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Integrated Methods General Candidate Work Sample

ED 433-Dr. McAllister

Section One

Instructional Strategies

During lesson number two, students used the process of inquiry to investigate diffusion through a laboratory activity with dialysis, cornstarch and iodine. While as the instructor, I could have provided the students with the "cookbook" like instructions, I chose to use the inquiry approach of posing the students with the dilemma, "Does water move through a membrane?" Scholars have demonstrated that inquiry based learning in the science classroom is the strategy most reflective of the work of professional scientists (Handelsman et al., 521). Through inquiry, students are encouraged to construct their knowledge themselves making their learning more personal and relevant than a simple lecture or guided lab procedure. Furthermore, using inquiry based practices helps students to develop the "soft skills" of communication, collaboration, and self-directed learning which are not measured academically but are critical life-long learning skills (Hmelo-Silver et al., 106). In addition to the strategy of inquiry in this lesson, I used student generated questions, student choice for summative assessment in the form of a vine, and mini-lecture as strategies to engaged learners in various manners.

For the inquiry lab, the students were instructed to develop their own method to answer question which they had to have approved before they could continue to carry out their experimentation. Students were informed through a demonstration that cornstarch reacted with iodine to turn purple. As students broke up into their assigned lab groups, and I moved about the classroom, I heard many different "what if" questions provoked by the initial question including, "what will happen if we put the dialysis tubing in the water mixed with cornstarch?" "what will happen if we add only iodine and water to the tubing and mix the cornstarch with water and set the tubing in this mixture?" Each of these questions demonstrated that students were considering

how they could demonstrate the movement of water, in addition to, the multiple methods of conducting science experiments (the multiplicity of science).

This lesson facilitated the development of the basic process skills of observing, and inferring as students had to observe the iodine reacting to the cornstarch and infer how this would react when combined with water and used with the dialysis tubing. Students were encouraged to develop their prediction skills as they had to develop an experimental design to demonstrate the process of osmosis to test a hypothesis. Through this lesson, students also had to interpret the results of their experiment to demonstrate if they could conclude their model of the process of osmosis worked. Students were able to develop basic as well as integrated process skills through the application of this lesson in the classroom.

This lesson was difficult for some students who struggled without explicit instructions. I noticed particular groups were slow to address the question and needed significant prompting to begin working on the problem. I feel that this was a particular weakness of the lesson. In addition, I think I did a poor job of demonstrating the relevance of understanding water movement through membranes. If I were to make adjustments to this lesson, I would set the students up with a formal problem instead of relying on a question--something to the effect of contaminated water samples and testing for contamination without being able to handle the water sample. I think this method would have generated more student engagement. I think overall the greatest strength of this lesson was the inquiry approach itself. This process got students out of their seats, working collaboratively in the lab setting, and thinking in a scientific manner to make predictions, observations, and conduct a testable experiment.

For the additional strategies that I used as an instructor, the most effective was the mini lecture as the explanation piece of the 5 E cycle. Students were provided with a handout to paste in their interactive notebooks and then they were instructed on notes to include in their notebooks about membranes. While the other methods used in this lesson were successful, I would assert that this was the most successful for helping the students to understand the information and for me to address questions and misconceptions. The weakness with this activity is that student engagement can be quickly lost if the information is presented in too long a manner. I liked the Vine activity, but this was difficult to facilitate and did not result in any actual products because we struggled with the technology. The weakness of this activity was in it's risk factor--it was a risky activity which had potential not to produce results. If I were to

amend this activity, I would either just have the students perform their Vines in front of the class or I would have tested the technology and provided an explicit example. I did not initially do this because I was hesitant to provide an example since a key component of the activity is to allow for student creativity; I feel that providing a model can eliminate a certain amount of student creativity all together as students just slightly adjust the example to fit their assignment. Another method might have worked better here to have the students demonstrate a particular form of transport through inventing a game or writing a skit.

Overall, I was happy with the use of the inquiry process in this lesson. While at times it was difficult, I think it benefited the students and allowed them to think critically by challenging them to think like scientists to answer a question. I am able to reflect on how I need more experience with this practice and on the ways I would change the lesson to be better, but in conclusion, I am excited about continuing the practice of inquiry in my future classroom.

