LESSON TITLE	Humans and Salt Water				
SUBJECT (S):	Biology, Earth Science, Environmental Science				
GRADE LEVEL:	6-12	**AUTHOR:**	Rebecca L. McKinney, MS		
TYPE OF LESSON (activity, lab, project…)	Lab			**DAY(S):**	1

OBJECTIVE

Students will perform an experiment to explain why humans cannot consume salt water.

NGSS/CC STANDARDS	ASSESSMENT(S) & GRADING/RUBRIC
NGSS Science and Engineering: 1, 3, 4, 5, 6, 8 Crosscutting Concepts: 2, 7 Core Ideas: ESS3, LS1, LS2 **PERFORMANCE EXPECTATIONS** Earth and Space Sciences: HS-ESS3-1, HS-ESS3-4; MS-ESS3-4 Life Sciences: HS-LS1, HS-LS2-7; MS-LS1, MS-LS2-5 **CC MATH** HS - HSN.Q.A.1, HSN.Q.A.3, MP.2, HSS-ID.A.1, HSS-ID.B.6; MS – MP.2, MP.4, 6.SP.B.4, 6.SP.B.5, 6.RP.A.3 **CC ELA/LITERACY** HS - WHST. 9-12.1, 9-12.2, 9-12.7; MS – SL.8.4, WHST.6-8.1, WHST.6-8.9	Answer key provided Mastery considered at >70%

SUBJECT AREA(S):

This lab could easily fit for the following courses as follows:
LIFE SCIENCE: osmosis, homeostasis or ecosystems
EARTH and ENVIRONMENTAL: ecosystems, natural resources

TEXTS/MATERIALS/TECHNOLOGY/AUDIO-VIDEO/OTHER RESOURCES:

Water, salt, beakers, balance, timer, stir bar, tweezers (or something to remove samples from the beaker), pieces of fruit/vegetable/chicken/pork (sources of cells), paper towels

To decrease setup time: pre-make salt solutions (2%, 4%, 6%) and/or pre-cut sources of cells

INSTRUCTIONAL STRATEGIES/PROCEDURES/GROUPING:

Pass out the worksheets to the students. Have them work in lab teams of 2 to 6. Students need to read the introduction on the first page then state their hypothesis. They can then set up and run the experiment. Set up should take approximately 10 minutes and the experiment runs for 25 minutes. If you are concerned about not having enough time to complete this experiment, then you can have the saltwater solutions pre-made. Students can finish their conclusions and data analysis for homework.

The source of cells for this experiment should be fruit, vegetable, or uncooked meat. Celery is a very cheap and effective cell source that will yield excellent results. To be more similar to human cells, small pieces of pork or chicken can be used. Having the pieces cut ahead will save time for this experiment. Size of cell source should be approximately 1 inch x 1 inch.

To help the student identify their variables you can remind them of the definitions.

- The **independent** variable is the item they are changing in the experiment
- The **dependent** variable is the data being measured
- The **controlled** variables are everything in the experiment that stays the same

If you want students to write a formal lab report, you could use an additional class day for them to either work on computers or assemble their data and start their report.

For more advanced classes, an inquiry style lab can be completed instead. The page for this experiment is provided at the end of the Worksheets. This lab would permit students to design and perform their own experiment.

SAFETY/SECURITY ISSUES:

Though salt water is nontoxic, goggles should be worn in order to ensure safe lab practice. If using uncooked meat, students should wear gloves.

REFERENCES

http://www.nextgenscience.org/next-generation-science-standards

http://www.cde.ca.gov/re/cc/

http://science.howstuffworks.com/science-vs-myth/what-if/what-if-you-drink-saltwater.htm

NOTES/REFLECTIONS/EXTENSIONS:

Depending on the source of cells, if fruits or other plant items are used that have a peel, encourage students to remove the peel in order to increase surface area for better, more consistent results.

This lab can be performed with sugar solutions instead of salt to allow the student to

determine the sugar content in fruit. However, the questions associated with the conclusions would not be applicable to a sugar solution lab. Feel free to use the following questions for the sugar experiment.

