Disagree
- c. No opinion

II. **Survival studies**

- Nazi survival study

Interactive Question#2

What do YOU think of the survival study? Choose the item that BEST reflects your view.

- a. *Although the study was unethical, the benefits of what was learned outweighed the harm to the few participants of the study.*
- b. *It is always unethical to collect data that would harm participants in this way, and such studies should not be done regardless of the benefits that could be accrued.*
- c. *This was an unethical study, primarily because the participants were forced to partake in the study and did not give their consent.*

III. **Science is a reflection of society, not something apart from it.**

A lesson learned well from the research of the 19th century (Mismeasure of Man, Stephen Jay Gould).

- Plessy v. Ferguson
- Eugenics Science: The idea that one can improve the human race by careful selection of those who mate and produce offspring

IV. **Should science be regulated?**

A Parade of horrors in US

- Tuskegee syphilis studies
- Milgram
- Willowbrook

V. **If science should be regulated, how should it be?**

Congress in the 1970s asked for a thoughtful examination. Result: Belmont Report.

- Science not to take place without oversight.

- IRB, to include
 - Peer review
 - Public input
 - Usually clergy, but sometimes ethicist, member of the public advocate
 - Scientific concern, but ultimate acceptance of IRB

VI. Science is part of society

- What about public role in overseeing? Answer from the 1970s on is “Yes”. For example...
 - Health/Sexuality
 - Birth control and abortion
 - Use of fetuses
 - Fast moving science: Balance advances versus the interest of societal oversight
 - Genome Project
 - Political and public concerns
 - ELSI (Francis Collins, now NIH head)
 - Big Success: One aspect of the success, public involvement

Interactive Question#3

What do you think of genetically modifying salmon by combining the genes of salmon with the genes of humans?

- Agree*
- Disagree*
- No opinion*

Interactive Question#4

What about genetically modifying crops to make them drought tolerant or able to withstand pests?

- Agree*
- Disagree*
- No opinion*

VII. The Case of Nanotechnology

- Congressional mandate for ELSI
- Specific call for public involvement
 - Q: Types of Involvement?
 - A: New forms
- What works & why?
 - Our research and students’ role in it: Learning about features of PP
- What else might it mean?
 - Substantive information about NT
 - Learning about providing public input

- Contribute to our work
 - Asking attitude and knowledge Qs

Interactive Question#5

Define eugenics:

- a. *The idea that one can improve the human race by careful selection of those who mate and produce offspring.*
- b. *You-tube videos of genetics lectures*
- c. *The study of European gene lines*

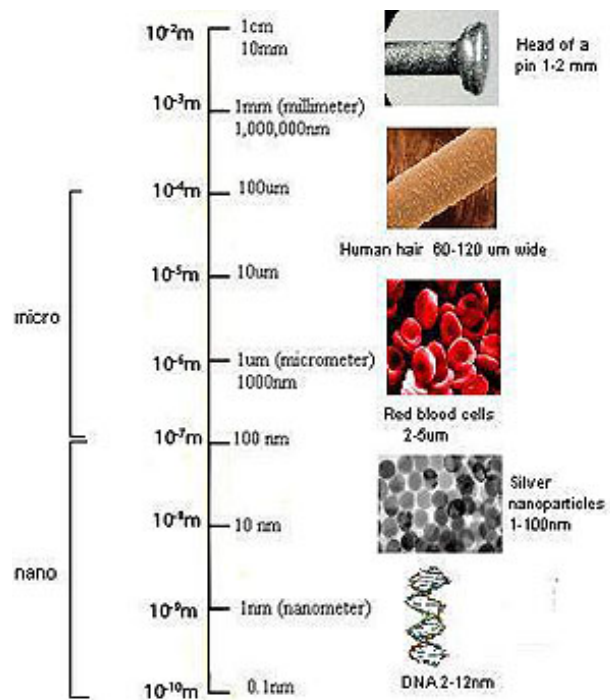
4.2.2. Background documents

NOTE: This is the background information to accompany the online New Biology Genomics assignment (instructions are under the “New Biology” tab on your Biology 102 blackboard site). Be sure to complete that assignment BEFORE attending recitation next week. Bring this document, a laptop computer, and a printout of the final page of your online assignment to recitation.

