Msse 571S Field Experience in High School Natural Science, Practicum III

SAMPLING GENERAL & DUAL ENROLLMENT BIOLOGY TOPICS

Cassandra Harvey
December 3rd, 2009

Instructor & University Supervisor:
Dr. Slykhuis

Placements at Fort Defiance High School, August County:

Cynthia Schroer
Dual Enrollment Biology
11th & 12th Grade Students
1st Block
8:20am - 9:55am

Brent Hull
Agriculture/Forestry Biology
10th Grade Students
2nd Block
10:00am - 11:30am

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A COLLECTION OF HIGH SCHOOL LESSONS

This document contains four mini lessons with outlines, materials, and self reflections. The mini lessons cover topics on water and enzymes, the scientific method, cells, and Mendelian genetics. Following the mini lessons, there are two extended (90minute) lesson plans for cell theory and mitosis.

MINI LESSON PLAN 1

At Fort Defiance High School the administration requires teachers to have planned activities which the students can work on immediately after the bell rings at the start of each block. These "bell works" vary from classroom to classroom. In one science classroom I observed, the teacher used this as an opportunity for the students to independently practice responding to standardized test questions. In other classes, the students may read a course-long assigned book or study vocabulary. In the dual enrollment biology class I work with during 1st block, the "bell work" varies day to day depending on what activities are planned for the class. The students may read the background to a lab, study for a quiz, or review the PowerPoint slides the teacher will go over.

Teachers at FDHS are expected to plan "bell works" that are self explanatory. The students should be able to begin working quietly as soon as they find their seats with very few directions from the teacher. This helps the teachers manage the class while they take attendance and prepare for the lesson. Mr. Hull explained that "bell work" should also immediately introduce students to the topic they are going to explore during the block and ask them to recall any prior knowledge they may have about a subject.

Each day in Mr. Hull's introductory biology sections the students find a skills worksheet from the Holt Science *Biology* textbook series on their desk to begin working on as they come in. Mr. Hull tells them what chapter or chapters of the book they can refer to in answering the questions. The students work individually or with their table partners to complete the handout for about 10 minutes. The students may have longer to work depending on how difficult Mr. Hull perceives the questions to be based on his assessment of the students' knowledge and strengths in a particular topic. After taking attendance, Mr. Hull is able to walk through the rows of desks and help answer questions. When most of the class looks ready, Mr. Hull calls on students to read their answers and explain their reasoning. He repeats big ideas clearly and slowly. He elaborates on interesting topics and emphasizes what the class is going to learn that day. The students save their "bell works" in their notebooks, which are checked every six weeks to make sure they are complete and well organized.

Very early in my practicum field experience, Mr. Hull looked for ways to involve me in class activities. During my second visit to FDHS, and my first time meeting his second section of Ag. Biology students, Mr. Hull allowed me to administer a "bell work" and lead a discussion with the students related to the questions on the skills worksheet. The Virginia Standards of Learning addressed in this mini lesson included the properties of water and the nature of macromolecules. The first part of the "bell work" required students to be familiar with polarity, hydrogen bonding, and turgor pressure. The second part contained questions which introduced the role of enzymes as a catalyst in chemical reactions. These questions focused on the students' ability to read graphs and recognize the significance of varying pH measurements on the activity of enzymes.

Name _____ Class _____ Date _____

Skills Worksheet

Water and Enzymes

ANALYZING INFORMATION/INTERPRETING GRAPHICS

Dirt sticks to the body either by becoming trapped in microscopic wrinkles in the skin or, if the dirt is moist, by adhering to the body. Sometimes the natural oils on skin will give the dirt an oily coating. In such cases, water alone will not remove the dirt, but soap and water will. Use the information below and your understanding of polarity and chemical bonding to answer questions 1–3.

A. A soap molecule is long with one end attracted to oil molecules.

B. One end of a soap molecule is polar, and the other end is nonpolar.

C. Soap will dissolve, and the soap molecules will float freely in water.

D. A sewing needle will rest upon the surface of water. If powdered laundry detergent is gently sprinkled near the needle, the needle will eventually sink.

Read each question, and write your answer in the space provided.

1. Explain why adding soap to water will help remove dirt and oil.

2. Why does the needle float on the water?

3. Why does the needle sink after soap is added to the water?

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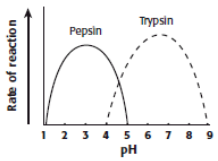
Name _____ Class _____ Date _____

The graph below shows the rate of enzyme activity in relation to pH for two enzymes—pepsin and trypsin. Both enzymes break down molecules in food taken into the human body, but the enzymes act in series. Pepsin breaks some bonds in very large molecules. Trypsin acts on the fragments produced by the action of pepsin, breaking them into even smaller units. Use the graph to answer questions 4–8 below.

Enzymes and pH



Read each question, and write your answer in the space provided.

4. The liquid in the stomach has a pH of about 2. Which of the two enzymes would be active in the stomach?

5. The liquid in the small intestine has a pH of about 8. Which of the two enzymes would be active in the small intestine?

6. What must happen to the liquid as it passes from the stomach to the small intestine for digestion to occur normally?

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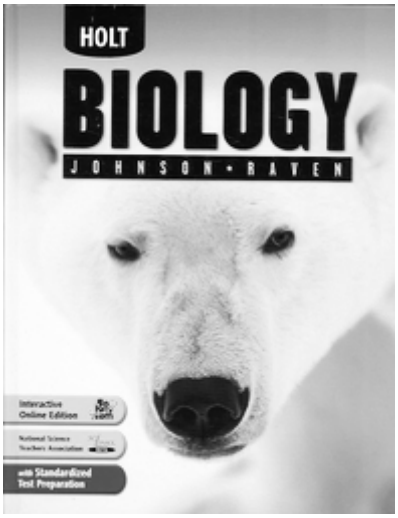

Name _____ Class _____ Date _____

7. Consider the data on the relationship between pH and enzyme activity shown in the graph. Do enzymes typically function only at a specific pH, or can they function at a range of pH values?

8. Can pepsin and trypsin function in the same environment? Explain.

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Lesson Self-Assessment Form Mini Lesson 1
MSSE 571: Practicum 3
Slykhuis/Fall 2009

Student: Cassandra Harvey
Host Teacher: Mr. Hull
Lesson Date: September 16th, 2009
School: Fort Defiance High School
Course: Introductory Ag. Biology
Lesson Topic: Water & Enzymes

Learning Goals

❑ Main goal(s) for student learning

The learning goals for this segment of a lesson were provided by the cooperating teacher. As a result of this mini lesson, students should be able to

- Explain how the polarity of water influences its interaction with polar and non-polar molecules,
- Describe how hydrogen bonds create surface tension, allowing water to maintain certain properties, and
- Interpret the role of pH in regulating the activity of enzymes illustrated in a graph.

❑ Degree of student achievement

The students seemed to perform well on the questions related to enzymes and were able to refer to the graph to support their answers. The students were also able to recall how surface tension allows water molecules to adhere to one another. However, the students seemed to struggle giving explanations for the way polar molecules interact and the role of hydrogen bonds.

❑ Changes needed in main goal(s)

The second learning goal could be adjusted to reflect the method of assessment used in this activity and the readiness level of the students. The way the questions were worded on the skills worksheet the students were able to identify the effects of surface tension without explaining the characteristics of water that create surface tension, even though, students were expected to demonstrate their understanding of both the causes and results of surface tension.

Learning Tools

❑ Learning tools used

For this mini lesson I used a skill worksheet from the Holt Science workbook used daily by my host teacher. I also used a dry erase board to draw illustrations of water molecules, soap molecules, and enzyme-substrate complexes to help students visualize key concepts.

❑ Their effectiveness

The questions in the "bell work" seemed interesting and relevant." However, the worksheet and answer key I used did not match up well. The students were able to answer single word responses correctly, but were not able to answer more open ended questions with as much detail as the skill book expected. The students were able to expand their answers by jumping in as I illustrated concepts, such as the structure of a water molecule, on the board.

❑ Future changes

In the future, I would modify the bell work by adding additional questions that reviewed the properties of water before asking students to apply those properties to varying situations. I would use multiple directed questions rather than a few open ended questions to help the students focus their thinking and to make it easier for the teacher to assess their achievement for each objectives. I might also include on the handout more illustrations. The students seemed to use the graph on the handout and my illustrations on the board well to support and revise their answers.

Student Grouping

- Format used

The student grouping for this activity was informal. Students were expected to work individually for the majority of the assignment, however, some interaction between table partners was allowed. The lesson ended with a whole group review and discussion.

- Its effectiveness

The expectation that students were to work individually and quietly on this activity helped me monitor behavior and answer questions efficiently. However, allowing the students to speak softly to their neighbor gave students the opportunity to help each other find information in their text and discussed how they could imagine the scenarios described in the handout. The students avoided directly giving each other the answers. The classroom setting established throughout the year and the student's own integrity may have contributed to the success of this informal grouping. In the whole class group, the students listened to each others responses and offered alternative answers without being critical. Students who tend not to participate could easily be called on.

- Changes needed

I would not change the student groupings for this lesson. The groupings worked well for the small class size, 9 students. At their tables, the students seem to help each other efficiently without copying or cheating. They discuss the problems so that each of them gains a better understanding. If this activity were not being used as a quiet bell work, I might have actually had the students work in groups of 4 or 5 to have more voices contributing to come up with the detailed answers the key was asking for. However, for behavior management purposes, in a larger classroom I might have clearly instructed the students to work individually and reminded students of this expectation more consistently.

Activities

- Activities used

The students independently read the prompts on a skill worksheet, referred to their textbooks for answers, and wrote a response to each question. The students were then asked to share and discuss their answers in a whole group discussion. The teacher cleared up misconceptions and introduced new topics.

- Their effectiveness

The activity went well. The students were familiar with the routine. Although they were not going to be given a specific grade as a result of the activity, each student appeared to put a genuine effort into answering the questions.

- Future changes

I would like to start the block with an activity that is more engaging and more interactive than the skills worksheet. However, in a school where individual "bell work" is expected, this activity was appropriate. The prompts on the worksheet allowed me to ask additional questions to explore how much prior knowledge the students really had and to introduce new concepts and applications that were going to be learned later in the block. Using this activity, in the future I might demonstrate the scenarios being described in the first part of the skills worksheet. I could easily have demonstrated or allowed the students to observe the interactions between water and soap and the way a pin floats on the surface of a drop of water. This may have been more engaging and concrete to the students.

Assessments

- Techniques used

I and my cooperating teacher stopped by each student as they were working to answer questions and check for understanding. I asked students to elaborate on answers they gave, to clarify where they found information, and to revise incorrect answers. As they finished the worksheet, I assessed how well the class as a group understood the main concepts by calling on students to share their answers with the class. There were 8 questions and 9 students, however, calling on students to correct or add onto the answers given by their classmates allowed every student to share their ideas with the class at least once. The handouts were then checked at the end of the six weeks for completeness as part of an organized binder.