1. Looking at the results, do you accept or reject your hypothesis? EXPLAIN.

2. What happened to the mass of the cells as the concentration of sugar increased?

3. Which sample had the largest % difference in mass? Why do you think this had the biggest difference?

4. In the beakers below, draw arrows to indicate the overall direction water flowed in each situation. In the box below each container, indicate if the solution is in an isotonic, hypertonic, or hypotonic.

5. The concentration of sugar in the sodas can range from 9 to 15%. If the cells had been placed in a 10% sugar solution what would the change in mass have been after 25 minutes? (Hint: use your graph)

6. OPINION: Should drinks that are high in sugar be given to people In order to quench their thirst? Explain your answer.

NAME _____ DATE _____

Why Can't I Drink Saltwater?

Approximately 70% of the earth is covered in water. Ninety-seven percent is saltwater, two percent is water found in the form of ice, and less than one percent is freshwater. If living organisms could drink saltwater, numerous issues involving lack of usable water could be solved. However, most living things cannot drink saltwater. Why?

Water moves freely across cell membranes. Osmosis is the movement of water from a high concentration to a low concentration. If cells are placed in a fluid environment that has a low concentration of water, a *hypertonic* solution, then water will leave the cells and the cell could die. In a *hypotonic* solution, where the concentration of water is greater outside of the cell, water moves into the cell which can cause the cell to burst. An environment where the concentration of water is the same both inside and outside of the cell is known as an *isotonic* solution. In this environment, water moves in and out of the cell in both directions at the same rate. Maintaining an isotonic environment is an important homeostatic mechanism in advanced organisms.

This experiment will allow you to determine exactly why saltwater cannot be used by humans.

QUESTION: If an item that is composed of cells is placed in a saltwater solution, what will happen to the water weight of the cells?

HYPOTHESIS: If cells are placed in a saltwater solution, then _____

_____

Why do you think this will happen?

VARIABLES

INDEPENDENT: _____

DEPENDENT: _____

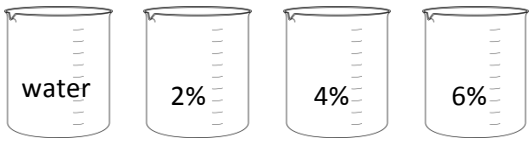
CONTROLLED (identify at least 3):_____

_____

MATERIALS: water, salt, 4 beakers, balance, timer, pieces of fruit/vegetable/chicken/pork (cells), tweezers, stir bar, paper towels

METHODS:

1. Acquire 4 beakers. Label the beakers: *water*, *2% saltwater, 4% saltwater, 6% saltwater*.
2. Add 300 mL of water to each beaker.
    a. Add 6.0 g of salt to the 2% saltwater beaker and mix.
    b. Add 12.0 g of salt to the 4% saltwater beaker and mix.
    c. Add 18.0 g of salt to the 6% saltwater beaker and mix.

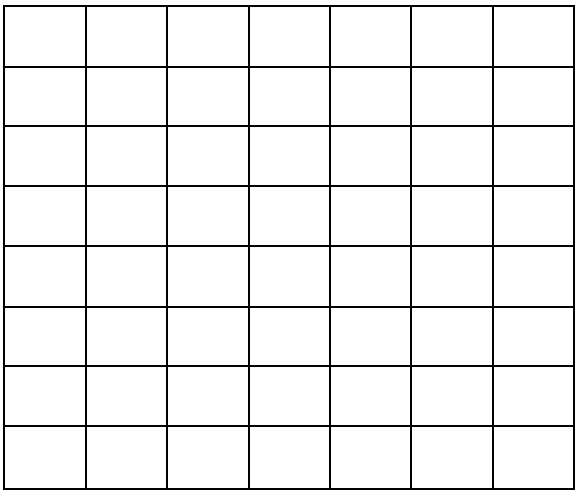


3. Collect four pieces of fruit, vegetable or meat. These are the cell samples. Weigh a piece and record its mass in Table 1 under *Initial Mass for Water*. Place the sample into the water beaker.
4. Weigh another piece. Record the mass under *Initial Mass for 2% Saltwater* then place it into the 2% saltwater beaker. Repeat this for the last 2 pieces, using the 4% and 6% beakers.
5. Allow the cell samples to sit for five minutes in the beaker then carefully remove each sample with the tweezers, blot dry and reweigh. Record the masses then put the pieces back into the appropriate beakers.
6. Repeat step 5 every 5 minutes for a total of 25 minutes. Record their masses in the table.
7. Calculate the change in mass and percent difference in mass. A negative % difference indicates a weight loss. A positive % difference indicates weight gain.