The purposes of the “New Biology” assignments in this course are to help students to begin thinking about the social implications of scientific discoveries and methods, and to learn to articulate and evaluate the social, legal, ethical, and future implications of science discoveries and new scientific technologies. Nanotechnology as it applies to the fields of biology and genetics is an emerging field, and it is important to consider the implications of this “new biology.”

Because nanotechnology is a relatively new area, many people do not know much about it. With that in mind, we’ve prepared this brief introduction, with links to additional information, to provide you with some background. This background is not intended to limit or replace any reading you might like to do on your own regarding nanotechnology. In fact, we hope this information captures your interest and inspires you to read and learn more. As part of your course activities, you will be asked for your informed opinions on the ethical, social, and legal issues surrounding nanotechnology, and so the more informed you are, the better.

Figure 1 - Source: BPDNB (2010)



Nanoparticles are typically 1-100 nm.
Powerful electron microscopes are needed to see them.

Throughout this document, you can visit links using “CNTRL+CLICK”

Or, the full URLs are at the end of the document

What is nanogenomics?

“Nanotechnology” is a broad topic. Given that you are doing this as part of a biology course that includes discussion of genetics, this background will be focused on *nanogenomics*. When you are finished reading and exploring this background information, you will be asked to give your opinion on two questions related to **nanogenomics** and **human enhancement**.

To watch a short lecture about what the future holds in human enhancement, including benefits and risks, see [this video](#).

Nanotechnology is a term that encompasses a variety of scientific and technological developments. The feature that unifies all of these developments is a matter of *scale*: nanotechnology involves the manipulation of matter at the *nanoscale*. One **nanometer** (nm) equals one-billionth of a meter. As illustrated in Figure 1, at the nanoscale only the most powerful microscopes are able to actually see objects.

Nanotechnology refers to a set of techniques used to manipulate matter with precision at the molecular level. For example, scientists have found that they can manipulate carbon atoms and molecules to create nano-sized tubes and fibers with special properties. Even every day common materials can have special, new and different properties when reduced to nano-sized objects. Elements and substances behave differently when reduced to the nanoscale than they do at larger sizes. For example, elements may change color and materials that would normally *not* conduct electricity may do so at the nano scale. Carbon nanotubes, for example, are effective electrical conductors, as well as being extremely hard and durable and yet very light.

Nanogenomics is an area of study within both genetics and nanotechnology. The term “nanogenomics” implies the use of nanotechnology to aid in the study of the genes of cells at microscopic levels (DNA, mRNA, and protein). Sometimes the term “nanogenetics” is used to refer to using nanotechnologies that might be applied to change single genes within the genetic code. Here, we are using the term nanogenetics or nanogenomics broadly to refer to *any research and development involving both nanotechnology and genetics*.

Finally, **human enhancement** can refer very generally to *anything designed to “enhance” human capabilities*. This can include activities ranging from higher education and athletic training, to plastic surgery and bionic prostheses. Thus, human enhancement can include both curing diseases and disabilities and the enhancement of normal capabilities to be extraordinary.

Second-order effects: *Effects of technology that are extraneous to the purpose for which the technology was created, and often result from the different ways that people react to the technology as opposed to resulting directly from the technology.*

Questions to consider

When you are finished reading and exploring this background information, you will be asked to give your opinion on two questions related to nanogenomics and human enhancement. Please keep these questions in mind as you continue.

1. In your opinion, what are the most important benefits and drawbacks of nanogenomics –especially in the areas of human enhancement? Do the benefits outweigh the risks? Or do the risks outweigh the benefits?

2. In your opinion, how much should nanogenomic research and development be regulated? What guidelines, rules, regulations, or other means should be established to help ensure that important benefits of nanogenomics are achieved and that risks/drawbacks are avoided – especially in the area of human enhancement?

As you consider these questions, keep in mind that people have pointed out that when considering new technologies, you need to consider not only their immediate, direct, “first order effects,” but also their “second-order effects.” **Second-order effects** refer to the ways in which technologies change society more indirectly. For example, a first order effect of the creation of cell phone technology is that people are able to communicate more easily in more locations and situations. Some of the second-order effects cell phone technology relate to how culture responded to the technology. Use of cell phones while driving or by students during classes could be seen as having negative second-order effects detrimental to safety and learning. In addition, use of cell phones has resulted in new social norms and social pressures that influence when people use or do not use their phones. For example, you may notice many signs at businesses asking people not to use their cell phones while paying for their purchases.

