

THE EFFECT OF INTERACTIVE STRATEGIES IN A STEM CELL-FOCUSED UNIT
ON STUDENT KNOWLEDGE AND ENGAGEMENT IN AN ADVANCED PLACEMENT
BIOLOGY CLASSROOM

Dr. Claudia Singkornrat
Advanced Placement Biology Teacher
Pompano Beach High School
Broward County Public Schools
c.singkornrat@browardschools.com

ABSTRACT:

I want to increase the student's responsibility of his/her learning and engagement. I will frame the cell anatomy and physiology unit with information about stem cells gained in the Bench To Bedside workshop to increase the interest in the unit. I am also planning to significantly reduce my lecturing time and replacing it with interactive activities. I will assign guided readings for homework prior to class. Once the students come to class, understanding will be assessed by quizzes, student discussions and student-directed question/answer sessions. Furthermore biotechnological activities, blogs and learning logs will be incorporated. Quantitative assessments of pre/post tests, quizzes, lab reports and qualitative assessments of the discussions and learning logs will be used to evaluate the involvement of students and the learning gains

RATIONALE:

I have been reflecting on what changes to make in my AP Biology class. Most of the students that come into the class are motivated and want to be in the class. But it does not take them long to get overwhelmed with the amount of information that they need to know and understand. So many of my students, instead of challenging themselves to reach the next level, give up to a certain extent. They do the assigned work, but do not study on their own to a point of thorough understanding. So I am asking myself: How can I get these students to take the pride in really knowing the topics, to organize the information and to look up what may not be clear for them? How can I get them away from caring more for the grade than the learning? How can I get them ready for college classes?

It seems that an important aspect of these questions is that students need to take responsibility for their own learning. In order to build techniques that foster self directed learning it helps to understand Zimmermann's (2002) concept of learning and self-regulation in which he states "Learning is viewed as an activity that students do for themselves in a *proactive* way rather than as a covert event that happens to them in reaction to teaching. Self-regulation refers to self-generated thoughts, feelings, and behaviors that are oriented to attaining goals".

It then makes sense to ask how self-regulation is developed and what is it built on. Zimmerman elaborates that the self-regulation in learning involves self-motivation, self-evaluation and content mastery. These qualities can be learned and have to be adapted to the learning task at hand. So it seems that if we can teach students strategies for self-regulation, self-motivation and learning skills, they ultimately will be better able to learn. According to Schunk and Zimmermann (1998), the component skills that support the student's learning are: a) to set personal proximal and ultimate goals, b) to adopt strategies to implement the goals, c) to monitor progress and to adapt future methods. Research has shown that these techniques are successful. For example, training students in strategic reading and writing helped them to monitor their progress and become more effective learners (Paris and Paris, 2001).

Biotechnology seems to be a great topic for self directed learning, since my students are very interested in the newest development in science and they thrive on bioethical

contexts. This is supported by a study and implementation of biotechnology in the New Zealand High School curriculum. The findings showed that including bioethical issues provided opportunities for students to be prepared to respond to issues late on in life by giving them experience in discussing ethical personal, and social aspects. (Conner, 2000). The biotechnology activities and lectures that we learned during the Bench to Bedside workshop are excellent to foster self-directed learning, as they will intrigue the students, increasing their self-motivation. They can be presented in such a way that the students have to solve problems in a self-directed way.

In order to obtain accurate data, I plan to collect the data from my second period AP Biology class, when students are awake, but have not been exposed to too much academic information in the day.

The purpose of this study is to determine the effectiveness of using multiple interactive strategies in a stem cell-focused unit on student knowledge and engagement in an Advanced Placement Biology course.