- Their effectiveness

The class environment established by Mr. Hull throughout the year allows this assessment strategy to work. The students seem to be comfortable asking questions, taking in positive criticism, and discussing their thinking process aloud with their peers. Walking through the rows allowed me to check what answers individual students were doing well on or struggling on. I was able to see who skipped a question and who wrote more than a couple sentences for their answer. Calling on students to offer their answer to a particular question allowed me to select students who might understand the material very well or who might need to hear their own response aloud to make corrections. Asking for volunteers to change or elaborate on an answer helped me to observe how confident individual students were with their answers.

- Future changes

In a different classroom this strategy might not have been the best assessment method. The students must be respectful toward one another and have an understanding of the importance of mistakes and feedback in the learning process. In a larger class, it would have been hard to hear from every student on this assignment. I might have used white boards to see how every student answered every question, rather than taking a small sample of their performance on the activity. In the future, or in a larger, less accepting classroom, I would use the handout in some way to check for correctness as well as completeness.

General Reflections

I really appreciated being able to participate Mr. Hull's classroom instruction so early in my practicum field experience. Mr. Hull provided all of the objectives and materials for the mini lesson. He also gave me the opportunity to observe the teaching methods he uses for ensuring students benefit from the "bell work" activity a few days before I was asked to present a "bell work" activity to a class of students. Being familiar with the procedure and not having to plan the details of the lesson, allowed me to concentrate on becoming more familiar with the students and the classroom environment. I was able to practice my behavior management techniques by walking through the rows as the students worked and to practice calling on the students by their names. Mr. Hull did not evaluate my teaching for this mini lesson, however, I did notice some things about my teaching that I would want to continue to do and also things that I hope to change in the future. As the students were working on the activity, I was able to help some students who were struggling on particular questions find information in the chapter or work through the idea in their head so that they were able to improve their answers. I liked being able to call on the same students later to answer those questions, first to check that their understanding had improved as they shared their answer aloud, and second to give them confidence and encouragement in front of their classmates. I think I could improve on the amount of wait time I allow for students to demonstrate their understanding. When students answered questions incorrectly or incompletely, I asked the class as a whole who would like to volunteer to help out by sharing their answers. I think there were many times when this happened that I then turned to the board, turning my back on the class, to draw or explain an answer. I did not give the students a long enough opportunity to solve the problem on their own. I think especially with a guest instructor, the students may have needed more time to offer their ideas.

MINI LESSON PLAN 2

According to the *National Science Education Standards*, engaging students in scientific inquiry throughout their K-12 experience helps students to develop an "appreciation for 'how we know' " and "the skills necessary to become independent inquirers about the natural world". The Virginia Standards of Learning also emphasize inquiry in their science standards. Each section of the standard Bio1. encourages teachers to help students develop the skills necessary to "do" science and to understand the nature of science. In the biology curriculum frameworks I have reviewed, this objective is often referred to continually over the course of a year as students apply their skills of scientific inquiry to different topics of study. Many science teachers also choose to set aside time in the beginning to review with students the important components of scientific investigations. By 10th grade, students tend to be familiar at least with the typical sequence used for presenting science fair projects. Students know what to expect in each of the general section titles used to report scientific experiments, including introductions, hypotheses, procedures, data, results, conclusions, and works cited. For my second mini lesson, Mr. Hull asked if I could review the scientific method with both sections of his introductory biology course.

For this topic, I wanted to encourage the students to think about all of the different ways scientific investigations can be approached. I hoped to give students the opportunity to review their previous experiences with the scientific method, but I also wanted the students to be able to explore in more detail the idea that good scientific methods involve collaboration, review, controls, reliable recordings, and testable explanations for their observations. Mr. Hull allowed me to instruct the class during two blocks using my own lesson format and materials. I decided to plan my lesson using the 5E Model of Instruction. I wanted to encourage students to build on their prior knowledge using reasoning, communication with each other, and trial and error experimentation rather than relying solely on their textbook, a handout, or the instructors. The students were expected to use their curiosity, questioning, and reasoning to determine what comes next in an investigation. I asked the students to study a simple, but engaging natural occurrence, the behavior of whirly birds. The students had recently completed a unit on trees. I compared the whirly birds made in class with their observations of the samara design used by maple trees to help with seed dispersal.

Mr. Hull allowed me to use the full 90 minute block to work with his students on the scientific method. I used this lesson as a mini lesson, rather than an extended lesson, because in my planning I followed many of Mr. Hull's suggestions for key terms and concepts I should include, I thought there would be very little new material I was introducing to the students, and I adapted the main activity from a strategy I learned in my instructional methods course last semester.

Mr. Hull evaluated my lesson on both days. He paid close attention to my time management and let me know as I was instructing how much time was available during each new activity. Overall, he commented that my second presentation of the lesson was much more effective. With the first block of students, I did not use the engagement activity to introduce the topic well or transition into the following activities. He also encouraged me to direct my questions to the group at particular students so that strong individuals would not dominate the discussion and I could get a better idea of how well other students were following the discussion and check their understanding. He also advised me to write key terms on the board and repeat important concepts often and clearly. With the second block of students, Mr. Hull explained that my demonstrations, questions, and interaction with the students greatly improved my lesson. However, in both lessons he recommended that I work to develop a consistent way to catch the students' attention when I need to address the class or give important instructions or information during an activity.

Topic: Scientific Method **Class:** Brent Hull, 2nd block
Subject: Biology/Ag **Grade:** 10th

Lesson Content

Virginia Standards of Learning:

Bio1. The student will plan and conduct investigations in which
- b) hypotheses are formulated based on direct observations and information from scientific literature;
- c) variables are defined and investigations are designed to test hypotheses;
- f) sources of error inherent in experimental design are identified and discussed;
- k) differentiation is made between a scientific hypothesis and theory;

Lesson Objectives (UKDs): *As a result of this lesson students will:*

- **Understand that...**

- Science seeks to make sense of the natural occurrences and its explanations are tested using evidence from what people can observe, directly or with the help of technology, in the natural world.
- Scientific method refers to the strategies and reasoning scientists use to go about answering a question and rejecting explanations that do not fit their observations.
- The results of science must be testable, replicable, and open to revision as new knowledge is added through observation, research, and experimentation.
- Science involves questioning, investigating, and hypothesizing, but scientists may approach these tasks in any order.
- Theories are overarching explanations of the ways natural processes work that are accepted based on the evidence of many supported hypotheses; They are the unifying concepts in science.

- **Know. . .**

- An observation is a way of obtaining information by using your senses.
- A hypothesis is an explanation that is based on observations and that can be tested.
- Predictions are statements made ahead of time about what the outcome of an experiment will be if the hypothesis is supported. They describe the expected results from a specific test of a hypothesis.
- An experiment is the process used to test our hypothesis. An experiment is often carried out under controlled conditions or in a way that isolates particular variables being tested.
- In an experiment, a control group is used as a standard for comparison.
- An independent variable is a factor that is purposefully altered in an experiment to observe the effect or a particular outcome.
- In an experiment, a dependent variable is the observed response to a change in the independent variable. The dependent variable is the outcome determined by what is manipulated in the experiment.
- A theory is an explanation for a part of the natural world that is based on observation, experimentation, and reasoning. Theories in science are more then a guess or hunch. They are the overarching view of how something works based on several hypotheses that have been supported through multiple investigations. Theories in science are evidence-based, consistent, and well-tested.
- A law is a rule that can be followed when considering the natural world. A law is supported by theories, hypothesis, and experimental evidence and work when applied to a broad range of situations. However, laws may be disproven or may have limitations. For example, Newton's three laws of motions have been tested over and over again and are amazingly reliable for predicting the way everyday objects in motion will behave, however these laws cannot be applied as accurately to very large or very small objects, such as atoms.

- Scientific review is an important part of the process of doing science. Review allows scientists to check for mistakes due to human error. It ensures not that the methods and reasoning used agree with the basic principles of science.

- **be able to (SWBAT). . .**

- Recognize and logically sequence key components of scientific method.
- Create a hypothesis based on their observations of an event and their prior knowledge of forces acing in the natural world.
- Work collaboratively to develop an experimental design to test a prediction.
- Identify variables and define their importance in an experiment.
- Compare and contrast the terms hypothesis, prediction, theory, and law.

Brief Overview:

In this lesson the students will be given the opportunity to explore the scientific method by designing an experiment to test their hypotheses on the qualities that will produce the best "whirly birds". I will give a bell-work assignment that helps them consider what they already know about the nature of scientific investigations. After the "whirly bird" activity, students will be able to discuss the aspects of their experiment that were consistent with scientific method and where errors arose that would cause them to question their conclusions. Finally, I will ask the students to complete a handout that reviews major principles that scientists think about when conducting experiments. This lesson falls early in the year and is being given before a lab in which students will explore how to use microscopes while examining pond water.

Steps in Lesson:

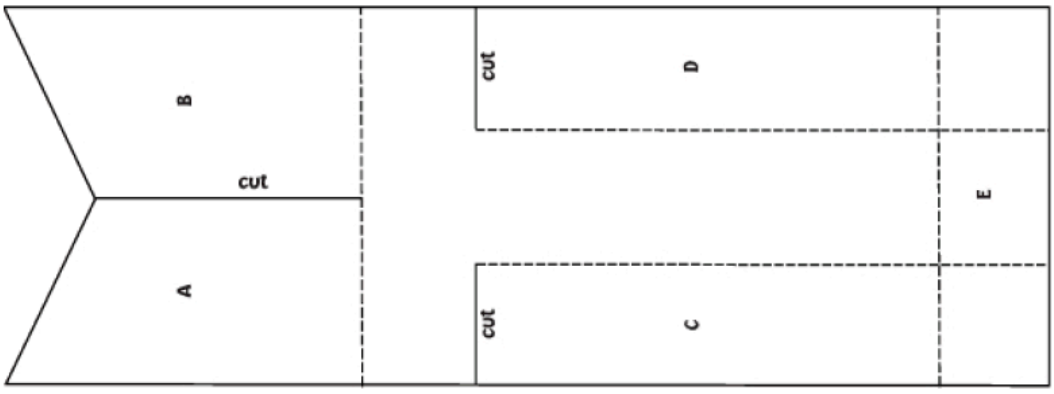
1. Engage: During the bell time, I will give each student a handout we will go over to review what they know about scientific methods. On the handout, the students will be asked to organize steps in conducting an investigation into the order they would use to answer a question about maple tree seeds (The students have recently been working on tree projects). We will go over how they could be ordered in this particular example. Then I will ask the students how they might have investigated the maple seeds in different scenarios. We will discuss how even though we normally think of scientific investigations in a linear way, scientists really work in many ways and do not always follow a specific procedure. We will discuss whether or not it is always necessary to conduct an experiment for an investigation to be considered scientific and whether it is always possible to draw conclusions from an experiment and communicate the results. I will ask the class to identify which elements they think are most important, such as questioning, observing, and hypothesizing, but for this activity they will not need to know specific terms.