These second-order effects are not easy to predict and that is one reason why, during the development of new technologies, scientists and policy makers solicit the public’s help in considering what sorts of second-order effects might occur. In general, it is easier to avoid the negative impacts of second-order effects if you think about them ahead of time than if you wait until they are a large part of the culture. Part of what we would like you to do, then, while considering the benefits and drawbacks of nanogenomics is to tell us what you think might be some of the positive and negative ethical, social, and legal second order effects of nanotechnology.

A short, informative video about RNA interference can be found [HERE](#) (YouTube).

Prior students considering these issues said that they would like to know three things: (1) How is nanotechnology currently being used in the area of genetics? (2) Where is it heading?, and (3) What do other people think about it? In the next few pages we will offer some brief answers to these three questions.

Nanogenomics: Current Research & Development

Nanotechnology is currently being used in the area of genetics in a number of ways. Nanotechnology offers new methods for transforming genetic code or genetic expression and, thus, for **genetic engineering** (defined as the changing of the structure of genetic material). For example, tungsten, gold and silica nanoparticles can be coated with substances that carry genes and then shot into tissues so that they physically deliver the DNA into the tissue. The genes then transform the cells and ultimately change them. In general, genetic engineering techniques can be used to modify products such as the stress resistance of agricultural crops ([Moeller & Wang, 2008](#)) and for tissue engineering ([Ernest and Shetty, 2005](#)), in which new tissues are created outside the body and then surgically placed in the body.

In addition, nanogenomic research is being conducted to investigate new means for mapping the human genome (referred to as “nano-sequencing” of DNA) and to develop treatments for diseases. For example, some nanogenomic medicines consist of a manufactured strand of RNA that can be delivered to a set of cells to reduce the expression of or target the destruction of a specific gene. This technique, called **RNA interference** (or RNAi) is being explored for its potential to treat diseases such as cancer (Wang et al., 2008) and inflammatory bowel disease ([Wilson, 2010](#)), but with some debate regarding the likelihood of its eventual success (e.g., see [Ledford, 2010](#).)

To learn more about current developments visit and search for “genetic”

www.nanotech-now.com

Researchers also have been able to use nanotechnology to create **DNA “scaffolds,”** which are the same double helix shape, that can help scientists build smaller-than-ever computer chips ([Seeman, 2003](#); [Kershner, 2009](#); or see [Quick, 2009](#) for a reader-friendly overview). Though this line of research focuses on the technology industry, its concepts are rooted in biology, through the architectural design of DNA. This technology could allow computer chips to be made that are faster, more energy efficient and less expensive than they were before.

Where is nanogenomics heading?

If new advances in nanogenomic techniques continue to allow us to make advances in genetic engineering, theoretically, we could put an end to genetic diseases. For example, someday we may be

able to specifically modify genes that cause genetic diseases, by changing the sequence of nucleotides so that they no longer cause diseases. If someone has a genetic predisposition toward cancer, and that gene can be precisely targeted and changed, that person's genes could be modified so that they will no longer develop cancer as the result of their genetic predisposition.

Nanogenetic technological developments could also allow us to see if fetuses, in the womb, have any genetic disorders, making it possible to cure them even before birth. If advances in nanotechnology were to make any and all genetic alterations possible, it may also be possible to make other genetic enhancements. People could possibly be able to choose characteristics for their offspring, such as height, hair and eye color, athletic ability, intelligence and temperament. Although such traits as intelligence and temperament are, right now, too complex to predict a simple role of specific genes, as we make advances in nanogenomics, such choices may be more and more available to us.

What are people saying about nanogenomics?

There are currently a variety of perspectives on nanogenomic research and development ([National Citizens Technology Forum](#); [The Project on Emerging Nanotechnologies](#); [Center for Nanotechnology in Society](#); [Foresight Institute](#)). For example, some note that not enough is known about the risks associated with nanotechnology in general, and nanogenomics in particular. In addition to the fact that the properties of everyday substances can change when they are broken into nano-sized particles, we do not know for sure that materials that are harmless at typical scales are necessarily safe at the nano-level, and little is known about the long-term effects of exposure to nanoparticles. We also don't know if all nanomaterials will be inert and break down safely in the body, or whether they will have negative effects, although some research has begun to explore these issues (e.g., [Sereemasapun et al, 2008](#)).

