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

**Module 4: Ecological Aquatic Science**

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**Activity: Choice Activity – Photovoltaic Inquiry**

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

 I chose to do this activity second because we are currently studying the sun while students each work (independently) on power point presentations about one planet or dwarf 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 the 2 areas in a real world way – evaluating the potential to use solar energy to travel to, survey and explore surface conditions of the planets. I’d also like to use it to add a student designed hands on inquiry.

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

Students will practice designing their own inquiries with various PV panels and multimeters. Students will investigate variables that might impact their ability to use solar radiation as an energy source for scientific data collection on their planets. Students will also build on the understanding of the importance of standardization and replication gained in 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.

**4. What date do you plan to start this activity?** Wednesday, May 1, 2013

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

8.8.8 I can describe the composition of objects in the galaxy

8.6.3 I can explain the key characteristics and properties of mechanical and electromagnetic waves and provide real world examples

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 which variables will affect PV panels ability to generate power.

**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 solar panel efficiency.

**Ocean**

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

This lesson will have little to do with the ocean at all

**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 start by generating a list 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.

**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 the initial panel data collecting and variables generating. When they have created an inquiry design, however, researching their chosen variable will be difficult because of language issues. I will work with each pair to locate simpler resources to understand how PV panels work and what can affect their power generating abilities.

**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 gather accurate data. 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 the multimeter, the PV panels and the variables they choose 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
* 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.
* 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 a full lab report and 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 and graphs for each inquiry
* 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 PV panels in a space exploration on their planets etc.
 | Teacher | * Questioning to lead a discussion of “How would a human (scientist) fare on the surface of your planet? What factors would make data collection difficult? What changes from older moon mission technology would need to be developed?
* Lead students to PV panels as a power source with pictures of Apollo astronauts and the International Space Station deploying solar panels
 |
| Student | * Compute mean, median, mode and standard deviation for the data then graph the data.
* Answer activity questions and make inferences about the inquiry results.
* Discuss 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 and the effect on solar panel output.
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| 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 connecting up panels to multimeters by remembering 6th grade introduction to electrical circuits and Q2 electrolysis lesson, also of all the parts of an inquiry design |
| Student | Advise partners on pv panel connection, multimeter usage and data collection strategies Peer teach partners/review inquiry lab procedures |
| Assess (look for) | Correct set up and use of panel and multimeterPeer teaching and review of electrical circuits and inquiry elements  |
| **INVESTIGATION** | **INVENTION** |
| Mode | Experimentation, Description, Replication, | Mode(s) | Curiosity, Induction, 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 connecting the panels and the multimeter. Ask students to experiment with the panels to discover how to generate the most electricityAsk students to decide on a specific variable to design their inquiry aroundAsk student to generate a formal hypothesis, a procedure and a data table |
| Student | Students set up and run their investigations Students take multiple sets of data and trouble shoot issues as they occur | Student | Students strategize connecting the panels and the multimeter. Students experiment with the panels to discover how to generate the most electricityStudents choose a variable to design their inquiry aroundStudent generate a formal hypothesis, procedure and data table |
| Assess (look for) | Sampling accuracy & completenessData table accuracy & completeness. | Assess (look for) | Logic of pros and cons in the strategies and final procedureClarity 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 solar radiation as a power source for sampling equipment*

 *\*Discussing the idea of space mission needing to develop technology to deal with planetary conditions and needing an energy source for research & exploration*

**Invention *–*** *\*Connecting and investigating variables that affect PV panel outputs \*Generation of a list of relevant variables*

 *\*Settling on focus variable and designing inquiry studies in pairs*

 *\*Designing & building structures to allow variable manipulation & PV panel testing*

**Instruction *-*** *\*Peers advise each other on PV panel connection, multimeter usage and data collection strategies*

 *\*Partners peer teach/review inquiry lab elements & procedures*

**Investigation *–****\** *Questioning to help students set up and run each pair’s investigation*

 *\*Students take multiple sets of data and trouble shoot issues as they occur***Interpretation *-****\*Ask clarifying questions to help students review data tables & graphs for each inquiry + identify patterns in the data.*

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

 *\*Question students about issues that would come up when using PV panels in a space exploration on their planets.*

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

The overarching mode(s) will be curiosity, technology, induction and replication. Students will be naturally curious about developing a hypotheses and designing a test of their chosen variable. They will also discuss how to improve their test and make inferences about their data.

**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.**