2. Explore: As a class we will learn how to make whirly birds. We will try to identify aspects which affect how successfully a whirlybird hovers and what factors can be used to determine the best flight. The students will work in pairs or small groups to design an experiment to determine how one factor of a whirly bird's flight is affected by one of the variables. Students will be asked to predict what will happen when they change their variable in each whirly bird construction. Students will be able to measure and record data for different variables and flight measurements. At the end students will be asked to look at their data and determine which of their trials worked best. Each group will go around and say what they predicted, made, and measured and what their results were.

3. Explain: The students describe what they did in their whirly bird experiments, what results they found, and what they observed. As a class we will discuss how well this activity represented a scientific investigation. We will discuss the importance of observations throughout the process and the difference between a prediction and hypothesis. We will discuss the role of each type of variable (independent, dependent), what might have served as a control group in their experiment, and how scientists minimize environmental variables that may affect an experiment. We will also discuss problems that arose and possible sources of error in their results.

4. Extend: I will ask the class to come up with a "theory" on what characteristics make the best whirly bird from their individual experiments. For example, if one group determined that long wings stayed up longer, and another group found that a medium amount of weight made it spin better, would the best whirly bird have long winds and weights on the bottom? We will construct the hybrid whirly bird and test how it flies. Did it fly better than any of the individual trials? If not, why not? We will discuss the importance of and distinctions between hypotheses, theories, and laws in science.

5. Evaluate: Students will be given a handout with specific terms for steps in scientific experiments and vocabulary often used when referring to the scientific investigations. Students will be asked to write each term next to the corresponding step in the example they were given for their bell-work. They will also be asked to write down a definition or an important thing to remember about each term in their own words. The students will be asked to share some of their responses and we will review.

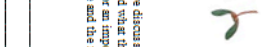


Name: _____ Date: _____

Scientific Processes

Part A. In the activity on the handout "Samaras & the Scientific Method" you ordered the steps of a scientific experiment to determine why the seeds spin. Below each step is a blank line. Use the following scientific method terms to describe each step by writing word or phrase in the line below the matching step.

Collecting Data
Researching
Questioning
Analyzing Results
Observing
Communicating/reporting results
Hypothesizing
Evaluating the hypothesis
Experimenting
Review



Part B. In class we discussed the scientific methods you used to determine what factors affect the flight of a vehicle/ bird and what the best flying vehicle/ bird might look like. Below each of the following terms, write a definition or an important thing to remember about the term considering their role in how we understand science and the natural world.

Observation: _____

Hypothesis: _____

Prediction: _____

Experiment: _____

Control group: _____

Independent variable: _____

Dependent Variable: _____

Theory: _____

Law: _____

Name: _____ Date: _____

Samaras & the Scientific Method

There are many objects which spin in the air in order to hover long enough to get from one place to another. Some examples are boomerangs, Frisbees, and helicopters. Imagine you are walking outside on a fall day and notice a samara flying by. A samara is a name for the type of seed we find on maple trees. You watch it spinning as it falls and wonder why a tree would make seeds that spin like a helicopter? Think about how you might go about answering this question.

Listed below are some steps you could take on one possible route to investigating the "helicopter seeds". Place a number beside each step to describe the order you perform them in to determine why some seeds spin.

_____ a. You write up your discovery in a report for your teacher. Your teacher asks you if it would be ok to publish your findings in the school newsletter.

_____ b. You determine from what you know about spinning objects in flight and your own observations that one possible explanation for why the trees have developed these seeds is to prevent them from falling directly in the shade beneath them.

_____ c. You conclude that your explanation was supported by the greater growth observed in seedlings planted in the sun and the greater distance traveled by seeds with both sides of the wings complete compared to seeds with no wings.

_____ d. You devise a plan to test your prediction by examining how well seedlings will grow in the shade beneath the tree and in the sun over a three month period. You also decide to test how far the samara shape allows the seeds to travel in a constant amount of wind by altering the shape of the seeds.

_____ e. You observe the way samara seeds behave when caught in the wind. You notice the texture and thickness of the winds and the appearance as it spins to the ground.

_____ f. You look up aerodynamic rules and other characteristics that are known about objects that spin and objects that fly.

_____ g. Your teacher makes a suggestion that another experiment could be performed to strengthen your conclusions by measuring how long the samara seeds with altered shapes hover in the air, their descent time.

_____ h. You ask why the trees have developed helicopter like wings on their seeds.

_____ i. You review your data and find that samara seeds with no wings fall the shortest distance and make a graph of the seedling height in the shade and sun over time.

_____ j. You measure the seedling height each week using a meter stick and the length of distance each samara falls for five trials for each altered seed.

Lesson Self-Assessment Form Mini Lesson 2
MSSE 571: Practicum 3
Slykhuis/Fall 2009

Student: Cassandra Harvey
Host Teacher: Mr. Hull
Lesson Date: September 21st and 23rd, 2009
School: Fort Defiance High School
Course: Introductory Ag. Biology
Lesson Topic: Scientific Method

Learning Goals

❑ Main goal(s) for student learning

The goal for this mini lesson was for students to expand their understanding of scientific methods. As a result of this mini lesson, students should be able to

- Recognize and logically sequence key components of scientific method.
- Create a hypothesis based on their observations of an event and their prior knowledge of forces acing in the natural world.
- Work collaboratively to develop an experimental design to test a prediction.
- Identify variables and define their importance in an experiment.
- Compare and contrast the terms hypothesis, prediction, theory, and law.

❑ Degree of student achievement

Although their answers varied slightly, the students in both blocks were able to organize the events in a scientific investigation into a logical sequence. The students seemed to recognize that their answers could vary depending on the observations they made or data they collected. They seemed comfortable with the idea that scientists can go back to previous stages at different points throughout an investigations as new information becomes available. The students in both classes were able to create a hypothesis for the behavior of their whirly birds using simple "if…then" statements. However, the students, especially in the second block, seemed to struggle isolating one variable to test. The students in the second block were very creative in their whirly bird designs, but often had multiple factors affecting the flight of their whirly birds. The students worked collaboratively in their groups and offered suggestions even between groups at times. The students were able to offer clear definitions of independent and dependent variables and applying them to their whirly bird experiments. The students were also able to discuss as a group the differences between a hypothesis, prediction, theory, and law and independently define each.

❑ Changes needed in main goal(s)

In the group discussions, the students went beyond explaining the key terms of the scientific method they used in their investigations and often evaluated errors in their experiments. I would include as an objective for this lesson the students' ability to evaluate a scientific investigation based on observations, design, and analysis, and, their ability to propose alternatives that follow scientific reasoning. I would also change the second objective to say, "As a result of this lesson, students will be able to create a hypothesis for the change in behavior that will be observed when a single variable is altered based on their observations of the natural world and prior knowledge," to help focus the exploration activity.

Learning Tools

❑ Learning tools used

For this lesson, I created two handouts and provided students with materials for exploring and experimenting with whirly birds. The first handout asked students to organize the events of an investigation and then later label these processes with the terms often used to describe a scientific method. The second handout asked students to describe key terms based on what they had learned from their exploration and class discussions. The students were not given an introduction, procedure, data collection tables, or questions for the exploration activity. Instead, as a large group, the students reviewed the main ideas of scientific inquiry and investigation by describing their experimental predictions, designs, variables, results, and errors on the dry erase board.

- Their effectiveness

The students had no questions about the directions on each handout and were able to complete them successfully. The handouts allowed the students to review individually their prior knowledge of the subject and what they learned from the group activities, and, express their knowledge in a way that could be shared with the class, collected, and evaluated by the teacher. The handouts also helped reinforce my instructions and allow me to monitor behavior as students worked. The first handout really helped demonstrate how scientists might repeat a step, go back, or begin again at many points in their research. The second handout helped me evaluate what students learned from the lesson's activities.

- Future changes

The students seemed to struggle with writing a hypotheses and narrowing their variables during the whirly bird exploration activity. I think a little more structure at the beginning of the lesson might have helped students to understand what they are changing (wing size, weight, etc.), what outcome they want to observe (number of spins, time of descent), and how they are going to measure the results. In the future I would provide a handout that gives students a place to record these variables and also record their procedure so that once they begin, they know where they are heading. The students could also use this handout to record their results, though I would let them create their own tables and charts. It would also be useful to use the overhead and excel, a document camera, or some similar form of projecting technology to allow students to easily observe and compare and check each others' results.

Student Grouping

- Format used

The students were directed to work on the engagement activity individually. Once they finished they volunteered and were called on to share their answers in a whole group discussion. This followed the grouping the students are used to for their normal "bell work" activities. The students worked in groups of two or three to design and conduct their whirly bird experiments. Then, the students explained what they observed and discovered in their exploration with whirly birds as a whole class group and worked in this large group to combine their results and conduct an additional experiment. Finally, the students individually completed a check-for-understanding handout which asked them record notes about each of the main concepts they reviewed during the block.

- Its effectiveness

For the first handout, the students organized the scientific method in slightly different, but logical ways. Rejoining as a class to share their responses helped the students engage in a conversation about how scientific investigations can be approached different ways and how scientists can repeat a step, go back, or begin again at many points in their research. The students worked well in their groups to construct their whirly birds. Both students in each pair appeared to contribute to the group. The students often assigned each other roles. For example, one student would construct whirly birds and the other would gather supplies, or, one would time decent while the other recorded their results. As a class, some groups explained what they observed in the activity with whirly birds, while one or two groups in each class seemed to be particularly good at applying terms, such as independent and depended variable, to their observations. The students seemed a bit less focused and connected during the extension activity. There were a couple students who took charge of combining the group results and building a "new and improved" whirly bird. However, a couple of the students looked confused or were not able to find a way to plug in to the activity. The students appeared focused and on task as they completed the final handout individually and only two students had to finish the handout for homework.

- Changes needed

In the future, I would combine only two or three pairs in the class into larger groups for the elaboration activity. The students would be able to combine results without leaving too many individuals out of the decision making, testing, or analyzing process. This would allow the students over the course of the lesson to review the material individually, as a class, in pairs, as a class, in small groups, and, finally, individually.

Activities

- Activities used

The students participated in five activities. First, they considered what series of steps a person might use to scientifically investigate and everyday occurrence, such as the flight of maple tree seeds, by completing a sequencing handout and engaging in a whole group discussion. Then, the students explored how they would investigate individual factors that might affect the flight of a whirly bird in pairs. They informally made predictions, conducted test trials, recorded observations, and analyzed their results. Next, they explained the process they used to test their predictions and considered how their separate methods contained similar key, scientific elements. Then, the students applied their general method to a new prediction and considered the use of the words hypothesis, prediction, theory, and law. Finally, the students completed a two part handout requiring them to label the common steps taken in scientific investigations and define key terms.

