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

**Module 2: Chemical Aquatic Science**

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Activity: Conductivity

1. Why did you choose to do this activity?

We are studying density and conductivity is another way to measure the salinity of a solution besides using a hydrometer.

2. What are your classroom learning goals?

I would like my students to be able to make connections between various topics that may seem to be isolated and also to understand the way that scientists conduct research in their laboratories and out in the field.

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

In this case, density of seawater is due to the dissolved salts and minerals in the water. We are comparing the density of seawater to fresh, brackish, hypersaline, and distilled water by layering solutions, but it is also possible to measure salinity indirectly using a hydrometer if directly using.

Most students know a little about electricity but have a limited understanding of how it works, so I would like to introduce them to the concept of conductivity in relation to the salinity of seawater. Scientists use conductivity meters to measure the salinity of water on location.

4. What date do you plan to start this activity? November 7, 2012

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

* **Benchmark SC.MS.1.3** Defend and support conclusions, explanations, and arguments based on logic, scientific knowledge, and evidence from data
* **Benchmark SC.MS.4.6** Describe how physical factors (e.g., light, temperature, pressure, current) define the region/zone in the ocean

**Ocean**

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

The ocean is saline because of the dissolved salts in it and therefore is a better conductor of electricity than fresh water because salts dissociate into positively and negatively charged ions. The salinity of the ocean is important for ocean circulation, currents, and also the life that it supports, so we spend a lot of time talking about it in class.

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

X 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**

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

In Measuring Salinity, the activity prior to this, the students learned that a hydrometer is used to measure salinity indirectly by measuring the density of a solution. In the lecture for this activity, the students will learn that a conductivity meter can also be used to measure salinity and watch a video showing scientists measuring the salinity of water underneath ice.

The students do not have any background in electricity, so I will explain the concept of conductivity by introducing the fact that the presence of charged particles allows electricity to flow in a solution and that salt is an ionic compound that breaks up into ions, which are charged particles in solution.

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.)

These students are 9th graders and have no background in Chemistry, so ions and charged particles may be a little confusing to them. I plan to explain them as simply as possible for now just so that they understand where Na+ and Cl- come from in seawater and come back to elements and compounds later on in our Chemistry unit.

**Questioning and Assessment Strategies**

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

* Ask students to explain the parts of the circuit and how the orientation of the wires matters
* Ask students to explain their reasoning for the identities of the solutions using the correct new vocabulary

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

* Formative assessment during activity
* Class discussion
* Lab Notebooks – Data and observations, 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) | Description, Authoritative knowledge, Induction, Deduction | Mode(s) | Curiosity, Description, Authoritative knowledge |
| Teacher | Wrap-up: Guide collection of class data and class discussion on how the circuit works & identities of unknown solutions. | Teacher | Intro: Introduce the concept of conductivity and state that it can be used to measure the salinity of a solution  Introduce charged particles and show on the board how salt (sodium chloride) dissociates into positively-charged sodium ions and negatively-charged chlorine ions |
| Student | Part 3. Use LED brightness to determine conductivities of solutions and identities. | Student | Intro: Take notes in science notebook and watch video about conductivity meters |
| Assess (look for) | Part 3: Check that students see the connection between ions (charged particles) and conductivity. | Assess (look for) | Intro: Check that students understand that when salt dissolves, the Na and Cl get separated. |
| **INSTRUCTION** | | | |
| Mode(s) | Description, Authoritative knowledge | | |
| Teacher | Intro: Tell students to look at the materials they will be using in their kit and give them safety precautions (don’t cross wires, etc.)  Parts 1-3: Make announcements regarding time periodically to keep students on track. | | |
| Student | Intro: Students check kit and practice the names of materials: LED, alligator clips, battery holder, etc.  Parts 1-3: Communicate with group members and work together to complete task.  Wrap-up: Share data and participate in class discussion. | | |
| Assess (look for) | Intro: Observe how students handle equipment.  Parts 1-3: Check that students are following the instructions and keeping a good pace of work. | | |
| **INVESTIGATION** | | **INVENTION** | |
| Mode(s) | Curiosity, Description, Experimentation, Product evaluation, Replication | Mode(s) | Experimentation, Product evaluation, Technology |
| Teacher | Parts 1-3: Monitor students testing their circuits and help troubleshoot as needed. | Teacher | Part 2: Monitor students and ask questions about what they are doing and why. |
| Student | Part 1: Test circuit to make LED light up and record what they did. Record observations of what they did to light up LED  Part 3: Test unknown solutions to determine LED brightness. | Student | Part 2: Expand circuit to include two paper clips to test solution. Draw diagram of circuit. |
| Assess (look for) | Part 1: Check that students are systematically testing their circuits.  Part 3: Check that students are testing their solutions and correctly washing and wiping their electrodes in between. | Assess (look for) | Part 2: See if students are understanding how circuits work and paying attention to the polarity of their circuits. |

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

* Initiation: Introduce conductivity as another way to measure salinity.
* Instruction: Have students check materials
* Investigation: Students try to light up LED with battery and LED only circuit
* Invention: Students add a third alligator wire in order to add electrodes to test a solution
* Investigation: Students test unknown solutions for conductivity by measuring LED brightness of the circuit
* Interpretation: Students determine from the LED brightness if the solution is a good, poor, or non-conductor
* Instruction: Students share group data with class
* Interpretation: Teacher leads class discussion to come up with a consensus about the identity of the solutions

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

The overarching mode in this activity will be Experimentation, because the students will mostly be trying to make their circuits work without much knowledge of electricity and polarity. They will guess and test to see how to successfully connect the wires to complete the circuit. Once their circuit is complete, they will test the unknown solutions to determine their conductivity and use this information to confirm their identities.

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.

This is the first time I will be teaching this activity. Due to time constraints, I will adjust the time as needed but would like to finish within two class periods.