

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. Open-ended data is not included by default but specific variables are 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

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Study 3 Detailed Methods¹

1. Study Overview

Study 3, conducted in the fall 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.

Study 3 was very similar to Study 2, but built on Study 2 by refining the items used to measure various constructs and eliminating the “information organization” condition that had been used in Study 2 as part of the manipulation of cognitive engagement. As in our other studies, 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 316 students (56.4% female) enrolled in a freshman-level introductory biology course at the University of Nebraska-Lincoln during the fall semester of 2011. The average age of participants was 19 (SD=2 years), with ages ranging from 17 to 40 years old. Participants included primarily first (40%) and second (40%) year students, and fewer students in their third (15%) or fourth years (or beyond) (5%). The majority of students (78%) came from science-related majors, with Biological Science (30%) having the most representation. Only two of the participants did not answer the political party question. Of those answering, the plurality of participants reported an affiliation with the Republican party (45%), while 27% reported an affiliation with the Democratic party and 28% identified as independent or other.

2.2. Participant Recruitment and Consent

¹ Any statistics reported in this document can be reproduced using the Study 3 Methods SPSS syntax and Study 3 data set. The syntax generally follows the order of this report but may include additional analyses not reported here.

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 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 316 students were in our final sample. While 393 students completed assignment 1, 45 students did not give consent for the use of their data (11%) and 32 students were omitted from the data set because they did not complete one or both of the experimentally manipulated assignments (A2 or A3, some of these students may have dropped the course). A total of 302 of the final 316 (96%) of the students in the sample had given consent at the beginning of the activities 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. If they were not present to revisit their consent, their initial choice from the beginning of the activities was honored. A total of 270 students indicated their willingness to participate at the end of the activities, including 14 additional persons who either had not given consent in Assignment 1 or had missing data during Assignment 1. A total of 28 students had given consent during assignment 1 but then retracted that consent during Assignment 4 and therefore are not included in the data. Reasons given for not consenting to the research included a lack of interest in the topics and concerns about the quality of their data, e.g., admitting random responding to the surveys.

2.3. Research Design Overview

This study consisted of a series of four assignments completed over the course of four weeks, each of which used 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 experimental manipulations. 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.

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 four different versions of this background assignment, according to a 2 (cognitive factor) x 2 (organization factor) between-groups design. Specifically, the background document varied in the presence or absence of explicit prompts to encourage critical thinking (cognitive factor), and whether the information was presented in a format consistent with National Issues Forum procedures of presenting competing viewpoints or a more traditional newsletter approach (organization factor).

In Assignment 3 (A3), students were asked to consider hypothetical future scenarios involving the ethical implications of nanotechnology. Using a 2x2 between-group design, students were randomly assigned either to complete this condition alone or to complete it as part of a small group of peers, as well as with critical thinking prompts or not (students were assigned to the same cognitive conditions they were assigned to 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 at the beginning of the semester, and consisted of questions regarding student 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*.

2.4.2. Assignment 2 (A2): Background Reading (2 x 2 design)

A2 was assigned approximately one week after A1. This second assignment presented a background document on nanotechnology and ELSI issues in science. The materials concerning nanotechnology included peer-reviewed information suggested by the nanoscientists consulted for the project as well as information from other resources. Also included were numerous links to sources of additional information. Students were randomly assigned by the online survey software to receive one of four different versions of this background assignment, according to a 2 (cognitive factor) x 2 (organization factor) between-groups design. Specifically, the background document varied in the presence or absence of explicit prompts to encourage critical thinking (cognitive factor), and whether the information was organized in a “dueling perspectives” or topical manner (organization factor). Students 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.

Cognitive factor. While reading the background document, the online survey software randomly assigned the participants to either receive (critical thinking) explicit critical thinking prompts (e.g., prompting them to look for bias, or look at the quality and bases of various arguments) or (control) prompts to write down “1-2 interesting or surprising things that you learned by reading the information above or by visiting the links” or suggestions for improving the readings. Participants in the critical thinking and control conditions each received four such prompts (in addition to providing two of the four possible versions of A2 in Appendix A, we extracted the two types of prompts and the two versions of the reading material, and present these in Appendix B). Note that, for those students that received these prompts in Assignment 2, prompts were also provided during the hypothetical scenario exercises in Assignment 3, as discussed next.

Information organization factor. Students were randomly assigned to either a “traditional” or “National Issues Forum” (NIF) format of the portion of the background reading concerning ELSI. Those who were assigned a traditional format read a list of potential ELSI concerns such as “unforeseen risks” and the “right to autonomy,” which included descriptions of arguments for why these may or may not be an issue for future nanotechnology research. Those in the NIF condition read the same information presented as two conflicting perspectives: the “Human Enhancement as ‘Human Progress’” approach and the “Human Enhancement as ‘Unnecessary Risk’” approach. As previously noted, these two versions

of the reading material are extracted from the Appendix A versions of A2, and presented in Appendix B for easy finding.

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 (1 group + 2x2 design).

A week after receiving the reading assignment, students were asked to consider a series of hypothetical future ethical scenarios. Two sections (recitations) of students ($n = 38$) were asked to do the study in an online discussion environment called Biofinity (see below), but most students completed this assignment in-person during their normal recitation period ($n = 278$). The in-class students were randomly assigned to experimental conditions. The two experimental factors concerned whether students completed the assignment alone or as part of a small group (social context factor), and a continuation of the critical thinking manipulation from A2 (cognitive factor).

Online “Biofinity” Context (1 group). In this study we piloted using an online context for deliberative discussion. Therefore, a small subset of students from two recitations were assigned to an online condition. It is recommended that these students be left out of analyses comparing experimental conditions, because, although they were randomly assigned to the same A2 conditions in the same way as other students, they were not randomly assigned to A3 and their experience with A3 was quite different. Students in the online group ($n = 38$) were asked to participate in A3 via an online discussion forum program called *Biofinity* (Eck & Soh, 2009), which allowed students to discuss the ethical scenarios in groups via interactive Wiki discussion posts. All students in the Biofinity group were in groups. Students in the Biofinity condition were in groups homogenous for A2 conditions, but the critical thinking prompts were not extended into A3. Homogenous groups were randomly assigned to one of two versions of the Biofinity Wiki (thus, creating quasi-experimental groups). In one version, comments were allowed under students’ posts, whereas in the other version, the comments section was disabled. Students interacted with one another’s posts in both conditions, but the format of these interactions varied (comments in one condition versus separate posts in the other). In actual practice, all student groups did discuss their postings. They sometimes did so in different parts of the wiki space regardless whether the comments section was enabled or not. Biofinity instructions are given in Appendix C.

In-Class Social context conditions. Students who deliberated on the ethical scenarios in class were randomly assigned to work on Assignment 3 either alone or in a group of three to six of their peers, with each group led by an outside moderator trained by the research team.

In-Class Critical thinking conditions. In addition, those who had been randomly assigned to be in the critical thinking condition in A2, continued to be in that condition in A3. A3 moderator training

and assignment materials were customized to use condition appropriate critical thinking or control prompts. For example, the A3 instructions preceding the ethical scenarios in the critical thinking condition included instructions to “remember to evaluate the evidence of different points of view. Is the evidence relevant or strong enough? Is there enough evidence? Keep an eye out for bias. Are some points of view more driven by values than others? Also try to think of any details relevant from when you read the background document, and incorporate those into your responses.” These instructions were not included in the A3 control (non-critical thinking) condition. Further, students in the critical thinking condition were given handouts with critical thinking prompts on them while they considered the scenarios (students in the control condition were simply given hard copies of the scenarios). All students in the Biofinity group were in the non-critical thinking condition and received no handouts.

Other procedures. In all conditions, students considered various ethical scenarios related to nanotechnology. Some of the scenarios presented were taken from prior research efforts. The scenarios were introduced with the following instructions:

The following are FICTIONAL potential FUTURE scenarios. Please write your responses to the scenarios. 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 that was provided to you, and any additional materials or your own research, to make these determinations.

In one scenario, titled “improving human memory development,” participants were asked to consider diverse potential reactions to a treatment for improving human memory that relied on nanogenomic research. In a second scenario, participants were presented with a disagreement between two parents about whether they should use an expensive treatment to ensure that their child is born without cystic fibrosis (see Appendix C for complete scenarios and moderator guidance.)

In the small groups condition (not including Biofinity students), the moderators asked students to briefly discuss their reactions to each scenario. The moderator introduced each of the two hypothetical future scenarios one at a time. After discussing each scenario with their peers, students were asked a series of questions to assess their thoughts about the ELSI concerns that were raised and their use of various sources of background information. The moderators also completed questions about group processes after discussion of each topic (see Appendix C for form). Students in the Biofinity group did the same except without any input from moderators, and 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. This last assignment involved completing a post survey of attitudes and knowledge about nanotechnology and was assigned to be completed online during the week immediately following these discussions. 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.

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 three time points, in Assignments 1 and 2 (pre and post), three questions were asked and averaged ($\alpha = .87-.93$) 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 medical research and development?" and "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. Students were also asked to assess whether and how much they learned about nanotechnology from completing A2. They were asked: "How much do you feel you learned about nanotechnology as a result of working on this assignment?" with a scale of five responses ranging from "nothing that I didn't know before" to "a great deal." In A4, they were asked a similar question accompanied by the same response scale: "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?"

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. As described next, certain questions were answered multiple times (e.g. at A1 and A4, or pre and post A2). (See Appendix A for all items.)

In A1, knowledge questions included five questions with a multiple choice format. Examples of multiple choice questions include "What is genetic engineering?" and "How many nanometers are in one meter?"

In A2, prior to reading the background document on nanotechnology, students were randomly assigned to one of two sets (set A or set B) of six true/false questions. Examples of these items include "Because of their special properties, nanomedicines may be able to reach the brain more effectively than traditional medicines" (true) and "RNAi is currently being used to effectively treat irritable bowel syndrome" (false). Each true/false knowledge question was followed by a measure of confidence in one's answer ("I am _____ confident in my answer"; 1=not at all, 2=a little bit, 3=moderately, 4=mostly, 5=completely).

At the end of A2, students were asked to revisit the same questions they completed before reading the background document (i.e., set A or set B). However, a programming error resulted in the final question from each question set being switched to the other set in the post-background items, and so composite variables should include only the first five items from each set. Once again, each knowledge question was followed by a measure of confidence in one's answer.

In A4, students were asked to revisit the five multiple choice questions used in A1. They were

then asked a set of 22 true/false questions, including the six introduced in A2 and those introduced during A2 (*both* set A and set B), as well as some new questions that none of the students had seen before (set C). Once again, each knowledge question was followed by a measure of confidence in one's answer.

Note that a randomly selected half the students saw "set A" true and false questions only in A4 but saw "set B" multiple times; and the other half the students saw "set B" true and false questions only in A4 but saw "set A" multiple times. Our design makes it possible to gauge the extent to which additional knowledge gains come from seeing a question multiple times rather than only after information is presented.

2.5.2. Attitudes toward Nanotechnology and Attitude Change

Repeated single item measures. Two attitude questions were asked in Assignment 1, and then repeated in Assignments 2, 3 and 4. The first question asked students, "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 the benefits outweigh the risks?" Students selected responses from a seven-point 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 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 and likelihood of opinion change. In A1, students were asked "how likely are you to change your views about the development and regulation" of nanotechnologies and also, via six items (ranging from "Very Unlikely" to "Very Likely" on 7-point scales) how likely it was that they would change their feelings and attitudes about the benefits and risks of nano-biological development. Using the same response scales, students were also asked "as you learn more about the development and regulation of nano-biological technologies, how likely are you to change your feelings and attitudes about..." scientists and policy makers associated with nanotechnology development and regulation.

After each of the two attitude items (risk/benefits and need for regulation) were repeated in Assignments 2 and 4, students were asked "During this assignment" (A2) or "Overall, from the time you began these exercises, until now" (A4), to what extent did you change your mind..." (e.g., "about the risk/benefits question above?").

During A4, students were also asked about the extent to which they changed their attitudes toward policy makers and the extent to which they changed their attitudes toward nanoscientists. For these items, the five point response scale ranged from "not at all" to "a great deal." They were similarly asked the extent to which they changed their minds about their views expressed in their essays on development and regulation of nanotechnology.

Finally, A4 also included seven items (response scale 1= "not at all" to 5= "a great deal") asking students to rate "To what extent did the following influence the final views that you gave about nano-biological technologies and human enhancement?" Items included "talking about the issue with others" as well as the background information, one's own research and study, and "views of people important to me."

General attitudes toward nanotechnology. In Assignments 1 and 4, students were presented

with six general goals of nano-biological research and development and asked to assess each on a five-point scale ranging from “unimportant” to “extremely 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 increased slightly from A1 to A4 ($\alpha = .68$ to $.70$).

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.

In Assignment 1 only, students were asked whether they agreed or disagreed with eight 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 seven-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 ($\alpha = .76$). 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 ($\alpha = .54$). 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, two items assessed the extent to which students trusted certain authorities to effectively manage the risks and promote the benefits associated with nanotechnology. These included “The government will effectively manage any risks associated with nanotechnology” and “Scientists working with nano-biological technologies will develop them in directions that are positive for society” ($\alpha = .52$).

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 (12 each of benefits and risks in A1, but only 10 of each in A4). 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 “Pollution of the environment by nanomaterials.” 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 seven-point scale ranging from “very important to AVOID” to “very importance to ACHIEVE,” with “NOT IMPORTANT to avoid or achieve” representing the midpoint (coded as -3= Very important to avoid, -2= Moderately important to avoid, -1= Slightly important to avoid, 0= Not important to avoid or achieve, 1= Slightly important to achieve, 2= Moderately important to achieve, 3= Very important to achieve). These items were then composited by multiplying the scores for likelihood and importance, and then averaged to create two sub-scales. One scale reflected the *importance of various benefits of nanotechnology* (disease cures and economic benefits; $\alpha = .66, .69$ for A1 and A4 respectively). The second scale reflected *[low] avoidance of various risks* (e.g., economic disruption, widened gap between the rich and

the poor; α s = .78, .82 for A1 and A4 respectively).²

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

Familiarity with nanoscientists. In A1 and A4, students were asked three questions designed to assess their familiarity with nanoscientists (A1, α = .76; A4, α = .73). Examples of these items include “How much do you know about nanoscientists?”; “To what extent have you had more experiences or interactions with nanoscientists?” and “To what extent do you feel certain in your views about nanoscientists?” Responses were recorded on a five-point scale ranging from “not at all” to “a great deal.”

Familiarity with policymakers. In A1 and A4, students were asked three questions designed to assess their familiarity with nanoscientists (A1, α = .83; A4, α = .83). These questions included “How much do you know about policy makers who regulate nanotechnology?”; “To what extent have you had more experiences or interactions with policy makers?” and “To what extent do you feel certain in your views about these policy makers?” Responses were recorded on a five-point scale ranging from “not at all” to “a great deal.”

Confidence and perceived trustworthiness/distrustworthiness of nanoscientists. In A1, students were asked a series of 11 questions to determine their level of confidence in nanoscientists as a group. In A4, students completed a short scale comprised of only three of the original 9 items. These items were created based on prior reviews of trust and confidence measures (PytlíkZillig et al., 2016). These items were then averaged to create a scale of *confidence in nanoscientists to do their jobs* (A1 all items, α = .93; A1 repeated items, α = .81; A4 repeated, α = .87). Each question began with the phrase “To what extent do you have confidence in nanoscientists to...”. Examples of these items include “do their jobs well?”; “meet their professional responsibilities?” and “make decisions about the most important directions for future development. 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 29 questions to determine their perception of nanoscientists’ trustworthiness or distrustworthiness. The stem for these items was “To what extent do you feel nanoscientists probably...” Responses were recorded on a five-point scale ranging from “not at all probable” to “very probable.” Three items were split into three subscales. Some items averaged to measure the level of *perceived trustworthiness* of nanoscientists (A1 all items, α = .95; A1 repeated items, α = .73; A4 repeated, α = .75). Examples of these items include the statements “...are trustworthy” and “...listen to everyone’s opinion.” Other items were averaged to measure the level of *distrustworthiness* students perceived in nanoscientists (A1 all items, α = .76; A1 repeated items, α = .55; A4 repeated, α = .64). These included the statements “...are primarily motivated by what will benefit them personally” and “...don’t really care about the long-term risks of their decisions.” Finally, a scale was created reflecting *perceived competence* of nanoscientists, which was only measured in A1 (α = .90). These included statements such as “...are competent to do their jobs” and “...have the skills needed to do their jobs well”.

Confidence in policymakers. The same items used to measure trust and confidence in nanoscientists were used to measure trust and confidence in policymakers. The same subscales were created: one for *confidence in policymakers to do their jobs* (A1 all items, α = .94; A1 repeated items, α = .83; A4 repeated, α = .89); one for *perceived trustworthiness* of policymakers (A1 all items, α = .97; A1

² In some of the studies, the item concerning human enhancement was kept as a separate single-item measure. In this study we made it part of the benefits scale.

repeated items, $\alpha = .81$; A4 repeated, $\alpha = .82$); one for *perceived distrustworthiness* of policymakers (A1 all items, $\alpha = .84$; A1 repeated items, $\alpha = .57$; A4 repeated, $\alpha = .74$); and one for *perceived competence* of policymakers (again, only asked in A1; $\alpha = .93$).³

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 *anti-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, $\alpha = .86$). 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

³ Note that a variety of different configurations of scales are given in the syntax file that is paired with this methods section.

Grades. During A1, participants were asked to self-report whether, on average, they would say they were an A, B, C, or D student.

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.

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 ($\alpha = .79$). 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).

Trait openness. In A1, a set of eight items was averaged to measure student’s openness to new experiences ($\alpha = .78$). These included the statements “I have a vivid imagination” and “I enjoy hearing new ideas.” These statements were taken from the Openness to Experience scale of the International Personality Item Pool (<http://ipip.ori.org>).

Disposition to trust. In A1, a set of five items were averaged to measure a student’s general inclination to trust others ($\alpha = .79$). These items include “I believe that others have good intentions,” “I trust what people say,” and “I believe most people try to be fair.” These items were taken from the National Opinion Research Center (1994) and the Trust scale included in the International Personality Identity Pool (<http://ipip.ori.org>).

Political efficacy. In A1, a set of four items, and A4, a set of five items, was averaged to measure a student’s evaluation of their own ability to meaningfully participate in the political process ($\alpha = .71, .79$). 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 (eg. “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, α s = .86, .83). These included the statements “I follow political and social issues because I want to learn more things” and “I follow political and social issues because I think it’s important.” 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, α s = .70, .76). These included items such as “I follow political and 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, α s = .75, .87).

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 (α s = .76, .86). 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 and religious attitudes

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

Interest in politics. Two items (α = .66 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).

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).

Religiosity. Students were asked “With regard to religion, which of the following best describes you?” Responses were recorded on a four-point scale ranging from “not at all religious” to “very religious.” “Prefer not to answer” was also provided as an option.

Religious affiliation. Students were asked “With regard to religion, which of the following most closely describes you?” Responses included “Mainline Protestant,” “Evangelical Protestant,” “Black Protestant,” “Roman Catholic,” “Jewish,” “Muslim,” “Agnostic,” “Atheist,” and “Other (please specify).” “Prefer not to answer” was also provided as an option.

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 phrase “During the assignment, I...” and including, for example, “gave careful consideration to all of the options presented” and “felt open-minded.” Students were asked to indicate the extent to which they agreed with 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 eight subscales using the method described in that paper. Specific items were given in random order by the survey program, so that items for each of the different forms of engagement were intermixed. The subscales are described in greater detail below. These items were presented at the end of Assignments 2 (40 items) and 3 (46 items).

Conscientious engagement. A subscale was used to measure the extent to which students were effortful, careful and thorough in completing the assignment (A2, $\alpha = .83$; A3, $\alpha = .83$). These included the statements “felt focused” and “gave careful consideration to all of the options presented.”

Open-minded engagement. A subscale was used to measure the extent to which students felt open to changing their opinions while completing the assignment (A2, $\alpha = .73$; A3, $\alpha = .84$). These included the statements “felt open to hearing new ideas about the topics,” “tried hard to understand perspectives that were different from mine” and “felt open-minded.”