- Their effectiveness

The students were able to recall the importance of the whirly bird design to maple seed dispersal. This connection to a previous unit on trees helped encourage the students to participate and offer relevant suggestions and interesting "what if…?" questions. The whirly bird experiments helped the students work collaboratively to solve a problem and make adjustments to their experimental design through trial and error. However, the students in one block in particular were extremely creative in their whirly bird designs, but as a consequence they altered multiple variables and found it hard to support or reject their hypotheses. In the group discussion the students found that they had similar experiences with their whirly bird experiments, even though they set out to investigate different aspects of whirly bird flight and design. They were able to explain to each other not only what changes they made to the whirly bird and how they tested their predictions, but also identified what problems there might be in their results and what methods might have made their conclusions less reliable. The students struggled to apply the common experimental methods they used to a larger problem – how to create the best flying design based on their combined hypotheses. However, as the students responded to guiding questions and explained their reasoning, they seemed to be able to make correct distinctions between a hypothesis, prediction, theory, and law. The students all completed the final handout successfully and were able to add more to their notes when Mr. Hull reviewed the terms during their next meeting.

- Future changes

In the future, I would use the 5E format again to help students review methods of inquiry and the nature of scientific investigation. However, I would have the students spend more time generating their hypotheses within their pairs and analyzing the errors in their experiments as a whole group. I would emphasize that in their hypotheses the students should use their background knowledge to describe how one aspect of design affects the flight of the whirly birds and in their predictions they should establish how a specific change in design will cause a specific result in flight pattern.

Assessments

- Techniques used

I assessed the students prior knowledge of the steps in scientific problem solving by calling on students to share their responses to the engagement exercise and collecting their work. I monitored how the students worked in their pairs and in the whole class group to design an experiment by visiting the groups, answering questions, and occasionally addressing the class as a whole to clarify the aim of the activities. I was able to gain a better idea of how much each student was able to contribute to the group's overall results. I also assessed the students understanding of key concepts in scientific method by collecting their notes on key terms.

- Their effectiveness

The students were able to effectively demonstrate logical sequencing of a scientific investigation. Each of the students completed the engagement, "bell work" activity and the students who were called on were each able to at least offer one or two points or scenarios that supported their organization of the events on the samara investigation handout. The students were able to design a scientific experiment to varying degrees of success, however, as struggling groups explained the problems they encountered, they were able to identify misconceptions and offer more scientific alternatives.

- Future changes

One of my objectives for this lesson was for the students to be able to "compare and contrast the terms hypothesis, prediction, theory, and law." The activities however only really required the students to discuss similarities and differences in a whole group discussion. On the handouts, individual students only needed to describe each. These concepts are very important in science and in the future I would like to include some written form of assessment that would allow me to evaluate more thoroughly how well each individual student was able to distinguish between these terms as a result of the lesson.

General Reflections

The students applied much more creativity and enthusiasm to the whirly bird activity than I expected. In this mini lesson, the students taught me that one of the most important strategies to understand scientific concepts is identifying what is not good science. The students, I think, learned the most from this lesson during the discussion of what problems may have occurred in their experiments. The students started by complaining that some whirly birds may only have appeared to perform better in the compiled data because some results were less valid than others or were not comparable. This gave me the opportunity to ask the students many more questions about their experimental methods. The students analyzed how reaction time could affect their measurements, how different instruments could yield different results, why a larger number of trials gives scientists greater confidence in their results, how controlled experiments differ from field observations, and why it is important for scientists to review each other's work before accepting all conclusions. I would modify this lesson plan to include specific questions that might help me encourage future students to also consider these ideas.

MINI LESSON PLAN 3

Instructional games can be very beneficial for both students and teachers. They allow students to interact with each other and with the material they are studying. For many games, students are given the opportunity to work in teams to combine their knowledge and skills. Students may be motivated by this social interaction alone or by the competition that takes place during some games. Games may help students to connect a concept with particular events and retain information longer. Announcing games in advance may encourage students to prepare better by reviewing their notes before class. Whether cards or a specific role such as a "game host" is used to confirm answers, teachers are often able to provide immediate feedback to students during games. Games which invite all students to participate and also excite and engage students help teachers preventively manage classroom behavior. Certain game formats may also save teachers considerable planning time. Many games are available in different formats which allow teachers to simply modify questions to fit the subjects and topics they are studying in their class. Teachers can also modify premade games to fit the interests, readiness levels, and learning styles of their students.

For my third mini lesson, Mr. Hull asked if I could plan a day for students in both of his introductory biology courses to review the material they had learned over the course of their unit on cells. The teachers were going to combine the students in the Ag. Biology sections to form a class of 18 students for one block prior to their cell unit test. I wanted the students to be able to be able to work together to review the material, so that they could share ideas and help each other understand key concepts from each lesson. I also wanted to make sure I gave the students many opportunities during the review session to ask questions and to clarify material where their notes might be thin. I hoped review games would allow me to excite and motivate the students. I decided to use three different forms of review games to ensure each student was given the opportunity to participate and review the material in different presentation formats. The lesson took approximately 45 minutes of class time. Mr. Hull did not evaluate this mini lesson.

Topic: Cell Test Review
Subject: Biology/Ag

Class: Brent Hull, 2nd block
Grade: 10th

Lesson Content

Virginia Standards of Learning:

Bio 2. The student will investigate and understand the history of biological concepts. Key concepts include:
a) evidence supporting the cell theory
e) the collaborative nature of scientists, past and present

Bio 4. The student will investigate and understand the relationship between cell structure and function. Key concepts include
a) characteristics of prokaryotic and eukaryotic cells
c) similarities between the activities of a single cell and a whole organism; and
d) the cell membrane model (diffusion, osmosis, and active transport)

Lesson Objectives (UKDs): *As a result of this lesson students will:*

- **Understand that...**

- Experimentation and collaboration between scientists during the 18th, and 19th century provided evidence and support for the founding principles of modern cell theory.
- Cells are the basic units of life.
- Organelles are part of the hierarchy of structure of living things and perform unique functions within cells that allow life processes to occur.
- Organelles have distinct, identifiable structures that allow them to carry out different functions.
- Cell membrane transport involves both passive and active transport within a cell.

- **Know. . .**

- All of the content present throughout a unit on cells, including the work of various cell scientists, cell structure, and mechanisms for transporting materials across a semi-permeable membrane.

- **be able to (SWBAT). . .**

- Work cooperatively within a group to review their knowledge of cells.
- Illustrate the roles of various organelles.
- Describe the perspectives and discoveries of early cell scientists.
- Recall the work of cell scientists, life processes, cell structures, and organelle functions.

Brief Overview:

In this lesson, the students will work in small teams to review their knowledge of cell theory, cell structure and function, and the processes that take place within cells for their unit test. The desks will be pushed together to form group tables and the teacher will assign groups of three or fours students to different areas of the room. The students will be given an index card with a space to record their team name and tally their score for three different review activities. The teams will be given a set amount of time to complete an altered charade activity, a variation of pictionary, and a jeopardy game. The students will be discouraged from using their notes or textbooks at any time during the review.

Steps in Lesson:

1. The first review game will be an altered form of charades in which the students take on the character of a particular cell scientist and their teammates must guess who they are acting out based on hints they give about their nationality, scientific instruments, fields of studies, or major discoveries. Each group of students will be given a deck of index cards. The side of the cards facing up will be blank. On the other side the students will find the phrase "I say…." and the name of a cell scientist they have studied during this unit. The teacher will introduce the game and instruct students to pass the deck around so that each student in the group takes turns being the "actor". The team will loose points if the "actor" says any part of the scientist's name aloud. The students will tally how many cards their team was able to guess correctly in 10 minutes. The teacher will be able to go around the room to assist groups which are struggling on a particular card. There will be enough cards that the students in each group will not be able to complete an entire set.

2. The second review game will be an altered form of pictionary in which the students will be able to draw or talk to describe the appearance of an organelle, the location of an organelle within a cell, and the role of an organelle in life processes. Their teammates must guess what organelle they are depicting based on hints about their structure and function. Each group of students will be given a deck of index cards. The side of the cards facing up will be blank which the students may use to doodle or diagram a process. On the other side the students will find the phrase "I am…." and the name of a cell organelle they have studied during this unit. The teacher will introduce the game and instruct students to pass the deck around so that each student in the group takes turns being the "illustrator". The team will loose points if the "illustrator" says any part of the organelle's name aloud or writes out any letters or words. The students will tally how many cards their team was able to guess correctly in 10 minutes. The teacher will be able to go around the room to assist groups which are struggling on a particular card. There will be enough cards that the students will not be able to complete an entire set.

3. The third review game will be a PowerPoint jeopardy game where all of the groups will play together in turns, starting with the team with the least points after the first two games. The students will gain points by choosing a topic and difficulty level, such as "Cell Scientists for 300 points", and correctly answering the prompt. The teams must select a spokesperson to give their final answer to the "game host" – Mr. Hull. The students will be given a full minute to discuss answers within their teams and allow their spokesperson to announce their best answer. If the question is not answered or answered incorrectly, the question and points will go to the first group to have their spokesperson raise their hands with the correct answer. The teacher will review each topic after the answers have been revealed.

Review Game 1 Example Card

I say....

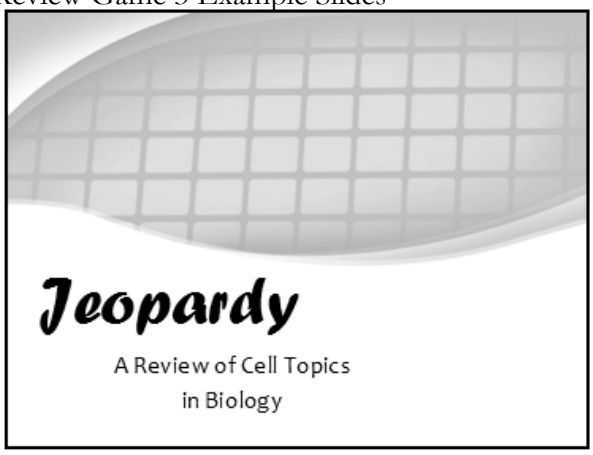
THEODORE SCHWANN

Review Game 2 Example Card

I am...

