Investigation #1 – Water

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Grade Level – Middle or High School

Summary

Since water is the basis of all life and because the unique properties of water allow it to be that basis, a study of its properties is essential at all levels of school science study. Water properties such as surface tension, adhesion and cohesion, solution, density and specific heat are all characteristics that define how all chemistry progresses and all life exists. In the physical world water creates, changes and defines landscapes and earth structures. This introductory activity will allow students to explore these properties and experience firsthand that water is not like any other substance on earth.

Objectives

Students will answer the following questions as they perform nine different investigations of water:

1. What are properties of water?
2. How are the properties of water important to our understanding of the hydrosphere, the water cycle, chemistry and earth science?
3. How do the properties of water, when applied to other earth science disciplines allow us to look further into and understand global climate change?
4. How does inquiry-based science lend itself to understanding the properties of water?
5. Why can it be determined that all properties of water are consequences of the chemical arrangement of the water molecule?

Nevada Science Standards

The science standards addressed in these lessons included:

E.5.A.3 – Students know most of the Earth's surface is covered with fresh or salt water.

E.8.A.3 Students know the properties that make water an essential component of the earth system.

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N.5.A.1 Students know science progress is made by conducting careful investigations, recording data, and communicating results in an accurate manner;
N.5.B.3: Students know the benefits of working with a team and sharing findings.
N.8.A.3 –Students know how to draw conclusions from scientific evidence and that different explanations can be given for the same evidence;
N.8.A.4 Students know how to design and conduct a controlled experiment.

Procedural Considerations

This activity has been designed so that the teacher can deliver the instructions in a minimalistic way in order that students may investigate in a manner approaching a pure inquiry method. The following directions are purposely vague and may be transmitted to students on a copied sheet or written onto a white or chalk board. Directions have been split into two parts, the first designed as an overview/general description, the second being a list of "hints" to get the students investigating. They may be used in their entirety, modified or as single parts. The first part also suggests ways for students to keep track of their findings during their investigation.

Investigation of Water: Description of Activities

1. Observe the properties of water on wax paper and on a penny.
Materials: water; eyedropper; wax paper; penny.
Data: Write all observations.

2. Paper Clips on water surface.
Materials: water; 600 ml beaker; 7 paper clips; forceps.
Data: 1) Describe the appearance of the water where it touches the metal.
2) How many clips could you suspend on the water's surface?

3. Observe ice melting for 5 minutes on a dry petri dish.
Materials: ice; dry petri dish or large dry watch glass.
Data: Write all observations.

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4. Temperature reading of air and standing water.

Materials: water (standing); thermometer.

Data: 1) Record air (room) temp in ^{o}C.

1) Record water temp in ^{o}C.

5. Water temp with ice.

Materials: water; ice; thermometer; 600 ml beaker.

Data: Record water temp after 5 minutes.

6. Water temp with ice and salt.

Materials: same as above (same system); salt (to add directly to 600 ml beaker.)

Data: record temp of system after 2 minutes.

7. Ice melting time.

Materials: water; Styrofoam cup; 1 ice cube; thermometer.

Data: 1) Record water temp-no ice.

2) Record time to melt ice cube completely (in the water).

3) Record final temp of water in ^{o}C.

8. Hot vs. cold.

Materials: glass bottles; hot water; standing water; food coloring.

Data: Write all observations and comparisons of changes in single color droplet.

9. Dry ice investigation.

Materials: dry petri dish or large dry watch glass; dry ice; 600 ml beaker; thermometer*

Data: 1) Observe dry ice on petri dish for 5 minutes.

2) Record temp of WATER* after dry ice is added to it (after 5 minutes).

*DO NOT TOUCH THE THERMOMETER DIRECTLY TO THE DRY ICE!

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DETAILS

1. many drops, move drops around, observe from all angles, penny competition, observe water on the top of the penny, write a lot! What is going on with that water?

2. use forceps to carefully place paperclips on the surface of the water-you will need to have the beaker filled with water nearly to the top.

3. one large, or 2 small ice cubes only

4. ^{o}C - ONLY in science (no ^{o}F)-read the temperature carefully.

5. lots of ice- mostly ice, not too much water, try to get a low temperature.

6. use the whole container of salt, stir carefully with thermometer

7. one large ice cube-time in minutes and seconds.

8. be sure to observe carefully for 10 full minutes.

9. make sure petri dish is totally dry-observe for five full minutes before placing the dry ice into the 600 ml beaker-beaker should be half full of water.

NOTE: You may place the thermometer in the water **near** the dry ice only. You are liable for the cost of a ruined thermometer. You are only trying to find out if the dry ice makes the water as cold as the regular ice.

ALSO: You will need a lot of good observations to answer the questions on the activity next time we meet, so work together and write a lot!

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Notes on implementation and assessment for teachers:

1. The two pages of this activity/investigation can be copied and handed out to student teams.

2. The information in these instructions is skeletal by design with the idea being that students not being supplied with recipe-style directions are freer to investigate the properties of water in a more inquiry-style manner.

3. The teacher can choose to go through the instruction sheet with the students, modeling some of the techniques students will use, or just allow students to read the sheets in their teams and design their own methods.

4. This activity is designed to allow teachers to mix and match activities, adding additional experiments or deleting ones that are not required by their curriculum.

5. The function of this activity is to allow student to investigate on their own and see for themselves how water behaves. This activity is critical especially for middle school and non-college-track students who have not had a strong science background. However, it is also a good opening activity for biology/chemistry students who may not have good lab skills.

6. Questions can be designed by the teacher to fit their program and pertain to each property of water displayed by each activity in the investigation. Alternatively, teachers can allow students to construct their own knowledge by having them write conclusions based on observations and describe the various properties of water in their own words in a well-wrtiten report.

7. The investigation can also be done as 90-minute activity incorporating the 5-E modeling, introducing water properties with an engagement demonstration or video and executing the several experiments within the 5-E structure.

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8. Some You Tube videos that will hopefully still have active links when you read this:

Properties of water: http://www.youtube.com/watch?v=QH1yphfgfFI

States of Matter: http://www.youtube.com/watch?v=s-KvoVzukHo

Water Molecules, Parts 1 & 2: http://www.youtube.com/watch?v=sBZfPmIcS-E
http://www.youtube.com/watch?v=moITG5Q7zzI

9. This blog site from Leawood Middle School is really slick and a good class project for students who are adept at blogging or website design:
http://lmsblogs.org/all-about-the-properties-of-water/

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