Active learning/metacognitive engagement. A subscale was used to measure the extent to which students actively engaged with the learning process, as opposed to becoming passive recipients of information (A2, $\alpha = .77$; A3, $\alpha = .80$). Examples of these items include the statements “tried to find answers to my questions about the topics” and “identified questions I still had about the topics.”

Social engagement. A subscale was used to measure the extent to which students engaged with others about the assignment (A2, $\alpha = .88$; A3, $\alpha = .94$). Examples of these items include the statements “discussed my ideas about the topics with others” and “asked others what they thought about the topics and issues.”

Creative engagement. A subscale was used to measure the extent to which students attempted to approach the assignment creatively (A2, $\alpha = .85$; A3, $\alpha = .88$). Examples of these items include the statements “used my imagination” and “felt inspired.”

Disinterested engagement. A subscale was used to measure disinterest as a form of disengagement in the learning process (A2, $\alpha = .89$; A3, $\alpha = .91$). Examples of these items include the statements “was impatient to get this over” and “wish I were doing something else.”

Angry engagement. A subscale was used to measure the extent to which students felt angry while completing the assignment (A2, $\alpha = .82$; A3, $\alpha = .93$). Examples of these items include the statements “felt angry” and “found it aggravating.”

Close-minded engagement. A subscale was used to measure the extent to which students felt unwilling to changing their opinions while completing the assignment (A2, $\alpha = .80$; A3, $\alpha = .82$). Examples of these items include the statements “felt like my mind was already made up,” “know how I would feel about the topic even before doing the task,” and “felt like new information would not change my opinions.”

Time spent on A2 assignment. After completing the background reading, but before finishing the items related to engagement and activity evaluations, students were asked to estimate the total time spent on A2 by first estimating the amount of time in minutes spent on reading and exploring information as well as the time spent answering questions and then adding these two estimates together.

A3 resource exploration. After completing the exercises associated with each of the

hypothetical scenarios in A3, students were asked “To what extent did you review or explore your background information or other sources (e.g., Google searches, links to other resources) as you answered this question?” (response options ranged from “not at all” to “a great deal”).

2.7.2. Evaluation measures

Background document 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 26 descriptive statements divided into two subscales. Each statement began with the stem “The information provided in this assignment was...” Responses were recorded on a five-point scale ranging from “strongly disagree” to “strongly agree.” The two subscales resulting from these items were: *Background document evaluation: good* and *Background document evaluation: bad*. A series of 13 items was used to measure the extent to which participants rated the background document in good ways ($\alpha = .89$). Examples of these items include the evaluative statements “trustworthy” and “fair in its presentation of the issues”. A series of 13 items was used to measure the extent to which participants rated the background document in bad ways ($\alpha = .89$). Examples of these items include the evaluative statements “untrustworthy” and “a biased portrayal of the issues”.

Assignment evaluation. Students were asked to consider the quality of the A2 assignment as a whole, including both the background reading and the subsequent exercises. Specifically, students were asked to indicate the extent to which they agreed with nine statements beginning with the phrase “Overall, to what extent did this assignment help to...” These included “more clearly articulate my own perspective” and “think critically about the evidence.” Responses were recorded on a five-point scale ranging from “not at all” to “a great deal” ($\alpha = .89$). In addition, they were asked to rate “Overall, how useful was this assignment for helping you to think more about nanogenomics and nanomedicine and preparing you to answer the two overarching questions?” and “How much do you feel you learned about nanotechnology as a result of working on this assignment?” with five-point ordinal response scales respectively ranging from “not at all” to “extremely” and “nothing I didn’t know before” to “a great deal.” These two items were then averaged to create a single scale ($\alpha = .80$).

Evaluation of A3 resources. After completing the exercises associated with each of the hypothetical scenarios in A3, students were asked about the resources they consulted to guide the response to these scenarios. These items included “To what extent do you feel like the information you explored or reviewed during recitation was helpful as you responded to this scenario?” and “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?” Response options ranged along a five-point scale from “not helpful at all” to “extremely helpful.”

Satisfaction with process. In A4, students were asked three questions designed to assess their level of satisfaction with all four assignments as a module. Specifically, they were asked “To what extent did you change your mind about the [importance of ELSI in science] over this semester?” and “Overall, to what extent was the public participation module a beneficial part of your learning in this course?” with responses to both on a five-point scale ranging from “not at all” to “a great deal.”

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: contrasting perspectives. In Assignments 1, 2, and 4 students were asked to write a short essay outlining their perspective on nanotechnology application. The essay focused on the students' own perspective, and asked "What *developments* should be prioritized and what *regulations* are needed?" In A1, this was comprised of a single essay response, but in A2 and A4, this consisted of two separate responses (one for developments and one for regulations). Additionally, in A4, students were asked to copy and paste their response from A2 and then simply revise accordingly.

ELSI attitudes. In A1, students were asked to respond to the following prompt: "What do you think? In your opinion, how important is it that science students--including beginning science students such as you and your classmates--learn how to think about the ethical, legal and social issues (ELSI) pertaining to science? In 2-3 sentences, give your answer and a brief explanation of why you think as you do."

"Who are you?" At the end of A1, students were asked to write two or three sentences in response to the following questions: "Think about the unique personality traits, political views, religious views, beliefs and interests that make you, 'you.' How do your characteristics impact your views? How might someone who differs from you in these characteristics and beliefs be 'starting out' approaching new technologies different than you?"

Critical thinking scenario. After completing this background reading in A2, students were asked to write a short paragraph responding to the following hypothetical future scenario: "Doug was recently diagnosed with a degenerative genetic disease. Scared about his future, Doug did some research and was convinced that his doctors should use nanotechnology to "fix" the genetic abnormality. Arguing that if the technology exists to manipulate genes with the help of nanotechnology, Doug believes failure to cure him of his disease constitutes malpractice. Doug's girlfriend Dianne, however, urges Doug to seek counseling in order to come to terms with his disease. Citing Doug's religious beliefs and a series of fears for the future, Dianne argues that it is not Doug's or his doctor's right to do something as dangerous and unethical as mess with his genetics."

Responses to A3 scenarios. After each of the A3 scenarios, participants were asked to write about their reactions and recommendations. Prompts with advice for responding corresponded to the critical thinking manipulation described above.

2.9. Data Quality Measures

We also included in our measures two questions related to data quality. In A2 and A4 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, 98% and 96%, of respondents to A2 and A4 respectively indicated giving honest answers.

On the A1 measure of potential negative or positive outcomes of nanotechnology, 12 persons (about 4%) did not classify three or more of six negative outcomes as expected (e.g., not classifying pollution as a negative rather than as a positive outcome).

On the A4 measure of potential negative or positive outcomes of nanotechnology, 5 persons (about 2%) did not classify three or more of five negative outcomes as expected.

3. References Cited

- Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology*, 42(1), 116-131.
- Cacioppo, J. T., Petty, R. E., Feinstein, J. A., & Jarvis, W. B. G. (1996). Individual differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin*, 119, 197-253.
- Cobb, M. D., & Macoubrie, J. (2004). Public perceptions about nanotechnology: Risks, benefits and trust. *Journal of Nanoparticle Research*, 6, 395-405.
- Eck, A., & Soh, L.K. (2009). Intelligent User Interfaces with Adaptive Knowledge Assistants. *Department of Computer Science & Engineering, University of Nebraska-Lincoln, Technical Report, TR-UNL-CSE-2009-0011*.
- Hamlett, P. W., & Cobb, M. D. (2006). Potential solutions to public deliberation problems: Structured deliberations and polarization cascades. *Policy Studies Journal*, 34(4), 629-648.
- Koestner, R., Losier, G. F., Vallerand, R. J., & Carducci, D. (1996). Identified and introjected forms of political internalization: extending self-determination theory. *Journal of Personality and Social Psychology*, 70(5), 1025-1036.
- Lee, C.-J., Scheufele, D. A., & Lewenstein, B. V. (2005). Public attitudes toward emerging technologies examining the interactive effects of cognitions and affect on public attitudes toward nanotechnology. *Science Communication*, 27(2), 240-267.
- Losier, G. F., & Koestner, R. (1999). Intrinsic versus identified regulation in distinct political campaigns: The consequences of following politics for pleasure versus personal meaningfulness. *Personality and Social Psychology Bulletin*, 25(3), 287-298.
- Muhlberger, P., & Weber, L. M. (2006). Lessons from the Virtual Agoral Project: The effects of agency, identity, information, and deliberation on political knowledge. *Journal of Public Deliberation*, 2(1), 1-39.
- PytklikZillig, L. M., Hamm, J. A., Shockley, E., Herian, M. N., Neal, T. M., Kimbrough, C. D., . . . Bornstein, B. H. (2016). The dimensionality of trust-relevant constructs in four institutional domains: Results from confirmatory factor analyses. *Journal of Trust Research*. doi: <http://dx.doi.org/10.1080/21515581.2016.1151359>.
- PytklikZillig, L. M., Hutchens, M., Muhlberger, P., Wang, S., Harris, R., Neiman, J., & Tomkins, A. J. (2013). The Varieties of Individual Engagement (VIE) measure: A confirmatory factor analysis across two samples and contexts. *Journal of Public Deliberation*, 9(2), Article 8. Retrieved from <http://www.publicdeliberation.net/jpd/vol9/iss2/art8>
- Rosenstone, S. J., Behr, R. L., & Lazarus, E. H. (1996). *Third parties in America: Citizen response to major party failure*: Princeton University Press.
- Satterfield, T., Kandlikar, M., Beaudrie, C. E., Conti, J., & Harthorn, B. H. (2009). Anticipating the perceived risk of nanotechnologies. *Nature Nanotechnology*, 4(11), 752-758.
- Scheufele, D. A., & Lewenstein, B. V. (2005). The public and nanotechnology: How citizens make sense of emerging technologies. *Journal of Nanoparticle Research*, 7(6), 659-667.
- Xenos, M. A., Becker, A. B., Anderson, A. A., Brossard, D., & Scheufele, D. A. (2011). Stimulating upstream engagement: An experimental study of nanotechnology information seeking. *Social Science Quarterly*, 92, 1191-1214.

4. Appendices

4.1. Appendix A – All Assignments

APPENDIX A: Study 3 Survey Questions and materials

4.1.1. Study 3 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.

[consent language was included here, in original survey]

a1_CONSENT Do you consent to participate in the research by allowing us to use your coursework-related data as indicated above?

- ☐ Yes (1)
- ☐ No (2)

a1_t2 Timing

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

a1_Q3 PLEASE NOTE Keep in mind that this assignment should take about the same amount of time as a single recitation period (i.e. 50 minutes), and is best done in one sitting. Make sure that you have enough time to finish it, so that you do not need to start over later. 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.

a1_Name This assignment is worth 10 points. The points are awarded simply for making an effort to reflect on the issues raised -- not for the specific views that you express. In order to get credit for

completing this assignment, please fill out the following information.

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

First Name (1)

Last Name (2)

Blackboard user name (e.g., s-name2) (3)

a1_RECI Please indicate which Bio 102 recitation you are enrolled in (see list below):

Recitation section number (Please check list below for accuracy) (1)

Recitation instructor name (2)

Professor's name (3)

a1_t3 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a1_Q5 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" One purpose of a university education is to create well-informed community members (i.e., citizens) who can advise government on the direction that society should move and public policies. While "facts" might be determined by experts, in a democracy, it is the public that decides ethical and "value-related" issues. More and more people are adopting the viewpoint that it is not enough to teach science students "science" divorced from society. Science developed apart from a consideration of its role in society may not be utilized or utilized correctly.

a1_elsiimp_txt What do you think? In your opinion, how important is it that science students--including beginning science students such as you and your classmates--learn how to think about the ethical, legal and social issues (ELSI) pertaining to science? In 2-3 sentences, give your answer and a brief explanation of why you think as you do.

a1_t4 Timing

First Click (1)

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

a1_Q6 Throughout this survey, blue bolded text indicates that you can use your cursor to roll over the text for more information. The goals of the New Biology assignments used in this course are to provide you with practice applying your biological knowledge across and within different science and social disciplines. Specifically, the New Biology assignments in this course will take you through a specific method of public engagement, focused on biology and nanotechnology, that has been developed by the University of Nebraska Public Policy Center. The public engagement process includes the following steps: 1. Opening reflections. This is the step you are on right now. During this step you will reflect on what you know, what you feel, who you trust, and who you are. The purpose is just to reflect on your "starting point" related to the discussion. 2. Information Investigation & Exploration. Later this semester, you will have a reading assignment about Nanotechnology and hear a guest lecture on Ethical, Legal and Social Issues in science. 3. Issue Deliberation. Following the reading, you will consider some ethical scenarios pertaining to nanotechnology and biology, and deliberate about the best courses of action in light of those scenarios. 4. Public Input. The final step in the process is for you to give your input on the issues. Based on what you learned, at the end of the semester, you will write down what you think nano-biological scientists should pursue, and how policy makers should regulate nano-biological developments. Note: Although this is a classroom exercise rather than an actual public engagement, if you give your consent for your course work to be used in the evaluation of these assignments, your input will be reported (anonymously of course) in articles, and will therefore become part of the public record regarding what people think should be the future of nanotechnology.

a1_t5 Timing

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

a1_Q7 Ok, that was a fair bit of text to read -- we promise that the text about nanotechnology later in the semester will be a lot more interesting. For now, however, did you at least get the following main points? If not, use the back button at the bottom of the page (not your browser's back button) to reread prior pages.

a1_purp What are the goals of the "New Biology" activities you will be completing this semester?

- ☐ To practice thinking about the social implications of science (e.g., of new technologies used 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)

a1_byndbio_ From a "New Biology" perspective, why should biology courses go beyond "biology" and include information about other sciences, and consider ethical questions pertaining to science? (check all that apply)

Note: 0 = not selected, 1 = selected.

- ☐ To prepare those students who will be future biologists to do interdisciplinary work. (a1_byndbio_1)
- ☐ To prepare those biology students who will be future engineers and physical scientists to take advantage of advances in biology in their own work. (a1_byndbio_2)
- ☐ To prepare all biology students, as citizens, to form informed opinions about policies involving relevant biological knowledge. (a1_byndbio_3)

a1_activ Which of the following are some of the components of the process you will be part of, as you complete the New Biology activities this semester? (check all the apply)

Note: Note: 0 = not selected, 1 = selected.

- ☐ Opening reflections: Where you reflect on what you know & feel, who you trust, and who you are in society. (1)
- ☐ Information Investigation: Where you learn about and consider available information on the topic. (2)
- ☐ Issue Deliberation: Where you deliberate about some ethical issues. (3)
- ☐ Public input: Where you give your opinion on the issues after having had a chance to study them. (4)
- ☐ None of the above. (5)

a1_t6 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a1_Q8 Answers to Questions... Check your answers below. If you got any of the questions incorrect, use the back button at the bottom of the page to go back to the prior page and change your answers before continuing.

a1_Q9 QUESTION 1: What are the goals of the "New Biology" activities you will be completing this semester? Your answer was: $\{q://QID192/ChoiceGroup/SelectedChoices\}$ The correct answer was: To practice thinking about the social implications of science (e.g., of new technologies used in biology)

a1_Q10 QUESTION 2: From a "New Biology" perspective, why should biology courses go beyond "biology" and include information about other sciences, and consider ethical questions pertaining to science? (check all that apply) Your answer(s) was/were: $\{q://QID298/ChoiceGroup/SelectedChoices\}$

The correct answers were all choices: To prepare those students who will be future biologists to do interdisciplinary work. To prepare those biology students who will be future engineers and physical scientists to take advantage of advances in biology in their own work. To prepare all biology students, as citizens, to form informed opinions about policies involving relevant biological knowledge.

a1_Q11 QUESTION 3: Which of the following are some of the components of the process you will be part of, as you complete the New Biology activities this semester? (check all the apply) Your answer(s) was/were: $\{q://QID194/ChoiceGroup/SelectedChoices\}$ The correct answer(s) were all choices: Opening reflections: Where you reflect on what you know & feel, who you trust, and who you are in society. Information Investigation: Where you learn about and consider available information on the topic. Issue Deliberation: Where you deliberate about some ethical issues. Public input: Where you give your opinion on the issues after having had a chance to study them.

a1_Q12

a1_difans It seems that you did not correctly answer all three of the questions. Because this is a science assignment that is different from typical science assignments, it's important that you understand its purposes (you are free to disagree with the value of the purposes, but we want to be sure you understand them!) Please go back and see how your answers differ from the correct ones. Then you can either change your answers, or come back here and use the text box below to explain why your answers differ from the ones identified as correct. (E.g., Is the assignment description not clear or hard to understand? Are the questions about the assignment hard to understand? etc.).

a1_Q13 Great! You got all the questions correct! You seem to get the gist of what we are doing and why.

a1_Q14 Next: Before we really dive into the "Reflection" process...Please answer the questions on the next page.

a1_Q7 Demographics Note: Your answers to these questions will *not* be shared with anyone. They will ONLY be used (in anonymous form) if you give permission for your work on the New Biology assignments to be analyzed as part of the evaluation and research being conducted on the assignments. Before we get started, please answer the questions below.

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

a1_Age [may be 'Age' in data set]

What is your age? (1)

a1_Gender [may be 'gender' in data set]

What is your gender?

- ☐ Male (1)
- ☐ Female (2)

a1_Year What is your year in school?

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

a1_Major What is your major?

	Biochemistry (3)	Biological science (1)	Biological Science Engineering (2)	Chemistry (5)	Pre- Med (6)	Pre-Vet (4)	Psychology (8)	Other (7)
(1)	☐	☐	☐	☐	☐	☐	☐	☐

A1_MajrTxt 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.

a1_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_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 (0)
- ☐ 1 (1)
- ☐ 2 (2)
- ☐ 3 (3)
- ☐ 4 (4)
- ☐ 5 (5)
- ☐ More than 5 (6)

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_t7 Timing

- First Click (1)
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- Page Submit (3)
- Click Count (4)

a1_Q16 Where do you start? Note: Most of your reflections will be kept confidential, and *not* shared with your professor or recitation instructor. You can assume that all questions are confidential except the ones marked with a note saying otherwise. The spirit of this assignment is to simply get you to reflect on your current knowledge and opinions. So please don't spend any time "googling" or researching the topics. (You will be doing that later!).

a1_Q17 Ok! Let's get started with "Step 1: Opening Reflections." Some (perhaps most) of you may never have even heard of nanotechnology before now, so you will want more information to help you form your opinions. You'll be provided with that information as the semester goes along. For now, however, consider the questions below. You may not know a lot about nanotechnology yet, so don't worry about completely answering the questions. Just write one paragraph describing what comes to mind as possible preliminary answers to these two questions. (1) What developments should be prioritized? What should the future of nano-biological technology development look like, especially when it comes to human enhancement applications? What should it not look like? Why do you feel that way? What ethical, legal and social issues need to be considered and resolved when making decisions about the future development of these technologies? In your opinion, how should these issues be resolved, and why? (2) What regulations are needed? Given current developments in nano-biological technologies and the various developments that are possible in the future, what social policies, rules, limits and regulations should be in place? What policies and regulations should not be in place? Why do you feel that way? What ethical, legal, and social issues need to be considered when making decisions about the regulation of nano-biological technologies, especially when it comes to human enhancement?

a1_devregs_txt Your one paragraph reflection: Note: Your answer to this question WILL be turned in to your instructors. It will be graded for effort (i.e., did you make some effort in completing it?), *not* content or accuracy, because it is understood that you have not yet learned anything about the topic.

a1_t8 Timing

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a1_Q18 What do you know?

a1_Q19 Next, you will reflect on how your "starting point" is impacted by what you currently know and don't know, your attitudes and values, and by the trust you have or don't have in people who produce science or regulate new technologies.

a1_famnano How familiar are you with nanotechnology?

☐ Not at all familiar (1)

☐ Slightly familiar (2)

☐ Somewhat familiar (3)

- ☐ Very familiar (4)
- ☐ Extremely familiar (5)

a1_fammed How familiar are you with how nanotechnology is used in medical research and development?