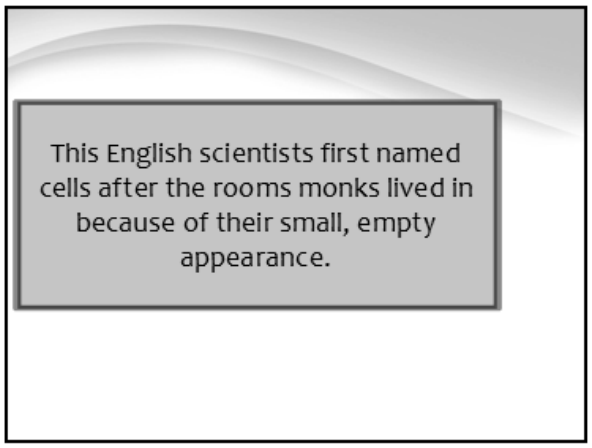
A RIBOSOME

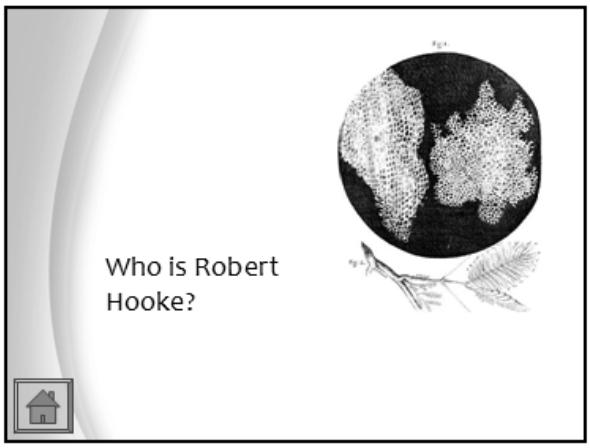
Review Game 3 Example Slides



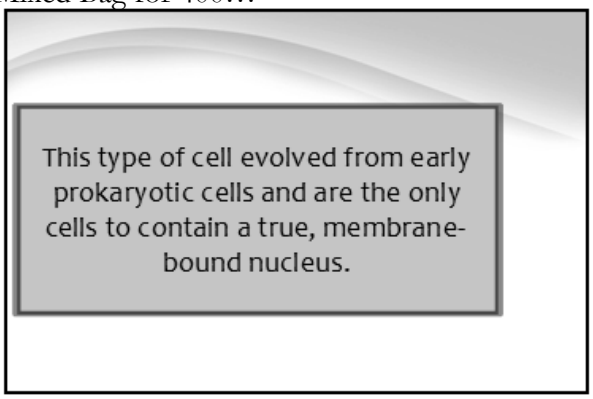
Cell Scientists	Mixed Bag	Functions Of Organelles	Finding Organelles	Membrane Transport
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	?
600	600	600	600	☺

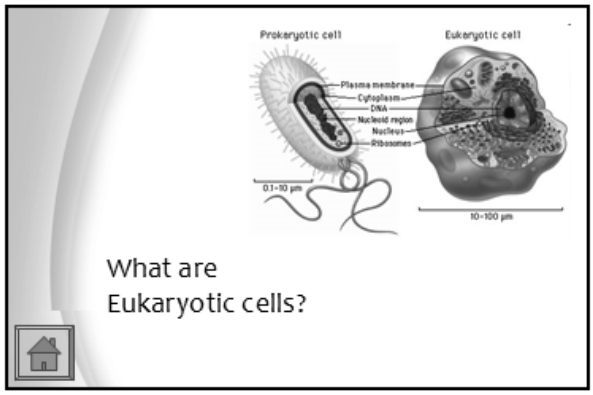
Cell Scientists for 200…





Mixed Bag for 400…

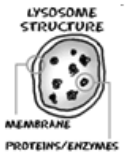




Functions of Organelles for 600…

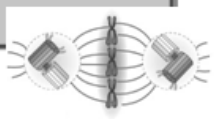
These organelles are responsible for keeping animal cells clean by digesting food, worn out organelles, and engulfed viruses or bacteria.

What are lysosomes?

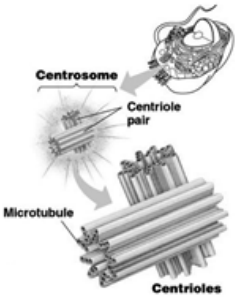


Finding Organelles for 200…

These organelles are found in the cytoplasm, are made up of nine tubes, each with three tubules, and help in the process of cellular division.



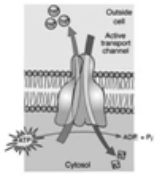
What are centrioles or centrosomes?



Membrane Transport for 200…

This type of material transport into and out of a cell requires energy from the cell to occur.

What is Active Transport?



Lesson Self-Assessment Form Mini Lesson 3
MSSE 571: Practicum 3
Slykhuis/Fall 2009

Student: Cassandra Harvey
Host Teacher: Mr. Hull
Lesson Date: October 21st, 2009

School: Fort Defiance High School
Course: Introductory Ag. Biology
Lesson Topic: Cell Review

Learning Goals

❑ Main goal(s) for student learning

The learning goals for this segment of a lesson were discussed with the cooperating teacher. As a result of this mini lesson, students should be able to

- Work cooperatively within a group to review their knowledge of cells.
- Illustrate the roles of various organelles.
- Describe the perspectives and discoveries of early cell scientists.
- Recall the work of cell scientists, life processes, cell structures, and organelle functions.

❑ Degree of student achievement

All of the students worked well throughout most of the lesson to review their knowledge of cells within their groups. A few of the students struggled at first taking on a character for the cell scientist review game, but even if they choose not to act and respond as the person might have, all of the students seemed able to at least list facts about their cell investigations and major discoveries. The students seemed to recall most of the cell organelles they studied, although, a few groups struggled to illustrate the structure and function of centrioles and plastids during the second review game. The class was able to remember the work of cell scientists, life processes, cell structures, and organelle functions when they were prompted by the jeopardy game. All of the questions were answered without the instructors having to interject the game. Only three questions were answered incorrectly and had to be passed on to another group to answer correctly. One group of girls struggled significantly more than the other students during the jeopardy portion of the review games. The group seemed to communicate with each other less when they were pressured by other classmates to come up with the answers..

❑ Changes needed in main goal(s)

Most of the main goals seemed to match the students' readiness level, the lesson activities, and learning outcomes Mr. Hull hoped to assess in his unit test. However, in the future I would omit the first learning goal. I think the teacher can influence how well students work together by setting up consistent classroom expectations and assigning groups based on a strong knowledge of the students' strengths, interests, and ability to express their ideas to others. In planning this lesson, I wanted to remind myself to encourage the students to collaborate and improve on one another's ideas. However, I don't think students should be assessed on their ability to work cooperatively within a group for this particular assignment. This skill should be strengthened throughout the course through multiple activities and varied grouping strategies.

Learning Tools

❑ Learning tools used

For this mini lesson, I used index cards to prompt students in small group activities and a PowerPoint presentation to present review questions and provide answers for the students.

❑ Their effectiveness

The index cards were sometimes easy to see through and timely to write by hand for five groups of students. The index cards also did not provide students with hints, feedback, or correct information. The teacher had to help and correct each group individually. They did, however, allow the groups to work independently and easily keep track of their progress. The PowerPoint allowed the teacher to review different topics instantly, with clear visuals, and to elaborate on main ideas or address student misconceptions.

- Future changes

In the future, I would use a label printer and colored construction paper to make the index card prompts less visible to other team members. On the jeopardy PowerPoint, I would include additional squares in each category for wildcard questions. These would allow the teacher to make up questions on the spot in response to topics the students seemed to struggle with in their groups during the first two activities. The teacher could create extra review opportunities for topics that appear more difficult.

Student Grouping

- Format used

The students were grouped in assigned teams of three to four throughout the review session. During the first two activities the groups worked independently and simultaneously. For the jeopardy review game, the groups were brought together and were able to listen to the responses given by other teams and make corrections when necessary.

- Its effectiveness

For the first two activities, the groups varied only slightly in their ability to work together efficiently. Their scores were close in range and they kept the noise and distraction level to a minimum. However, during the jeopardy review game, there was one group that seemed particularly intimidated and pressured by the presence of other groups judging their performance on each question.

- Changes needed

The students were assigned into teams based on everyday table partners and how well the students seem to interact with one another. The groups were also mixed fairly well according to readiness level and achievement so far on this particular unit. In the future, I would also consider learning styles and personality types when arranging the groups for competitive games. I think the groups might have been more fairly matched if the shy, self-motivated students and the outgoing, peer-motivated students were more evenly distributed. The students could instead be grouped as they were, but only required to participate in one review game. The games could be set up as stations the students could choose from, so that less competitive students might be able to choose a game format that requires them to record their achievement, but not necessarily have the pressure of answering each question correctly in from of other teams.

Activities

- Activities used

The teams participated in an altered charade activity, a variation of pictionary, and a jeopardy game. The students were discouraged from using their notes and other resources. They tallied their scores for all three games to determine the group of cell "experts". The first review game required the students to take on the character of a particular cell scientist. Their teammates' goal was to guess who they were acting out based on hints they gave about their nationality, scientific instruments, fields of studies, or major discoveries. The second review game involved the students drawing or talking to describe the appearance of an organelle, the location of an organelle within a cell, and the role of an organelle in life processes. Their teammates needed guess what organelle they were depicting based on hints about their structure and function. The jeopardy review game required groups to answer each question prompt their team answered correctly through an assigned spokesperson.

- Their effectiveness

A few of the students appeared hesitant about the first review game. They requested a demonstration for how to take on the character of a cell scientist. After a while, the students began to understand the objective of the game and became much more creative with their responses. During the second review game, one group completed all of the cards that were given to them before it was time to move on to the next activity. Many of the students seemed familiar with and excited about the jeopardy review game.

- Future changes

In the future, the students might benefit from participating in the whole group jeopardy game first. This would allow the students to review all of the key topics in the unit before working independently in their smaller groups where, rather than identify or name an idea, they need to be able to recall specific concepts in much greater detail. The students might also be given an anchoring activity or study guide they could work on in case a group finishes a review game before their time is up.

Assessments

- Techniques used

The students were not assessed in a written format for this lesson. The score calculated from adding the tallied points each group earned during the review activities was not used to assess their understanding of cells. Instead, the cooperating teacher and I circulated the room to hear the ideas different students were able to contribute to the group and to observe what topics the students seemed to struggle to remember the most. The students were formally assessed two days later during a summative test on cells. I was also able to watch when the students present their six week projects on cells two weeks after this review lesson.

- Their effectiveness

The following week after the review lesson, the cooperating teacher announced that the scores for the cell unit tests were very high compared to previous years. On the students' six week project, where they were to construct a model of a cell out of any material, the cooperating teacher and I were impressed by how many students were comfortable enough to present their cells and describe each organelle without reading off a key.

- Future changes

I think the purpose of this review was to help students assess their own, individual learning. Students were given the opportunity to check their knowledge on material that would be presented on the final unit test. In the future, I would ask students to record topics on a piece of paper where they notice themselves struggling to help their group during a particular game or exercise. This would help the students remember what topics they need to study and review the most before the test, and also after the test to retain what they learned.

General Reflections

The students seemed to take a flight-or-fight response to the competitive aspect of the review games. Some students seemed motivated and excited about the idea of demonstrating their skills and knowledge to their classmates by achieving higher scores. Other students completed the tasks and found them entertaining, but seemed indifferent about the scores or even embarrassed. The first two games went quietly because the students were working only within their small group to achieve a visible, attainable goal. They wanted to obtain the maximum score possible be acting out all of the cards they were given before time was up and identifying each card on the first try. During the jeopardy game, it became clearer that some groups preferred to simply see how many answers they could get correct over how many points they could earn. I think in the future, if the review games used are engaging enough on their own, I would encourage students in each group to reach an objective goal (only two missed questions) rather than to compete with other groups. I would change "points" to "study minutes". For each question or prompts the students are able to respond to correctly, they earn back minutes they would have had to spend studying for the test. Therefore, the questions that students note they had trouble on should be the topics they spend the most time studying for.