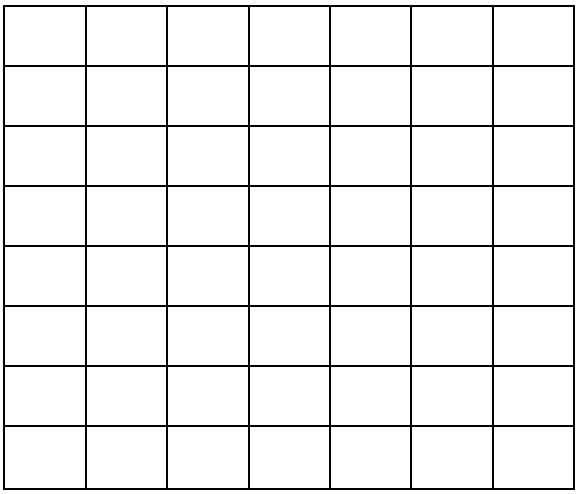
RESULTS

TABLE 1	**Water**	**2% Saltwater**	**4% Saltwater**	**6% Saltwater**
Initial Mass (g) at 0 minutes				
Mass (g) at 5 minutes				
Mass (g) at 10 minutes				
Mass (g) at 15 minutes				
Mass (g) at 20 minutes				
Final mass (g) at 25 minutes				
Change in Mass (final – initial)				
% Difference $\frac{final - initial}{initial} x100$				

Make a line graph of the data below. Label *time* on the x-axis and *mass* on the y-axis. Plot the data for each treatment on the graph. There will be four lines. Label the axes, provide a title, and label each line.



Make a line graph of the data below. On the x-axis put *concentration of salt* and on the y-axis put *% difference*. Plot the data on the graph. There will be one line. Label the axes and provide a title.



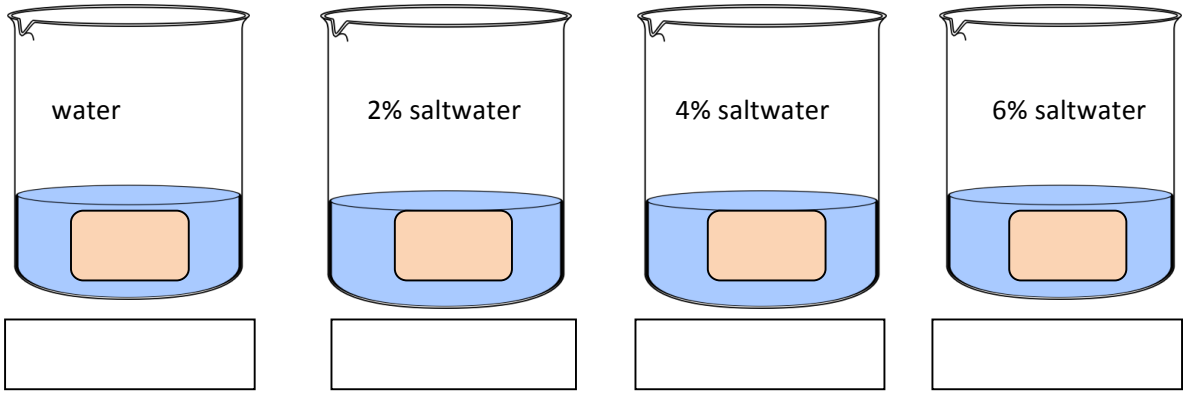
CONCLUSIONS

1. Looking at the results, do you accept or reject your hypothesis? EXPLAIN.

2. What happened to the mass of the cells as the concentration of salt increased?

3. Which sample had the largest % difference in mass? Why do you think this had the biggest difference?

4. In the beakers below, draw arrows to indicate the overall direction water flowed in each situation. In the box below each container, indicate if the solution is in an isotonic, hypertonic, or hypotonic.