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

a1_famgen 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)

a1_t9 Timing

- First Click (1)
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- Page Submit (3)
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a1_Q20 What do you know?

a1_Q21 The "New Biology" issues that you think about later in the semester will involve thinking about biological applications of nanotechnology. Take a moment to consider your current levels of knowledge of nanotechnology and its biological applications. See if you can answer the following questions. Once again, the following questions are simply to help you reflect on what you know right now, at the beginning of the semester. Please don't "google" the answers! (You will learn more about these things below later in the semester).

a1_know3_ Which of the following are areas of current nanogenomic research and development? Check all that apply.

0 = not selected 1 = selected

- ☐ Use of nano-sequencing to map the human genome (a1_know3_1)
- ☐ Development of better genetic engineering procedures (a1_know3_2)
- ☐ Adapting biological transmodification for medical delivery (a1_know3_3)
- ☐ Synthesizing biochemical reactions more quickly (a1_know3_4)

- ☐ Development of simplified genetic code capable of supporting nanobot reproduction (a1_know3_5)
- ☐ None of the above (a1_know3_6)

a1_know2 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)

a1_know4 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)

a1_know5 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 organisms. (3)
- ☐ DNA "scaffolds" have been shown to be sentient. (4)

a1_know1 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)

a1_t10 Timing

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

a1_Q22 What do you know?

a1_Q23 When you were asked what comes to mind when you think about the development and regulation of nano-biological technologies, you wrote the following:

"\${q://QID234/ChoiceTextEntryValue}"

a1_chng What Do You Know: Question for Reflection In your estimation, as you become more knowledgeable about nano-biological technologies, how likely are you to change your views about the development and regulation of those technologies?

- ☐ Very Unlikely (1)
- ☐ Unlikely (2)
- ☐ Somewhat Unlikely (3)
- ☐ Undecided/ Cannot Judge (4)
- ☐ Somewhat Likely (5)
- ☐ Likely (6)
- ☐ Very Likely (7)

a1_chngexp_txt Write at least one or two sentences explaining why you gave the answer above. Why or how might things you learn impact your views about the regulation and development of these technologies? Note: Your answer to this question WILL be turned in to your instructors. This question, like the other opinion questions, will only be graded for whether or not you made an effort to reflect -- *not* for content.

a1_t11 Timing

- First Click (1)
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a1_Q24 How do you feel?

a1_Q25 Now that you have thought about what comes to mind when you think of nanotechnology development and regulation, and considered what you know, take a moment to reflect on any attitudes you may be bringing to your consideration of the issues. For example, do you approach the idea of new technologies with suspicion, fear, doubt and distrust? Or with excitement, interest, and hopes for a brighter future? Or perhaps a bit of both? Or neither? How might you answer the following attitude questions? Again, don't worry if you 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 reflect on your initial impressions by answering the questions based on your "gut" feelings--It's perfectly fine just to guess!

a1_riskben 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 (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)

a1_regslid In your opinion, how much regulation is needed with respect to nano-biological research and development? Slide the slider to reflect your view. Zero 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.

_____ None at all (1)

a1_genrate_ When it comes to nano-biological technologies, how important are the following general goals?

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

- Minimizing potential risks for humans. (a1_genrate_1)
- Minimizing potential environmental risks. (a1_genrate_2)
- Making decisions about the most important directions for future development. (a1_genrate_3)
- Studying the social and ethical impacts and implications of future developments and regulations. (a1_genrate_4)
- Maximizing potential benefits for human enhancement. (a1_genrate_5)
- Maximizing potential environmental benefits. (a1_genrate_6)

a1_gensum_x 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. What percentage of resources would you assign to each category?

_____ Minimizing potential risks for humans. (a1_gensum_x1)

_____ Minimizing potential environmental risks. (a1_gensum_x2)

_____ Making decisions about the most important directions for future development. (a1_gensum_x3)

_____ Studying the social and ethical impacts and implications of future developments and regulations. (a1_gensum_x4)

_____ Maximizing potential benefits for human enhancement. (a1_gensum_x5)

_____ Maximizing potential environmental benefits. (a1_gensum_x6)

a1_t12 Timing

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a1_Q26 How do you feel?

a1_rbkly_SPECIFIC RISKS & BENEFITS -- How likely? As research in nanotechnology and biology develops, people say that some of the benefits and risks listed below might be possible. Meanwhile other risks and benefits are not very likely or possible. Based on what you know right now, how likely do you think it is that each of these potential benefits or risks will become a reality as a result of developments in nano-biological technologies? You should guess based on your other knowledge of science even if you don't know anything about nano-biological technologies.

	Not at all likely (1)	Slightly likely (2)	Somewhat likely (3)	Very likely (4)	Extremely likely (5)
--	--------------------------	---------------------	------------------------	-----------------	-------------------------

- The extension of human life expectancy. (a1_rbkly_1)
- Cheap and more universal healthcare. (a1_rbkly_2)
- Fewer side effects of medicines. (a1_rbkly_3)
- Higher rates of terminal illness survival (e.g., cancer survival). (a1_rbkly_4)
- Improvement of individuals' physical abilities and muscle function. (a1_rbkly_5)
- Improvement of individuals' mental abilities and brain function. (a1_rbkly_6)
- New and better ways to clean up the environment. (a1_rbkly_7)
- The ability to improve humans through genetic manipulation. (a1_rbkly_8)
- Increased national security and defense capabilities. (a1_rbkly_9)
- Cheaper, longer lasting consumer products. (a1_rbkly_10)
- New and better ways to treat and detect human diseases. (a1_rbkly_11)
- A greater utilization of renewable energy. (a1_rbkly_12)
- The elimination of genetic inheritance of disease. (a1_rbkly_13)
- Economic development through investment and research. (a1_rbkly_14)
- Drastic reductions in the effects of aging. (a1_rbkly_15)
- The ability to choose the traits of one's children. (a1_rbkly_16)
- No more passing on of genetic diseases to one's offspring. (a1_rbkly_17)
- Economic disruption caused by the loss of traditional jobs. (a1_rbkly_18)
- Loss of personal privacy to tiny new surveillance devices. (a1_rbkly_19)
- A nanotechnology inspired arms race between the U.S. and other nations. (a1_rbkly_20)
- New health problems for people due to the use of nanomedicine. (a1_rbkly_21)
- Unexpected problems due to the use of nanogenomics to alter genetic code. (a1_rbkly_22)
- Pollution of the environment by nanomaterials. (a1_rbkly_23)
- Breathing tiny nano-sized particles that accumulate in your body. (a1_rbkly_24)
- A new eugenics movement. (a1_rbkly_Roll over bold text for definition.) (a1_rbkly_25)
- Unforeseen side-effects from nanomedicines. (a1_rbkly_26)
- Overpopulation due to the eradication of genetic inheritance of disease. (a1_rbkly_27)
- Siphoning of US funds away from more important purposes (e.g., related to the immediate economic crisis or other priorities). (a1_rbkly_28)

- The widening of the gap between the rich and the poor. (a1_rblkly_29)
- Problems caused by a loss of genetic variability in the human population. (a1_rblkly_30)
- Loss of religious liberties. (a1_rblkly_31)
- Contamination of the human gene pool as nanoparticles become part of human DNA and are passed on to future generations. (a1_rblkly_32)
- Increased prejudice and discrimination. (33)

a1_t13 Timing

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a1_rbimpt_ SPECIFIC RISKS & BENEFITS -- How valuable or important? As previously noted, the public's input is especially important when it comes to values. In a democracy, it is the public that is supposed to work together to determine what it values for society. Below, the potential risks and benefits are listed again. This time, please indicate your values, and how important the different outcomes are to try and achieve or avoid -- regardless of how possible you think the outcomes may be.

	Very important to AVOID (-3)	Moderately important to AVOID (-2)	Slightly important to AVOID (-1)	NOT IMPORTANT to avoid or achieve (0)	Slightly important to ACHIEVE (1)	Moderately important to ACHIEVE (2)	Very important to ACHIEVE (3)
--	---------------------------------------	---	---	--	---	--	---

- The extension of human life expectancy. (a1_rbimpt_x1)
- Cheap and more universal healthcare. (a1_rbimpt_x2)
- Fewer side effects of medicines. (a1_rbimpt_x3)
- Higher rates of terminal illness survival (e.g., cancer survival). (a1_rbimpt_x4)
- Improvement of individuals' physical abilities and muscle function. (a1_rbimpt_x5)
- Improvement of individuals' mental abilities and brain function. (a1_rbimpt_x6)
- New and better ways to clean up the environment. (a1_rbimpt_x7)
- The ability to improve humans through genetic manipulation. (a1_rbimpt_x8)
- Increased national security and defense capabilities. (a1_rbimpt_x9)
- Cheaper, longer lasting consumer products. (a1_rbimpt_x10)
- New and better ways to treat and detect human diseases. (a1_rbimpt_x11)
- A greater utilization of renewable energy. (a1_rbimpt_x12)
- The elimination of genetic inheritance of disease. (a1_rbimpt_x13)
- Economic development through investment and research. (a1_rbimpt_x14)

- Drastic reductions in the effects of aging. (a1_rbimpt_x15)
- The ability to choose the traits of one's children. (a1_rbimpt_x16)
- No more passing on of genetic diseases to one's offspring. (a1_rbimpt_x17)
- Economic disruption caused by the loss of traditional jobs. (a1_rbimpt_x18)
- Loss of personal privacy to tiny new surveillance devices. (a1_rbimpt_x19)
- A nanotechnology inspired arms race between the U.S. and other nations. (a1_rbimpt_x20)
- New health problems for people due to the use of nanomedicine. (a1_rbimpt_x21)
- Unexpected problems due to the use of nanogenomics to alter genetic code. (a1_rbimpt_x22)
- Pollution of the environment by nanomaterials. (a1_rbimpt_x23)
- Breathing tiny nano-sized particles that accumulate in your body. (a1_rbimpt_x24)
- A new eugenics movement. (Roll over bold text for definition.) (a1_rbimpt_x25)
- Unforeseen side-effects from nanomedicines. (a1_rbimpt_x26)
- Overpopulation due to the eradication of genetic inheritance of disease. (a1_rbimpt_x27)
- Siphoning of US funds away from more important purposes (e.g., related to the immediate economic crisis or other priorities). (a1_rbimpt_x28)
- The widening of the gap between the rich and the poor. (a1_rbimpt_x29)
- Problems caused by a loss of genetic variability in the human population. (a1_rbimpt_x30)
- Loss of religious liberties. (a1_rbimpt_x31)
- Contamination of the human gene pool as nanoparticles become part of human DNA and are passed on to future generations. (a1_rbimpt_x32)
- Increased prejudice and discrimination. (a1_rbimpt_x33)

a1_t14 Timing

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a1ATTPRE04_ Finally, 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)	Undecided/ Cannot Judge (4)	Slightly Agree (5)	Agree (6)	Strongly Agree (7)
--	-----------------------------	-----------------	-----------------------------	-----------------------------------	-----------------------	-----------	-----------------------

- Nanotechnology is one of the more important issues confronting government today. (a1ATTPRE04_1)
- The risk of nanotechnology directly affecting physical things like human health, wildlife, or the environment in general is currently too high. (a1ATTPRE04_2)
- The risk of nanotechnology affecting social systems like the economy, trade, and sustainable food supply is currently too high. (a1ATTPRE04_3)
- The government will effectively manage any risks associated with nanotechnology. (a1ATTPRE04_4)
- Scientists working with nano-biological technologies will develop them in directions that are positive for society. (a1ATTPRE04_5)
- We should develop nanotechnology at full speed despite its possible risks, in order to keep the U.S. from falling behind other countries. (a1ATTPRE04_6)
- There are serious ethical problems associated with not quickly developing nanotechnologies. (a1ATTPRE04_7)
- Due to the fact that some have expressed strong concern about nanotechnology's risks, we should have a world ban on new nanotechnology products. (a1ATTPRE04_8)

a1_attchn_g_ How Do You Feel: Question for Reflection In your estimation, as you learn more about nano-biological technologies, how likely is it that you may change your feelings and attitudes about the following:

	Very Unlikely (1)	Unlikely (2)	Somewhat Unlikely (3)	Undecided /Cannot Judge (4)	Somewhat Likely (5)	Likely (6)	Very Likely (7)
--	-------------------------	-----------------	--------------------------	-----------------------------------	------------------------	------------	--------------------

- The possibility or likelihood of various benefits. (a1_attchn_g_1)
- The possibility or likelihood of various risks. (a1_attchn_g_2)
- The value or importance of various benefits. (a1_attchn_g_3)
- The value or importance of various risks. (a1_attchn_g_4)
- The overall risk to benefit ratio of nano-biological developments. (a1_attchn_g_5)
- The extent to which nano-biological development needs to be regulated. (a1_attchn_g_6)

a1_chgrepl_txt Write at least one or two sentences explaining the answers that you gave above. Why might you change your feelings about some items but not others? Note: The rest of the questions on

this page are confidential. However, your answer in the text box below WILL be turned in to your instructors. Again, this question will only be graded for whether or not you made an effort to reflect -- *not* for content.

a1_t15 Timing

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a1_Q27 Who Do you Trust?

a1_Q28 To some extent, your "starting point" with regard to your feelings about nano-biological technologies might be impacted by your trust or faith in the people who are developing or regulating new technologies. Nanoscientists are generally seen as responsible for the development of nanotechnologies, as their expertise and interests will impact that development. However, policy makers also make decisions about which technologies to provide funding for, and also how much to regulate new technologies. Such funding and regulations can, in turn, influence decisions scientists make about future developments. Next, you will reflect on the extent to which you generally trust the scientists developing new nano-biological technologies, and policy makers who influence decisions about funding for and regulations of such technologies.

a1_knowNS_ NANOSCIENTISTS First, consider what you know 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? (a1_knowNS_1)
- To what extent have you had experiences or interactions with nanoscientists? (a1_knowNS_2)
- To what extent do you feel certain in your views about nanoscientists? (a1_knowNS_3)

a1_Q29 Next, 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.

a1_sconfNS_ 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. (a1_sconfNS_1)
- Meet their professional responsibilities. (a1_sconfNS_2)
- Meet their ethical responsibilities. (a1_sconfNS_3)
- Go above and beyond what is expected of them professionally in order to better society. (a1_sconfNS_4)
- Go above and beyond what is expected of them professionally in order to protect society from risks. (a1_sconfNS_5)
- Minimize potential risks for humans. (a1_sconfNS_6)
- Minimize potential environmental risks. (a1_sconfNS_7)
- Make decisions about the most important directions for future development. (a1_sconfNS_8)
- Study the social and ethical impacts and implications of future developments and regulations. (a1_sconfNS_9)
- Maximize potential benefits for human enhancement. (a1_sconfNS_10)
- Maximize potential environmental benefits. (a1_sconfNS_11)

a1_gconfNS_ In general, 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 (a1_gconfNS_1)
- Are untrustworthy (a1_gconfNS_2)
- Are honest (a1_gconfNS_3)
- Are ethical (a1_gconfNS_4)
- Are dishonest (a1_gconfNS_5)
- Are fair (a1_gconfNS_6)
- Are competent to do their jobs (a1_gconfNS_7)
- Are incompetent to do their jobs (a1_gconfNS_8)
- Have the knowledge needed to do their jobs well (a1_gconfNS_9)
- Have the skills needed to do their jobs well (a1_gconfNS_10)
- Have the training needed to do their jobs well (a1_gconfNS_11)
- Use fair procedures when making decisions (a1_gconfNS_12)
- Listen to everyone's opinion (a1_gconfNS_13)
- Treat people fairly (a1_gconfNS_14)
- Care about the community they serve (a1_gconfNS_15)
- Are impartial to their findings (a1_gconfNS_16)
- Reach the correct conclusions (a1_gconfNS_17)
- Reach conclusions that are best for everyone (a1_gconfNS_18)
- Care about people like you, your friends, and your family (a1_gconfNS_19)
- Are concerned with how their work impacts everyday people (a1_gconfNS_20)
- Care about how their work affects culture (a1_gconfNS_21)
- Care about the long-term impacts of their work (a1_gconfNS_22)

- Are motivated to "do the right thing" (a1_gconfNS_23)
- Are likely to do the right thing because they see themselves as "good" (a1_gconfNS_24)
- Would feel bad about themselves if their work put others at risk (a1_gconfNS_25)
- Need oversight (a1_gconfNS_26)
- Are primarily motivated by self-interest (a1_gconfNS_27)
- Are primarily motivated by what will profit them (a1_gconfNS_28)
- Are primarily motivated by what will benefit them personally (a1_gconfNS_29)
- Will do the right thing only if they are punished for doing the wrong thing (a1_gconfNS_30)
- Don't really care about the long-term risks of their work (a1_gconfNS_31)

a1_t16 Timing

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a1_Q30 Who Do you Trust?

a1_knowPM_ POLICY MAKERS Next, consider what you know about the policy makers responsible for making decisions about funding and regulations 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? (a1_knowPM_1)
- To what extent have you had experiences or interactions with these policy makers? (a1_knowPM_2)
- To what extent do you feel certain in your views about these policy makers? (a1_knowPM_3)

a1_Q31 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.

a1_sconfPM_ 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 (a1_sconfPM_1)
- Meet their professional responsibilities (a1_sconfPM_2)
- Meet their ethical responsibilities (a1_sconfPM_3)

- Go above and beyond what is expected of them professionally in order to better society (a1_sconfPM_4)
- Go above and beyond what is expected of them professionally in order to protect society from risks (a1_sconfPM_5)
- Minimize potential risks for humans. (a1_sconfPM_6)
- Minimize potential environmental risks. (a1_sconfPM_7)
- Make decisions about the most important directions for future development. (a1_sconfPM_8)
- Study the social and ethical impacts and implications of future developments and regulations. (a1_sconfPM_9)
- Maximize potential benefits for human enhancement. (a1_sconfPM_10)
- Maximize potential environmental benefits. (a1_sconfPM_11)

a1_gconfPM_ 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 (a1_gconfPM_1)
- Are untrustworthy (a1_gconfPM_2)
- Are honest (a1_gconfPM_3)
- Are ethical (a1_gconfPM_4)
- Are dishonest (a1_gconfPM_5)
- Are fair (a1_gconfPM_6)
- Are competent to do their jobs (a1_gconfPM_7)
- Are incompetent to do their jobs (a1_gconfPM_8)
- Have the knowledge needed to do their jobs well (a1_gconfPM_9)
- Have the skills needed to do their jobs well (a1_gconfPM_10)
- Have the training needed to do their jobs well (a1_gconfPM_11)
- Use fair procedures when making decisions (a1_gconfPM_12)
- Listen to everyone's opinion (a1_gconfPM_13)
- Treat people fairly (a1_gconfPM_14)
- Care about the community they serve (a1_gconfPM_15)
- Are impartial to their findings (a1_gconfPM_16)
- Reach the correct conclusions (a1_gconfPM_17)
- Reach conclusions that are best for everyone (a1_gconfPM_18)
- Care about people like you, your friends, and your family (a1_gconfPM_19)
- Are concerned with how their decisions impact everyday people (a1_gconfPM_20)
- Care about how their decisions affect culture (a1_gconfPM_21)
- Care about the long-term impacts of their work (a1_gconfPM_22)
- Are motivated to "do the right thing" (a1_gconfPM_23)
- Are likely to do the right thing because they see themselves as "good" (a1_gconfPM_24)
- Would feel bad about themselves if their decisions put others at risk (a1_gconfPM_25)

- Need oversight (a1_gconfPM_26)
- Are primarily motivated by self-interest (a1_gconfPM_27)
- Are primarily motivated by what will profit them (a1_gconfPM_28)
- Are primarily motivated by what will benefit them personally (a1_gconfPM_29)
- Will do the right thing only if they are punished for doing the wrong thing (a1_gconfPM_30)
- Don't really care about the long-term risks of their decisions (a1_gconfPM_31)

a1_confchg_ Who Do You Trust: Questions for Reflection In your estimation, as you learn more about the development and regulation of nano-biological technologies, how likely are you to change your feelings and attitudes about ...