ACTION RESEARCH INTERVENTION:

I will do the intervention during the unit of cell anatomy and physiology for the research. I will use information, labs, simulations and web quests that I learned during the Bench to Bedside Workshop I took at UF over the summer. Even though I will work with my three AP classes, I will select Period two for evaluation. I am planning to decrease my lecturing considerably in order to have the students actively look for the knowledge. I am planning to use more book reading followed by in-class comprehension and applications questions. I will have students outline the read information prior to class. Once students come to class, the topics can then be discussed and misconceptions can be cleared up. I will also start class with a quiz to verify that the reading was done and that topics were understood

I also plan to use the web quests, simulations and labs to reflect the practicality of the information that the students are learning. I am anticipating that these activities will make the topics more meaningful and memorable. It also gives the student a kinesthetic component, which will add to the auditory and visual components of learning.

In addition, students will have discussions about stem cell topics, so that they can reflect and respond to different points of view. Finally, I plan to introduce journaling in which each student will take a few minutes at class end to describe salient facts and reflections regarding the objective covered that day. The log will also be used to address critical thinking questions in which students have to apply the knowledge learned in class to form an opinion

The unit will be taught over 14 schooldays (which is 3.5 weeks in my school). I plan to open the topic with question: Should we do stem cell research and should we use stem cell products in medicine? After a brief discussion, I will ask my students to journal about their stance. This will provide a baseline opinion. During the unit I will invite Dr. Darwiche to present a lecture and a wet lab about stem cells, which applies the cell information learned in class. At the end of the unit I will ask the initial question again and I will ask to support the stance with the topics learned throughout the unit. I will also ask the students to reflect on their change or constancy of their opinion.

I am planning to incorporate the stem cell activities such as the Stem cell science take out, the Edheads' Create a Stem Cell Type and a stem cell web quest in the unit in addition to the labs previously used in the cell unit. Attached is a lesson plan, which shows the objectives, essential questions, timeline and activities.

CONNECTION TO THE BENCH TO BEDSIDE SUMMER INSTITUTE:

I am planning to incorporate several activities and lectures into my cell unit. Since I want to catch my student's desire to learn more about the topics, I plan to use the stem cell information as a hook. As the students learn about the cell structure and physiology, I will be able to provide details on the way stem cells work and how they can be engineered. Several of the labs can then be used to have the students experience lab techniques used in stem cell research and in biotechnology in general. The unit culminates with discussions, reflections and critical thinking questions about ethics of stem cell research, ways to produce stem cells and reasons to use them.

DATA COLLECTION AND ANALYSIS

| QUANTITATIVE DATA | QUALITATIVE DATA |
|---|---|
| Unit pretest | |
| Reading Quizzes | Participation in discussion about stem cells (teacher journal, checkmarks) |
| Lab: Diffusion across a membrane design and write up | Journal entries |
| Quizzes: Cells, membrane transport, cell reproduction, cell communication | Computer activities: function of organelles, evolution of the cell (checkmarks, student interviews) |
| Cell unit post-test | Participation in labs (checkmarks, student interviews) |

In the assessments for which I have data, I will compare how the class performed with the classes from the last two years. Even though each class is different, it will give me an idea if they as a class understand the topics better than previous, lecture based classes. The pre and posttest will indicate individual learning gains. The reading quizzes will allow me to track if students are doing the work and therefore being more involved in their learning.

The qualitative data will be assessed by observing engagement (active participation), answers to questions during the activity, signs of interest during activities and the depth of thoughts and interest placed in the journal entries.

LITERATURE CITED:

1. Zimmerman, B. (2002)., Becoming a Self-Regulated Learner: An Overview, *Theory Into Practice*, 41:2, 64-70.

2. Conner, L (2000): *Inquiry, Discourse and Metacognition: Promoting Students' Learning in a Bioethical Context*. (Presented at the Annual Meeting of the National Association for Research in Science Teaching in New Orleans, LA, April 28-May 1, 2000). Retrieved From <http://eric.ed.gov>

3. Brand, L. (2011): *Evaluating the Effects of Medical Explorers a Case Study Curriculum on Critical Thinking, Attitude Toward Life Science, and Motivational Learning Strategies in Rural High School Students*. (A Dissertation Presented to The Faculty of the Graduate School Ball State University). Retrieved From <http://eric.ed.gov>