MINI LESSON PLAN 4

During first block at Fort Defiance High School, I observe and take part in Ms. Schroer's Dual Enrollment Biology Course. The students in this class are juniors and seniors planning to attend college and considering concentrating in life science. They are self-motivated, respectful, and find interesting ways to connect their studies and personal interests. Ms. Schroer mirrors the planning, grading, instruction, and materials used in the class to those she uses in an introductory biology course at Blue Ridge College. She expects all of her students to be able to work independently, think critically, focus longer, and organize information for themselves. Ms. Schroer is the only teacher who teaches this course and her lessons are set up in a very specific format. Over the course of about a week, the students listen and take notes as Ms. Schroer introduces a topic, complete practice exercises, and conduct laboratory experiments. For their independent and small group activities, Ms. Schroer facilitates learning and exploration, but gives little direct supervision. However, when introducing a new topic, she presents a much more teacher-centered lesson. On these days the students listen and take notes during a PowerPoint presentation of the material.

The pace and atmosphere in Mr. Hull's classes and Ms. Schroer's class are very different, but both teachers have mad a genuine effort to include me and support my future teaching. In Mr. Hull's class I have presented a majority of my short and extended lessons. I have been able to review homework and bell work activities with the class and help the students at their seats during study periods. In Ms. Schroer's class, I have been less involved with direct student instruction and lesson planning, and work instead on becoming more familiar with other aspects of the teaching profession. Ms. Schroer has helped me gain experience navigating the school site to take attendance, prepare materials for class activities, order supplies, assign grades and provide students with feedback on research reports, and observe different teaching styles.

Hoping to allow me more interaction with the students, Ms. Schroer asked if I could introduce a new topic to the class, Mendelian Genetics. She suggested I work within her usual lesson format. Ms. Schroer explained that her PowerPoint presentations would prepare her students for the type of lessons they will see given soon by their college professors. She states that her lectures are long enough to challenge students to focus and her slides are brief enough that students must look for the key information, beyond what is given to them.

I was reluctant to give a fully teacher centered lecture. I have been taught that students learn best when they are encouraged to explore concepts and construct their own meaning. As I worked on my presentation I discovered that Mendelian genetics is a very interesting and engaging topic. I searched for ways to involve students in uncovering concepts and encourage them to actively think about the information being presented. I found that there were many ways I could stick to Ms. Schroer's presentation format while motivating students to build their own understanding of the material. I tried to ask students guided questions, find topics and examples that they would be familiar with, and encourage the students to practice important skills as we went along.

Example Slides from a Presentation of Mendelian Genetics

Patterns of Inheritance

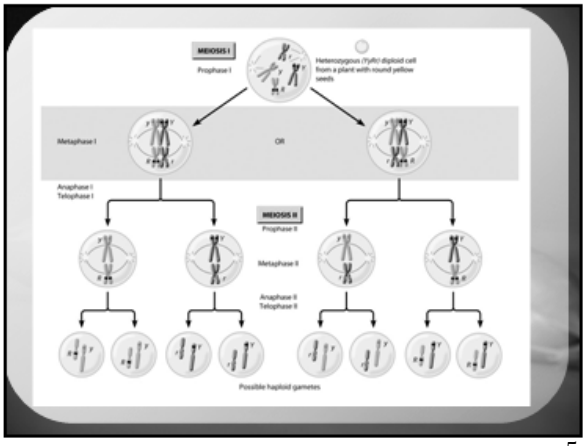
Applications of Mendelian Rules of Genetics and the Exceptions

1

The Physical Unit of Inheritance

- Inheritance:
  The process through which characteristics of an individual are passed from parent to offspring
- Gene:
  A unit of heredity composed of a segment of DNA with a particular nucleic acid sequence that encodes for the amino acid sequence of a protein
  Production of a protein results in specific traits expressed in an individual

2



5

Dominant or Recessive?

6

Try Your Own!

	T	t
T		
t		

Both parents are mixed hybrids, name the 4 possible offspring and the expected ratio.

	T	T
T		
t		

One parents is dominant tall, one is mixed hybrid, name the 4 possible offspring.

11

Try Your Own!

	T	t
T	TT	Tt
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Both parents are mixed hybrids, name the 4 possible offspring and the expected ratio.

	T	T
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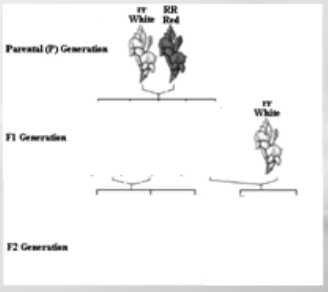
One parents is dominant tall, one is mixed hybrid, name the 4 possible offspring.

12

What Would Mendel Predict?



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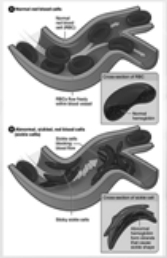
Incomplete Dominance

- The phenotype of a heterozygote is indeterminate between the phenotypes of individuals homozygous for either allele
  - The blending hypothesis is not supported
  - Sometimes symbolized with the capital letter of the darker color and the same symbol prime fro the other colors (if colors), such as R = red and R' = white
  - Examples: Pink Snapdragons, Roan, Wavy Hair

22

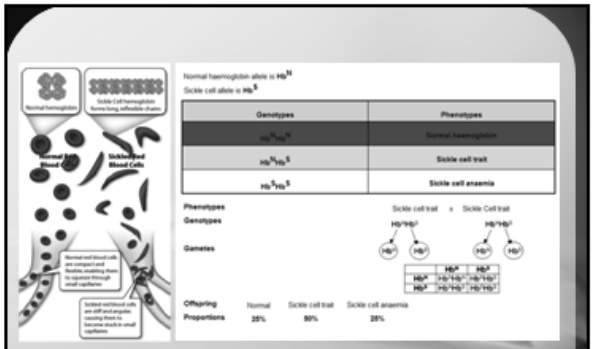
What is the Ratio of Phenotypes?



AA = normal
Aa = sickle cell trait (few symptoms)
aa = sickle cell anemia

	A	a (Sickle cell allele)
A		
a (Sickle cell allele)		

23



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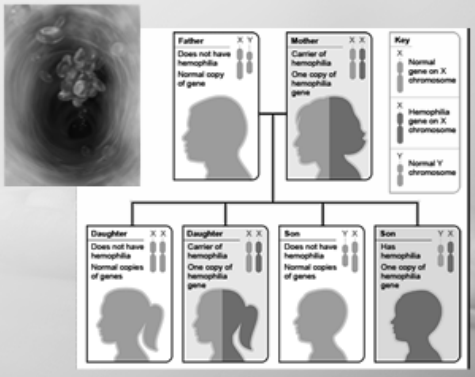

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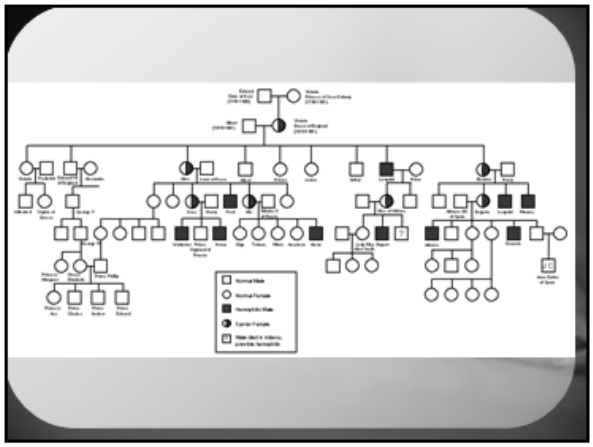


30

Topic: Mendelian Genetics
Subject: Dual Enrollment Biology

Class: Cynthia Schroer, 1st block
Grade: 11th & 12th

Summary of Student Evaluations

I reviewed and listed the most frequent comments the students made regarding my presentation. They were instructed to write constructive criticism and general reflections on a piece of paper to be turned into Ms. Schroer following my introduction of their unit on genetics.

Pacing, Projection, and Presence:

- "You went a little fast. Just slow down a little bit between slides and between explaining things."
- "You should slow down and speak a little louder, because I could barely hear you sometimes."
- "Don't second guess yourself."
- "Don't say PP." [I used the letter p as a symbol for an allele and it actually helped lighten the presentation a bit.]
- "Good vibe."

Depth, and Difficulty:

- "Good and well explained."
- "Make sure you have our attention the whole time. I lost you a bit."
- "Don't make the slide show as long. We loose focus."
- "The notes were really good."

Lesson Self-Assessment Form Mini Lesson 4
MSSE 571: Practicum 3
Slykhuis/Fall 2009

Student: Cassandra Harvey
Host Teacher: Mr. Hull
Lesson Date: November 11th, 2009
School: Fort Defiance High School
Course: Dual Enrollment Biology
Lesson Topic: Mendelian Genetics

Learning Goals

❑ Main goal(s) for student learning

The learning goals for this segment of a lesson were provided by the cooperating teacher. As a result of this mini lesson, students should be able to

- State the three main principle or laws of inheritance defined by Gregor Mendel.
- Explain the role of variable alleles in the expression of different traits in different individuals.
- Construct and operate Punnett Squares.
- Analyze the genotypic and phenotypic ratios predicted by different purebred, hybrid, and dihybrid crosses.
- Evaluate the modern application of Mendelian genetics to complex patterns of inheritance, including incomplete dominance, co-dominance, multiple alleles, and sex linked genes.

❑ Degree of student achievement

When questioned and called on, the class was to make predictions and support the information they learned in this presentation with evidence from previous lessons on mitosis, meiosis, and the characteristics of living things. As a class, the students used their observations, reasoning, and questioning to achieve each of the learning goals outlined above.

❑ Changes needed in main goal(s)

The learning goals for this lesson appeared to be achievable and relevant. The final learning goal was the most challenging learning goal for the students. I think this learning goal could have been have been an objective for the entire unit. The students could spend many days practicing and applying the rules of Mendelian genetics to different traits, populations, and inheritance mechanisms.

Learning Tools

❑ Learning tools used

For this short lesson I used only PowerPoint presentation with images and key terms. I projected the document on the overhead and gave the students a handout with six sides per page for note taking.

❑ Their effectiveness

The students were very pleased with the completeness of the notes handout. I learned later that Ms. Schroer normally omits important words and phrases on her handouts to help students stay focused. However, I wanted the students to have the key terms and phrases on the handouts as a minimum to allow them more time to copy down interesting notes, phrases and diagrams that would help them understand and remember the concepts later in their studying.

❑ Future changes

In the future, I would discard the entire PowerPoint document. I might use some of the images and diagrams to illustrate key points to students, but I would not run these images as a slideshow going from one idea to the next. Rather, I would use them as a reference to come back to again and again as new discoveries are made. I would use or create multiple new learning tools to introduce the topic of Mendelian Genetics if I were able to plan my lesson using a more student-centered approach, such as the 5E Model.

