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1. Selection of teaching strategy with rationale and citation (s).

The following criteria and class characteristics were kept in mind when developing this assignment and selecting this particular teaching strategy and classroom assessment technique for the students enrolled in the [target] course:

Target Group/Class:

- The assignment is designed to be implemented in the first term biology laboratory sections for science majors; BSC-2010-Lab.

BSC-2010-lab Class Demographics:

- o Class size: maximum size allowed = 24 students/lab
- o Number of repeaters: 0
- o Age: 100 % 21 to 25 y/o
- o Declared major: 90 % pharmacy; 5% pre-med; 2 % dentistry ; 3% other
- o Most are “part-time” students, taking a few courses per term and working full/part-time

Lecture Topic:

- Molecular Biology: Genetic Engineering
- Symbiosis: The Benjamin Cummings Custom Laboratory Program for the Biological Sciences.
- Pearson Custom Publishing; (2009): pages 261-283

Teaching strategy:

The goal in selecting the teaching strategy for this exercise is:

- A) To survey students’ pre-conceived notion(s), background knowledge and/or attitudes towards the topic of genetic engineering.
- B) To investigate how these might influence their learning of the laboratory on Molecular Biology: DNA mapping
- C) To survey students’ attitudes and knowledge on the topic of genetic engineering at the conclusion of the laboratory to see if:
 - a. There were any changes in students’ knowledge regarding the topic of genetic engineering on concluding this laboratory.
 - b. There were any changes in students’ perceptions and/or opinions regarding the topic of genetic engineering on concluding this laboratory.

D) Students will demonstrate the specific incorporation of sustainability resources from MDC databases and/or proof of strategic web searching as relates to sustainability materials.

- Selection of Teaching Strategy

Based on these goals, I have chosen to implement an *active learning / Discovery learning technique* whereby:

- A) Students are challenged to elucidate the DNA map of a bacterial plasmid through the use of endonuclease digestion and agarose gel electrophoresis.
- B) Students are called to discuss the ethical and academic implications of this technology in the sciences and our daily life.

According to William Timpson and Paul Bendel-Simso (1) “students benefit greatly from these kinds of activities, especially those who get discouraged by the typical lecture format.” “Visual and kinesthetic learners certainly benefit when they can see and touch objects which relate to their studies.” According to Timpson & Bendel-Simso [4] effective instruction should be varied, elicit students’ learning, and increase interest level. This multi-modal focus included the following strategies [2]:

Out-of-Class Activities

- Students will be asked to read the chapter on molecular biology pp. 261-288 from the Benjamin Cummings Custom Laboratory Program for the Biological Sciences; Pearson Custom Publishing; (2009), in preparation for the laboratory.

Instructor-based techniques

- Introductory Lecture on principles of genetic engineering
- Demonstrations: electrophoresis equipment; proper use of laboratory instruments, safety operations.

Traditional Instructional Aids

- Whiteboard
- Lecture notes

Technology-Driven Aids

- Angel-based lecture

- Activity: Elucidation of DNA map of a bacterial plasmid through the use of endonuclease digestion mapping.
- Students (groups of 4) are provided with the following materials
 - Electrophoresis equipment
 - Bacterial endonucleases and DNA plasmid
 - Agarose gel preparations

Procedure

1. Greet the class and discuss the **Learning Goals** of the lesson/lecture: (10 minutes)
 - Learn/understand the basic principles of genetic mapping and DNA recombinant technology.
 - Describe ways in which the technology of molecular biology is being used in industry, medicine, criminal justice, agriculture, and basic research.
 - Explain the use of endonucleases to map DNA molecules, and discuss the importance of mapping.
 - Construct a tentative map of DNA molecules based on their restriction fragments.
2. Discuss the exercise to be done at end of class: address questions (10 minutes). Please note that this exercise will be directed at:
 - a. Assessing students' knowledge and opinions regarding genetic engineering,
 - b. Re-assessing students' knowledge and opinions on the topic of genetic engineering on conclusion of laboratory activity; after they had the opportunity to further research this topic using MDC sustainability resources from MDC databases and providing proof of strategic web searching as relates to this topic.
3. Laboratory recess (10 min)
4. Student based participation: (90 minutes)