References

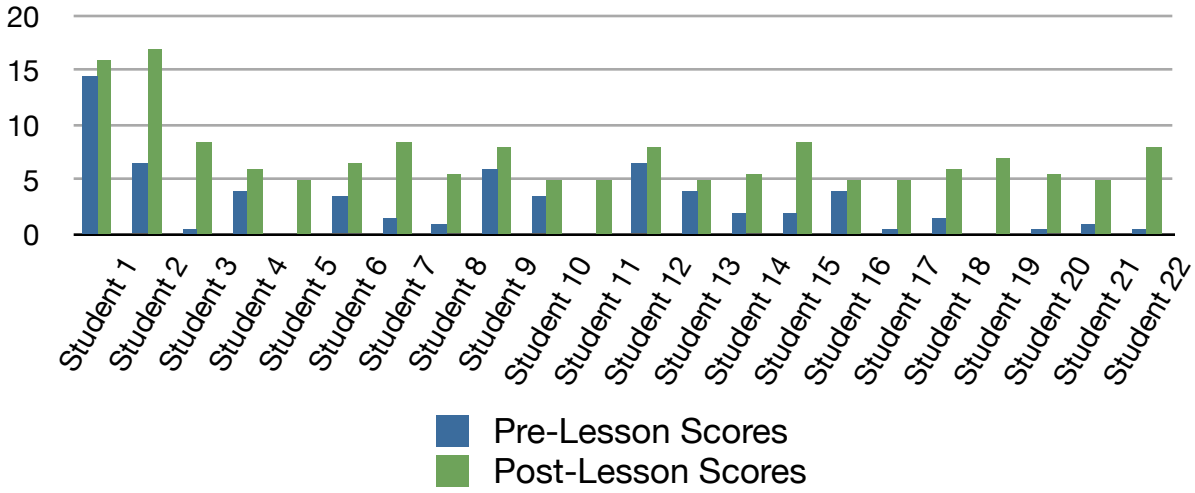
Handelsman, Jo, Diane Ebert-May, Robert Beichner, Peter Bruns, Amy Chang, Robert DeHann, Tim Gentile, Sarah Lauffer, James Stewart, Shirley M. Tilghman, and Willaim B. Wood. 2004. Scientific Teaching. *Science.* 304, 521-522.

Hmelo-Silver, Cindy E., Ravit Golan Duncan, and Clark A. Chinn. 2007. Scaffolding and Achievement in Problem-Based and Inquiry Learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*. 42(2), 99-107.

Section Two

Analysis of Pre Lesson and Post Lesson Assessments

	Pre	Post	Difference
Student 1	14.5	16	1.5
Student 2	6.5	17	10.5
Student 3	0.5	6.5	6
Student 4	4	5	1
Student 5	0	6.5	6.5
Student 6	3.5	6.5	3
Student 7	1.5	8.5	7
Student 8	1	6.5	5.5
Student 9	6	8	2
Student 10	3.5	5.5	2
Student 11	0	5	5
Student 12	6.5	8	1.5
Student 13	4	5	1
Student 14	2	5.5	3.5
Student 15	2	8.5	6.5
Student 16	4	5	1
Student 17	0.5	5	4.5
Student 18	1.5	6	4.5
Student 19	0	7	7
Student 20	0.5	5.5	5
Student 21	1	5	4
Student 22	0.5	8	7.5
	Descriptive Statistics	**Descriptive Statistics**	
Range	14.5	12	9.5
Median	1.75	6.5	4.5
Mode	0.5	5	1
Mean	2.88636363636364	7.25	4.36363636363636
Total For Exam:	20 points	20 points	



Prior to the start of the first lesson on membranes, I passed out a short 20 point quiz to the students to gauge their background knowledge and to inform my instruction. The students reaction to the quiz was immediately disheartening. I had structured the quiz to be entirely short answer, staying away from multiple choice because this could produce false positives if the students just guessed at answers. Shortly after I handed out the quiz, hands were in the air as students were anxious about clarifying that this was not for a grade. They seemed unfamiliar with the pre-testing protocol, mostly because I think this was a practice Mr. Drumwright had not used in the classroom with them.

In order to alleviate some of the stress which was quickly mounting in the room as students began to work through the problems, I stopped the students short and amended the instruction. I asked the students to circle or mark all the questions in which they had absolutely no idea. I further asked them to underline vocabulary which was unfamiliar. If they had an idea of the correct answer, they were encouraged to put it. By amending the instructions in this manner I hoped to inform my instruction so I knew which skills to target for future lessons, as well as reduce the pressure on the students in this situation.