	Very Unlikely (1)	Unlikely (2)	Somewhat Unlikely (3)	Undecided /Cannot Judge (4)	Somewhat Likely (5)	Likely (6)	Very Likely (7)
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- The scientists responsible for studying and developing nanotechnologies. (a1_confchg_1)
- The policy makers responsible for making decisions about the funding and regulation of nanotechnologies. (a1_confchg_2)

a1_confexp_txt Write at least one or two sentences explaining the answers you gave above. What sorts of things might or might not impact your trust of nanoscientists and policy makers? Note: Once again, the rest of the questions on this page are confidential. However, your answer in the text box below WILL be turned in to your instructors. Again, this question will only be graded for whether or not you made an effort to reflect -- *not* for content.

a1_t17 Timing

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a1_Q32 Who are you?

a1_Q33 So far, you've considered: Where do you start? What do you know? How do you feel? and Who do you trust? Last but not least, think about who you are -- your traits, your attitudes about related topics, your beliefs, and your place in larger society. As you answer the questions below, consider -- are your initial reactions to nanotechnology impacted by your other characteristics, traits, and beliefs? Would people with different characteristics and beliefs likely "start out" viewing nanotechnology differently from you? Remember: Your answers are confidential. None of these answers will be shared with any of your instructors or classmates. Your answers also cannot be used in research unless you give your consent.

a1_Traits_ 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 (a1_Traits_1)
- I trust what people say (a1_Traits_2)
- I believe that others have good intentions (a1_Traits_3)
- I suspect hidden motives in others (a1_Traits_4)
- I believe most people try to be fair (a1_Traits_5)
- The notion of thinking abstractly is appealing to me (a1_Traits_6)
- I like to have the responsibility of handling a situation that requires a lot of thinking. (a1_Traits_7)
- Thinking is not my idea of fun. (a1_Traits_8)
- I try to anticipate and avoid situations where there is likely a chance I will have to think in depth about something (a1_Traits_9)
- I really enjoy a task that involves coming up with new solutions to problems. (a1_Traits_10)
- Learning new ways to think doesn't excite me very much (a1_Traits_11)
- I usually end up deliberating about issues even when they do not affect me personally (a1_Traits_12)
- A good citizen should listen to people who disagree with them politically (a1_Traits_13)
- A good citizen should allow others to challenge their political beliefs (a1_Traits_14)
- A good citizen should discuss politics with those who disagree with them (a1_Traits_15)
- A good citizen should be willing to justify their political views (a1_Traits_16)
- If a citizen is dissatisfied with the policies of government, he or she has a duty to do something about it. (a1_Traits_17)
- I follow political and social issues because I want to learn new things. (a1_Traits_18)
- I follow political and social issues because that's what I'm expected to do. (a1_Traits_19)
- I follow political and social issues because it bothers me when I don't. (a1_Traits_20)
- Being politically and socially conscious is important to who I am. (a1_Traits_21)
- I follow political and social issues because that's what I'm supposed to do. (a1_Traits_22)
- I follow political and social issues because I will feel bad about myself if I don't. (a1_Traits_23)
- I follow political and social issues because I think it's important. (a1_Traits_24)
- People like me don't have any say about what the government does. (a1_Traits_26)
- Sometimes politics and government seem so complicated that a person like me can't really understand what's going on. (a1_Traits_27)
- I consider myself well-qualified to participate in politics. (a1_Traits_25)
- I think that I am better informed about political and social issues than other students. (a1_Traits_28)

- I feel I have a pretty good understanding of current political and social issues facing my world. (a1_Traits_29)
- I consider myself well-qualified to provide input on political and social issues. (a1_Traits_30)
- Obedience and respect for authority are the most important virtues children should learn. (a1_Traits_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. (a1_Traits_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". (a1_Traits_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. (a1_Traits_34)
- I believe in the importance of art. (a1_Traits_35)
- I have a vivid imagination. (a1_Traits_36)
- I tend to be a person who will carry the conversation to a higher level. (a1_Traits_38)
- I enjoy hearing new ideas. (a1_Traits_39)
- I am not interested in abstract ideas. (a1_Traits_40)
- I do not like art. (a1_Traits_41)
- I avoid philosophical discussions. (a1_Traits_42)
- I do not enjoy going to art museums. (a1_Traits_43)

a1_Q34 Who are you? Remember: Your answers are confidential. None of these answers will be shared with any of your instructors or classmates. Your answers also cannot be used in research unless you give your consent.

a1_intrnat 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)

a1_intrloc 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)

a1_ideolog_ 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 (a1_ideolog_1)
- When it comes to ECONOMIC issues (a1_ideolog_2)
- When it comes to SOCIAL issues (a1_ideolog_6)

a1_party_id In politics today, do you consider yourself a Republican, Democrat, or Independent/Other?

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

a1_relig With regard to religion, which of the following best describes you?

	Not at all religious (1)	A little bit religious (2)	Moderately religious (3)	Very religious (4)
Overall (1)	☐	☐	☐	☐

a1_religty With regard to religion, which of the following most closely describes you?

- ☐ Protestant Christian (1)
- ☐ Other Christian (2)
- ☐ Catholic (3)
- ☐ Buddhist (4)
- ☐ Hindu (5)
- ☐ Jewish (6)
- ☐ Agnostic (7)
- ☐ Athiest (8)
- ☐ Other (9)

a1_reflect_txt Who Are You: Final Questions for Reflection Think about the unique personality traits, political views, religious views, beliefs, and interests that make you, "you." How do your characteristics impact your views? How might someone who differs from you in these characteristics and beliefs be "starting out" approaching new technologies differently than you? Write at least 2-3 sentences in response to these reflection questions. Note: Once again, the rest of the questions on this page are confidential. However, your answer in the text box below WILL be turned in to your instructors. Again, this question will only be graded for whether or not you made an effort to reflect -- *not* for content.

a1_t18 Timing

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

a1_Q35 Print this Page. You will need to hand it in at your next recitation to be graded. Note: On the next page, you will also have the option to have the information from this page emailed to you. This is a record of your answers to the open-ended questions. Please print this page from your browser, or copy and paste into a word document to print it, and hand it in at your next recitation.

a1_Q36 \${q://QID80/ChoiceGroup/AllChoicesTextEntry}

\${q://QID82/ChoiceGroup/AllChoicesTextEntry} Starting Point: Your one paragraph reflection on your "starting point" regarding the development and regulation questions: "

\${q://QID234/ChoiceTextEntryValue}" Reflections: Your reflections on how the following impact your "starting point" or might change your views as you learn about the topics. What do you know?

"\${q://QID258/ChoiceTextEntryValue}" How do you feel? "\${q://QID257/ChoiceTextEntryValue}"

Who do you trust? "\${q://QID261/ChoiceTextEntryValue}" Who are you?
"\${q://QID327/ChoiceTextEntryValue}"

a1_Q37 The End!

a1_email Get an Email copy of your assignment: This assignment is worth up to 10 points. It will be graded on effort, not content. Enter your email address below, and a copy of this assignment will be emailed to you after you have completed it. When you receive the email, SAVE IT. The emailed copy of your assignment will be your verification that you completed the assignment in case there is a grading discrepancy later. Email:

a1_comment_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.

a1_Q38 When you are done, click continue to submit your assignment. Then a copy of the page you need to give to your recitation instructor will be emailed to you.

4.1.2. Study 3 Assignment 2

In the 2x2 design, this is the assignment including information organization resembling that used by the national issues forum and NO use of critical thinking prompts. See Appendix B for Manipulations of these conditions.

a2_Q1 This assignment will take approximately 60-90 minutes 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.

a2_name This assignment will be graded and is worth 7 points. To receive credit for this assignment, the following information is required:

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

First Name (1)

Last Name (2)

a2_reci Please indicate which Bio 102 recitation you are enrolled in (see list below if you are not sure):

Recitation section number (Please check list below for accuracy) (1)

Recitation instructor name (2)

Day and time of recitation (3)

a2_time1 Timing

First Click (1)

Last Click (2)

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a2_Q3 At the beginning of the semester, you began a specific method of public engagement that has been developed by the University of Nebraska Public Policy Center. The public engagement process includes the following steps: 1. Opening reflections You did this at the beginning of the semester. 2. Information Investigation & Exploration (This is the step you are on now!) This step includes a reading assignment about Nanotechnology and a guest lecture on Ethical, Legal and Social Issues in science. The last two steps you will do next week: 3. Issue Deliberation In this step, you will consider some ethical scenarios and deliberate about the best courses of action. 4. Public Input Finally, you will give your input on developments that you think nano-biological scientists should pursue, and how nanotechnology should be regulated. Note: If, at the beginning of the semester, you gave your consent for your coursework to be used in the evaluation of these assignments, your input will be reported (anonymously of course) in articles, and become part of the research basis regarding what people think should be the future of nanotechnology.

a2_time2 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a2_Q4 Where Are You Starting From? Before getting started, please indicate what you think right NOW about the following questions. Don't worry if you do not know much about nanotechnology and human enhancement yet--just make your "best guess." The assignment may change your opinions, and you can indicate this later.

a2_fnanopr How familiar are you with nanotechnology?

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

a2_fmepre How familiar are you with how nanotechnology is used in medical research and development?

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

a2_fgpre 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)

a2_Q5 You may feel like you do not have enough information to answer the next two questions -- Please try to answer them anyway. We will give you a chance to change your answer later, after you have more information.

A2pre_riskben 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 (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_regslid In your opinion, how much regulation is needed with respect to nano-biological research and development? Slide the slider to reflect your view. Zero 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.

_____ No regulation at all (1)

a2_time3 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a2_Q6 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!!

A2know1 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)

A2know2 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)

A2know3 Which of the following are areas of current nanogenomic research and development? Check all that apply.

0=not selected, 1 = selected

- ☐ 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)

A2know4 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)

A2know5 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 organisms. (3)
- ☐ DNA “scaffolds” have been shown to be sentient. (4)

A2know_cond A or B (received set A or B of the knowledge questions, in addition to the knowledge questions everyone received)

Display This Question:

If A2know_cond Is Equal to A

A2knowA_1_ (for t/f) and A2knowA_2_ (for conf) Indicate whether the following statements are true or false. Also rate how confident you are in your answer to the true/false question.

This statement is: (1)		I am _____ confident in my answer: (2)					
True (1)	False (2)	Not at all (1)	A little bit (2)	Moderately (3)	Mostly (4)	Completely (5)	

- Although they both deal with biological applications of nanotechnology, there is very little overlap in nanogenomic and nanomedicine research. (A2knowA_1_1; all of the items also have an item for confidence, e.g., A2knowA_2_1)
- Because of their special properties, nanomedicines may be able to reach the brain more effectively than traditional medicines. (A2knowA_1_2)
- 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. (A2knowA_1_3)
- A few companies already offer nanogenomic-based services that allow parents to select particular traits in their children. (A2knowA_1_4)
- Research and development in nanotechnology is already affecting economic systems. (A2knowA_1_5)
- Currently, it is really hard to predict the potential second order-effects of nano-technology. (A2knowA_1_6)

Display This Question:

If A2know_cond Is Equal to B

A2knowB_1_ and A2knowB_2_ Indicate whether the following statements are true or false. Also rate how confident you are in your answer to the true/false question.

This statement is: (1)		I am _____ confident in my answer: (2)				
True (1)	False (2)	Not at all (1)	A little bit (2)	Moderately (3)	Mostly (4)	Completely (5)

- Second order effects refer to unanticipated impacts of nanogenomic treatments on the offspring of the individual who was treated. (A2knowB_1_1 for TF and each item has a version such as A2knowB_2_1 for confidence)
- The government currently uses nano-scale devices to monitor people. (A2knowB_1_2)
- RNAi is currently being used to effectively treat irritable bowel syndrome. (A2knowB_1_3)
- 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. (A2knowB_1_4)
- Nanotechnology has already been used to develop materials to improve products such as tennis rackets. (A2knowB_1_5)
- A good example of a "nano"-sized object is a red blood cell. (A2knowB_1_6)

a2_time4 Timing

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a2_Q7 One purpose of the “New Biology” assignments is to help students to begin thinking about the social implications of scientific discoveries and methods. Another reason for this assignment is that...
a.rollover:link { color: blue; text-decoration: underline; font-size: 14px } a.rollover:active { color: blue; text-decoration: underline; font-size: 14px } a.rollover:visited { color: blue; text-decoration: underline; font-size 14px } a.rollover:hover { color: blue; text-decoration: underline; font-size: 24px } --> The Government Wants to Know <-- (click on the text above to see something neat) Nanotechnology is an up-and-coming hot topic--it is at the cutting edge of scientific developments. It is revolutionizing everything from tennis balls to cancer treatments. However, the general public knows very little about it. The U.S. government, therefore, has mandated that funds be spent on telling the public (that's you!) about nanotechnology and finding out what they (you again!) think should be the future of nanotechnology. (Isn't that neat? Note that throughout this document, more information will appear when you click on blue bold underlined text!) Two questions in need of public input are below. Read the two questions below carefully. You will be asked to answer these questions later in the assignment, so you may want to take notes on them as you read. Nanotechnology, Biology, and Human Enhancement Overarching Questions (1) What developments should be prioritized? In your

opinion, what should the future of nano-biological technology development look like, especially when it comes to human enhancement applications? What should it not look like? Why do you feel that way? What ethical, legal and social issues need to be considered and resolved when making decisions about the future development of these technologies? In your opinion, how should these issues be resolved, and why? (2) What regulations are needed? Given current developments in nano-biological technologies and the various developments that are possible in the future, what social policies, rules, limits and regulations should be in place? What policies and regulations should not be in place? Why do you feel that way? What ethical, legal, and social issues need to be considered when making decisions about the regulation of nano-biological technologies, especially when it comes to human enhancement? In your opinion, how should these issues be resolved, and why?

a2_time5 Timing

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Click Count (4)

[those in the control condition received this instruction:]

a2_Q8tr Get Ready to Explore! Because nanotechnology is a relatively new area and many people do not know much about it, we've prepared a brief introduction document. But don't let the background information that you are about to read limit or replace your own exploration of nanotechnology and human enhancement. When it comes to providing useful answers to questions about the future of nanotechnology, the more you can learn about the topic, the better.

[those in the critical thinking condition received this instruction:]

a2_Q8CT

Put on your Thinking Cap! Because nanotechnology is a relatively new area and many people do not know much about it, we've prepared a brief introduction document. **But** don't let the background information that you are about to read limit or replace *your own critical thinking* about nanotechnology and human enhancement. When it comes to providing useful answers to questions about the future of nanotechnology, the more critically you have analyzed the various options, the better.

Critical thinking is one of the challenges of public engagements, because it requires a lot of hard mental work. Throughout this document, watch for links to additional information that you may want to consider as you weigh the options, and "Tips for Critical Thinking" to help you practice critical thinking skills as you read.

a2_time6 Timing

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Click Count (4)

[SEE APPENDIX B FOR BACKGROUND DOCUMENTS which were in either traditional or NIF format]

[Each of 3 prompts during the readings were designed to evoke either critical thinking or simpler reflection]

Reflection:

a2cntrlex1_txt

Below, give 1-2 interesting or surprising things that you learned by reading the information above or by visiting the links.

You can also help us improve these assignments by giving us suggestions for interesting ideas that you think should be included or excluded from the main text. All suggestions are welcome!

Critical thinking:

a2_Q11

TIP for Critical Thinking: Detecting Bias To provide useful input on the future of nanotechnology, you need to be able detect and see past biased presentation of information.

As you read about nanotechnology—especially as you visit the links to additional information that are provided—look for signs of bias. Signs of bias include: Selective use of adjectives and examples
Strong, persuasive language Presentation of only one perspective on an issue If mostly positive or negative adjectives are used, or if mostly (or exclusively!) positive or negative examples are given, then ask yourself how someone with a different viewpoint might describe the same “facts.” Although such examples do not guarantee bias, but it does suggest the possibility the author is giving a one-sided

perspective on something that may be less clear-cut. You may want to do some of your own research to see how others are describing the same topics.

a2_biasex_txt

Below, give 1-2 examples of bias that you see in the background information so far -- or in links that you visited -- and indicate the changes that would be needed to make the information or source less biased.

a2_time7 Timing

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Click Count (4)

Reflection:

a2cntrlex2_txt

Below, give 1-2 interesting or surprising things that you learned by reading the information above or by visiting the links.

You can also help us improve these assignments by giving us suggestions for interesting ideas that you think should be included or excluded from the main text. All suggestions are welcome!

Critical thinking:

a2_Q13

TIP for Critical Thinking: Consider the Quantity and Quality of Evidence

In the above text (and links you visit), consider the claims that are made. Ask yourself: What is the *evidence* for the claims that are being made? Keep in mind that good evidence:

Will be **relevant**. For example, if one claims that something is expensive, one needs to give evidence of its price, not refer to the numbers of people who use it (which would instead support a claim about wide use, not cost of use). Will be

accurate. For example, it will be *typical* evidence--there will not be a lot of other evidence that would contradict the evidence presented. A short cut for looking for accurate information is to look for a *credible source*.

Will be **sufficient**. Is there *sufficient* evidence that the claim is true? Or are the claims made based on only a little evidence?

a2_suppex_txt

Below, give one example of a claim made above (in the text or a link that you explore) that you think is poorly supported, and one example of a claim that is well-supported.

For each claim, explain why the evidence for the claim is good, or not very good.

For example, is the evidence relevant? Accurate? Typical? And/or sufficient?

a2_time8 Timing

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a2_Q14 **(We hope so!)**

But regardless...wake up now...because that's it for the background on: What nanotechnology is What human enhancement is And some of the current developments taking place at the interface between nanotechnology and biology.

We hope you enjoyed hearing about this new science, and maybe learned some things you didn't know before. Momentarily, we will be asking you, as promised: **What developments do YOU think should be prioritized? What regulations do YOU think are needed? But first**, prior students have said that, in forming their opinions, it would be helpful to know a little bit about what *others* think about nanotechnology and human enhancement. On the next page we outline some issues and perspectives.

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IMPORTANT NOTE! <--Click here

Remember, additional information opens up when you click on blue bold underlined text. On the next page, reading this additional information will be a *tremendous* help in providing information for your answers, so be sure to click on them and read them! Then, click on the link again to close it.

The next page is written in "interactive" format. Only the bare bones of the different issues and perspectives are shown, while details can be seen by clicking on the bold, blue, underlined text. **DO click on these and read them!** They contain important details for helping you decide what you think about the issues.

a2_time9 Timing

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Reflection:

a2cntrlex3_txt

Below, give 1-2 interesting or surprising things that you learned by reading the information above or by

visiting the links. You can also help us improve these assignments by giving us suggestions for interesting ideas that you think should be included or excluded from the main text. All suggestions are welcome!

Critical thinking:

a2_Q18

TIP for Critical Thinking: Consider the Bases of Arguments Next week you will take what you've learned about nanotechnology, and use it to think about some potential ethical scenarios. One problem with ethical scenarios is that they typically involve shades of grey and controversy. Understanding the bases of different arguments can help you sort through the controversy, gain a clearer understanding of why people disagree, and form your own perspective and clearly articulate why you hold it.

Consider the claims that are made by different perspectives above and especially the points of disagreement. If two perspectives disagree, do they disagree because they disagree on **the facts?** This is a disagreement over whether certain claims are *accurate*. Or **values?** This is often a disagreement over which claims are most *important*.

a2_factex_txt

Examine the issues and arguments above and describe one place where people seem to disagree on the facts and one place where they seem to disagree on values.

Describe the disagreements and what facts or values they disagree on. Then describe your opinion. Which facts do you think are true and why? What values match your values?

a2_time10 Timing

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[The traditional and NIF background documents differed. Below is how they differed in their conclusion. See appendix b for the full background documents]

Traditional:

a2_Q20trad

Conclusion

We must form our opinions according to how we balance the benefits and risks of nanobiological research. In a sense, we are deciding which benefits are practical, and which risks are acceptable. However, we shouldn't feel pressured to take a moderate stance, because some argue that there are drawbacks to such a position. For example, a moderate stance on nanobiological research could lead to

more spending of money than if there was no regulation at all. Similarly, frequent debates as to what the exact regulations on this research should be could cause political stalemates and lead to financial losses. Also, if you support nanobiological research, you might acknowledge that people who might otherwise be helped would suffer due to the slowing effects of regulation. On the other hand, if you oppose nanobiological research, the limited regulations of a moderate approach might not be able to prevent certain long-term consequences such as impacts on society because regulations are too focused merely on *immediate* risks.

The question is, which risks are acceptable and which are unacceptable to you? Which directions for future research and development should be prioritized, and which should either not be prioritized, or perhaps forbidden? These are the questions that you need to consider next.