Part # 1:

- Classroom Opinion Polls & Everyday Ethical Dilemmas:
 - Students are surveyed on their attitudes and knowledge regarding genetic engineering, and the use of this technology for the production of genetically engineered food. This survey (questionnaire attached as addendum #1) will be done prior to the lecture and before the onset of the hands-on experience.
- Part # 2: Active learning Activity
 - Lecture: Instructor-based techniques
 - Class discussion

- Question/answer sessions
 - Demonstrations of equipment, reagents and proper use/safety operations
- Students work on the DNA digestion and map determination as per laboratory manual instructions.
 - Results from the laboratory exercise are discussed.

5. Lecture closure:

- On concluding the hands-on activity, students are asked to read a selection from the article entitled “*Genetically Engineered Food*” dated August 09, 2002, from the instructional site *FACTS.com, Issues & Controversies*.
- After reading the article, and concluding the hands-on activity, students will be asked to re-take the attitude questionnaire (Addendum # 1) in order to assess whether there had been any changes on students’ knowledge and/or attitudes regarding the topic of genetic engineering as a result of our laboratory session.
- Results of survey activity are tallied and discussed at the end of the laboratory session.

6. Homework

- a. Students will research the topic of bioengineered food products (especially plant and animal species) using MDC library databases.
- b. Students will use Professor Steve Kronen’s “Library Resources for teaching sustainability” as a resource list:
http://www.earthethicsinstitute.org/facultycurriculum_pdf/Kronen_LibraryResources_Sustainability.pdf
- c. On completing this assignment, students will provide:
 - i. An outline of their database search: in bulleted form
 - ii. Appropriate URL links of the search engines used
 - iii. Students will write a short essay (one/two pages long) where they will discuss how this online search and laboratory hands on experience has affected their attitudes and perceptions regarding the topic of bioengineered food products and their [possible] effects on health and the environment.

iv. Students will address the effect(s) of growing bioengineered plants (e.g. rice, corn, wheat) on the environment and gene pool for such species.

2. What is hoped to be accomplished through this exercise:

- The goal of this exercise is *to assess learners' (students) attitudes, values, and self-awareness* regarding the laboratory topic (molecular biology/genetic engineering), previous to, and after the implementation of the molecular laboratory on DNA mapping and recombinant techniques.
 - *Specific objectives this exercise are:*
 - To determine baseline level of knowledge/understanding that students have regarding the topic of genetic engineering.
 - To assess students' perceptions & opinions regarding the topic of genetic engineering, in particular, the use of genetically engineered food products, and the [relative] safety of these for humans and our environment.
 - To assess these two variables after the implementation of the hands-on laboratory session and take home assignment on the [possible] effects of bioengineered food products on the environment. In this assignment, students will be expected to further research the topic by performing an online search using MDC library databases on this topic as it pertains to the issue/topic of sustainability.

3. Why was this particular exercise designed/selected?

I chose to implement this exercise in order to assess students' opinions on ethical dilemmas/issues such as the topic of genetic engineering, and the implications that this might have on issues such as food and environmental safety.

- The estimated level of faculty preparation [time] to use this CAT was rated as medium .
- Students' time and energy needed to respond to the assessment: low
- Faculty's time needed to respond to this assessment: low
- This assessment provides faculty with a simple way of collecting specific information about students' perspectives and values regarding a particular subject.

- This exercise provides the foundations for students to earn the appropriate information – **through the use of MDC library databases on sustainability** -- to make informed decisions regarding ethical choices and/or positions regarding the safety of bioengineered food products and their [possible] effect on the environment.
- This exercise promotes discussion of opinions and/or perceptions regarding ethical issues, and develops openness to new ideas.

5. Implications/applications of this exercise:

According to Angelo and Cross (5), classroom opinion polling “encourages students to discover their own opinions about issues, to compare their own opinions with those of their classmates, and to test their opinions against evidence and expert opinion.” These opinion polls are an excellent tool for us to prepare our students to discuss a controversial issue, such as that of bioengineering, and to assess their opinions after they have studied the material.