In looking at the results of the pre-test, it seems conclusive that many of the students were highly unfamiliar with the content. The scores on the pre-test ranged from 0 to 14.5 out of the 20 points possible which is a statistic reflective of the large disparity in skill amongst this particular group of students. The score of 14.5 serves to skew the overall a scores significantly as it is 8 points above the next closest score. Without this score, the spread decrease to 0 to 6.5 points with the average score dropping from 2.89 to 2.33 with a median score of 1.75.

In the administration of the post test, students were more familiar with the procedure, and seemed relaxed. The same exam was given for the post test immediately after the lesson, and from the results, we observe an initial jump in average score up to 7.25. There were two high scores from this round of testing which served to through off the scores. When reanalyzed without these two scores, the range decreased from 12 points to 3.5 and the average moved up from 7.25 to 6.33 with the median at 6 points.

If we are to determine the effectiveness of this lesson at achieving the target learning objectives specified in the lesson plan, we would deem this lesson only mildly successful at achieving the learning objectives tested in the quiz. While the average score increased nearly three fold, the scores remain well below the passing rate for the quiz which was out of 20 total

points. In closer examination, breaking down the quiz question by question, some questions were more consistently correctly answered than others. For example, question 2 about the structure of the membrane, was answered correctly 85% of the time as opposed to question 4 about the type of transport being depicted--this question was only answered correctly 9% of the time (2 instances). Question 5 was never correctly answered. This could potentially lead us to concluded that either the lesson and quiz were misaligned or a particular concept was not covered in adequate detail for students who needed more time to learn the material.

Analysis of Student 1

Student 1, who we will refer to here as Kyle, scored well above his peers in the pre test. While this particular section of Mr. Drumwright's class includes a wide range of student abilities, Kyle consistently stands apart as near the upper end of the class. He seems to posses more background knowledge than the other students but, when looking at his quiz, some serious misconceptions which needed to be addressed. Kyle is a quiet student who is reluctant in leadership roles although I have tried to encourage him to assume one among his peers. He posses a particular talent for drawing--one of the first observations I made about him in class was his continuous doodling at the side of his notebook. Kyle was one of the two students to answer question number 4 about transport types correctly. He had attempted this question in the pre-test producing the wrong answer, however, over the course of the lesson he seemed to correct his mistake and correctly answer the question by the end of the class. Kyle, like many students incorrectly answered the last question, number 5, but he did attempt it both times.

Analysis of Student 2

Student 2, who we will refer to here as Tie, significantly increased his score from the pre to post test. The average increase in score from the pre to post test was 4.4 points, while Tie increased his score by 10.5 points. Tie is historically a good student with slightly above average test scores. He works hard in the classroom and will ask questions if he is confused. He was highly engaged in the lesson, exhibiting more effort than I have seen before, throughout the 50 minute period asking questions and completing the activities. This seemed to increase his understanding as he was able to demonstrate his knowledge on the post test.

Analysis of Student 3

Student 3, who we will refer to her as Rachel, was most reflective of the rest of the class. Her score increased from 0.5 to 6.5 from her pre test to her post test. Rachel is one of the more vocal students in the class, she participates well and always raises her hand, but she is quickly distracted by the conversations taking place around her. She is a student who is easy to engage but difficult to monitor. Rachel's tests exhibited patterns consistent with her peers, she did not attempt the last question but answered the majority of the first, second, and third question. Because she represents the average, it seems fair to conclude that the quiz and the lesson were somewhat misaligned and the students needed more time with a few of the concepts before they would have felt comfortable demonstrating them on a quiz.

Conclusions

After examining these three particular students scores, in conjunction with the scores from the rest of the class, it seems that the quiz did not adequately address the lesson plan, or the students needed more time with a few ideas before they could demonstrate them on an exam. For example, students seemed to understand and correctly answer question 2 about membrane structure, however, when asked about hypertonic, hypotonic, and isotonic solutions in question number 5, not a single individual could answer that question. While this makes sense because these tasks represent two levels of Bloom's Taxonomy, it is important to acknowledge that this is why exams must be designed and aligned with units from the beginning--so it is always clear that the learning objectives being met through lessons, are also being tested.