One problem with reading background information like you have just read, however, is that it is very abstract. So, as a final exercise in thinking about these issues, please consider the scenario below.

NIF formatted:

a2_Q20nif

Conclusion Of course, many people probably fall between these two perspectives. Many people probably agree that there are some risks that should be taken seriously, and that certain potential benefits should not be undermined. However, we shouldn't feel pressured to take a moderate stance, because some argue that there are drawbacks to such a position. For example, a moderate stance on nanobiological research could lead to more spending of money than if there was no regulation at all. Similarly, frequent debates as to what the exact regulations on this research should be could cause political stalemates and lead to financial losses. Also, if you support nanobiological research, you might acknowledge that people who might otherwise be helped would suffer due to the slowing effects of regulation. On the other hand, if you oppose nanobiological research, the limited regulations of a moderate approach might not be able to prevent certain long-term consequences such as impacts on society because regulations are too focused merely on immediate risks. The question is, which risks are acceptable and which are unacceptable to you? Which directions for future research and development should be prioritized, and which should either not be prioritized, or perhaps forbidden? These are the questions that you need to consider next. One problem with reading background information like you have just read, however, is that it is very abstract. So, as a final exercise in thinking about these issues, please consider the scenario below.

a2_doug_txt For Your Consideration... Doug's Dilemma Doug was recently diagnosed with a degenerative genetic disease. Scared about his future, Doug did some research and was convinced that his doctors should use nanotechnology to "fix" the genetic abnormality. Arguing that if the technology exists to manipulate genes with the help of nanotechnology, Doug believes failure to cure him of his disease constitutes malpractice. Doug's girlfriend Dianne, however, urges Doug to seek counseling in order to come to terms with his disease. Citing Doug's religious beliefs and a series of fears for the future, Dianne argues that it is not Doug's or his doctor's right to do something as dangerous and

unethical as mess with his genetics. What do you think of Doug's situation in this scenario? Write a short paragraph with some advice to Doug. Be sure to explain your reactions. Need some hints? Click Here. If you are having trouble thinking of how to respond to this scenario, you could ask yourself questions like these: What are your thoughts about using nanotechnology to help reverse Doug's disease? Can you empathize with how Doug must feel? How do you feel about Dianne's advice for Doug to seek therapy? Have you ever experienced a similar situation where what you wanted conflicted with what your partner, parent, or friend, thought was best for you? How would you react if you were in Doug's position?

a2_Q21 Still need help? See an example answer here. "I think that Dianne has no place to tell Doug whether or not he should be able to use nanotechnology to cure his disease. But I also think that Doug has no right to say that the doctor's refusal to treat him is malpractice. I believe it is Doug's right to decide whether or not he is willing to undergo genetic manipulation, but it is also the doctor's right to refuse to use that technology. I have been in situations where my interests conflicted with those of others before. I wanted to play football when I was younger, but my mother said it was too dangerous. Because of her fears, I never got the opportunity to play and become good at football. If I was Doug, I would make it clear to Dianne that I respect her opinion, but my opinion is different and I plan on pursuing the genetic treatment."

a2_time11 Timing

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a2_Q22 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 questions. NOTE: You may use the "back" button to re-read information or to remind yourself how you answered the prior questions. You may also download the background information at the link below, or use any other resources you would like. Download a PDF of the Background Information [HERE](#)

a2_develop_txt (1) What developments should be prioritized? In your opinion, what should the future of nano-biological technology development look like, especially when it comes to human enhancement applications? What should it not look like? Why do you feel that way? What ethical, legal and social issues need to be considered and resolved when making decisions about the future development of these technologies? In your opinion, how should these issues be resolved, and why? Write one paragraph responding to this question in the box below. Also SAVE a copy of your answer (e.g., in a word document), because you will be revising it in Step 4.

a2_regs_txt (2) What regulations are needed? Given current developments in nano-biological technologies and the various developments that are possible in the future, what social policies, rules,

limits and regulations should be in place? What policies and regulations should not be in place? Why do you feel that way? What ethical, legal, and social issues need to be considered when making decisions about the regulation of nano-biological technologies, especially when it comes to human enhancement? In your opinion, how should these issues be resolved, and why? Write one paragraph responding to this question. Also SAVE a copy of your answer (e.g., in a Word document), because you will be revising it in Step 4.

a2post_rskben 1. Based on what you now know: Do you think the risks of nanogenomic and nanomedical 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)

a2_chngmnd_riskben During this assignment, 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)

a2post_regslid 2. In your opinion, how much regulation is needed with respect to nanogenomic and nanomedical 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)

a2_chgmnd_reg During this assignment, 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)

Display This Question:

If A2know_cond Is Equal to A

a2_knowa2_ Indicate whether the following statements are true or false. Also rate how confident you are in your answer to the true/false question.

	This statement is: (1)		I am _____ confident in my answer: (2)				
	True (1)	False (2)	Not at all (1)	A little bit (2)	Moderately (3)	Mostly (4)	Completely (5)

- Nanotechnology has already been used to develop materials to improve products such as tennis rackets. (a2_knowa2_1_1 and a2_knowa2_2_1)
- Although they both deal with biological applications of nanotechnology, there is very little overlap in nanogenomic and nanomedicine research. (a2_knowa2_1_2 and a2_knowa2_2_2)
- Because of their special properties, nanomedicines may be able to reach the brain more effectively than traditional medicines. (a2_knowa2_3 and a2_knowa2_2_3)
- 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. (a2_knowa2_1_4 and a2_knowa2_2_4)
- A few companies already offer nanogenomic-based services that allow parents to select particular traits in their children. (a2_knowa2_1_5 and a2_knowa2_2_5)
- Research and development in nanotechnology is already affecting economic systems. (a2_knowa2_1_6 and a2_knowa2_2_6)

Display This Question:

If A2know_cond Is Equal to B

a2_knowb2_ Indicate whether the following statements are true or false. Also rate how confident you are in your answer to the true/false question.

	This statement is:		I am _____ confident in my answer:				
	True (1)	False (2)	Not at all (1)	A little bit (2)	Moderately (3)	Mostly (4)	Completely (5)

- Second order effects refer to unanticipated impacts of nanogenomic treatments on the offspring of the individual who was treated. (a2_knowB2_1_1 and a2_knowB2_2_1)
- The government currently uses nano-scale devices to monitor people. (a2_knowB2_1_2 and a2_knowB2_2_2)
- RNAi is currently being used to effectively treat irritable bowel syndrome. (a2_knowB2_1_3 and a2_knowB2_2_3)
- 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.

(a2_knowB2_1_4 and a2_knowB2_2_4)

- Currently, it is really hard to predict the potential second order-effects of nano-technology. (a2_knowB2_1_5 and a2_knowB2_2_5)
- A good example of a "nano"-sized object is a red blood cell. (a2_knowB2_1_6 and a2_knowB2_2_6)

a2_time12 Timing

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a2_Q23 Assignment Evaluation These "New Biology" assignments are being developed with assistance from the University of Nebraska 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.

Display This Question:

If ☐ hide Is Equal to ☐ hidden

a2_time How long did it take you to do this assignment? Please only include the time you spent actively working on the assignment. Do not include any breaks you took, interruptions that may have lengthened your time on the pages, or any time spent on web pages not directly linked to the assignment.

- ☐ 15 minutes or less (1)
- ☐ 16 minutes to 30 minutes (2)
- ☐ 31 minutes to 60 minutes (3)
- ☐ 60 minutes or more (4)

a2_sptime Estimated time spent completing this assignment (in *Minutes*). Please only include the time you spent actively working on the assignment. Do not include any breaks you took, interruptions that may have lengthened your time on the pages, or any time spent on web pages not relevant to the assignment.

Reading and exploring information (number of minutes) (1)

Writing your answers to questions (number of minutes) (2)

Total time (number of minutes) (3)

a2_engage_ As you read the materials and worked on the assignment, to what extent did you feel or think each of the following? During the assignment, I...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
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- Gave careful consideration to all of the options presented. (a2_engage_1)
- Thought it was important to be thorough in my consideration of the issues. (a2_engage_2)
- Tried hard to understand perspectives that were different from mine. (a2_engage_3)
- Was concentrating hard. (a2_engage_4)
- Felt open to hearing new ideas about the topics. (a2_engage_5)
- Felt focused. (a2_engage_6)
- Carefully evaluated the relevance of various arguments. (a2_engage_7)
- Felt open-minded. (a2_engage_8)
- Tried to find answers to my questions about the topics. (a2_engage_9)
- Explored topics related to the issues in order to satisfy my own curiosity. (a2_engage_10)
- Checked myself to see how well I understood the issues related to the topics I was learning about. (a2_engage_11)
- Identified questions that I still had about the topics. (a2_engage_12)
- Took notes about the issues related to the topics. (a2_engage_13)
- Thought about how the topics related to other things I know. (a2_engage_14)
- Discussed my ideas about the topics with others. (a2_engage_15)
- Talked to others about the topics to get their opinions. (a2_engage_16)
- Asked others what they thought about the topics and issues. (a2_engage_17)
- Listened to what others thought about the issues. (a2_engage_18)
- Felt creative. (a2_engage_19)
- Used my imagination. (a2_engage_20)
- Felt inspired. (a2_engage_21)
- Worked to think of novel or inventive issues related to the topic. (a2_engage_22)
- Tried to be innovative in my ideas. (a2_engage_23)
- Was impatient to get this over. (a2_engage_24)
- Wished I were doing something else. (a2_engage_25)
- Felt bored. (a2_engage_26)
- Felt distracted. (a2_engage_27)
- Was uninterested in the task I was asked to do. (a2_engage_28)
- Thought this process was not worth my time. (a2_engage_29)
- Didn't care at all about the activities and tasks. (a2_engage_30)
- Was upset. (a2_engage_31)
- Felt angry. (a2_engage_32)
- Found it aggravating. (a2_engage_33)
- Was resentful. (a2_engage_34)

- Felt frustrated. (a2_engage_35)
- Became irritated. (a2_engage_36)
- Felt like my mind was already made up. (a2_engage_37)
- Knew how I would feel about the topic even before doing the task. (a2_engage_38)
- Felt like my ideas on the topic were better than the other ideas presented. (a2_engage_39)
- Felt like new information would not change my opinions. (a2_engage_40)

a2_time13 Timing

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a2_asseval_ 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)
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- Understand nanotechnology (a2_asseval_1)
- Learn about nanotechnology (a2_asseval_2)
- More clearly articulate my own perspective (a2_asseval_5)
- Compare the positives and negatives related to nanogenomics (a2_asseval_9)
- See the issues from multiple perspectives (a2_asseval_10)
- Formulate my arguments better (a2_asseval_13)
- Think critically about evidence (a2_asseval_12)
- Better understand what it means to think critically (a2_asseval_14)
- Motivate me to look at the evidence for different claims, rather than just accepting the claims (a2_asseval_15)

a2_bkgdevl_ What did you think of the background information? The information provided in the background materials was...

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
--	-----------------------	--------------	--------------------------------	-----------	--------------------

- Trustworthy. (a2_bkgdevl_1)
- Untrustworthy. (a2_bkgdevl_2)
- A biased portrayal of the issues. (a2_bkgdevl_3)
- A neutral portrayal of the issues. (a2_bkgdevl_4)
- Not always fair in its presentation of the issues. (a2_bkgdevl_5)
- Fair in its presentation of the issues. (a2_bkgdevl_6)
- Balanced. (a2_bkgdevl_7)
- Unbalanced. (a2_bkgdevl_8)
- Written to try to persuade people to believe what it says. (a2_bkgdevl_9)
- Written to allow people to make up their own minds on the issues. (a2_bkgdevl_10)
- Probably written by a party that would like to convince people to take their stand on the issues. (a2_bkgdevl_11)
- Probably written by a neutral party that would like people to make their own decisions on the issues. (a2_bkgdevl_12)
- Accurate. (a2_bkgdevl_13)
- Inaccurate. (a2_bkgdevl_14)
- Not always accurate in its characterization of the facts. (a2_bkgdevl_15)
- Pretty accurate in its characterization of the facts. (a2_bkgdevl_16)
- Thorough. (a2_bkgdevl_17)

- Not thorough enough. (a2_bkgdevl_18)
- A good resource for understanding multiple perspectives on the issues. (a2_bkgdevl_19)
- Not very good for understanding multiple perspectives on the issues. (a2_bkgdevl_20)
- A high quality source of information. (a2_bkgdevl_21)
- A low quality source of information. (a2_bkgdevl_22)
- Clear and easy to understand. (a2_bkgdevl_23)
- Unclear and difficult to understand. (a2_bkgdevl_24)
- Well-written. (a2_bkgdevl_25)
- Not very well-written. (a2_bkgdevl_26)

a2_time14 Timing

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a2_prepare Overall, how useful was this assignment for helping you to think more about nanogenomics and nanomedicine and preparing you to answer the two overarching questions?

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

a2_learn How much do you feel you learned about nanotechnology as a result of working on this assignment?

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

a2_fnanops Now that you've done some reading....How familiar are you with nanotechnology?

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

a2_fmepst Now that you've done some reading....How familiar are you with how nanotechnology is used in medical research and development?

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

a2_fgennpst Now that you've done some reading....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)

a2_time15 Timing

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a2_Q24 Finally, answer the following question. The reason for the question below is to ensure the accurate evaluation of the assignments.

a2_honest Did you give an honest evaluation of this assignment? (You will not be penalized for your answer. You will receive credit for participation regardless of how you answer.)

- ☐ 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) _____

a2_comment Please make any other comments that you would like, that could help to improve these assignments.

a2_time16 Timing

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a2_Q25 Please Print Your Answers Now You will need to hand them in at your next recitation. This is a record of your answers to the open-ended 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. Your Name: \${q://QID255/ChoiceTextEntryValue/1} \${q://QID255/ChoiceTextEntryValue/2} Your answers to the Open-ended Questions: 1. Question 1. \${q://QID366/ChoiceTextEntryValue} 2. Question 2. \${q://QID368/ChoiceTextEntryValue} 3. Question 3: \${q://QID370/ChoiceTextEntryValue} 4. Response to Doug's Dilemma. \${q://QID357/ChoiceTextEntryValue} Your answers to the Overarching Questions: (Note: These are the questions you will be revising in Step 4 -- Make sure you save a copy for yourself too) 1. Future Development: \${q://QID264/ChoiceTextEntryValue} 2. Future Regulation: \${q://QID116/ChoiceTextEntryValue}

a2_email If you would also like this page emailed to you, enter your email below:

Email address for assignment copy: (1)

a2_Q26 Be sure to click "Next" below to make certain your assignment is submitted. This will also trigger the copy to be sent to your email (if you chose that option).

a2_time17 Timing

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4.1.3. Study 3 Assignment 3—In Class Version

Note that this version of A3 was for students working during class (not using the Biofinity interface). Those using the Biofinity online interface had a slightly different version of this assignment (reported in 4.1.4.)

a3_Q1 ELSI Questions in Nano-biological Technology

a3_name This assignment will be graded and is worth 5 points. To receive credit for this assignment, the following information is required:

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

First Name (1)

Last Name (2)

a3_reci Please indicate which Bio 102 recitation you are enrolled in (see list below if you are not sure):

Recitation section number (Please check list below for accuracy) (1)

Recitation instructor name (2)

Day and time of recitation (3)

a3_t1 Timing

First Click (1)
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a3_Q3 Instructions The following are FICTIONAL potential FUTURE scenarios. Please write your responses to the scenarios. IMPORTANT NOTE: 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 that was provided to you, and any additional materials or your own research, to make these determinations.

a3_memesay 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.

a3_memqst 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?

a3_meminfo 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 (1)
- ☐ Slightly helpful (2)
- ☐ Somewhat helpful (3)
- ☐ Very helpful (4)
- ☐ Extremely helpful (5)

a3_membgh 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 (1)
- ☐ Slightly helpful (2)
- ☐ Somewhat helpful (3)
- ☐ Quite helpful (4)
- ☐ Extremely helpful (5)

a3_cysfesy 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.

a3_cysfqst 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?

a3_cysfinf 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 (1)
- ☐ Slightly helpful (2)
- ☐ Somewhat helpful (3)
- ☐ Very helpful (4)
- ☐ Extremely helpful (5)

a3_cysfbgh 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 (1)
- ☐ Slightly helpful (2)

- ☐ Somewhat helpful (3)
- ☐ Quite helpful (4)
- ☐ Extremely helpful (5)

a3_Q4 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 from the New Biology assignment coordinators) 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.

Q5 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 questions again.

a3_riskben 1. Based on what you now know: Do you think the risks of nano-biological technology 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)

a3_regslid 2. In your opinion, how much regulation is needed with respect to nano-biological technology 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)

a3_Q6 Activity Evaluation And lastly, once again, to assist in improving these activities for future students, please answer this last page of questions.

a3_Engage_ As you read the materials and worked on the assignment, to what extent did you feel or think each of the following? During the assignment, I...

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

- Gave careful consideration to all of the options presented. (a3_Engage_1)
- Thought it was important to be thorough in my consideration of the issues. (a3_Engage_2)
- Tried hard to understand perspectives that were different from mine. (a3_Engage_3)
- Was concentrating hard. (a3_Engage_4)
- Felt open to hearing new ideas about the topics. (a3_Engage_5)
- Felt focused. (a3_Engage_6)
- Carefully evaluated the relevance of various arguments. (a3_Engage_7)
- Felt open-minded. (a3_Engage_8)
- Tried to find answers to my questions about the topics. (a3_Engage_9)
- Explored topics related to the issues in order to satisfy my own curiosity. (a3_Engage_10)
- Checked myself to see how well I understood the issues related to the topics I was learning about. (a3_Engage_11)
- Identified questions that I still had about the topics. (a3_Engage_12)
- Took notes about the issues related to the topics. (a3_Engage_13)
- Thought about how the topics related to other things I know. (a3_Engage_14)
- Discussed my ideas about the topics with others. (a3_Engage_15)
- Talked to others about the topics to get their opinions. (a3_Engage_16)
- Asked others what they thought about the topics and issues. (a3_Engage_17)
- Listened to what others thought about the issues. (a3_Engage_18)
- Felt creative. (a3_Engage_19)
- Used my imagination. (a3_Engage_20)
- Felt inspired. (a3_Engage_21)
- Worked to think of novel or inventive issues related to the topic. (a3_Engage_22)
- Tried to be innovative in my ideas. (a3_Engage_23)
- Was impatient to get this over. (a3_Engage_24)
- Wished I were doing something else. (a3_Engage_25)
- Felt bored. (a3_Engage_26)
- Felt distracted. (a3_Engage_27)
- Was uninterested in the task I was asked to do. (a3_Engage_28)
- Thought this process was not worth my time. (a3_Engage_29)
- Didn't care at all about the activities and tasks. (a3_Engage_30)
- Was upset. (a3_Engage_31)
- Felt angry. (a3_Engage_32)
- Found it aggravating. (a3_Engage_33)
- Was resentful. (a3_Engage_34)

- Felt frustrated. (a3_Engage_35)
- Became irritated. (a3_Engage_36)
- Felt like my mind was already made up. (a3_Engage_37)
- Knew how I would feel about the topic even before doing the task. (a3_Engage_38)
- Felt like my ideas on the topic were better than the other ideas presented. (a3_Engage_39)
- Felt like new information would not change my opinions. (a3_Engage_40)
- Tried to think creatively about the impacts. (a3_Engage_41)
- Began to more clearly understand a new perspective on the issues that I'd not understood before. (a3_Engage_42)
- Felt like I wanted to understand certain perspectives that were different from my own original perspective. (a3_Engage_43)
- Tried to identify what people with different perspectives might think about the topics. (a3_Engage_44)
- Quickly felt like my mind was made up. (a3_Engage_45)
- Was bothered. (a3_Engage_46)

a3_comment 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.

a3_Q7 Finally, here are the answers that you entered to the 2 scenarios. Improving Human Memory Development Cystic Fibrosis Prevention

a3email You can print these for your records (e.g., print to a pdf) and/or, to receive a copy of your work on this assignment via email, please put your email below. The printed copy and/or the email will be your proof that you completed the assignment in case questions arise later.