5. The concentration of salt in the ocean is approximately 3%. If the cells had been placed in a 3% salt solution what would the change in mass have been after 25 minutes? (Hint: use your graph)

6. Explain in detail, using data from your experiment, to support why humans cannot drink saltwater.

7. Approximately 1% of all freshwater is potable, or drinkable. Identify at least 3 human activities that decrease our usable water.

   a.

   b.

   c.

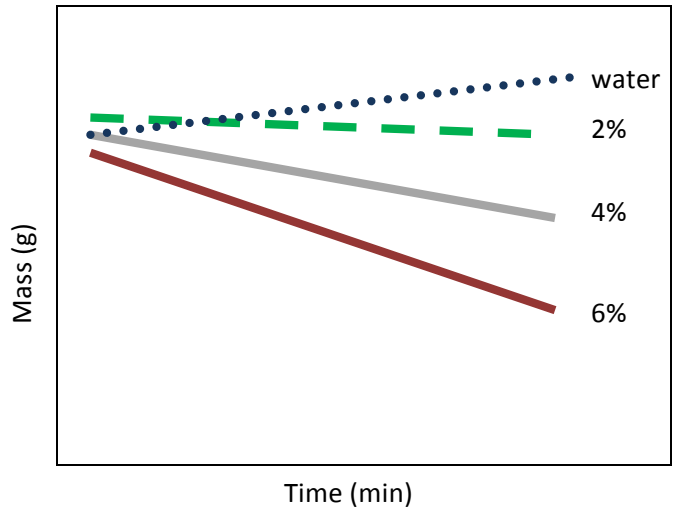
8. How has decreased access to freshwater influenced human activity?

9. Desalination is a technique that removes the salt from water. Many believe that desalination is an extremely effective method that will provide usable freshwater. Make a list of pros and cons for desalination.

10. OPINION: In order to acquire more freshwater should humans continue to invest in desalination, should they decrease pollution of freshwater, or should they increase wastewater reuse? Explain your answer.

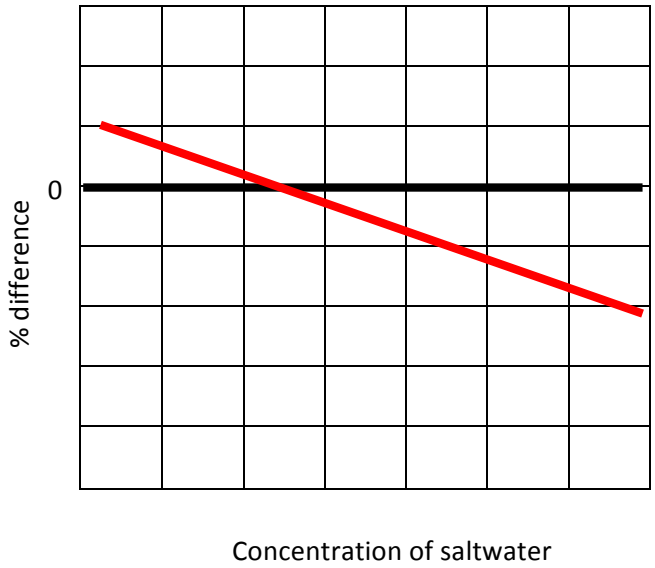
ANSWER KEY

Make a line graph of the data below. Label *time* on the x-axis and *mass* on the y-axis. Plot the data for each treatment on the graph. There will be four lines. Label the axes, provide a title, and label each line.



Data should reflect a linear trend of water loss. The sample without salt will likely show water gain.