Some see curing genetic diseases as an obvious positive impact, and a natural extension of what we are doing with current medical technology. However, the ability to get rid of diseases raises the question: "What exactly is a disease?" Some may consider genes that alter phenotypes to be disease-related. Others may categorize as a disease any condition (physical, mental, or emotional) that is undesirable ([Freitas, 1999](#)). By this definition, some would consider *aging* a disease.

This raises a whole host of questions: If people who have phenotypes that include traits that are associated with prejudice, discrimination, and bias (e.g., skin color, height, weight), should it be permissible for them to use advanced technology to change those traits, or to change them for their children? Should people be allowed to choose the hair and eye color of their offspring? Height? Athletic ability? Intelligence? Or should people be limited in the genetic changes they are allowed to make to themselves or their offspring? What would be the impact of allowing people to alter any genetic predispositions they would like to alter, whether others think it is a "disease" or not?

Some would argue that we have the right to alter ourselves, and to some extent our children, because of our inherent right to autonomy. On the other hand, it concerns some people that, instead of relying on natural processes to select the genes that are passed on to future generations, we could, instead, choose for ourselves the genes we want most for our offspring to have. Some who are opposed to such developments may note that the choices people make may not necessarily reflect the genes most

beneficial for the human species in the long term. In addition, some of the discussion of human genetic enhancement reflects attitudes felt in the early twentieth century that led to the United States eugenics movement—a movement that supported sterilization of people who had, what some deemed to be, genetic deficiencies. The difference between eugenics through sterilization versus eugenics through gene selection is seen as hazy by some ([Leung, 2004](#)).

Some worry, too, that human enhancements may create undesirable pressures to enhance, and that a greater gap between the rich and poor would result, as only the very rich could afford to pay for such enhancements. Would it be possible to compete for a job if everyone else was enhanced mentally; to compete in athletics if everyone else was strength-enhanced; or compete for a spouse if you were not physically enhanced? Should only the rich be able to have access to these enhancements, or should additional price-control regulation be used to ensure the affordability and availability of the enhancements for every consumer?

Your turn...

We've only pointed to a few of the existing and potential technologies and the corresponding ethical concerns of some people, that also may concern *you*. Hopefully this introduction will inspire you to think of other issues important to you. To explore these and other issues in more detail, see Box 1 for some additional resources.

In your next recitation, you will be asked some questions regarding how you feel about different ethical scenarios. Before then, make sure that you complete the online assignment that goes along with this background document. As a reminder, please keep the following in mind as you complete your assignment:

- 1. In your opinion, what are the most important benefits and drawbacks of nanogenomics – especially in the areas of human enhancement? *Do the benefits outweigh the risks? Or do the risks outweigh the benefits?***
- 2. In your opinion, *how much should nanogenomic research and development be regulated?* What guidelines, rules, regulations, or other means should be established to help ensure that important benefits of nanogenomics are achieved and that risks/drawbacks are avoided – especially in the area of human enhancement?**

Box 1: Learn More about Nanotechnology and Ethics

[Allhoff, Lin, Moor, and Weckert \(2009\)](#) prepared a report for the National Science Foundation that covers a number of the ethical and moral issues and concerns specifically surrounding human enhancement.

Ethics of Human Enhancement:
25 Questions & Answers



In addition, [Understandingnano.com](#) lists some of the ethical questions surrounding nanotechnology in general. It also lists numerous organizations that are thinking about ethical issues related to nanotechnology, and which may serve as a resource for you as you think about the issues for yourself. A screen shot of some of that information is presented below.

The [Nanoethics Group](#) is a non-partisan organization that studies the ethical and societal implications of nanotechnology. They also engage the public as well as collaborate with nanotech ventures and research institutes on related issues and initiatives.

The [Center for Responsible Nanotechnology](#) (CRN) is a non-profit research and advocacy think tank concerned with the major societal and environmental implications of advanced nanotechnology.