The students’ opinions and/or perceptions about ethical issues are strongly embedded, and – sometimes- difficult to modify. If anything, our duty as instructors is to provide our students with the appropriate information (data), and resources to enhance their knowledge on a subject area in order to allow them to become informed consumers and/or advocates, by using this information to strengthen and/or support their own point of views. The implementation of opinion polls in order to “survey” my students’ opinions regarding a controversial issue (such as genetic engineering and environmental/health effects, etc.) in preparation to discuss a particular issue for which students might be holding different standpoints and/or opinions. This is an excellent tool to provide a common/neutral platform for students to discuss these, without fear of being chastised by their peers (since the survey is done anonymously), or feeling intimidated by others. The take home assignment where students are to research the topic at hand (bioengineered food products and their possible effects for health and the environment) through the use of independent online research using MDC library databases on sustainability, will provide the students with an additional opportunity to gather more information and data on the topic. In addition, this exercise provides us with a post-assessment devise to determine whether and how students’ opinions have changed in response to class discussions and/or assignments.

References & Citations:

1. William Timpson and Paul Bendel-Simso (2003): Concepts and Choices for Teaching: Meeting the Challenges in Education; Atwood Publishing; chapter 6, pp.95-108
2. Donald, G. (2003); A Handbook for Adjunct and Part-time Faculty & Teachers of Adults; The Adjunct Advocate, Inc. “Large Group Instruction” pp. 88-90
3. Bloom, B. et.al. (1956). Taxonomy of Educational Objectives. New York: David McKay.

4. Timpson, W. & Bendel-Simso P; (2003); Concepts and Choices for Teaching: Meeting the Challenges in Higher Education; Atwood Publishing. “Part II: Teaching Strategies” pp. 50-62
5. Angelo, T. and Cross, P; (1993): Classroom Assessment Techniques: A Handbook for College Teachers. Second Edition, Jossey Bass (Publishers). Pp. 258-274

ADDENDUM # 1:

	<p><u>Lecture Topic:</u> Molecular Biology: Gene cloning techniques and applications to health and environment</p> <p><u>Classroom Opinion Polls:</u> Bio-engineered Food Products</p> <p><u>Course:</u> BSC- 2010 laboratory</p> <p><u>Professor:</u> Jorge L. Obeso, Ph.D.</p>

Instructions: Pre-Lecture & Discussion Survey

Part # 1: Please select an answer which best describes your feelings and/or attitude regarding the statement(s) presented by the question.

1. “Organic” or “organically grown/produced” food products are best (better) for our health:
 A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree

2. Genetically bio-engineered food products are better in quality than their “natural” or “organically grown” counterparts:
 A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree

3. When shopping for fresh produce in the super market, I would select [buy] the “organically grown” or “natural” food products (e.g. vegetables) instead of the genetically engineered (bio-engineered) ones, even if these latter ones are of equivalent quality and available at a cheaper price:
 A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree

4. Bio-engineered food products can be detrimental to our health and/or the environment:
A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree
5. I can recognize (at plain sight) if a food product (e.g. vegetable) at the super market is a “bio-engineered” food product or not:
A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree

Instructions: Post-Lecture & Discussion Survey

Part # 2: Please select an answer which best describes your feelings and/or attitude regarding the statement(s) presented by the question.

6. “Organic” or “organically grown/produced” food products are best (better) for our health:
A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree
7. Genetically bio-engineered food products are better in quality than their “natural” or “organically grown” counterparts:
A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree
8. When shopping for fresh produce in the super market, I would select [buy] the “organically grown” or “natural” food products (e.g. vegetables) instead of the genetically engineered (bio-engineered) ones, even if these latter ones are of equivalent quality and available at a cheaper price:
A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree
9. Bio-engineered food products can be detrimental to our health and/or the environment:
A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree
10. I can recognize (at plain sight) if a food product (e.g. vegetable) at the super market is a “bio-engineered” food product or not:
A) Strongly Agree B) Agree C) Disagree D) Strongly Disagree

