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

**Module 4: Ecological Aquatic Science**

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**Activity: Sampling for Abundance**

1. **Why did you choose to do this activity?**

I chose to do this activity 3rd while students each work (independently) on power point presentations about one planet or dwarf planet as a continuation of the idea that students would design a scientific mission to their planet. We have been talking about the history of the Moon missions and chemical testing of Moon rocks. I’d like to use this activity to connect to the previous two lessons in a real world way –planning to survey, take samples and explore surface conditions of the planets once the mission landed.

1. **What are your classroom learning goals?**

Students will practice sampling a planet’s surface in a logical and consistent style. They will investigate measurement strategies that might impact the reliability of data collected on their planets. Students will also build on the understanding of the importance of standardization and replication gained from the M&M Sampling Design activity.

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

I will be tying together several standards and concepts with this activity! Curriculum that I will be focusing on includes relationships between objects in the solar system, technology and how it enables humans to study the solar system. We will also be reviewing the history of the Moon missions to remind students that space missions are exciting opportunities but inherently difficult and dangerous. You might only get ONE shot to get the data right! Planning is essential!

**4. What date do you plan to start this activity?** Wednesday, May 15, 2013

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

8.8.8 I can describe the composition of objects in the galaxy

8.2.1 I can describe significant relationships among society, science, and technology and how one impacts the other

7.1.1 I can design & safely conduct a scientific investigation to answer a question or test a hypothesis

8.1.2 I can communicate significant components of an experimental design & results of a scientific investigation

**6. Describe how this activity relates to at least one of the TSIA PD Themes.**

**Themes: Community, Metacognition, Science as a Human Endeavor, Observations and Inference, Modeling Science, Scientific Language, Connections**

**Science as a Human Endeavor –** In the lead in to this activity we will have completed lessons that focus on Theories of the Moon’s formation and on the history of Moon studies from ancient times focusing on Apollo and Luna Moon Missions and the technology required to get a rocket to the Moon. We’ve also looked at how the US and Soviets have used solar technology to power their space missions. This lesson will delve into what you would do to collect reliable data once you got to the surface of the planet you would be exploring.

**Modeling Science –** Space missions have a high level of inherent danger. NASA has always used modeling as a part of mission planning. When we plan for a theoretical mission to the other planets of the solar system, we will be modeling the behavior of NASA scientists as well as modeling issues that might affect data collection on the planet.

**Ocean**

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

This lesson will have little to do with the ocean at all!!! Sorry – I can’t figure out a connection!!!

**8. 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 supports a great diversity of life and ecosystems.

□ 6. The ocean and humans are inextricably interconnected

□ 7. The ocean is largely unexplored

**Preparation**

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

We will be extending previously taught lessons about moon exploration, the solar system and the sun. We’ll review previously generated lists of issues that might come up if you were to travel to and try to take samples on the surface of the various planets and dwarf planets. We’ll look at and discuss pictures of Apollo astronauts sampling the Moon and of Curiosity sampling the surface of Mars. We’ll also review key points about sampling reliably from the pizza and M&M activities.

**10. 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.)**

My students are likely to have little difficulty with proposing sampling strategies - transect laying etc. When they have created a sampling strategy, however, calculating percent coverage may be tough for the students with weaker math skills. I will work with each pair to discuss ways to estimate and calculate totals. My students are capable of identifying elements that could create errors and of understanding that low frequency items could get over looked if I don’t focus them, so I will use questioning to draw attention to these issues and use images to remind them of the parallels between the pizza’s one anchovy and Moon ice.

**Questioning and Assessment Strategies**

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

* CLARIFYING – while the students are in the invention stage, I will use clarifying questions to help students decide how best to arrange the transect lines. Clarifying questions will help students root out murky details that needed to be planned for to avoid sampling errors. I also will also use them during the interpretation phase to get students to explain their thoughts more completely and clearly.
* EXTENDING – I’ll use extending questions to help students apply what they are beginning to understand about transects and quadrats to understanding issues with planning a mission to their planet.
* FOCUSING – its middle school… this is always necessary
* LIFTING and SUMMARIZING – I’ll use these types of questions during our final discussion.

12. What ***TSI practices of inquiry teaching strategies*** will you focus on implementing to help your students meet your learning goals? See TSI Practices of Inquiry teaching strategies handout for suggestions (Mod 4 Binder under “TSI Pedagogy” and online in Mod 4 PD section)

Science as a Discipline:

* Model and require students to exhibit the demeanors of scientists – students will be planning as though they had to design for as serious a project as a interplanetary research mission. They will have to think carefully about the issues based on a theoretical surface structure without being able to actually see the surface in a concrete way.
* Recognize and teach science as a human endeavor – Understanding the history of space exploration as part of the history of technological advancements and as an exciting currently ongoing discipline – we are exploring and data collecting on the surface of Mars right now!
* Design or use a curriculum grounded in the history and content of the scientific discipline. – Space exploration history will be the underpinnings of the lesson.