[The International Council on Nanotechnology](#) is an international, multi-stakeholder organization whose mission is to develop and communicate information regarding potential environmental and health risks of nanotechnology, thereby fostering risk reduction while maximizing societal benefit.

[Latin American Nanotechnology and Society Network](#) (ReLANS) intends to create a forum for discussion and exchange of information that follows the process of nanotechnology development in Latin America. To that end, ReLANS will establish links and collaboration agreements with academic institutions, governments and society, intending to examine and evaluate the political, economic, social, legal, ethical and environmental implications of nanotechnologies that are domestically developed, and/or in collaboration with foreign centers and institutions, and imported goods that contain nanocomponents.

Works cited

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Videos

[Deepening Dialogue: Debating Nanotechnology's Responsible Development](#)

<http://www.youtube.com/watch?v=2AKUBwCWhiA>

[Nanotechnology, what's that?!](#)

http://www.sciencedaily.com/videos/2006/0611-nanotechnology_whats_that.htm

[Nanotechnology takes off](#)

www.kqed.org/quest/television/view/189

[To Upgrade is Human](#)

http://www.ted.com/talks/gregory_stock_to_upgrade_is_human.html

Web pages

[National Nanotechnology Initiative](#)

<http://www.nano.gov/>

[Understanding Nanotechnology: Ethics and Technology](#)

www.understandingnano.com/nanotechnology-ethics.html

[Human Enhancement and Nanotechnology](#)

<http://www.foresight.org/policy/brief2.html>

[Nanotech Now: Your Gateway to Everything Nanotech](#)

www.nanotech-now.co

4.3. Appendix C—Assignment 3 Materials

4.3.1. Ethical Scenarios Used in Assignment 3

NOTE: These scenarios were included within the online assignment 3.

Instructions

The following are **FICTIONAL potential FUTURE** scenarios. Please spend the entire time available in recitation, writing your responses to these scenarios. You may not be able to finish responding to all three scenarios (actually, you should not be able to, if you are writing high quality answers) -- this is intentional. **You may choose to answer the following in any order you wish.**

The goal of the assignment is to provide opportunities to think carefully about ELSI (ethical, legal and social issues) in science. So, **it's better to answer one or two of the questions "well" than to come up with mediocre or poor answers to all three.**

IMPORTANT NOTE: Some of the scenarios include **things commonly said by people** reacting to nanotechnology. These are **NOT necessarily FACTS.**

It is your job, as you reflect on what the fictional people say, to determine if it is likely true or false, and the extent to which you agree with it. Use your background document and additional materials and any of your own research you would like to do, to make these determinations. If you finish early, please look at the background information or additional resources that you were provided for additional considerations and things to write about. The background document, if you did not bring it with you, is available here. Note: If the background document fails to load, right click on the link and choose "save link as" or "save target as" and then save to your computer.

Possible Scenario: Cystic Fibrosis Prevention

Imagine that some time in the future nanotechnology has enabled doctors to be able to screen for and prevent many common genetic disorders. The following scenario reflects this possibility.

Mr. and Mrs. Vanderbilt have decided they would like to have a baby. Both Mr. and Mrs. Vanderbilt have the genetic markers for Cystic Fibrosis. Their doctor informs them that for \$250,000, he can, through the use of nanogenetics, ensure that their baby is not born with Cystic Fibrosis. The Vanderbilt family can afford this, but wonder if they should.

Mrs. Vanderbilt favors any kind of intervention that may keep their future children healthy, "we have a responsibility to our future children to keep them from suffering," she says. "If there is something that can be done to ensure that our son or daughter is born healthy, then how could we *not* take advantage of it and still call ourselves good parents?"

Mr. Vanderbilt is against use of this technology. He thinks that technology that is applied to genetics is always wrong. Sure, this technology may benefit his child, but he worries that the same technology could be misused and that people will engineer children based on physical appearances. "This technology should be outlawed," he says. "It can only lead to no good. For example, people will start to create super-babies," he says, "and future generations will all end up looking and acting the same." "Furthermore," he worries, "what does this say about people alive now who have diseases and disabilities? Does this mean that we think that they are less worthy of life than others? And what if 'mistakes' are made in messing with our human genetic code and these mistakes are passed down from generation to generation?"

What ethical, legal and social issues are raised by this scenario?

