**Teaching Science as Inquiry (TSI) Lesson Plan**

**Module 2: Chemical Aquatic Science**

Name: *Anne McKnight*

Activity: *Modeling Micro-Evolution*

1. Why did you choose to do this activity?

 *I’ve decided to do this lesson as the second activity of Mod 3 because we are currently finishing the rock cycle and I think the tie in to fossil remains in sedimentary rock and to species that are no longer found living on Earth is my best chance to make micro-evolution relevant in an Earth Space Science class.*

2. What are your classroom learning goals?

 *I would like the students to understand that evolution and the changes that can cause extinction are as extremely slow a process, stretching out over millennia, as the gradual buildup of the sedimentary rocks that the fossil remains can sometimes be found in.*

3. How does this activity tie into your classroom learning goals?

 *I recognize that microevolution is a stretch to tie in to my class’s learning goals and 8th grade standards, but fossils and the rock cycle seems possible.*

4. What date do you plan to start this activity?

*Thursday, February 21, 2013.*

*5. If applicable:* HIDOE standards this lesson will address

*8.8.1 I can illustrate the rock cycle & explain how igneous, sedimentary & metamorphic rocks are formed*

*8.8.2 I can compare the characteristics of the three main types of rocks*

**Ocean**

6. Describe how you will connect this activity to the ocean:

*I made the connection between fossils, sedimentary rocks and all types of water when I taught the gyotaku lesson. This lesson will have only an indirect connection as the fossil record is a source for evidence of extinctions through history.*

7. Select the Ocean Literacy Principle(s) that you anticipate this activity will address. (check all that apply)

□ 1. The Earth has one big ocean with many features.

□ 2. The ocean and life in the ocean shape the features of the Earth.

□ 3. The ocean is a major influence on weather and climate.

□ 4. The ocean makes earth habitable

🗵 5. The ocean *HAS SUPPORTED* a great diversity of life and ecosystems *OVER THE COURSE OF ITS HISTORY*.

□ 6. The ocean and humans are inextricably interconnected

□ 7. The ocean is largely unexplored

**Preparation**

8. How will you prepare your students for this activity? (For example, review of prior knowledge.)

 *We will have just completed the Gyotaku: Fish & Fossils lesson and have been discussing igneous rocks and rocks from coral reefs previous to this activity. We will also have just completed a lab where students use chocolate to model the rock cycle. I will ask students to think about how and why fossils of species that are no longer found alive on Earth are sometimes found in sedimentary rock. We will discuss why this might be focusing on the amount of time required to even have any type of rock or fossil form. This will lead into the idea of evolutionary changes occurring in populations (not individuals) over long periods of time.*

9. Explain any instructional struggles that you foresee and how you will address these issues. (For example, student misconceptions, classroom discussion, aspects most difficult for students to grasp, etc.)

 *I think my students will struggle with the concept of evolutionary change occurring in populations over long periods of time rather than in individuals. I think the lesson will be difficult to complete in a single class period as well, because discussions requiring control of advanced vocabulary and concepts tend to take longer with ELL students.*

**Questioning and Assessment Strategies**

10. What *questioning strategies* will you use to help your students meet your learning goals?

 *I will be asking students to remember things they learned about reproduction (asexual and sexual), evolution and heredity from 7th grade so I will be asking a lot of extending and focusing questions when I ask students to explain traits that might lead to survival or extinction at the point where one of the pairs has only 1 surviving typical or mutated bacterium, I will ask the students about how the bacterium’s fate would be different if it reproduced sexually. I will also try to bring in lifting questions to ask students to think about how changes in the dice values could occur – what that would mean about the antibiotic and the bacteria - and what effect value changes would have on survival vs. extinction rates*

11. What *assessment strategies* will you use to help your students meet your learning goals and monitor their progress?

 *I will ask the students to answer the TSI Activity Questions (most) plus some of my own that ask students to think about how genetic evolution in bacteria helps us understand the fossils found in sedimentary rocks better. This discussion plus the initiation use of the article and images in “Beelzebufo the Devil Frog: As Mean as He Sounds” will help us extend the discussion to the concept of continental drift.*

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| Use the following table to plan your lesson using TSI. For each phase:* **Mode(s):** List the Mode(s) of Inquiry you will incorporate
* **Teacher:** Describe what you will be doing
* **Student:** Describe what your students will be doing
* **Assess:** Describe how you will assess your students in this phase so you can monitor their progress through the activity

\*Modes: Curiosity, Description, Authoritative knowledge, Experimentation, Product evaluation, Technology, Replication, Induction, Deduction, Transitive knowledge |