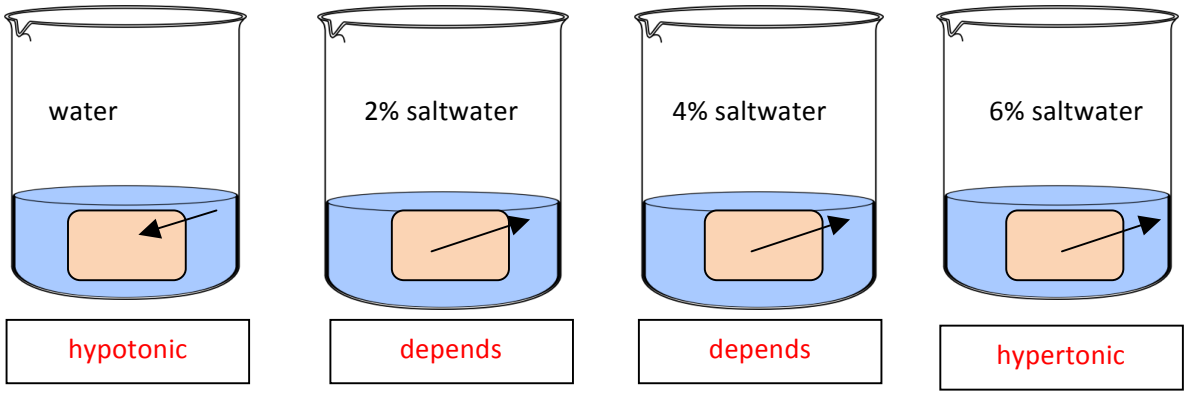
Make a line graph of the data below. On the x-axis put *concentration of saltwater* and on the y-axis put *% difference*. Plot the data on the graph. There will be one line. Label the axes and provide a title.



Data should reflect a trend of weight loss. The sample without salt will likely be above the 0 line.

CONCLUSIONS

1. Looking at the results, do you accept or reject your hypothesis? EXPLAIN. Answers will vary.
2. What happened to the mass of cells as the concentration of salt increased? As salt increased, the mass decreased due to water loss.
3. Which sample had the largest % difference in mass? Why do you think this had the biggest difference? Answers will vary.
4. In the beakers below, draw arrows to indicate the overall direction water flowed in each situation. In the box below each container, indicate if the solution is in an isotonic, hypertonic, or hypotonic.



Depending on the cell sample, the 2% or 4% beakers could be isotonic or hypertonic, although both samples will likely be hypertonic.

5. The concentration of salt in the ocean is approximately 3%. If the cells had been placed in a 3% salt solution what would the change in mass have been after 25 minutes? (Hint: use your graph) Answers will vary. Using their second line graph, students can accurately determine the change in mass.
6. Explain in detail, using data from your experiment to support why humans cannot drink saltwater. Answers should address how water will flow out of cells because they are in a hypertonic solution. This causes a person to become severely dehydrated which will lead to death.
7. Approximately 1% of all freshwater is potable, or drinkable. Identify at least 3 human activities that decrease our usable water. Fracking, sewage, gas/oil leaks, dumps, acid rain, etc
8. How has decreased access to freshwater influenced human activity? Answers will vary but some examples include: people have had to reduce use, increase cost of water, recycle water, relocate, etc
9. Desalination is a technique that removes the salt from water. Many believe that desalination is an extremely effective method that will provide usable freshwater. Make a list of pros and cons for desalination. Answers will vary.
10. OPINION: In order to acquire more freshwater should humans continue to invest in desalination, should they decrease pollution of freshwater, or should they increase wastewater reuse? Explain your answer. Answers will vary but credit should be given to supported answers.

NAME _____ DATE _____

Why Can't I Drink Saltwater?

(Student-Designed Experiment)

Approximately 70% of the earth is covered in water. Ninety-seven percent is saltwater, two percent is water found in the form of ice, and less than one percent is freshwater. If living organisms could drink saltwater, numerous issues involving lack of usable water could be solved. However, most living things cannot drink saltwater.

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You will design and perform an experiment to determine exactly why saltwater is dangerous to living things.

The **materials** made available to you are: Water, salt, beakers, balance, graduated cylinder, celery or other items composed of cells, flasks, tweezers, stir bar, items as requested

STEPS

1. Identify an experimental question.
2. State a hypothesis.
3. Identify the variables to the experiment.
4. Determine the materials and methods that will be used.
5. Show procedure to teacher for approval.
6. Test the hypothesis.
7. Gather the results in a table. Generate at least one graph of the data.
8. Analyze the results. Apply the data to the real world.
9. Upon completion, write a formal lab report.