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

a3_Q8 Be sure to click continue to submit your work, and to have your work emailed to you.

Note that following the A3 data is data from the group facilitator record sheets (See Appendix C and section 4.3.3)

4.1.4. Study 3 Assignment 3 – Biofinity Version

Note that this version of A3 was for students using the Biofinity interface. Those completing the scenarios in class had a slightly different version of this assignment (reported in 4.1.3.)

a3_Q1 ELSI Questions in Nano-biological Technology

a3_name This assignment will be graded and is worth 5 points. To receive credit for this assignment, the following information is required:

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

First Name (1)

Last Name (2)

a3_reci Please indicate which Bio 102 recitation you are enrolled in (see list below if you are not sure):

Recitation section number (Please check list below for accuracy) (1)

Recitation instructor name (2)

Day and time of recitation (3)

a3_t1 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a3_Q3 Instructions The following are FICTIONAL potential FUTURE scenarios. Please write your responses to the scenarios. IMPORTANT NOTE: 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 that was provided to you, the wiki that you created with your group, and any additional materials or your own research that you would like, to make these determinations.

a3_memesay_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.

a3_memqst_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?

a3_meminfo To what extent do you feel like the information collection that you created with your group on the Biofinity Wiki was helpful as you responded to this scenario?

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

a3_membgh To what extent do you feel like the background document that you were provided with in Assignment 2 (before you worked with your group) was helpful as you responded to this scenario?

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

☐ Extremely helpful (5)

a3_cysfesy_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.

a3_cysfqst_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?

a3_cysfinf To what extent do you feel like the information collection that you created with your group on the Biofinity Wiki was helpful as you responded to this scenario?

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

a3_cysfbgh To what extent do you feel like the background document that you were provided with in Assignment 2 (before you worked with your group) was helpful as you responded to this scenario?

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

a3_Q4 NOTICE Do not continue past this page until you have completed your responses to the scenarios completely. Keep in mind that the quality of your responses will be graded. Use the "back" button below to return to the scenarios if you would like to add to your response. Use the "continue" button below ONLY if your responses are complete. Otherwise, use the "back" button below to continue working on the assignment.

a3_Q5 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 questions again.

a3_riskben 1. Based on what you now know: 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 (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)

a3_regslid 2. In your opinion, how much regulation is needed with respect to nano-biological 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)

a3_Q6 Activity Evaluation And lastly, once again, to assist in improving these activities for future students, please answer this last page of questions.

a3_Engage_ As you read the materials and worked on the assignment, to what extent did you feel or think each of the following? During the assignment, I...

	Not at all (1)	Just a little (2)	Some (3)	Quite a bit (4)	A great deal (5)
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- Gave careful consideration to all of the options presented. (a3_Engage_1)
- Thought it was important to be thorough in my consideration of the issues. (a3_Engage_2)
- Tried hard to understand perspectives that were different from mine. (a3_Engage_3)
- Was concentrating hard. (a3_Engage_4)
- Felt open to hearing new ideas about the topics. (a3_Engage_5)
- Felt focused. (a3_Engage_6)
- Carefully evaluated the relevance of various arguments. (a3_Engage_7)
- Felt open-minded. (a3_Engage_8)
- Tried to find answers to my questions about the topics. (a3_Engage_9)
- Explored topics related to the issues in order to satisfy my own curiosity. (a3_Engage_10)
- Checked myself to see how well I understood the issues related to the topics I was learning about. (a3_Engage_11)
- Identified questions that I still had about the topics. (a3_Engage_12)
- Took notes about the issues related to the topics. (a3_Engage_13)
- Thought about how the topics related to other things I know. (a3_Engage_14)
- Discussed my ideas about the topics with others. (a3_Engage_15)
- Talked to others about the topics to get their opinions. (a3_Engage_16)
- Asked others what they thought about the topics and issues. (a3_Engage_17)
- Listened to what others thought about the issues. (a3_Engage_18)
- Felt creative. (a3_Engage_19)
- Used my imagination. (a3_Engage_20)
- Felt inspired. (a3_Engage_21)
- Worked to think of novel or inventive issues related to the topic. (a3_Engage_22)
- Tried to be innovative in my ideas. (a3_Engage_23)
- Was impatient to get this over. (a3_Engage_24)
- Wished I were doing something else. (a3_Engage_25)
- Felt bored. (a3_Engage_26)
- Felt distracted. (a3_Engage_27)
- Was uninterested in the task I was asked to do. (a3_Engage_28)
- Thought this process was not worth my time. (a3_Engage_29)
- Didn't care at all about the activities and tasks. (a3_Engage_30)
- Was upset. (a3_Engage_31)

- Felt angry. (a3_Engage_32)
- Found it aggravating. (a3_Engage_33)
- Was resentful. (a3_Engage_34)
- Felt frustrated. (a3_Engage_35)
- Became irritated. (a3_Engage_36)
- Felt like my mind was already made up. (a3_Engage_37)
- Knew how I would feel about the topic even before doing the task. (a3_Engage_38)
- Felt like my ideas on the topic were better than the other ideas presented. (a3_Engage_39)
- Felt like new information would not change my opinions. (a3_Engage_40)
- Tried to think creatively about the impacts. (a3_Engage_41)
- Began to more clearly understand a new perspective on the issues that I'd not understood before. (a3_Engage_42)
- Felt like I wanted to understand certain perspectives that were different from my own original perspective. (a3_Engage_43)
- Tried to identify what people with different perspectives might think about the topics. (a3_Engage_44)
- Quickly felt like my mind was made up. (a3_Engage_45)
- Was bothered. (a3_Engage_46)

a3_comment_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.

a3_Q7 Finally, here are the answers that you entered to the 2 scenarios. Improving Human Memory Development \${q://QID2/ChoiceTextEntryValue} Cystic Fibrosis Prevention \${q://QID1/ChoiceTextEntryValue}

A3email You can print these for your records (e.g., print to a pdf) and/or, to receive a copy of your work on this assignment via email, please put your email below. The printed copy and/or the email will be your proof that you completed the assignment in case questions arise later.

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

a3_Q8 Be sure to click continue to submit your work, and to have your work emailed to you.

4.1.5. Study 3 Assignment 4

S4 A4 post survey final version

a4_Q1 Final Analysis: Where Do You Stand? Please think carefully about the questions in the 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.

a4_name This assignment will be graded and is worth 8 points. In order to get credit for completing this assignment, please fill out the following information.

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

First Name (1)

Last Name (2)

a4_reci Please indicate which Bio 102 recitation you are enrolled in (see list below):

Recitation section number (Please check list below for accuracy) (1)

Recitation instructor name (2)

Day and time of recitation (3)

a4_t1 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4_Q3 At the beginning of the semester, we gave you this information about the goals of the "New Biology" assignments, and the steps we would be taking to try to meet those goals. Specifically, the New Biology assignments took you through the following steps of a specific method of public engagement: 1. Opening reflections. During this step you reflected on what you know, what you feel, who you trust and who you are. The purpose was to reflect on your "starting point" related to the discussion. 2. Information Investigation & Exploration. Then you had a reading assignment about

Nanotechnology and heard a guest lecture on Ethical, Legal and Social Issues in science. 3. Issue Deliberation. Following the reading, you considered some ethical scenarios pertaining to nanotechnology and biology and deliberated about the best courses of action in light of those scenarios. 4. Public Input. The final step in the process is for you to give your input on the issues. Based on what you learned, you now will write down what you think nano-biological scientists should pursue, and how policy makers should regulate nano-biological developments. <-- You are doing this NOW!

a4_getsum Remember...if you gave consent, your (anonymous) answers will become part of the research base regarding what people think should be the future of nanotechnology. So please do your best to give thoughtful answers. Would you like to receive a copy of the results from your class? -- If yes, we would use the email you enter at the end of this survey to send you a summary of your class's views. The summary would come sometime next semester.

- ☐ yes, please send me a summary of the results (1)
- ☐ no thanks (2)

a4_Q4 Remember...if you gave consent, your (anonymous) answers will become part of the research base regarding what people think should be the future of nanotechnology. So please do your best to give thoughtful answers.

a4_t2 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4_Q5 Final Analysis: Where Do You Stand? Now that you have responded to the ethical scenarios and have had more experience thinking about the ethical, legal and social issues related to nanotechnology, you may have changed your mind about the overarching questions. Please start with the answers that you saved from Assignment 2 in which you read about nanomedicine, nanogenomics and ELSI issues. Revise your prior answers to expand upon and reflect your current opinions. Your final grade on THIS assignment will be based on your improvements between your answer in Assignment 2 and your answer below. Even if you didn't change your mind between Assignment 2 and now, your answer can be improved by expanding it.

a4_develop_txt (1) What developments should be prioritized? In your opinion, what should the future of nano-biological technology development look like, especially when it comes to human enhancement applications? What should it not look like? Why do you feel that way? What ethical, legal and social issues need to be considered and resolved when making decisions about the future development of these technologies? In your opinion, how should these issues be resolved, and why? Please copy and paste your one paragraph response to this question from Assignment 2, and revise and expand on it now that you have had a chance to think about the ethical scenarios presented at your last recitation:

a4_chngmnd Overall, from the time you began these exercises, until now, to what extent did you change your mind about the developments question above?

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

a4_regs_txt (2) What regulations are needed? Given current developments in nano-biological technologies and the various developments that are possible in the future, what social policies, rules, limits and regulations should be in place? What policies and regulations should not be in place? Why do you feel that way? What ethical, legal, and social issues need to be considered when making decisions about the regulation of nano-biological technologies, especially when it comes to human enhancement? In your opinion, how should these issues be resolved, and why? Please copy and paste your one paragraph response to this question from Assignment 2, and revise and expand on it now that you have had a chance to think about the ethical scenarios presented at your last recitation:

a4_regchng 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)

a4_t3 Timing

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

a4_riskben 1. Based on what you know right now: Do you think the risks of nanobiological 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)

a4_chgmnd_riskben 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_regslid 2. In your opinion, how much regulation is needed with respect to nanobiological research and development? Slide the slider to reflect your view. Zero means that you believe there should be NO regulation of nanobiological developments. 100 means that you believe EVERY ASPECT of nanobiological research and development should be HIGHLY regulated.

_____ None at all (1)

a4_chgmnd_reg 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)

a4_inflnce_ To what extent did the following influence the final views that you gave about nanobiological technologies and human enhancement?

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

- Talking about the issue with others. (a4_inflnce_1)
- The background information that I read about the topics. (a4_inflnce_2)
- Learning about new arguments that I'd not thought of before. (a4_inflnce_3)
- My own research on the issue. (a4_inflnce_4)
- Views of people important to me. (a4_inflnce_5)
- The additional resources provided by the background documents. (a4_inflnce_6)
- My study and knowledge of biology in this course. (a4_inflnce_7)

a4_chgexp_txt Please explain briefly why you did or did not change your mind about any of the questions regarding nanobiological research for human enhancement, and what sorts of factors influenced your input.

a4_t4 Timing

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

a4_ATTPRE_ Next, please indicate your opinions about some of the specific issues relating to nanotechnology and human enhancement.

	Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Undecided/ Cannot Judge (4)	Slightly Agree (5)	Agree (6)	Strongly Agree (7)
--	-----------------------------	-----------------	-----------------------------	-----------------------------------	-----------------------	-----------	-----------------------

- The risk of nanotechnology directly affecting physical things like human health, wildlife or the environment in general is currently too high. (a4_ATTPRE_2)
- The risk of nanotechnology affecting social systems like the economy, trade and sustainable food supply is currently too high. (a4_ATTPRE_3)
- The government will effectively manage any risks associated with nanotechnology. (a4_ATTPRE_4)
- Scientists working with nano-biological technologies will develop them in directions that are positive for society. (a4_ATTPRE_5)
- We should develop nanotechnology at full speed despite its possible risks, in order to keep the U.S. from falling behind other countries. (a4_ATTPRE_6)
- There are serious ethical problems associated with not quickly developing nanotechnologies. (a4_ATTPRE_7)
- Due to the fact that some have expressed strong concern about nanotechnology's risks, we should have a world ban on new nanotechnology products. (a1ATTPRE_8)

a4_genrate_ When it comes to nanobiological technologies, how important are the following general goals?

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

- Minimizing potential risks for humans. (a4_genrate_1)
- Minimizing potential environmental risks. (a4_genrate_2)
- Making decisions about the most important directions for future development. (a4_genrate_3)
- Studying the social and ethical impacts and implications of future developments and regulations. (a4_genrate_4)
- Maximizing potential benefits for human enhancement. (a4_genrate_5)
- Maximizing potential environmental benefits. (a4_genrate_6)

Carry Forward All Choices - Displayed & Hidden from "When it comes to nanobiological technologies, how important are the following general goals?"

a4_gensum_x 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 (e.g., 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. What percentage of resources would you assign to each category?

_____ Minimizing potential risks for humans. (a4_gensum_x1)

_____ Minimizing potential environmental risks. (a4_gensum_x2)

_____ Making decisions about the most important directions for future development. (a4_gensum_x3)

_____ Studying the social and ethical impacts and implications of future developments and regulations. (a4_gensum_x4)

_____ Maximizing potential benefits for human enhancement. (a4_gensum_x5)

_____ Maximizing potential environmental benefits. (a4_gensum_x6)

a4_t5 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4speckly_ SPECIFIC RISKS & BENEFITS -- How likely? As research in nanotechnology and biology develops, people say that some of the benefits and risks listed below might be possible. Meanwhile other risks and benefits are not very likely or possible. Based on what you know now, how likely do you think it is that each of these potential benefits or risks will become a reality as a result of developments in nanobiological technologies?

	Not at all likely (1)	Slightly likely (2)	Somewhat likely (3)	Very likely (4)	Extremely likely (5)
--	--------------------------	---------------------	------------------------	-----------------	-------------------------

- The extension of human life expectancy. (a4speckly_1)
- Cheap and more universal healthcare. (a4speckly_2)
- Higher rates of terminal illness survival (e.g., cancer survival). (a4speckly_3)
- Improvement of individuals' mental abilities and brain function. (a4speckly_4)
- New and better ways to clean up the environment. (a4speckly_5)
- Increased national security and defense capabilities. (a4speckly_6)
- The elimination of genetic inheritance of disease. (a4speckly_7)
- Economic development through investment and research. (a4speckly_8)
- Economic disruption caused by the loss of traditional jobs. (a4speckly_9)
- Loss of personal privacy due to tiny new surveillance devices. (a4speckly_10)

- Pollution of the environment by nanomaterials. (a4speckly_11)
- Unexpected problems due to the use of nanogenomics to alter genetic code. (a4speckly_12)
- Breathing tiny nano-sized particles that accumulate in your body. (a4speckly_13)
- A new eugenics movement. (Eugenics refers to methods designed to improve the genetic make-up of a human population). (a4speckly_14)
- Unforeseen side-effects from nanomedicines. (a4speckly_15)
- The widening of the gap between the rich and the poor. (a4speckly_16)
- Increased prejudice and discrimination. (a4speckly_17)

a4_t6 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

Carry Forward All Choices - Displayed & Hidden from "SPECIFIC RISKS & BENEFITS -- How likely?

 As research in nanotechnology and biology develops, people say that some of the benefits and risks listed below might be possible. Meanwhile other risks and benefits are not very likely or possible.

 Based on what you know now, how likely do you think it is that each of these potential benefits or risks will become a reality as a result of developments in nanobiological technologies? "

a4specimpt_ SPECIFIC RISKS & BENEFITS -- How valuable or important? As previously noted, the public's input is especially important when it comes to values. In a democracy, it is the public that is supposed to work together to determine what it values for society. Below, the potential risks and benefits are listed again. This time, please indicate your values, and how important the different outcomes are to try and achieve or avoid -- regardless of how possible you think the outcomes may be.

	Very important to AVOID (1)	Moderately important to AVOID (2)	Slightly important to AVOID (3)	NOT IMPORTANT to avoid or achieve (4)	Slightly important to ACHIEVE (5)	Moderately important to ACHIEVE (6)	Very important to ACHIEVE (7)
--	--------------------------------------	--	--	--	---	--	---

- The extension of human life expectancy. (a4specimpt_x1)
- Cheap and more universal healthcare. (a4specimpt_x2)
- Higher rates of terminal illness survival (e.g., cancer survival). (a4specimpt_x3)
- Improvement of individuals' mental abilities and brain function. (a4specimpt_x4)
- New and better ways to clean up the environment. (a4specimpt_x5)
- Increased national security and defense capabilities. (a4specimpt_x6)
- The elimination of genetic inheritance of disease. (a4specimpt_x7)
- Economic development through investment and research. (a4specimpt_x8)
- Economic disruption caused by the loss of traditional jobs. (a4specimpt_x9)
- Loss of personal privacy due to tiny new surveillance devices. (a4specimpt_x10)
- Pollution of the environment by nanomaterials. (a4specimpt_x11)
- Unexpected problems due to the use of nanogenomics to alter genetic code. (a4specimpt_x12)
- Breathing tiny nano-sized particles that accumulate in your body. (a4specimpt_x13)
- A new eugenics movement. (Eugenics refers to methods designed to improve the genetic make-up of a human population). (a4specimpt_x14)
- Unforeseen side-effects from nanomedicines. (a4specimpt_x15)
- The widening of the gap between the rich and the poor. (a4specimpt_x16)
- Increased prejudice and discrimination. (a4specimpt_x17)

a4_t7 Timing

First Click (1)

Last Click (2)

[PARTICIPANTS RECEIVED ONLY ONE SCENARIO, A4SCNLOWR OR A4SCNHIR]

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 nano-biological technology. 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 and then were asked their opinions about the risks and benefits of nanogenomics and nanomedicine, and the types of regulations that should be imposed on research and development. and then were asked their opinions about the risks and benefits of nanogenomics and nanomedicine, and the types of regulations that should be imposed on 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 nano-biological 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 nano-biological research would make the U.S. a leader in the area and that the benefits would greatly outweigh the risks. Imagine that, based on these results, the U.S. government decided to increase its investment in and funding for nano-biological 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 "nanotechnology" per se. Given this scenario, please rate your agreement with the following statements.

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Slightly agree (4)	Agree (5)	Strongly agree (6)
--	-----------------------	--------------	-----------------------	--------------------	-----------	--------------------

- The process used by the government to make decisions about this issue was fair. (a4fscnlwr_1)
- The government made the right choices with regard to this issue. (a4fscnlwr_2)
- The government made the same choices you would have made. (a4fscnlwr_3)
- The government should have made different decisions about the issue. (a4fscnlwr_4)
- The government should have used a different process to get public input about this issue. (a4fscnlwr_5)

a4fscnhir_ 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 and nanomedicine, 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 nanomedicine, and the types of regulations that should be imposed on 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 nano-biological 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 nanomedicine and nanogenomic research would lead, and feared that the risks might greatly outweigh the benefits. Imagine that, based on these results, the U.S. government decided to increase its regulation of nano-biological research and development and to primarily fund studies of the potential risks associated with 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 nanotechnology. Given this scenario, please rate your agreement with the following statements.

