Lesson Title: Making Artificial Seawater
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Topic: Density, salinity, water changes
Grade level: 3-8
Lesson Length: 45 minutes

Overview: Students prepare synthetic saltwater to be used in a partial water change in the aquarium.

Objectives: Students will:

- Understand that increased levels of dissolved salts results in increased buoyancy
- Understand that seawater is a complex blend of many different salts
- Investigate the relationship between quantity of salt and the specific gravity of the solution
- Understand that fresh water has a density of 1.000 g/mL, and that seawater has (on average) a density of 1.025 g/mL.

Prior Expectations from Learner: Ability to measure (volume, hydrometer). Basic understanding of dissolution, density.

Assessment: See section below for possible questions. Worksheet, quiz, exit-pass, oral question, etc.

Materials	Teacher	Student (working in groups of 3-4)	Notes
		~1 gallon container (small bucket, large bowl, etc.)	
	Large buckets/tub to contain student's water Extra salt and water Various hydrometers (homemade or professional bobber-style, swing-arm style, etc.) Absorbent materials (towels, newspaper, etc.) Two cups (for drinking out of) (2) Glass containers, .5-1 L (Flask, jar, etc.)	.75 gallon water (can be dispensed into container) Stirring tool (anything non-toxic and non-reactive) Hydrometer (inexpensive "swing-arm" box type are fine and relatively sturdy) Synthetic salt (such as Instant Ocean--any brand is fine) Measuring device for salt (tablespoon, scale, etc.)	Students can build their own "bobber-style" hydrometers in about 10-30 minutes, depending on the accuracy desired. See Sources for online lesson plans.

Section/Time	Teacher Activity	Student Activity	Notes
Prep:	Fill the two glass containers with water. Add synthetic salt (approximately 5 tbsp. is sufficient) to ONE container. Mix, make sure it dissolves completely (it needs to be clear). Prepare group kits--each group needs 1		Normal table salt will NOT dissolve clear! Use

	hydrometer, 1 container for mixing, 1 stirrer, 1 measuring device (tablespoon, etc.)		synthetic seawater, or water softening pellets.
Engagement (5 min)	Pick two volunteers who will perform a taste test of two samples of water. Tell the volunteers that their task is to determine which cup contains salt water. Hold up the two beakers of water (one salt, one fresh). Ask the class if they can tell which one has salt just by looking at it (no, the salt dissolves clear). Ask what are some other ways to determine if the water is salty? (Possible answers include: taste test, measuring density, evaporating the water and checking for salt residue, conductivity tests, comparing buoyancy of an object between the two samples, etc.)	Volunteer, observe classmates.	Some students react very strongly to the salty water (i.e. spitting it out--be prepared! Also, warn the students that it may be very unpleasant-tasting)
Instruction (2-4 min)	Form lab groups. Instruct students that the goal of this activity is to create saltwater of the appropriate salinity so that we can change some of the water in the aquarium. Their goal is to answer the question: How much salt does it take to create 2 liters of water with a salinity of 1.025 g/mL? Ask the class how much salt they think will be needed to create 2L of normal seawater strength). Record estimates on board. Remind the students that they need to keep track of how much salt they add to their container (on scratch paper)! Add salt in measurable increments (1 tablespoon). When groups reach the desired salinity, they are to raise their hands and have their salinity verified by the teacher. Ideally, the teacher would have a different type of hydrometer to confirm the salinity of the student's solution.	Listen to instruction. Answer question (Estimate how much salt will be necessary to create 2 L of seawater)	
Main Activity (20 min)	Distribute materials. Allow students to begin mixing salt into the water. Monitor activity, ensure that everyone has a chance to measure salinity, add salt, stir, etc. Also ensure that accurate records are being kept. Suggested guiding questions: What did you notice about the density as you add salt? If there is salt on the bottom of the container, is it dissolved? When salt is dissolving, where exactly is it going? What is happening to it? What would happen if you didn't stir when you added salt? What observations did you notice as you added salt? (if using bobber-style hydrometers): Why do you have to wait until the water is still to measure the	Students gather materials and begin adding salt. They will add salt in small increments and measure the density after each addition. The goal is to reach a density of 1.025 g/mL. If the students go over, they need to figure out a way to reduce the salinity (dilution with freshwater)	

	density? As groups finish, confirm the salinity. Make sure there is no salt on the bottom--if so, ask: When that salt dissolves, what is going to happen to the density? If the salinity is too high (common mistake), ask the students how they can lower it? (By adding freshwater.)	
Closure (5 min)	When groups are approved by the teacher, instruct them to dump their water into the collection tub. After clean-up, ask the students why we need to make saltwater? Can't we just go get it from the ocean? (Yes, but its very heavy! And what about people who don't live near the ocean? And the water we collect might polluted, or have too much plankton that will die when it comes into the aquarium.) What does changing out part of the water in the aquarium do? (Removes waste, replenishes minerals.) What did you discover about the effect of salt on density?	Students pour their prepared saltwater into a tub.
Assessment:	Possible questions include: Does dissolved salt increase or decrease the density of water? Would a liter of saltwater weigh more or less than a liter of freshwater? Are there more than one kind of salt? What is the most common salt in the ocean? If you were to evaporate some of the water from a bucket of saltwater, would the density increase or decrease? When we are mixing saltwater for the aquarium, why is it important to make sure it is the same salinity as in the aquarium? If the density of a saltwater solution is too high, does that mean there is too much salt or not enough salt? If there was too much salt, how would you decrease the density of the saltwater? If there was not enough salt, how would you increase the density of the saltwater? How could they increase the rate that the salt dissolved into the water? Is there a limit to how much salt will dissolve in water? If so, what is this called?	Students complete the assessment
TAG Differentiation:	Some of the ingredients in salt are: Sodium chloride, Magnesium sulfate, Sodium bromide, Potassium iodide. Ask them to look for patterns in these ionic compounds (usually a salt is made from one element from the far left and one element from the far right of the table).	

Source: Lesson plans about building hydrometers can be found by doing an Internet search ("lesson plan hydrometer") or: http://www.lessonplanspage.com/ScienceMakingAHydrometer79.htm