4. Paris, S., & Paris A. (2001): Classroom Applications of Research on Self-Regulated Learning, *Educational Psychology* , 36:2, 89-101

BUDGET AND BUDGET JUSTIFICATION:

| | |
|---|------------------|
| Movie: Extreme Measures | \$ 6.50 |
| 7 student micropipettes (\$27 each plus S+H)) | <u>\$ 210.00</u> |
| Total | \$ 216.50 |

PERMISSIONS:

My principal is very enthusiastic about the process, particularly the visit from UF scientists; no written permission is need in my case.

LESSON PLAN FOR THE CELL UNIT

UNIT 3: ALL IN A CELL'S LIFE: HOW IT WORKS, REPRODUCES AND COMMUNICATES

LESSON GOALS:

1. To explain how each component of the cell leads to the function and specificity of each cell.
2. To compare and contrast normal and abnormal reproductive processes in a cell and how these relate to normal function and disease
3. To decide what form of cell transport is adequate for different substances
4. To appraise when different forms of cell communications are used
5. To discuss the stance on stem cells and support it with biological facts

ESSENTIAL QUESTIONS:

1. Why are specialized organelles needed in cells?
2. How does a cell control its internal environment with the different types of membrane transport?
3. How do cells transmit their information to the next generation?
4. How do cells communicate in order to effectively work as a part of an organism or as a single cell?
5. What is your stance on stem cell research and why?

TOPICS AND ACTIVITIES:**RATIONALE HOW CONTENT IS ORGANIZED**

1. The unit will be framed by knowledge and discussions of stem cells. This will allow the students to have a point of reference to the new, abstract information. It will also increase the student's interest since there is controversy in this topic and just about every student has a strong opinion on it. I am hoping that this will be a motivating point to learn the more challenging aspects of this unit.
2. All the sub sections of this unit can be connected to the stem cells, giving a solid big picture of cell physiology.
3. The unit will culminate in a discussion and in journaling on how students feel about stem cell research after obtaining all the information, which stance they support and strong argument of why they support this stance.

RATIONALE OF SEQUENCE OF EVENTS

1. The unit will be opened with a journal entry of the feelings and reason for these feelings on stem cells research. A short discussion and a poll will ensue to share the stances of the students.
2. Next, cell anatomy and physiology, cell membrane transport and cell reproduction will be covered.
3. Now that students understand the processes of cells, a lecture on stem cells will be given. If available, Dr. Houda Darwiche from UF will give the lesson. The lecture will be followed by activities demonstrating how stem cells are manipulated in the lab.
4. Now cell communication will be covered and it will be related to the relationship of some cancers which are caused by a lack of communication and how stem cell research is addressing this issue
5. The unit culminates with first a journal entry on how the perception of the student in regards to stem cell research has changed, what misconceptions they had and topics that were particularly interesting to them, and second, a class wide discussion on how much the government should or should not control stem cell research.

RELATIONSHIP TO PREVIOUS LESSONS, UNITS OR OTHER CONTENT

1. Characteristics of macromolecules and their structures determine their function in cells
2. Unit relates to ethical and political issues regarding stem cells
3. Unit relates to medical issues, particularly cancer, its treatments and causes

POSSIBLE CONFUSIONS/MISUNDERSTANDINGS

1. Students think cells are simple and have little control over their environment
2. Students do not know that there are adult stem cells which do not deal with embryos at all and do not affect the life of the person from which the cells were harvested
3. Students have difficulty understanding how mitosis and meiosis differ in the end result of the number of chromosomes and the consequences of this.

LESSON PROGRESS OVER TIME:

HOW DO LESSONS PROGRESS TO DEEP UNDERSTANDING AND TRANSFER OF CONTENT?