	Strongly disagree (1)	Disagree (2)	Slightly disagree (3)	Slightly agree (4)	Agree (5)	Strongly agree (6)
--	-----------------------	--------------	-----------------------	--------------------	-----------	--------------------

- The process used by the government to make decisions about this issue was fair. (a4fscnHlr_1)
- The government made the right choices with regard to this issue. (a4fscnHlr_2)
- The government made the same choices you would have made. (a4fscnHlr_3)
- The government should have made different decisions about the issue. (a4fscnHlr_4)
- The government should have used a different process to get public input about this issue. (a4fscnHlr_5)

a4fscnexpl_txt If you would like to comment on this scenario, or explain your ratings, please do so here.

a4_t8 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

[Participants were randomly assigned to receive one of the following two questions:]

a4slowsch 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)

a4_t9 Timing

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

a4_Q6 Who Do you Trust? Back at the beginning of the semester, we promised you would be able to change your mind on various questions. Here are a few more of those questions.

a4_knowNS_ NANOSCIENTISTS First, consider what you know 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? (a4_knowNS_1)
- To what extent have you had experiences or interactions with nanoscientists? (a4_knowNS_2)
- To what extent do you feel certain in your views about nanoscientists? (a4_knowNS_3)

a4_sconfNS_ 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. (a4_sconfNS_1)
- Meet their professional responsibilities. (a4_sconfNS_2)
- Make decisions about the most important directions for future development. (a4_sconfNS_3)

a4_gconfNS In general, 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 (a4_gconfNS_1)
- Listen to everyone's opinion (a4_gconfNS_2)
- Care about the community they serve (a4_gconfNS_3)
- Are primarily motivated by what will benefit them personally (a4_gconfNS_4)
- Will do the right thing only if they are punished for doing the wrong thing (a4_gconfNS_5)
- Don't really care about the long-term risks of their work (a4_gconfNS_6)

a4_t10 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4_knowPM_ POLICY MAKERS Next, consider what you know about the policy makers responsible for making decisions about funding and regulations 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? (a4_knowPM_1)
- To what extent have you had experiences or interactions with these policy makers? (a4_knowPM_2)
- To what extent do you feel certain in your views about these policy makers? (a4_knowPM_3)

a4_sconfPM_ 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 (a4_sconfPM_1)
- Meet their professional responsibilities (a4_sconfPM_2)
- Make decisions about the most important directions for future development. (a4_sconfPM_3)

a4_gconfPM_ 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 (a4_gconfPM_1)
- Listen to everyone's opinion (a4_gconfPM_2)
- Care about the community they serve (a4_gconfPM_3)
- Are primarily motivated by what will benefit them personally (a4_gconfPM_4)

- Will do the right thing only if they are punished for doing the wrong thing (a4_gconfPM_5)
- Don't really care about the long-term risks of their work (a4_gconfPM_6)

a4_t11 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4chgscipo_ 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 ...

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

- The scientists responsible for studying and developing nanotechnologies. (a4chgscipo_1)
- The policy makers responsible for making decisions about the funding and regulation of nanotechnologies. (a4chgscipo_2)

a4_t12 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4_Q7 What do you know? The purpose of the next questions is to find out what you may have learned as a result of working on these assignments....So as usual, please don't Google the answers!

A4know1 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)

A4know2 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)

A4know3_ 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 (A4know3_1)
- ☐ Development of better genetic engineering procedures (A4know3_2)
- ☐ Adapting biological transmodification for medical delivery (A4know3_3)
- ☐ Synthesizing biochemical reactions more quickly (A4know3_4)
- ☐ Development of simplified genetic code capable of supporting nanobot reproduction (A4know3_5)
- ☐ None of the above (A4know3_6)

A4know4 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)

A4know5 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 organisms. (3)
- ☐ DNA “scaffolds” have been shown to be sentient. (4)

a4_t13 Timing

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

a4_Q8 What do you know?

a4TFABC_ Now, please indicate whether the following statements are true or false. Also rate how confident you are in your answer to the true/false question.

This statement is: (1)		I am _____ confident in my answer: (2)					
True (1)	False (2)	Not at all (1)	A little bit (2)	Moderately (3)	Mostly (4)	Completely (5)	

- Although they both deal with biological applications of nanotechnology, there is very little overlap in nanogenomic and nanomedicine research. (a4TFABC_1_x and a4TFABC_2_x where x=1)
- Because of their special properties, nanomedicines may be able to reach the brain more effectively than traditional medicines. (a4TFABC_1_x and a4TFABC_2_x where x=2)
- 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. (a4TFABC_1_x and a4TFABC_2_x where x=3)

- A few companies already offer nanogenomic-based services that allow parents to select particular traits in their children. (a4TFABC_1_x and a4TFABC_2_x where x=4)
- Research and development in nanotechnology is already affecting economic systems. (a4TFABC_1_x and a4TFABC_2_x where x=5)
- Currently, it is really hard to predict the potential second order-effects of nano-technology. (a4TFABC_1_x and a4TFABC_2_x where x=6)
- Second order effects refer to unanticipated impacts of nanogenomic treatments on the offspring of the individual who was treated. (a4TFABC_1_x and a4TFABC_2_x where x=7)
- The government currently uses nano-scale devices to monitor people. (a4TFABC_1_x and a4TFABC_2_x where x=8)
- RNAi is currently being used to effectively treat irritable bowel syndrome. (a4TFABC_1_x and a4TFABC_2_x where x=9)
- 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. (a4TFABC_1_x and a4TFABC_2_x where x=10)
- Nanotechnology has already been used to develop materials to improve products such as tennis rackets. (a4TFABC_1_x and a4TFABC_2_x where x=11)
- A good example of a "nano"-sized object is a red blood cell. (a4TFABC_1_x and a4TFABC_2_x where x=12)
- Nanotechnology is already being used to map the human genome. (a4TFABC_1_x and a4TFABC_2_x where x=18)
- Due to the increased cost of surgical and diagnostic tools, nanotechnology will inevitably increase the cost of health care. (a4TFABC_1_x and a4TFABC_2_x where x=19)
- One outcome already identified as possible with nanotechnology is innovative diabetes treatments that stimulate insulin production from outside the body. (a4TFABC_1_x and a4TFABC_2_x where x=20)
- Research at the interface of nanotechnology and biology has been used for seemingly non-biological applications such as the creation of faster computer chips. (a4TFABC_1_x and a4TFABC_2_x where x=21)
- Nanotransdermal technology can be used to liquefy coal and turn it into gas. (a4TFABC_1_x and a4TFABC_2_x where x=22)

a4_t14 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4_traits_ On this page, please complete the following questions about your general views about citizenship and social issues.

Extent of Agreement						
	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. (a4_traits_1)
- A good citizen should allow others to challenge their political beliefs. (a4_traits_2)
- A good citizen should discuss politics with those who disagree with them. (a4_traits_3)
- A good citizen should be willing to justify their political views. (a4_traits_4)
- If a citizen is dissatisfied with the policies of government, he or she has a duty to do something about it. (a4_traits_5)
- I follow political and social issues because I want to learn new things. (a4_traits_6)
- I follow political and social issues because that's what I'm expected to do. (a4_traits_7)
- I follow political and social issues because it bothers me when I don't. (a4_traits_8)
- Being politically and socially conscious is important to who I am. (a4_traits_9)
- I follow political and social issues because that's what I'm supposed to do. (a4_traits_10)
- I follow political and social issues because I will feel bad about myself if I don't. (a4_traits_11)
- I follow political and social issues because I think it's important. (a4_traits_12)
- People like me don't have any say about what the government does. (a4_traits_13)
- Sometimes politics and government seem so complicated that a person like me can't really understand what's going on. (a4_traits_14)
- I consider myself well-qualified to participate in politics. (a4_traits_15)
- I think that I am better informed about political and social issues than other students. (a4_traits_16)
- I feel I have a pretty good understanding of current political and social issues facing my world. (a4_traits_17)
- I consider myself well qualified to provide input on political and social issues. (a4_traits_18)

a4_t15 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

a4_Q9 At the beginning of the semester, you saw this text: 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" One purpose of a university education is to create well-informed community members (i.e., citizens) who can advise government on the direction that society should move and public policies. While "facts" might be determined by experts, in a democracy, it is the public that decides ethical and "value-related" issues. More and more people are adopting the viewpoint that it is not enough to teach science students "science" divorced from society. Science developed apart from a consideration of its role in society may not be utilized or utilized correctly.

a4_IrnELSI_txt What do you think? In your opinion, how important is it that science students--including beginning science students such as you and your classmates--learn how to think about the ethical, legal and social issues (ELSI) pertaining to science? In 2-3 sentences, give your answer and a brief explanation of why you think as you do.

a4ELSIchgm To what extent did you change your mind about the question above over this semester?

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

a4_ppben 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)

a4_learn 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 (1)
- ☐ Just a little (2)
- ☐ Some (3)
- ☐ Quite a bit (4)
- ☐ A great deal (5)

a4_t16 Timing

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

a4_Q10 Consent - revisited (please read) Speaking of democracy, deliberation and public input...Remember...if you gave consent, your (anonymous) answers will become part of the public record regarding what people think should be the future of nanotechnology. 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 any assignments, and so did not know what all they entailed. On the next page is the official consent form (the realllllllyyyyy loooooong one!), the same consent form that you saw at the beginning of the semester. Please indicate again if you are willing to allow researchers to analyze your anonymous data. There are no benefits to you, and no one will know whether you said yes or no. If you do allow your data to be used, however, it will be used to improve the assignments and will become part of the public record concerning how people feel about the future of nanotechnology.

a4_t17 Timing

First Click (1)

Last Click (2)

Page Submit (3)

Click Count (4)

[Consent materials were shown here]

a4_consent Do you consent to participate in the research by allowing us to use your coursework-related data as indicated above?

☐ Yes (1)

☐ No (2)

a4_Q12 Finally, on this last page of the assignment, please provide us with some feedback as to your work and experience with the assignment.

a4dataqual Did you give your honest answers in this assignment? (You will not be penalized for your answer. Your instructors 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) _____

a4finlfdbk_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 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.

a4email Finally, to receive your work on this assignment via email, please put your email below.

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

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a4_Q13 THANK YOU! Click continue to submit your assignment. After submitting, a copy of your work will be emailed to you if you entered an email address. You may also wish to print a copy of your answers from this window to have for your records. Email to which you sent your work: \${q://QID232/ChoiceGroup/AllChoicesTextEntry} Your answers: Developments to prioritize: \${q://QID293/ChoiceTextEntryValue} Regulations to implement: \${q://QID346/ChoiceTextEntryValue}

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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?

- a. Agree
- b. Disagree
- c. No opinion

Interactive Question#4

What about genetically modifying crops to make them drought tolerant or able to withstand pests?

- a. Agree
- b. Disagree
- c. 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: Varied in organization

All students read the same information introducing them to nanotechnology as a topic. However, students were randomly assigned to see one of the two following versions of the ELSI portion of the background reading: Traditional format or NIF-inspired format.

Common Background Information

Nanotechnology refers to a variety of scientific and technological developments that involve the very precise manipulation of matter at the *nanoscale*. One **nanometer** (nm) equals one-billionth of a meter. **Nanoparticles** are typically between 1 and 100 nanometers long. As illustrated in Figure 1, DNA and silver nanoparticles are examples of "nano"-sized materials, red blood cells are bigger "micro"-sized, and objects we can see easily are "macro"-sized. At the nanoscale, only the most powerful microscopes are able to actually see objects.

An important feature of nanoscale materials is how their properties differ from normal-scaled materials. Everyday common materials can have special, [new and different properties](#) when reduced to nano-sized objects. For example, elements may change color and materials that would normally not conduct electricity may do so when made into nano-sized objects. In fact, scientists have found that they can manipulate carbon atoms and molecules to create nano-sized carbon tubes and fibers with special properties. Although normal-scale carbon does not conduct electricity, carbon nanotubes are effective electrical conductors, as well as extremely hard and durable and yet very light.

The discovery of the changing properties of nano-sized materials has resulted in the creation of a number of new and revolutionary technologies that are *already* impacting our lives. For example, some [nanocomposites](#) and [nanocrystals](#), are more scratch-resistant, light-weight, rust-proof, stronger, and longer-lasting than traditional materials, leading to their use in tennis rackets, tennis balls, and display screens. Because of their [water dispersion properties](#), nanoparticles are also being incorporated into things like exterior paints, adhesives, paper,

textiles, and even [stain-resistant clothing](#). Meanwhile, certain nanoparticles are extremely effective in absorbing light and are being used in cosmetics and sunscreens. As for developments in science industries, aluminum and copper nanoparticles are being used to create rocket propellants that burn at double the rate of traditional propellants and automotive lubricants that reduce engine wear. Additionally, nanofilters are being used to sterilize water much more efficiently than any other means thus far.

These developments are also having broad economic impacts. For example, China has licensed [nanocatalyst technology](#) (this link is in Chinese, but should be seen as a citation if anything) that will enable it to liquefy coal and turn it into gas, which may make the company much more competitive on a global scale. Similarly, the automotive industry has seen development due to the use of nanocatalysts in [automotive catalytic converters](#), thus making certain chemical reactions more efficient and resource-saving, which has had [industrial implications](#).

New Biology: Biology Meets Technology

Two technologies that exist at the interface of nanotechnology and biology are *nanomedicine* and *nanogenomics*. Both technologies have shown potential for use in human enhancement applications. **Human enhancement** refers to anything designed to “enhance” human capabilities. Human enhancement does *not* need to refer to extreme examples—such as turning average humans into superheroes with special powers. Instead, human enhancement includes common activities such as higher education and athletic training, as well as plastic surgery and the creation and use of artificial prostheses. Human enhancement can include both curing diseases and disabilities and the enhancement of normal capabilities to be extraordinary. We'll next talk a bit more in detail about human enhancement developments specific to nanomedicine and nanogenomics.

Nanomedicine

Nanomedicine refers to the application of nanotechnology to medical work, such as health diagnoses and treatments. Doctors use nanotechnology in a variety of ways, including research with **liposomal nanoparticles**, in order to find new and better ways to treat various diseases. **Liposomes** are man-made, sphere-shaped cell organelles (a type of vesicle), only 100 nanometers in diameter, that are generally used to house and [deliver drugs](#). For example, liposomes have been used to deliver highly potent anticancer chemotherapy drugs in a way that gets a higher proportion of the drug to the target and less to the rest of the body, possibly minimizing serious side-effects ([LaVan, McGuire & Langer, 2003](#)). Liposomes have also been used to deliver drugs to organs and tissues that are otherwise hard to reach, such as the brain. This is important because roughly 90% of non-nanotechnologically-delivered drugs showing therapeutic benefits for treating diseases like Alzheimer's, Multiple Sclerosis and brain tumors cannot reach sufficient concentrations in the brain in order to be effective ([Freitas, 2005](#)). Additionally, there is a newer class of “biological medications” (called biologics) which are destroyed in the stomach and thus can't be taken as traditional tablets. Biologics are much more expensive than traditional medications, so the smaller doses that are made possible by nanotechnology-enabled delivery systems could make these drugs cheaper and thus more accessible to more people ([Freitas, 2005](#)). Also, nanoparticles are being incorporated for their [water dispersion properties](#) into [certain vitamins and pharmaceuticals](#) that have precursors that are insoluble in water.

In addition to drug delivery, nanomedicine has been used for cutting-edge diagnostic

purposes. For example, diagnostic techniques that involve injecting nano-sized particles into the bloodstream prior to an MRI (magnetic resonance imaging) have been developed. The presence of the iron oxide nanoparticles serves to significantly enhance MRI's ability to detect the spread of cancer from its point of origin to lymph nodes in the body ([Cavalcanti et al., 2007](#)). Further diagnostic techniques that utilize nanotechnology are being researched for the potential to detect early signs of skin cancer, Alzheimer's Disease and other cell diseases.

Currently, researchers are also working to develop a variety of novel medical treatments. Some research involves internal use of engineered nanosized gold-coated silica particles. These nanoshells, which are being tested in mice, collect in tumor tissues. The nanoshells can be selectively heated when illuminated from outside the body with near infrared light. The heat destroys the tumor tissue ([Nanoscale Informal Science Education, 2007](#)). Clusters of heated, magnetic nanoparticles have been used to control ion channels in cell membranes, and may someday result in [new treatments for cancer, diabetes and some neurological disorders](#). If this research and development continues to be successful, doctors will be able to target and treat tumors more efficiently and with fewer side effects than with traditional treatments.

Nanogenomics

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.

Nanogenomics has some overlap with nanomedicine. 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).

Nanotechnology is also currently being used in the area of genetics to investigate new means for mapping the human genome (referred to as "nano-sequencing" of DNA) and to provide new methods for transforming genetic code or genetic expression and, thus, for **genetic engineering** (defined as the changing of the structure of genetic material). 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 & Shetty, 2005](#)), in which new tissues are created outside the body and then surgically placed in the body.

Research at the interface of nanotechnology and genetics goes beyond typical "medicinal" purposes, however. Since 2003, researchers have been able to use nanotechnology to manufacture mechanical devices that are DNA-based, including DNA "scaffolds," which are the same double helix shape, that can help scientists build smaller-than-ever computer chips ([Seeman, 2003](#); [Kershner, 2009](#)). 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.

ELSI: An Overview

So far this background document has focused on describing current developments at the interface of nanotechnology and biology. As with any issue that holds significant implications for society, however, there exist many opinions about the role of nanotechnology in today's world—and what future development and regulation should look like. In this section, we review a variety of viewpoints on the ethical, legal and social issues pertaining to these topics, in order to provide you with a starting point for exploring your own opinion.

The Costs of Not Pursuing Available Benefits

According to some, the benefits of nanogenomic and nanomedical research that have already been discovered (as reviewed above), as well as those potentially available in the future, far outweigh the risks that might accompany such research. Even [some of the risks that do exist are somewhat unlikely](#). It is often argued that it is our nature as humans to progress, and we should take advantage of new technology as it is developed. We have the potential to save many lives, and the longer we wait, the more lives go unsaved. The costs of slowing down research and development can be measured in numbers of lives lost while waiting for the research. Therefore, some argue that we should keep regulation on nanogenomic and nanomedical research to a minimum, and fund such research aggressively.

Some benefits of nanomedical and nanogenomic research that people bring up include that nanobiological human enhancements could be used to [increase the quantity and quality of life](#), to provide cheaper and more [universal healthcare](#), and to make the country [stronger and more independent](#) by creating a new industry based on nanobiological research and human enhancement developments that could produce jobs.

However, some bring up tradeoffs of these benefits, such as the fact that there could be [side effects](#) of nanogenomic and nanomedical research, or that [traditional jobs might be lost](#). However, for those who support nanobiological research, these tradeoffs are not severe enough to warrant heavy regulation. In fact, according to these people, [the existence of risks does not mean you should completely refuse to fund this research](#). [Every risk has a benefit](#) that can be achieved with it. Besides, some say, it is in our nature to advance, and [without progress, we are lost](#).

Changing Social Concepts

It is often noted that these benefits might produce significant structural changes in society that could change how we think about many aspects of life. For example, the concepts of [“age” and “disease”](#) could come to be understood quite differently. There is also much discussion as to what the implications of such research would be for the concept of [“human nature.”](#)

Right to Autonomy

Some people believe that [we should have the right](#), especially in the United States, to alter ourselves, and to some extent, our children via nanobiological technology. On the other hand, some people note that the nanobiological research can be *contrary* to human autonomy because [it violates the rights of children](#) whose parents decide to alter their genes.

Risks: Unforeseen, Unpredictable, and Unacceptable?

Some say that the risks of pursuing nanogenomic and nanomedical research and development too quickly are quite serious, especially if human enhancement is the goal. For example, it is often suggested that there could be unforeseen side effects of nanomedicines and nanogenomic treatments. Alternatively, using such technology could interfere with the nature of the human body and have devastating consequences. Some people wonder if there could be severe, negative biological and social implications that would stem from such rapid changes to the human genome and human biology. It is often suggested even that [the "promises" offered by nanobiological research could be unrealistic](#) . Therefore, some argue that nanogenomic and nanomedical research should be extremely regulated, if allowed at all; and that only very limited amounts of funding should be used for clearly beneficial research.

Some of the specific risks of nanomedical and nanogenomic technologies and research that people bring up include the [possibility of overpopulation](#) that could result from increased life expectancy and new treatments of diseases, and the fact that there could be [unpredictable and unacceptable health and genetic-related problems](#) . Others note that there is always the possibility of ["second-order" effects](#). That is, effects that happen indirectly rather than directly from the new technologies. For example, traditional jobs may be lost, raising unemployment for certain groups of people and causing [economic disruption](#). There could also be severe environmental and national security implications down the road. In the case of nanogenomics, a [genetics gap](#) might result, where people with "good genes" are significantly different than those with "bad genes." This could, according to some, spark a new eugenics movement. Finally, some claim that [personal privacy](#) could be threatened by nanobiological research.

On the other hand, tradeoffs of taking these risks so seriously are often noted. For example, some say there might be some [admitted benefits](#) of nanobiological research, such that some forms of nanotechnological research might be okay to fund, and some people might be helped that wouldn't if there was heavy regulation. However, for those who oppose nanobiological research, these tradeoffs are not convincing enough to warrant a lack of regulation on nanogenomic and nanomedical research.