Student Grouping

- Format used

The students were not grouped for this activity. The class itself is only made up of a small group of students and they were all addressed simultaneously in their usual seating arrangement.

- Its effectiveness

In this class of 9 students, whole class discussions work very well. During the lesson there were many opportunities to hear everyone speak and offer predictions or explanations. The physical arrangement of the class makes it easy to see everyone's work and navigate through the rows to answer questions.

- Changes needed

I would not change the student grouping for this lesson. There are many activities that can be used to introduce topics in Mendelian genetics which would require different student groupings. However, with a class of nine students an activity, such as a Jigsaw, would have been difficult to use.

Activities

- Activities used

The main activity used in this lesson was the presentation of a PowerPoint on Mendelian genetics. However, I encouraged students to participate in the presentation by setting aside time for the students to be engaged in question and answer discussions, note taking, making predictions, performing Punnett Squares, and evaluating "what if" scenarios.

- Their effectiveness

The students appeared to loose interest in the middle of the presentation, but were brought back to focus by the end of the presentation when the discussion shifted to applications of inheritance in society with individuals, populations, and research. The students seemed particularly interested in a discussion on genetic disorders – including sickle cell anemia, trisomy x, muscular dystrophy, down syndrome, and others – and what mechanisms of inheritance allow these disorders to appear in society and drastically alter an individual's experience of life.

- Future changes

In the future, I would begin the lesson with an intriguing case or story of a person who struggled with a genetic disorder and allow the questions from their discussion of the case to introduce, guide students through and engage students in the topics within Mendelian genetics. I would replace the PowerPoint presentation with a series of activities that make it easier to engage students and allow periodic movement around that classroom to keep students focused and alert during their first block of the day.

Assessments

- Techniques used

I formatively checked for understanding by asking questions targeted at particular students throughout lesson and reviewing the student's written responses to example problems that were incorporated into the presentation. I tried to lead discussions and provide practice problems that would help the students demonstrate their ability to master each of the lesson objectives. However, the students would continue to work on and explore Mendelian genetics problems throughout the week through various activities and assignments.

- Their effectiveness

This form of assessment helped to interrupt the presentation and allow the students to become more involved or engaged in the material. For many students, this lesson was the first time they had seen genetics since 10th grade. As the instructor for the mini lesson, I had very little idea to begin with for how much prior knowledge the students had or remembered. By assessing the students understanding at various

checkpoints throughout the presentation, I was able to adjust the depth of my explanations in response to what students seemed to already know and what they had more questions about. However, it was difficult to go around to check each student's work on more complex problems, such a dihybrid cross for a sex-linked trait. As I was reviewing a student's work, other students became bored and fidgety.

- Future changes

In the future, I would use a greater variety of activities to allow me to assess the students learning in multiple forms. I would include an individual written assessment of student learning at the beginning and end of the lesson to obtain a more reliable measure of the students' level of improvement.

General Reflections

After my short lesson presentation, 30 minutes, Ms. Schroer reviewed the positive aspects of my presentation and areas she suggested I could improve on. Overall, she liked the way I involved the students in the presentation by leaving examples open ended for the students to work out aloud and, as a group, explain the underlying processes based on their prior knowledge and new discoveries. Ms. Schroer then gave me lots of advise and helpful hints on differentiating material for struggling and advanced learners and told me how I could have adjusted my presentation. Ms. Schroer also allowed the students to contribute their own, anonymous, constructive criticism of my presentation. Their comments were brief, but very helpful to me as I work toward finding my own voice as a teacher.

EXTENDED LESSON PLAN 1

Presented October 5th and 7th, 2009
Observed by University Supervisor (ST-8)

Topic: Cell Theory
Subject: Biology/Ag

Class: 2nd block
Grade: 10th

Lesson Content

Virginia Standards of Learning:

Bio 1. The student will plan and conduct investigations in which
- a) observations of living organisms are recorded in the lab and in the field;
- l) alternative scientific explanations and models are recognized and analyzed; and
- m) a scientific viewpoint is constructed and defended (the nature of science).

Bio.2 The student will investigate and understand the history of biological concepts. Key concepts include
- a) evidence supporting the cell theory; and
- e) the collaborative efforts of scientists, past and present

Lesson Objectives (UKDs): *As a result of this lesson students will:*

- **Understand that...**

- The development of the microscope and the independent observations and experiments of various scientists led to the rejection of the theory of spontaneous generation and, over time, the proposal of modern cell theory.
- Scientific investigations are based on observations and testable hypotheses. Science is collaborative and all scientific conclusions are subject to peer review over time.

- **Know. . .**

- The three main tenants of cell theory accepted by scientists by the end of the 19th century.
- The widely accepted views held by society and the scientific community about the basic units of life and the origins of living organisms prior to the discoveries of key scientists, such as Anton van Leeuwenhoek, Robert Hooke, Robert Brown, Matthias Schleiden, Theodore Schwann, and Rudolf Virchow.
- The tools, observations, and experiments which led key scientists between the 1600's and 1900's to their conclusions related to cell theory.
- The methods used by scientists to observe cells through a microscope.

- **be able to (SWBAT). . .**

- Make predictions based on observations of natural occurrences.
- Describe the three main tenants of the cell theory formed by the late 1800s.
- Interpret past, recorded observations of cells.
- Evaluate the evidence used to support scientific hypotheses of the nature of cells and the origin of life.
- Organize the discoveries made by various scientists which were used to develop the cell theory.
- Draw observations of cell parts from microscope field views.

Brief Overview:

In this lesson the students will be introduced to the concept of spontaneous generation, the processes of scientific observation and review, and the development of the cell theory over time. Students will learn about the collaborative nature of science by studying the contribution of several independent observations to a single overarching theory, while participating in their own collaborative learning experience. The students will also be given the opportunity to independently explore cells using the microscope.

Steps in the Lesson:

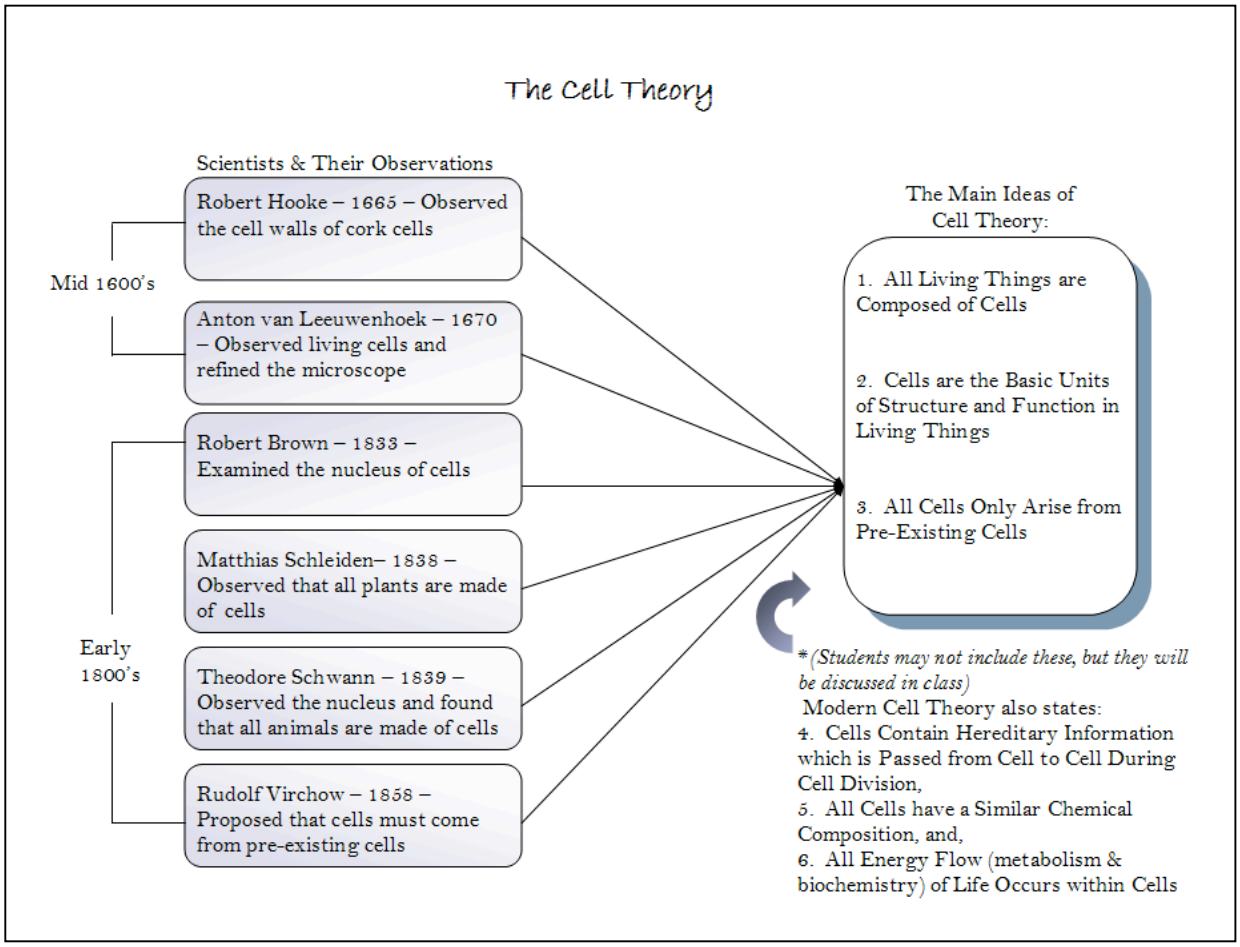
6. Engage: (10min) In the beginning of the block, I will introduce the students to the social environment of Europe during the 1500's and 1600s which gave rise to scientific investigations exploring origin of cells. I will explain what daily life was like, where questions about the natural world arose, and what type of men became scientists (gentlemen with leisure time – science was cool and fashionable!) Then, I will hand each base group/pair of students in the class a half sheet of paper describing a daily event people observed and ask students to make predictions. For example, medieval farmers stored grain in barns with thatched roofs. As a roof aged, it would often start leaking which would cause the grain to become moldy or spoiled. Then lots of mice would appear (other than the neighboring fields – where the first mouse came from). The students will be asked to predict where the mice came from. Each group with a different scenario or observation will share their prediction and we will see if the students came up with a similar explanation of the origins of lower life forms as early Europeans did. If their predictions were different, we will discuss what prior knowledge led them to think differently. I will tie these explanations to the concept of spontaneous generation.