Section Three

Planning

Stage One: Desired Results
Established Goals: Students will understand that all organisms are made of cells and that life is a quality which distinguishes living things from non-living things. Students will be able to know that organisms are complex organized and built on a hierarchical structure from chemical foundations to cells and systems of organisms, to species and populations. Students will be able to identify that a central feature of life is that organisms grow, reproduce, and die transferring their genes to their offspring. Students will be able to explain how traits are unevenly distributed in a population contributing to diversity.
Standards: **Next Generation Science Standards** **HS-LS1-4.** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. [Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.] **HS-LS3-1.** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.] **HS-LS3-2.** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.] **HS-LS3-3.** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]
Data Used: Debating Rubric and Cells Exam

Stage One: Desired Results	
Understandings: Students will understand that... 1. All organisms are made up of cells. 2. Cells grow and divide by the process of either mitosis or meiosis. 3. The phases of cell growth include Interphase which is made up of G1, S, and G2. 4. The phases of cell division include Interphase, Prophase, Metaphase, Anaphase, Telophase, and Cytokinesis 5. Cells specialize to form tissues which from organs. 6. DNA and chromosomes code genetic information which is heritable by offspring 7. The process of meiosis produces gametes which may be genetical variable from parent cells. 8. Mutations due environmental factors also cause genetic diversity. 9. Traits are not evenly distributed in a population.	**Essential Questions...** 1. What are the steps in the process of gamete cell growth and division? 2. What are the steps in the process of somatic cell growth and division? 3. How are tissues and organs formed? 4. What is the role of DNA in and chromosomes in coding information to be passed from parent to offspring? 5. How does genetic variation occur? 6. How are traits distributed in a population?
Students Will Know... 1. Cells are the most basic unit of life. 2. Growth, Mitosis, and Meiosis are the processes of cell division. 3. Science cannot answer all questions (the tentative nature of science) but it is a framework for how we answer and solve difficult problems. 4. Morality and law are important in science (subjective nature of science) and determine the “limits” of science.	**Students Will Be Able To...** 1. Model the process of cell growth and division. 2. Describe that cells are the basic unit of life which specialize to form tissues, organs, and organ systems resulting in a complex organism. 3. Apply statistical analysis to explain variation and distribution of traits in a population. 4. Make and defend claims based on evidence for where new genetic information comes from.

Stage Two: Assessment
Performance Tasks: Debate, Cell Growth and Reproduction Exam
Self Assessments: Exit slips, Homework, Closure Activities.
Standard Assessments: n/a
Other Assessments: Debate Rubric, Presentation Rubric

Stage 3: Learning Plan
Learning Activities: The following at 8 abbreviated lesson plans which include the central topic, key objectives, summary of student activity and how learning will be assessed in this lesson. **Lesson #1: The Basic Unit of Life: Structures of the Cell** Objectives: Students will understand that the basic unit of life is the cell which is a complex unit made up of many organelles. Students will begin view themselves as critical thinkers and competent scientists through the use of inquiry. Inquiry unit on cell membranes. Students be engaged in through an inquiry lab to better understand how cells maintain homeostasis through processes like transport, diffusion, and osmosis. Using cornstarch and iodine students will be posed with the problem of identifying the contents of "the cell" (in this case dialysis tubing) without being able to directly access the contents inside dialysis tubing. Students will have to create a laboratory procedure using collaboration with their peers to test their a hypothesis. Through this lesson students will develop various process skills which will be formatively assessed through observation and summatively assessed through the lab procedures they produce. After the lab is complete, students will participate in an interactive lecture (the explanation process of the 5 E Cycle, to clarify their learning about the cellular processes of transport). Assessment: Laboratory procedures, observations of students in the lab. **Lesson #2: Cells: Carriers of our Genetic Code.** Objectives: Students will be able to describe how cells carry or genetic information in the nucleus of the cell. Students will be able to generalize how information in science is tentative and changing as new discoveries are made. Students will be able to identify important characteristics of the nature of science. Students will participate in an investigation about the structure of DNA through a jigsaw activity. Students will be introduced to the idea of DNA as the "stuff" inside of the nucleus but they will be left with the idea that one of the most significant questions of the 20th century was the search to understand this "stuff" and how it was structured. Students, organized in collaborative groups, will be provided with packets which have materials including articles, comics, and basic facts about the search for DNA. They will be asked to complete "research" and identify the main ideas of their information which they will share out to the class ultimately forming a timeline for the discovery and explanation of the structure of DNA. Class will end with a discussion on how the scientists demonstrated the nature of science. Students will be posed with a specific question based on the contents their packet and asked to discuss how the information they had described a particular tenant of the nature of science. This lesson specifically targets the tentative nature of science, how information in science is creative, how there is no universal scientific method, the difference between theory and law, the naturalistic method of science, as well as the multiple contributions made to science theories. Assessment: Student presentations of information, creation of a timeline, student discussion.