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

Students will be assessed through informal discussions in small groups and as a full class. They will also complete the worksheet activity questions.

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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) | Induction, Deduction, Transitive Knowledge | Mode(s) | Curiosity, Description, Transitive Knowledge |
| Teacher | * Ask clarifying questions * Review data tables * Lead students to identify patterns in the data. * Question students about issues that occurred and their effect on the data * Questions students about issues that would come up when using transects and quadrats in a space exploration on their planets etc. | Teacher | * Viewing images from Apollo Moon missions and of Curiosity on Mars. Questioning to discussion what factors would make data collection difficult on planets of different types. What changes from older moon mission technology would need to be developed? * Lead students to think of the mock sampling layout as a model of a different terrestrial planet (not Earth, Mars or the Moon) |
| Student | * Compute mean for the data then graph the data. * Answer activity questions and make inferences about the results. * Discuss & write up issues that affect the data & how they relate to missions on the surface of the planet. | Student | * Generate a list of issues that would need to be planned for * Discuss sampling on the various planet types * Discuss proximity and distance from the Sun, type of atmosphere and amount of gravity etc and their effect on solar panel output. |
| Assess (look for) | Look for accuracy and depth in discussion responses and written answers on worksheet | Assess (look for) | Understanding of planet relative position, surface type and insights about sampling issues that would arise |
| **INSTRUCTION** | | | |
| Modes | Authoritative knowledge, transitive knowledge | | |
| Teacher | Ask students to assist each other in considering how to lay the transect lines and quadrats  Ask students to review for each other how to estimate and record the percentage that each surface material takes up within the quadrat frame if the material is an irregular solid. | | |
| Student | Advise partners on quadrat and transect laying pros & cons  Peer teach partners/review inquiry lab procedures | | |
| Assess (look for) | Correct set up and use of panel and multimeter  Peer teaching/review for each other how to calculate the percentage that each surface material takes up within the quadrat frame if the material is an irregular solid. | | |
| **INVESTIGATION** | | **INVENTION** | |
| Mode | Experimentation, Description, Technology | Mode(s) | Curiosity, Product Evaluation, Transitive Knowledge, Experimentation |
| Teacher | Ask questions of individuals and groups as they collect data  Monitor class and answer questions.  Monitor accuracy of class data table entries & calculations | Teacher | Ask students to suggest strategies for laying the transects and quadrats. Ask students to decide which method to use: transect point, quadrat point or quadrat percent.  Ask student to generate a hypothesis. |
| Student | Students set up and begin testing the 3 collection strategies.  Students choose the best strategy for collecting data  Students take multiple sets of data and trouble shoot issues as they occur | Student | Students strategize laying the transects  Students experiment with transect point, quadrat point or quadrat percent to learn the strategies and to decide which is the best choice to use on the planet  Students choose the best method for data collection.  Students generate a hypothesis. |
| Assess (look for) | Sampling accuracy & completeness  Data table accuracy & completeness. | Assess (look for) | Logic of pros and cons in the strategies and final procedure  Clarity of the hypothesis |

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

**Initiation *–*** *\*Scaled sun + planets and dwarf planets in order of proximity image + questioning to focus on what issues might come up for scientists sampling the surface of each planet*

*\*Images of Apollo 17 moon sampling + International Space Station focusing on solar panel use + discussion of sampling equipment especially TRANSECT LINES in the moon images!!!!*

*\*While students view our “planet surface”, ask students to identify the planet type, generate names for the surface materials based on the Moon & Mars, rock cycle etc. suggest reasons for dips & protrusions on surface (impact crater etc…)*

**Invention –** \*Ask students to suggest strategies for laying the transects and quadrats.

\*Ask students to decide which method to use: transect point, quadrat point or quadrat percent.

*\*Ask student to generate a hypothesis.*

**Instruction -** \**Ask students to plan how to lay the transect lines and quadrats*

*\*Ask students to review for each other how to estimate and record the percentage within the quadrat frames if the material is an irregular solid.*

**Investigation** *\*Ask questions of individuals and groups as they collect data*

*\*Monitor class and answer questions.*

*\*Monitor accuracy of class data table entries & calculations*

**Interpretation *-****\*Ask clarifying questions to help students review data tables & graphs*

*\*Question students about issues that occurred, their effect on the data & potential sources of error.*

*\*Question students about issues that would come up in a space exploration*

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

The overarching mode(s) will be curiosity, description, product evaluation and induction. Students will be naturally curious about sampling a surface in the same way the Apollo astronauts did. They will also be interested in the idea that they could be in the position to choose the measurement strategy. Description will make up a lot of the time spent sampling because at each point, the students will need to describe the materials being sampled. Thinking about technology and how or which type can best be used on an alien planet surface means a lot of time will be spent on product evaluation too.

**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.**