7. Explore: (40min) The students will participate in a jigsaw activity to learn and teach each other about the major findings of key cell scientists during the 1600s and 1800s. There will be four folders in different locations around the room. The students will be divided into pairs and assigned to these groups based on readiness level for this particular topic. The groups will study Anton van Leeuwenhoek, Robert Hooke, Robert Brown, and Matthias Schleiden & Theodore Schwann. In each folder there will be pictures of the objects these scientists observed, tools, used, and actual view through the microscope they drew. The students will then try to draw a conclusion about cells based on the visual artifacts. Then they will each read a fictional newspaper article from the scientists' time describing their biography, research, conclusions, and interesting/quirky facts. The students will complete differentiated worksheets that each ask for the scientists' origin, major experiment or observation, and contribution to our knowledge of cells. The students will then form two large groups of four or five, with at least one person from each pair in each group. They will share their discoveries and help one another complete a worksheet that compiles the information for each scientist. As groups finish, the students will begin exploring the appearance of cells under a microscope using a mini-lab that directs them through observing onion cells, cheek cells, and skin cells using a compound light microscope. The students will draw diagrams of the views they see just as the scientists they studied earlier in the lesson did in their own research.

8. Explain: (20min)) I will go over the worksheet with the class, asking for their answers and elaborating. I will then introduce another scientist, Rudolf Virchow. I will pass around pictures of his observations and describe the other research of the time that influenced his proposal – all cells must come from pre-existing cells. I describe this as the last of three tenets of the cell theory and list the other two that the students have already described from their discussion of van Leeuwenhoek, Hooke, Schleiden, and Schwann. I will then briefly describe later experiments that further disproved spontaneous generation and also contributed to our modern understanding of cell theory.

9. Extend: (5min) As a class we will then watch a video, *The Inner Life of a Cell*, produced by Harvard researchers to show that cells are not stagnant and to introduce the structures and functions of cells that will be studied in later lessons as active organelles that are constantly involved in processes that make cells work.

10. Evaluate: (10min) The students will be given a graphic organizer to go in their notes to help them practice identifying the contribution of each scientist and also serving as a quick reference on the major principles of cell theory that they may be able to refer back to as they continue their unit on cells. The students' large group handouts and graphic organizers will be collected at the end of class to ensure students understand the material and have correct information for their notes.



EXTENDED LESSON PLAN 2

Presented November 2nd, 4th, and 9th, 2009
Recorded and Modified for iMovie Project

Topic: Mitosis
Subject: Genomics
Class: Ag./Biology, 2nd Block
Grade: 10th

Lesson Content

Virginia Standards of Learning:

Bio 6. The student will investigate and understand common mechanics of inheritance and protein synthesis. Key concepts include:
a) Cell growth and division
Bio 1. The student will plan and conduct investigations in which
a) Observations of living organisms are recorded in the lab and in the field

Lesson Objectives (UKDs): *As a result of this lesson students will:*

- **Understand that...**

- Cell division results in genetically identical daughter cells.
- The mitotic phase is only part of the cell cycle in which cells grow and divide.
- The eukaryotic cell cycle is regulated by a molecular control system.

- **Know. . .**

- The role of mitosis in the reproduction, growth, development, repair, and renewal of eukaryotic organisms.
- The phases of the cell cycle, including interphase (G1, S, G2), mitosis (prophase, metaphase, anaphase, telophase), and cytokinesis.
- The characteristics, movement, and assortment of chromosomes during the cell cycle.
- The mechanisms by which eukaryotic organisms control and check the cell cycle.
- The possible result of errors in the replication and division of nuclear materials during the cell cycle.

- **be able to (SWBAT). . .**

- Discuss the role of cell division in single celled and multicellular eukaryotic organisms.
- Describe and summarize the phases of the cell cycle.
- Create a moving model illustrating the distribution of chromosomes during mitosis.
- Predict where mistakes in the phases of the cell cycle could occur, how the cell or organism would be effected, and determine possible solutions for cells.
- Identify the checkpoints and mechanisms used to control the cell cycle in eukaryotic cells.
- Analyze how errors in mitosis can lead to cancer growth.

Essential Question:

What is the role of the cell cycle in Eukaryotic organisms? How are the phases of mitosis carried out and regulated by cells to produce genetically identical daughter cells? How can scientists use knowledge of the cell cycle to improve our understanding of human health (tissue maintenance, growth, and disorders)?

Brief Overview:

In this lesson, the students will discuss the role of cell division and the cell cycle. The students will have the opportunity to explore the different phases and processes involved in mitosis using compound light microscopes. The class will discuss the points where error can be introduced and the mechanisms used in eukaryotic cells to ensure identical replication of genetic material during mitosis.

Materials:

- Single eukaryotic cell labels for the human body
- Dry erase board and markers
- Onion root tip slides, compound light microscopes, and photographs
- Handout for onion root tip exploration
- Handout for notes on the stages of the cell cycle and checkpoints
- Handout for brainstorm activity adapted from "Genes in Motion", yarn, and scissors
- Handout on control of the cell cycle, textbooks
- Index cards

Steps in the Lesson:

1. Engage: (15 minutes) I will introduce the topic the class will be exploring during the block – Mitosis and the cell cycle. To review what the students already know about cells and genes, and to engage student interest in the topic, I will ask for a student assistant in the class to be a model human being. The student will come to the front of the room and I will give them directions to tape one different piece of paper on each of their feet, hands, arms, legs, stomach, and head which will represent single eukaryotic cells. Then I will ask the class, "Suppose that your hand or your arm or your leg was made up of only one cell. What would happen if that cell stopped working or died?" I will draw an X over the hand cell. Possible answers might be that you would loose your entire hand, the body part would no longer function, or the cell would fall off. I will then ask the students to predict how many cells are in the human body. (It is impossible to count, but scientists estimate about 50 to 100 trillion cells – 100,000,000,000,000). What happens if just one cell in your hand or body dies, either from an accident or normal wear and tear? Will you loose your whole hand? (No). What does the body do to replace cells that die? Do wounds heal from the outside in or inside out? (Outside in because other cells divide to fill in the space left by the cell that died). I will write on the board "*Omnis cellula e cellula"* (Every cell from a cell) and ask students, thinking back to cell theory, what scientist stated this. (Rudolf Virchow). So when we talk about mitosis today, we are going to be talking about a process of cell division that allows us to make new cells from pre-existing cells. I will give the students a definition of mitosis to write in their notes. Mitosis is a process of cell division in eukaryotes that produces two new nuclei that have the same number of chromosomes. I will explain that today we are going to look at what happens in a cell during mitosis and what can happen when mitosis goes wrong. First, we will think about "Why mitosis?". We will try to come up with a list of where we use mitosis in our bodies and where other organisms can use this process. Students should include this in their notes.
    a. Tissue repair or renewal: We already mentioned one in thinking about how wounds heal.

Cells can divide to heal, repair, or create new tissue. It is important to think about how most of the time division occurs in cells of the same cell type to produce replacement cells – that is why stem cell research is so fascinating.

b. Growth and development: Thinking back to where we came from, I can ask students how many cells they had when they were born? (Probably still in the trillions) and how many cells they had when they were only a few days conceived? Although a different process produces that first fertilized egg cell, mitosis is how we get to be multicellular organisms.
c. Reproduction: Thinking back to when the students were studying single celled eukaryotic organisms (protists), I can ask the students to explain what would happen if their single cell divides. (Two new protists are formed). Going back to the definition I gave them, I can ask why we say archaea and bacteria do not undergo mitosis even though they also reproduce asexually, with one parent dividing to produce two. (Bacteria and Archaea do not have a defined nucleus to divide) Then I can explain how some multicellular organisms can also reproduce through mitosis. (Hydra go through budding, strawberries go through vegetative reproduction, and sea stars can grow from a fragment of the old one)

2. Explore: (30 minutes) I will have set up at 6 tables a microscope pin pointing a particular cell of an onion root tip undergoing the different stages of the cell cycle. (There will be one for interphase, prophase, metaphase, anaphase, telophase, and cytokinesis). Before encouraging the students to explore these stations, I will give a brief overview of the characteristics of chromosomes and the importance of their activity during the cell cycle. I will tell the students to look carefully for what is happening at each stage and start to think about how the stages fit together with one another. The stations are just snapshots of a process cells are continually undergoing. I will give each student a handout to guide their observations at each station. The students will work in pairs to rotate through each of the 6 stations. I'm going to give each group about five minutes to work on each station, but they can switch before that if you see one open. The students should talk to each other about what they are seeing and what they think is happening to the cell.

3. Explain: (25 minutes) The class will come together and I will help walk the students through each of the phases of the cell cycle. I will encourage the students to share their observations and describe what they saw at each station by calling on particular students. I will draw a picture of what they tell me they saw on the board and then tell them the name scientists have given each of the processes and structures they described. I will give the students a handout to write notes for each of stage of the cell cycle. I will write down the main points and terms on the board as we go along. I will elaborate on certain stages, for example, including the difference between cytokinesis in animal and plant cells due to the cell wall. Then I will give the students another handout that asks them to brainstorm individually ways they could act out each of the steps of mitosis. The handout will give students clues, but I will also encourage students to think creatively. As a class we will discuss each of their ideas. I will help the students generate a list of parts and assign roles (For example, spindle fibers and sister chromatids. There will probably be too many roles. Yarn or string can be used to represent the nuclear and cell membranes.). The class will work together to act out mitosis in a fluid and clear way. The students will have to defend how each of their movements represents a process in cell division. After students re-enact mitosis, they will watch a sort animation on mitosis. Then I will ask them to reflect on their performance and evaluate, compared to the movie, how well their model could be used to explain the cell cycle.

4. Elaborate: (15 minutes) Based on their knew knowledge of the goals of cell division, I will ask the students to individually predict where things can go wrong during the cell cycle and what consequences these mistakes could have for cell or whole eukaryotic organism. (They can think first in terms of what has to go right to get two daughter cells with identical genetic

instructions). Then, I will ask students to read page 126 of their textbook and take notes. I will ask them as a group to describe the checkpoints used by eukaryotic cells to regulate the cell cycle. Students will be selected to draw the stoplights where in the cell cycle these checkpoints occur and what the cell is checking for. Students will also be asked to explain how cell division plays a role in the development of cancer and predict two methods the cell can use to prevent damaged DNA from becoming cancerous. (Repair the DNA or force the cell with damaged DNA to die – I will need to introduce the term apoptosis, which is not in their textbooks). We will go over the main ideas in control of the cell cycle and add key points and terms to the back of their notes handout.

5. Evaluate: (5 minutes) To check for understanding, I will ask the students before leaving to spend a couple minutes answering the following questions, without looking back at their notes, on an index card:
    1. The life of a eukaryotic cell includes three main phases, _____, _____, and _____. (interphase, mitosis, cytokinesis)
    2. Mitosis divides a cell's _____ equally between two daughter cells, while cytokinesis divides _____. (chromosomes, the cytoplasm)
    3. The cell has many proteins and feedback mechanisms that act like stoplights at the _____, _____, and _____ checkpoints to inspect whether the cell is ready to continue to the next phase in the cell cycle. (Cell growth/G1, DNA synthesis/G2, Mitosis)
    4. Think about: (students will not have to write an answer for this question) What would happen if mitosis was used produce entirely new individuals in humans the way it does for single-celled eukaryotic organisms?