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| **INTERPRETATION** | **INITIATION** |
| Mode(s) | Description, Induction, & transitive knowledge. | Mode(s) | Curiosity, Authoritative Knowledge & Transitive Knowledge |
| Teacher | I will ask students to share their graphs of the data + answers to the activity questions and create a full class combined response to relate evolution and extinction of some fossil species. | Teacher | Present the PowerPoint slides on fossils of extinct species. Ask the students to answer: Why do sedimentary rocks sometimes contain fossil remains of species that are no longer found living on Earth? Use questioning to get students curious about sedimentary rocks, traits that assist survival, evolution & extinction. Use questioning to dig back into 7th grade knowledge about sexual & asexual reproduction (always interesting in middle school) heredity and genetics. |
| Student | Students share & discuss observations with the class by sharing graphs, hypotheses and answers to the discussion questions.  | Student | Students will view the fossils and suggest answers + definitions/details from 7th grade.  |
| Assess (look for) | Involvement in the discussion and a growing understanding of the concepts in the lesson through appropriate use of key vocabulary and transitive connections to outside examples.  | Assess (look for) | I will look for intelligent observations, correlations, interpretations and also misconceptions about the sedimentary rocks, evolution, traits,  |
| **INSTRUCTION** |
| Mode(s) | Description, Authoritative Knowledge, Transitive Knowledge |
| Teacher | During the presentation, question students as they observe and respond to each fossil. During the investigation lead the students through understanding the instructions and how elements of the model represent real life. During discussion asking students to evaluate their data and graph outcomes plus answers to the discussion questions.  |
| Student | Observe and discuss the fossils. Discuss and follow the steps of the investigation (using T1.1 to analyze each throw’s outcome.) |
| Assess (look for) | Student ideas and answers that show them making headway with evolution, heredity, reproduction and survival or extinction concepts. Students peer teaching partners who are asking for clarification, etc. |
| **INVESTIGATION** | **INVENTION** |
| Mode(s) | Curiosity. Experimentation, Replication, Induction | Mode(s) | Description, Transitive Knowledge, Induction, Product Evaluation |
| Teacher | I will monitor and guide the students through setting up the 20 bacteria and rolling the dice +completing Table 1.2 accurately by asking and answering procedural and interpretation questions while they investigate | Teacher | During the discussion after the investigation. I will ask students to suggest modifications of Table 1.1 that could affect the survival or extinction outcomes for typical and mutated bacteria + scenarios that could cause the modifications.  |
| Student | Students will observe the fossil samples. They will discuss the procedure while rolling the dice and completing Table 1.2 to calculate the survival and death rates of each bacterium. | Student | Student will suggest their own modifications of Table 1.1 that could affect the survival or extinction outcomes for typical and mutated bacteria + scenarios that could cause the modifications. |
| Assess (look for) | I’ll look for intelligent observations of procedures and outcomes. I’ll also look for peer suggestions for reasoning behind outcomes. | Assess (look for) | I will use their discussion question answers as a form of assessment. I will look to see if the explanations are clear & complete and if they are reasonable. I will also be listening to group  |

12. Briefly describe how you will direct your students through the Phases of Inquiry.

**Initiation** *– Show fossil images that are of strange species we never see now. Questioning to create curiosity about what happened to them and why they became extinct.*

**Invention** *– Encourage students to discuss new values for dice rolls that would change the bacteria’s fate over the generations + why that might be.*

**Instruction** *(directions) - Introduce the TSI procedure for rolling dice and using the table to decide each bacterium’s fate. Use questioning to review & remind students about asexual reproduction in bacteria (from 7th grade) and explain why each bacterium doubles at the end of the generation.*

**Investigation** *– Students throw their dice and gather data on each bacterium’s fate over each generation.*

**Interpretation** *- Students graph their data then discuss & share their answers to the worksheet questions in a class discussion. Discuss why the data is similar but not identical.*

13. What will be the *overarching* mode(s) of this activity?

*Experimentation, replication and induction will be the overarching mode as the students learn look at the effect of die throws on the bacteria’s survival rate.*

Please provide any additional comments that will help you prepare to teach this activity or help the TSI facilitators understand how you plan to teach this activity.

*I have very small classes. I also have many students who, because of vocabulary issues and slow processing speed, must be given instructions multiple times and then again one on one to check understanding. I’ll be trying not to spread this activity out to keep it down to a shorter lesson. Still, I expect it to take 2 full days if I push my students to work as quickly as possible.*