Students will pre-read and lectures will clarify concepts. Students then will interact with the topics by using worksheets, have discussions on stem cells, and run experiments on membrane transport and stem cell production. Students will be asked to record the misconceptions and opinions about stem cells, applying the concepts learned in this during this unit.

HOW WILL STUDENTS MAKE CHOICES AND TAKE INITIATIVE? HOW WILL LEARNING BE EXTENDED?

1. By forming a stance on stem cells, and revising it at the end of class
2. By designing and performing the experiment on diffusion across a cell membrane
3. By watching a TED talk on cancer and relating it to the cell structure.

COMMON CORE IMPLEMENTATION:

RST 9-10. 1,2, RST 11-12.1,2 Students will apply reading techniques: citing textual evidence to support information, determine the central ideas

RST.9-10.3., RST 11-12.3 Follow precisely a complex multistep procedure when carrying out experiments

RST.9-10.4. RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases

RST.9-10.5., RST.11-12.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms

RST.9-10.7, RST.11-12.7. Translate quantitative or technical information expressed in words in a text into visual form

RST.11-12.10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

COLLEGE BOARD EXPECTATIONS:

1. Essential Knowledge: 2.A.2, 2.A.3, 2.B.1, 2.B.2, 2.B.3, 2.D.1, 3.D.1, 3.D.2, 3.D.3, 3.D.4, 4.B.2

2. Learning Objectives: 2.6 -2.14, 3.31-3.39, 4.4-4.6, 4.18

STRATEGIES TO EVOKE CRITICAL THINKING:

1. Reflect before and after the unit on stem cell research
2. Designing a lab
3. Answering essay questions which require application of the knowledge

KEY KNOWLEDGE AND SKILLS STUDENTS WILL ACQUIRE

1. Anatomy and Physiology of the cell
2. Relating the information to current topics (cancer and stem cells)
3. Designing and executing a scientific experiment
4. Research a topic and discussing controversial issues

MATERIALS, METHODS, TECHNOLOGY and HOW DO THEY ENFORCE LEARNING

Technology: Power Points, Promethean Interactive Board, Web-based research, Computer/clicker quizzes, web quests, virtual labs, video clips, online resources

HOW DO THESE ENHANCE STUDENT'S UNDERSTANDING OF CONTENT

Worksheets will provide practice

Power Points will help organize information

Video clips will help show information in different ways

Web quest will students allow to follow a real life lab process

Lecture by an expert will help students obtain the latest information on the topic

ASSESSMENTS/ PERFORMANCE TASKS

1. Pre Test to evaluate prior knowledge
2. Pre and Post unit journal entries
3. Quizzes throughout the unit to check understanding and learning
4. Quizzes and a unit test to assess knowledge gained
5. Lab report to assess lab design and understanding
6. Essays to assess critical thinking skills

LESSON PLAN:

| DAY | LESSON/ACTIVITIES |
|------------|--|
| 1 | Introduction: Stem cell journal and discussion Cell structure and organelles Computer activity: Investigate functions of organelles (http://learn.genetics.utah.edu/content/begin/cells/insideacell/) Prior to the unit, students complete a unit pre-test |
| 2 | Cell organelles Animal vs. Plant cells Eukaryotes vs. prokaryotes Investigation: The Evolution of the Cell (http://learn.genetics.utah.edu/) |

| | |
|----|--|
| | Discussion: can we use prokaryotic stem cells |
| 3 | Organelle Quiz Membrane structure |
| 4 | Membrane structure and transport Build a membrane (http://learn.genetics.utah.edu/) |
| 5 | Membrane Quiz Membrane lab |
| 6 | Membrane lab |
| 7 | Test membranes and cells |
| 8 | Mitosis |
| 9 | Meiosis |
| 10 | Mitosis Meiosis quiz Stem Cell lecture |
| 11 | Stem cell lab |
| 12 | Test: mitosis meiosis, stem cells Cell communication |
| 13 | Test: mitosis meiosis, cell communication |
| 14 | Discussion stem cells; review for test |
| 15 | Cell Unit test |