Approaches & Perspectives: An Overview

So far this background document has focused on describing current developments at the interface of nanotechnology and biology. As with any issue that holds significant implications for society, however, there exist many opinions about the role of nanotechnology in today's world—and what *future* development and regulation should look like. In this section, we review two major approaches or perspectives on the ethical, legal and social issues pertaining to these topics, in order to provide you with a starting-point for exploring your own opinion.

Approach 1: Human Enhancement as “Human Progress”

According to the *Human Progress* perspective, the benefits of nanogenomic and nanomedical research that have already been discovered (as reviewed above), as well as those potentially available in the future, far outweigh the risks that might accompany such research. Those with this opinion argue that it is our nature as humans to progress, and we should take advantage of new technology as it is developed. We have the potential to save many lives, and the longer we wait, the more lives go unsaved. The costs of slowing down research and development can be measured in numbers of lives lost while waiting for the research.

Action Implications:

The major implication of the *Human Progress* perspective is that we should keep regulation of nanogenomic and nanomedical research to a minimum, and fund such research aggressively.

Support:

In support of the *Human Progress* perspective, many proponents argue points such as the following:

- **Quality of life:** With nanobiological technologies, we may be able to increase the *quantity and quality of life*.
- **Universal healthcare:** We may be able to provide *cheaper and more universal healthcare*.
- **A stronger country:** We could *make the country stronger* and more independent. This would include creating a *new industry* based on nanobiological research and human enhancement developments that could *produce jobs*.
- **Human autonomy:** Individuals have the *right to self-improvement*, if they want it.

Trade-offs:

Even though the proponents of the *Human Progress* perspective may strongly believe the points above, they still tend to admit that rapid advances in nanobiological human enhancements would probably include the following likely trade-offs:

- **Potential side effects:** There could be some *side effects* of nanomedical and nanogenomic treatments.
- **Traditional job loss:** Some *traditional jobs might be lost*.
- **Social Changes:** There would be significant structural changes in society that could change how we think about many aspects of life, including our understanding of concepts like "disease" and "age". There would also be implications for how we think about "human nature."

However, according to this approach, these tradeoffs are not severe enough to warrant heavy regulation.

Opposition:

Of course, a number of people oppose the *Human Progress* perspective, and offer the following opposing points:

- **Unacceptable risks:** There would be unpredictable (and unacceptable) risks, including potentially devastating biological and genetic problems.
- **Unrealistic promises:** Many of the benefits and promises are unrealistic.
- **Economic disruption:** Economic disruption could result from the introduction of this new industry.

Approach 2: Human Enhancement as "Unnecessary Risk"

According to a second perspective, the risks of nanogenomic and nanomedical research are *too great*, especially if human enhancement is the goal. For example, it is often suggested that there could be unforeseen side effects of nanomedicines and nanogenomic treatments. Alternatively, using such technology could interfere with the nature of the human body and have devastating consequences. People in this approach wonder if there could be severe, negative biological and social implications that would stem from such rapid changes to the human genome and human biology.

Action Implications:

The major implication of the *Unnecessary Risk* perspective is that nanogenomic and nanomedical research should be extremely regulated, if allowed (and if funded) at all. Very limited amounts of funding should only be used for clearly beneficial research.

Support:

In support of the *Unnecessary Risk* perspective, many proponents argue points such as the following:

- **Over population:** Overpopulation could result from increased life expectancy and new treatments of diseases.
- **Unacceptable risks:** There could be unpredictable and unacceptable health and genetic-related problems.

- **Second-order effects:** "Second-order" effects could result that are unexpected.
- **A genetics gap:** A genetics gap might result, where people with "good genes" are significantly different than those with "bad genes." This could spark a new eugenics movement.
- **Personal privacy:** Personal privacy could be threatened.
- **Rights of children:** Children could be (and should not be) genetically altered subject to the desires of their parents.

Trade-offs:

Even though the proponents of the *Unnecessary Risk* perspective may strongly believe the points above, they still tend to admit that overregulation of nanobiological human enhancements would probably include the following likely trade-offs:

- **Admitted benefits:** Some forms of nanotechnological research might be okay to fund, and some people might be helped that wouldn't be helped if there was heavy regulation.
- **Varied risk likelihood:** Some risks are somewhat unlikely.

However, for those who oppose nanobiological research, these tradeoffs are not convincing enough to warrant a lack of regulation on nanogenomic and nanomedical research.

Opposition:

Of course, a number of people oppose the *Unnecessary Risk* perspective, and offer the following opposing points:

- **Importance of benefits:** The existence of risks does not mean you should completely refuse to fund this research.
- **Each risk has a benefit:** There are benefits that accompany and outweigh most risks.
- **We must progress:** We must progress as a society and as a race when we can, or we are lost.

4.2.2. Prompting engagement

Some students were randomly assigned to view prompts designed to stimulate critical thinking throughout Assignment 2. These prompts are reproduced below.

Critical Thinking Condition

The following prompts were included throughout Assignment 2 for those students randomly assigned to the Critical Thinking condition.

Prompt 1. Put on your Thinking Cap!

Because nanotechnology is a relatively new area and many people do not know much about it, we've prepared a brief introduction.

But don't let the background information that you are about to read limit or replace your own critical

thinking about nanotechnology and human enhancement. When it comes to providing useful answers to questions about the future of nanotechnology, the more critically you have analyzed the various options, the better.

Critical thinking is one of the challenges of public engagements, because it requires a lot of hard mental work. Throughout this document, watch for links to additional information that you may want to consider as you weigh the options, and “Tips for Critical Thinking” to help you practice critical thinking skills as you read.

Prompt 2. TIP for Critical Thinking: Detecting Bias

Your goal is to provide useful input on the future of nanotechnology. To provide useful input on the future of nanotechnology, you need to be able detect and see past biased presentation of information.

As you read about nanotechnology—especially as you visit the links to additional information that are provided—look for signs of bias. Signs of bias include:

Selective use of adjectives and examples

Strong, persuasive language

Presentation of only one perspective on an issue

If mostly positive or negative adjectives are used, or if mostly (or exclusively!) positive or negative examples are given, then ask yourself how someone with a different viewpoint might describe the same “facts.” Although such examples do not guarantee bias, they do suggest the possibility the author is giving a one-sided perspective on something that may be less clear-cut. You may want to do some of your own research to see how others are describing the same topics.

Below, give one example of bias that you see in the background information so far -- or in links that you visited -- and indicate the changes that would be needed to make the information or source less biased.

Prompt 3. TIP for Critical Thinking: Consider the Quantity and Quality of Evidence

In the above text (and links you visit), consider the claims that are made. Ask yourself: What is the evidence for the claims that are being made?

Keep in mind that good evidence:

Will be relevant. For example, if one claims that something is expensive, one needs to give evidence of its price, not refer to the numbers of people who use it (which would instead support a claim about wide use, not cost of use).

Will be accurate. For example, it will be typical evidence--there will not be a lot of other evidence that would contradict the evidence presented. A short cut for looking for accurate information is to look for a credible source.

Will be sufficient. Is there sufficient evidence that the claim is true? Or are the claims made based on only a little evidence?

Below, give one example of a claim made above (in the text or a link that you explore) that you think is poorly supported, OR one example of a claim that is well-supported.

For the claim, explain why the evidence for the claim is good, or not very good.

For example, is the evidence relevant? Accurate? Typical? And/or sufficient?

Prompt 4. TIP for Critical Thinking: Consider the Bases of Arguments

Next week you will take what you've learned about nanotechnology, and use it to think about some potential ethical scenarios. One problem with ethical scenarios is that they typically involve shades of grey and controversy. Understanding the bases of different arguments can help you sort through the controversy, gain a clearer understanding of why people disagree, and form your own perspective and clearly articulate why you hold it.

Consider the claims that are made by different perspectives above and especially the-points of disagreement. If two perspectives disagree, do they disagree because they disagree on

The facts? This is a disagreement over whether certain claims are accurate.

Or values? This is often a disagreement over which claims are most important.

Examine the issues and arguments above and describe one place where people seem to disagree on the facts and one place where they seem to disagree on values.

Describe the disagreements and what facts or values they disagree on. Then describe your opinion. Which facts do you think are true and why? What values match your values?

Non-Critical Thinking Condition

No prompts were given in the non-critical thinking condition.

4.3. Appendix C—Assignment 3 Materials

4.3.1. Ethical Scenarios Used in Assignment 3

Initial Instructions: The following are FICTIONAL potential FUTURE scenarios. Please write your responses to the scenarios.

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 that was provided to you, and any additional materials or your own research, to make these determinations.

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?

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 xx250,000, 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?

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?

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, somewhat, quite, 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, somewhat, quite, extremely helpful)

4.3.2. Moderator Scripts and Questions

“New Biology: ELSI Scenario Discussions”

Discussion Leader Guide

You will be helping to lead the discussion of the ethical scenario questions related to nano-biological technology. Students should answer the questions on their computers (via a link provided during class), but those who do not bring a laptop will be given a paper version.

IMPORTANT: We expect to have about 30 min total for these discussions -- that is 15 min per each of the 2 questions. It would be good if the discussion were 7-10 min (at least) and the writing 5-7 min (at least). If discussion is dragging, use the “Follow up” questions (#5) to encourage participants to talk so that each question takes about one half of the time.

1. **Handouts:**
 - a. **Background docs:** Ask students if they downloaded the background information or if they'd like to refer to a paper copy. Your group will have ONE color of background document that matches the condition that they were in for their online assignment.
 - b. **Handout & Ask students to read it.** This will be a “Put on your thinking cap!” OR a “Get ready to explore!” sheet. Everyone in your group should have the same one.
2. **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.
3. **Have a student read the first ELSI Scenario.** Ask for volunteers, or ask one student to read the question for the group. You can also have students take turns reading.
4. **Ask each group member to give an opinion: How would they answer the scenario questions?** 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 what they think about what has been said so far, and why.
5. **Ask Follow-Up Questions:** Now that you have given some initial answers, let's go a little deeper into your thoughts about this question...

CRITICAL THINKING:

If you are leading a Critical thinking group: Ask them to consider the Critical Thinking Tips on the sheet they were given. Ask:

- a) **In general:** What are the major perspectives people may take on this scenario? Do these critical thinking tips help you to think about the different perspectives? How?
- b) **Quality of evidence:** What are the most important “Facts” or things that you would like to know “for sure” pertaining to this scenario?
 - o What is the evidence for those facts?
 - o Is the evidence that is available clear, strong, relevant? Is it sufficient (is there enough?)
- c) **Bias:** Values need to influence our decisions – but hopefully the values inform our decisions without biasing them. Do you see bias either in your own views (within the group), or in the views of the persons in the scenarios?
 - o How are these biases impacting your/their thinking about the issues? E.g., do you see places where you have to be careful not to let your biases make you less open to certain information?
 - o What other negative impacts might biases have?
 - o Do certain biases have positive impacts too? Or are they always negative?

CONTROL:

If you are leading the Control group: Ask them to look again at their handout that has the question written on it. Ask:

- a) **In general:** What do you think of the views other people in your group expressed in response to this question? Did you have any reactions to anyone else's views?
- b) **Clarification questions: Ask:** What questions would you like to ask each other to clarify each other's views?
 - o As the moderator, you can also ask clarification questions, e.g., as follows:
 - Tell me a little more about what you meant when you said...
 - Tell me a little more about situations that you are thinking about when you said...
- c) **Encourage responses to each other:**
 - o I heard someone say (insert something here)...what do the rest of you think about that?
 - o A number of people have agreed with (insert something here)...can you imagine anyone disagreeing with this? If so, why might they disagree?

6. **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** (see Data Form for some specific questions to answer):

7. **Move on to the 2nd question once all or most students are done writing.**

8. **Remind students during the discussions that they can change or add to any of their answers at any time.**

4.3.3. Data Form for Moderators

[begins on next page]

Group Discussion Data Form

Initial Questions:

Reci Instructor: _____

Your (Discussion Leader) Name: _____ Reci #: _____

Date: _____ Day of week: *Mon Tues Wed Thurs* Time Start Discussion: _____

What "condition" is this group in? Circle one: Crit Think or Control Circle one: NIF or Traditional
(purple) (green) (yellow) (blue)

First names and Last Initials of group members:

Number of Males: _____ Number of females: _____ Total number: _____

(1) Memory Enhancement

(Was this answered: First or Second ← Circle one)

About how long did students spend discussing this question: _____ Writing about the question: _____

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/engaged</u> did they seem to be in or with the question?	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
How <u>controversial</u> was this question? That is, how much did it spark debate or disagreement?	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
To what extent did students give <u>evidence</u> for their views? (e.g., because the background document said...)	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
To what extent did they <u>evaluate</u> the evidence available or challenge it? (e.g., its accuracy or relevance)	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
To what extent did students explicitly talk about <u>bias</u> ?	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
To what extent did students seem to <u>acknowledge</u> different perspectives? (e.g., "I can understand that some people might think that....")	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely

- What were the most common topics that came up in response to the scenario? (e.g., religion, overpopulation, health benefits, specific risks, etc.)
- What were the most common disagreements about?
- Is there anything that the students said that you think was false? (ie., misconceptions you thought they had)?

(2) Cystic Fibrosis

(Was this answered: First or Second ← Circle one)

About how long did students spend discussing this question: _____ Writing about the question: _____

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/engaged</u> did they seem to be in or with the question?	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
How <u>controversial</u> was this question? That is, how much did it spark debate or disagreement?	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
To what extent did students give <u>evidence</u> for their views? (e.g., because the background document said...)	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
To what extent did they <u>evaluate</u> the evidence available or challenge it? (e.g., its accuracy or relevance)	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
To what extent did students explicitly talk about <u>bias</u> ?	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely
To what extent did students seem to <u>acknowledge</u> different perspectives? (e.g., “I can understand that some people might think that....”)	Not at all	Slightly/Somewhat	Moderately	Quite	Very/Extremely

- What were the most common topics that came up in response to the scenario? (e.g., religion, overpopulation, health benefits, specific risks, etc.)
- What were the most common disagreements about?
- Is there anything that the students said that you think was false? (ie., misconceptions you thought they had)?

Final Questions:

Time End Discussion: _____ Total Length in Minutes of Discussions: _____

Was the amount of time for this assignment: (circle one below)

Not nearly enough Almost but not quite enough Just right A little too much Way too much

Which follow-up questions (on the moderator sheet) did you discuss with your group? (check all that apply)

- ☐ ONLY the critical thinking discussion questions
☐ ONLY the control group discussion questions
☐ I accidentally asked students BOTH types of questions
☐ I accidentally asked students the WRONG set of questions

What colors of handouts did the students in your group have?

Single sheets: Green or Purple

Background documents: Blue or Orange

4.3.4. Critical Thinking Prompts

(Given to groups in CT condition; Control groups just given printed copies of scenarios)

Put on your Thinking Cap! Tips for Discussions

PLEASE RETURN this
to the New Biology Assistants or
your recitation instructor before
you leave today

TIP 1: The Bases of Arguments

When there are disagreements, are these disagreements on:

- The **facts**? Is there a disagreement over whether certain claims are *accurate*?
- Or **values**? Is there a disagreement over which claims are most *important*?

Use some of the other tips to next decide:

- Are those facts accurate and well supported with evidence?
- Are values represented appropriately? (i.e., values *need* to be considered, but they should not result in biased consideration of the evidence, e.g., ignoring evidence, or misrepresenting it).

TIP 2: Quantity and Quality of Evidence for “Facts”

Characteristics of good evidence: Good evidence...

- Will be **relevant**. For example, if one claims that something is expensive, one needs to give evidence of its price, not refer to the numbers of people who use it (which would instead support a claim about wide use, not cost of use).
 - **Consider: Is there evidence for specific claims?**
- Will be **accurate**. For example, it will be *typical* evidence--there will not be a lot of other evidence that would contradict the evidence presented. A short cut for looking for accurate information is to look for a *credible source*.
 - **Consider: Is the evidence accurate and from credible sources?**
- Will be **sufficient**. There will be “enough” evidence.
 - **Consider: Is there sufficient evidence that the claim is true? Or are the claims made based on only a little evidence?**

TIP 3: Detecting Bias

Do you notice bias in the materials under discussion, or in the discussion itself?

Signs of bias include:

- Selective use of adjectives and examples
 - **Consider: Are there other examples that should be considered?**
- Strong, persuasive language
 - **Consider: Are any of the claims about nanotechnology exaggerated?**
- Presentation of only one perspective on an issue
 - **Consider: What other perspectives might there be?**

4.1.4. Biofinity Wiki Instructions

Ethical Scenarios

New Biology Assignment #3

Homework to be completed between 11/10 and 11/18

Note: prior to doing this assignment, you should have completed New Biology Assignment #2 located [HERE](#).

In this assignment, you are asked to form and opinion about and respond to two fictional scenarios. There are 2 parts to this assignment. In Part 1, you will work with your group to collect information relevant to the scenarios. In Part 2, you will work alone to write your own responses.

IMPORTANT NOTE: 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 the extent to which you agree with it, **and why or why not**. Use the background document that was provided to you, the background bioinfinity article that you created with your group, and additional materials or any of your own research to make these determinations.

Here are the two scenarios that you will be responding to:

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:

Cystic Fibrosis Prevention

Imagine that sometime 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?"

Part 1-Information Gathering

Goal: Work with your group to create a background article containing information that you and your group feel is relevant to the scenarios. You will be working on this in an online forum, Biofinity, that was designed for collaborations such as these.

- 1) To begin using the Biofinity Intelligent Wiki, please go to <http://iamas.unl.edu/wiki>. To access your group's page, first please login by clicking the login link in the top right of the screen, and using the user name and password that you previously set up. You will be automatically directed to your lab group. You should then go to the "browse" tab to look for your group's pages.

NOTE: THERE ARE OTHER CLASSES USING THIS WEBSITE, SO YOU MAY HAVE TO SCROLL THROUGH THE LIST OF ACTIVE WIKI SITES BEFORE YOU FIND THE CORRECT ONE FOR YOUR GROUP.

- 2) First, visit the page titled "Welcome to New Biology". This page contains information for you to read on the ethical scenarios with which you will be working.
- 3) Next, click on "Intelligent Wiki" on the left side to to back to the main menu (NOTE: THE 'BACK' BUTTON DOES NOT WORK). Go into "browse" again, but this time click on the "Ethical Scenarios Assignment" page. This is where you will complete this assignment.
- 4) Begin creating and adding to your group's document by clicking the "edit" button under the "page control" header on the top right side of the page. Click "submit" to save your changes, or navigate away from the page to discard them.

NOTE: IF YOU RECEIVE A POP UP MESSAGE SAYING THAT SOMEONE ELSE IS CURRENTLY EDITING YOUR PAGE, CLICK "NO", YOU DO NOT WANT TO CONTINUE.

- 5) Each member of the group has the ability to add to and edit the document. Your goal is to work together to create **ONE** complete background document that will help you to effectively respond to the ethical scenario.
- 6) You are responsible for logging in at least 3 different times and making at least 6 contributions (minimum of 1 contribution per due date period listed below) over the next 8 days. The schedule for posting is as follows:

Between 12:00 a.m. on 11/10 and 11:59 p.m.11/12 – First login + first contribution

Between 12:00 a.m. on 11/13 and 11:59 p.m. on 11/15 – Second login and posts

Between 12:00 a.m. on 11/16 and 11:59 p.m. on 11/18 – Third login and posts

By 11/18 please go onto your group's page and use the star ratings to evaluate your project.

Your final product is due by 11:59 p.m. on 11/18

Contributions that will earn you credit include:

- Editing the main article *by adding main ideas, elaborations, evidence, alternative (or opposing) perspectives*.
- Adding substantive posts to the discussion area (below the main article).
- Eg., answering another student's question *about relevant article content* that was posted in the discussion area, bringing up points for discussion.

Contributions that may be necessary for the overall quality of your finished product but which are NOT for credit:

- Minor edits such as for grammar, punctuation, wording, etc.

****Keep in mind that the system tracks individual contributions and you will be graded on the quality of your work.****

PART 2-Individual Responses

You should complete this portion of the assignment AFTER your group project is complete. Your individual response is due prior to working on the next assignment. Please complete your individual response by 11:59 11/20.

- 1) Go to [link to Qualtrics survey].
- 2) Enter your responses to the ethical scenarios in the space provided, and click submit.

Once again, **keep in mind that the quality of your assignment will be graded.**