Stage 3: Learning Plan
Lesson #3: DNA and Chromosomes Explained Ojectives: Students will be able to explain the difference between DNA and chromosomes. Students will be able to predict that DNA is passed from parent to offspring resulting in the continued flow of DNA. It will be important for students to have an explanation for the importance of DNA and it's foundation in biology as a unifying concept. Therefore, this lesson would consist mostly of a student driven lecture after previewing the "Genome Treasure Trove" video http://newsvote.bbc.co.uk/2/hi/science/nature/1164839.stm Students will be posed with the questions after the video: Do you think we could predict how similar or different organisms would be if we only had the DNA sequences to look at? And lecture will follow based on student response. Assessment: Homework #3 on the Human Genome Project. See below. **Lesson #4: Cell Growth and Reproduction** Objectives: Students will be able to model the growth and reproduction of cells in mitosis. Students will engage with a guided laboratory using slides of onion tips which show cell growth and division. Student will be asked to make observations about the differences in the cells they observe in the root tip and this will lead to the creation of class generalizations. After compiling the observations, a mini-lecture will be completed formally explaining the process of cell growth and division. Students will then be asked to arrange a series of models of the stages of cell division from start to finish. Assessment: Student Lab-note books with recorded observations, Classroom discussion. **Lesson #5: Cell Growth and Reproduction Cont.** Objectives: Students will be able to model the process of meiosis in cells in differentiating and maintaining life. Students will complete the http://www.cellsalive.com/ activity on meiosis. Students will be given 10-15 minutes to complete the activity and then review mitosis in a teacher led discussion. Students will then engage in a compare and contrast activity in their notebooks, for the differences in mitosis and meiosis. At the conclusion of this, students will be given pipe-cleaners of different colors and instructed to arrange them in the phases of either mitosis or meiosis as called out by the instructor. Assessment: Formative through the manipulation of the pipe-cleaners.

Stage 3: Learning Plan
Lesson #6: Science and Society Objectives: Students will be able to synthesize through their understanding of DNA and the process of meiosis, that genetic diversity exists. Students will be able to understand that genetic diversity is key to health. Students will engage with case study packets in another jigsaw activity in their collaborative lab groups to investigate topics in science and society around genetics. This will lead to the formation of debate groups to debate ethical issues around rights to cells, genetic screening, human testing, etc. Student will be asked to formulate a debate group and then engage in a socratic style debate using the information they have leaned and reconciling it with what they believe. This will help foster a commitment to personal values, and critical thinking and discussion skills. Assessment: Summative via debate rubric. **Lesson #7: Case Studies** Objective: Students will apply the concept of statistics to explain the distribution of characteristics in populations. Students will be allowed to choose a topic ranging from polydactyly, colorblindness, or muscular dystrophy and asked to complete and independent study on the topic. They will used class time to research their topic using technology. Students will have to explain the frequency of their case, the first known case, how is it inherited, it's characteristics, if their are treatments, and other important features of their topic to their classmates in a presentation. Students will have to create a visual aide to go with their presentation. This lesson plan will focus on issues in science and how science is used to assist in society through technology and advances. Assessment: Summative Presentations. **Lesson #8: Review Lesson** Objectives: Students will be able to understand the hierarchical structure of life from chemical foundations to cells and systems of organisms, to species and populations. Students will be able to identify that a central feature of life is that organisms grow, reproduce, and die transferring their genes to their offspring. Students will be able to explain how traits are unevenly distributed in a population contributing to diversity. Students will complete a unit review activity before the exam over DNA, cell growth and cellular reproduction. They will be allowed to work in collaborative groups. Assessment: Exam.

Homework Lesson #3

Human Genome Project

Image Credit: National Human Genome Research Institute

INTRODUCTION

Your assignment is to write a feature article about the Human Genome Project. This student sheet will guide you through the process.