Possible Scenario: Improving Human Memory Development

Imagine that many years in the future Supernanotech Labs is trying to apply past nanogenomic research findings to improve human memory development. The head of the Food and Drug Administration is seeking advice from a panel of citizens regarding their opinions on how regulated this research should be.

Participant 1: "This research is an abomination. God would not want us messing with his work. I don't even think this research and development should be done -- regulated or not."

Participant 2: "Not everyone shares your views on what God wants. This research could help people with memory problems. What if this research could lead to cures for Alzheimer's? Plus, it would be better if we could all remember everything. We would all be so much smarter! I think that this research should be somewhat regulated, but not so much that research and creativity is stifled or delayed."

Participant 3: "I'm pretty sure that only rich and important people would have access to this kind of thing. Then they will be even more rich and important, and the poor will be even more poor. The cycle will never end. Assuming this research goes forward, there needs to be regulations in place that ensure that the developments from this research are not only available to the wealthy."

Participant 4: "I disagree. We live in a free market economy and if you don't let the rich buy this technology, you will slow its development. Let the rich buy it, and then more developments will occur so that it becomes cheaper for lower-income people. But if you do not let the rich buy it, future research and development won't even occur -- or it will occur very slowly and other countries will beat us to the 'big' findings. Then THEY will have the market, because they got there first."

Participant 5: "My concern is that we don't know the consequences of altering DNA. What if memory gets better but people get more aggressive, or crazy, or something? We just don't know. Also, what will be the very long term effects of using this technology? There has to be special regulations in place to make sure that these things don't happen."

What should the head of the Food and Drug Administration recommend to the FDA about regulation? How do you feel? Why? How would you respond to the participants above? Would you

have a different perspective to add that they did not think of?

Possible Scenario: Improving the Nutritional Value of Foods

Imagine that sometime in the future, Abracadabra Food Company develops a new method using nanotechnology to alter the genetic code of their food products to render the food more filling and nutritious. Abracadabra Foods claims that because this means one can eat less of their food and still be full and nourished, millions of starving people can be saved. Additionally, they say, obesity rates will decline as people will feel satisfied after much smaller meals.

A vocal group of protesters, however, are arguing that using nanotechnology to genetically engineer food is unsafe. They are afraid that the food that is produced will alter human DNA and harm us in the long run. They believe that mutations could occur as a result of eating the food, and that cancer rates will increase.

How do you feel about these claims? Do you think genetically engineered food is risky? If so, do the risks outweigh the benefits? Why or why not?

Writing Instructions

Please write a paragraph or two explaining how you feel. Whenever possible, use evidence that you found in the background resources or your own research, to support your claims.

Other Questions after Scenarios

What questions came up as you were answering this scenario, or would you like to have answered in order to be able to write a better response to the scenario above?

4.3.2. Moderator Scripts and Questions

“ELSI for Nanogenomics”

Leader Discussion Guide

You will be helping to lead the discussion of the “Nanogenomics” scenario questions. These will be accessible from Blackboard (under the “New Biology” tab, for the students), and in the form of a paper handout (for you). Students who do not bring a laptop can also have a paper version to write on.

Note that some students will be working alone, hopefully in a separate space from the groups that you are leading.

1. **Introductions:** Introduce yourself, and ask everyone their name. Note that you were involved in some discussions like this last year, and are helping lead this year.
2. **Give students time to read the questions.**
3. **Have a student read whichever question they find interesting.** Ask for volunteers, or ask one student to read the question for the group.
4. **Ask each group member to give an opinion.** Again, first ask for volunteers. If no one wants to volunteer then go around the group to have each person give an answer. No need to be pushy if someone doesn't want to add much to the discussion, but if someone isn't saying anything, ask if they agree or disagree with what has been said so far, and why.
5. **Once all the students have had a chance to say something, give students time to write their answers.** It's ok if they started writing during the discussion (so long as they also contributed to the discussion).

During this time, please take notes (use the paper copy of the questions to take notes upon) **on how you feel the question went:**

- Were the students engaged by the scenario and the question?
- What were the most common responses to the scenario?
- What were the most common disagreements about?
- What did most students agree upon?
- Would you change anything about the scenario to make it more engaging for students?
- Is there anything that the students said that you think was false?