The following items should be addressed in the story:

• Describe the human genome, its history and its development.
• Describe how the human genome project is the key to understanding our species as well as others.
• Discuss the degree of kinship between organisms or species that is estimated from the similarity of
their DNA sequences. Examples are worms and chimps, or other humans.
• How can DNA sequences show us that we share common ancestors with other organisms?
• How is the Human Genome Project affecting medicine today?
• What does it hold for the future?

NOTE: You must use quotes in your story. Cull them from the movie, and other resources used in this lesson.

What is a feature article?

Feature articles are lengthy and interesting, and can be found in some magazines. They are at least 1,000 words long. You can write up to 2,000 words if you need to. A feature

article can read like a story, but is nonfiction. This means that you can give personal anecdotes, be somewhat creative, and definitely be informative and descriptive.

Points to consider:

- • **Lead:** Lead in with something to grab the reader. The lead depends on the length of the article. If you were writing a 150-word news article, you would write a one-sentence lead. But since you're writing a feature article, you can do a much longer lead, around two paragraphs.
- **Nut graph:** The nut graph is where you let the reader know just what he or she is about to embark upon. So imagine that you've just grabbed the reader's attention with the lead, now you need to say in a paragraph what this entire article is about. In other words, you'll need to describe as simply and concisely as you can what the Human Genome Project is.
- **The meat of the story:** This is where the outline is really necessary. Take the topics you want to cover and put them in order. Your order can change as you write, but you'll want to know where to begin. Say you want to cover the history of the Human Genome Project—you'll need to figure out where you want that. Some writers would start with it, but others would reflect back on it partway through the article. You can have subheads for each of these topics. You'll still want to try to have a smooth link that connects one topic to the next. Some will seem natural; others will need some crafting.
- **Quotes:** Quoting people can do a number of things for you. It can say something from another angle, so that you as a writer are not saying it, the person is. Quotes can also break up the story and make it interesting. They can also support what you are writing about. In some cases, quotes are crucial in providing facts from a noteworthy source.
- **The ending:** The ending is similar to writing a paper. It can be conclusive, like what we have learned so far, but with a science story, it can be interesting to give future applications. Some stories link back to the beginning and connect the ending to the lead (if it isn't too forced).

This unit plan would take place after completion of a unit on the basics of cells. Typically the last lesson in this unit would be about the cellular processes of transport, and in this case there was a little overlap as this unit was meant to be an extension of the unit on cellular structure. A unit on growth and reproduction is incredibly important for students because it introduces the unifying concepts of the transfer of DNA which is the biological basis for evolution. Without this unit it would be impossible for students to fully understand The Modern Synthesis. Following this unit, students would likely move on to a unit in evolution by natural selection.

This unit represents a unique motivator for students because it seeks to answer the basic questions of how life exists as we know it. Students should be intrinsically motivated to answer this question because they themselves exist. It would be important for the teacher to frame the unit with the basic questions about life. For example, what is life, how do we know we are alive, how did you get to be the size you are, what happens to your body over time after you fall and scrape your knee, why do you look like your parents? Because some students may not be motivated by this question, it will important for the teacher to get to know these students to learn their interests so targeted student focused instruction can be achieved. There are notable areas in the lesson for student choice and this should serve to help students who may be reluctant to be motivated to learn the material.

Diverse learners are a critical part of the classroom. The case study lessons allow for the instructor to group students based on ability with student of like, or unlike ability. In addition the instructor can easily vary the material in each case study packet so students are able to self-select pieces which will be most suitable for their level of reading and learning. This take the anxiety away from students who may feel they are not strong readers, or need more time to work through difficult ideas. The teacher is the most important asset to diverse learners as a few lessons will require the teacher to pay close attention to student feedback in order to modify instruction appropriately.

Students will need to have the prior skills of working in the lab and being familiar with classroom procedures. As an instructor, I would plan to implement those within the first few weeks of school so I can tell right away if my students are ready to learn. Students to not need content knowledge about DNA or mitosis or meiosis before the unit, however, they do need prior knowledge about the cell which would be covered in the lessons leading up to this unit.

In order to address the safety of the students, it would be critical to maintain a well organized classroom at all times in this unit which is good practice in general. While this unit has only one lesson which involves the use of microscopes, students would need to be familiar with the procedures of using a microscope and slides. If students were not familiar with this, it would behoove the instructor to take the time to teach students about the microscope in a mini-lesson because misuse of the microscope could result in the damage of the expensive lab equipment.

Overall this unit is one which targets multiple intelligences and diverse learners, through teaching the critical ideas of cell growth and division.