6. **Move on to the 2nd question once all or most students are done writing.**

Note that we expect to have about 30 min total for these discussions -- that is 10 min per question. It would be good if the discussion were 5 min (at least) and the writing 5 min (at least). But it is ok if you only complete 2 questions, if the discussion is going well and if students are engaged. Try to finish 2 questions (gives you 15 min per question). If discussion is dragging, still try to encourage talk so that each question takes about 10 min. If you can't get them to talk for 5 min and write for 5, then there are extra questions at the end of this to use.

7. **Remind students during the discussions that they can change or add to any of their answers at any time.**

Tips and Tricks

In general, the following are the questions the students may be answering, related to the scenarios (you may think of other related questions):

- Should the Vanderbilts be able to make sure their baby is not born with cystic fibrosis?
- Should we try to use the experiments done on mouse memories to improve human memories as well? With which of the participants in the citizen panel do you most agree?
- Is it risky to consume genetically engineered food? If there are risks, are they outweighed by the benefits?

Ways to encourage discussion if students are not talking:

- You could play devil's advocate during the discussion.
- If there are areas of disagreement between students, explore the disagreements. E.g., summarize what you are hearing them say, ask questions about whether they do disagree, and why or why not?
- Ask students to explain why they feel various ways.
- Make sure that every student gives their opinion.

Other overall questions you could ask if the students finish writing answers to the input questions early:

- How do you feel about nanogenomics or nanotechnology in general?

-What are the risks involved with nanogenomics?

-What are the possible benefits of nanogenomic research?

-Which is greater? The risks or benefits?

- Do you think we should invest more money in nanogenomic research? What are the ethical, legal, and social implications of

-further investment in nanogenomic research?

-not investing in nanogenomic research?

- Are there some issues that are more important than others that should be invested in over others?
(*For example, should cancer research take precedence over diseases that may be more immediately curable or treatable, or should we do what we can now?*)

4.3.3. Data Form for Moderators

[begins on next page]

Group Discussion Data Form

Discussion Leader Name: _____

Reci #: _____

Date: _____ Day of week: *Tues Wed Thurs*

Time Start: _____

First names and Last Initials of group members:

Number of Males: _____

Number of females: _____

Total number: _____

(1) Which Question was answered first?

Cystic Fibrosis

GM Food

Memory Enhancement

To what extent did the student discussion stay "on topic"?	Not at all	About a quarter of the time	About half the time	Most of the time	All of the time
How <u>interested</u> did they seem to be in the question?	Not at all	Somewhat	Moderately	Quite	Very/Extremely
How <u>controversial</u> was this question? That is, how much did it spark debate or the raising of alternative perspectives?	Not at all	Somewhat	Moderately	Quite	Very/Extremely

About how long did students spend discussing this question: _____ Writing about the question: _____

Use below and back of page for comments about this question (e.g., answer questions on the discussion guide), or comments about the group interactions.

(2) Which Question was answered second?

Cystic Fibrosis

GM Food

Memory Enhancement

To what extent did the student discussion stay "on topic"?	Not at all	About a quarter of the time	About half the time	Most of the time	All of the time
How <u>interested</u> did they seem to be in the question?	Not at all	Somewhat	Moderately	Quite	Very/Extremely
How <u>controversial</u> was this question? That is, how much did it spark debate or the raising of alternative perspectives?	Not at all	Somewhat	Moderately	Quite	Very/Extremely

About how long did students spend discussing this question: _____ Writing about the question: _____

Use below and back of page for comments about this question (e.g., answer questions on the discussion guide), or comments about the group interactions.

(3) Which Question was answered third?

Cystic Fibrosis

GM Food

Memory Enhancement

To what extent did the student discussion stay "on topic"?	Not at all	About a quarter of the time	About half the time	Most of the time	All of the time
How <u>interested</u> did they seem to be in the question?	Not at all	Somewhat	Moderately	Quite	Very/Extremely
How <u>controversial</u> was this question? That is, how much did it spark debate or the raising of alternative perspectives?	Not at all	Somewhat	Moderately	Quite	Very/Extremely

About how long did students spend discussing this question: _____ Writing about the question: _____

Use below and back of page for comments about this question (e.g., answer questions on the discussion guide), or comments about the group interactions.

Time End: _____

Total Length in Min: _____