Notes for Suitcase Oceanography Mixtures and Solutions
Lesson 1

Why is the ocean salty?

1. In advance

A. Have the teachers prepare name tags for the students.

B. Students will need to have a sharp pencil and a ruler.

C. Teacher has students write their best answer to: "How did the ocean get salty?" Here it is best to use the phrase "how" (rather than "why") so the students think in terms of processes.

2. Introduction

A. Hang wall charts in advance; queue film; distribute handouts.

B. Give your name(s) and say you are from COAS-OSU.

1. Tell kids that you are an oceanographer.
2. Ask for a definition of "oceanographer."
3. Tell kids you are here to talk about ocean science.
4. Tell kids to raise their hands to be called on for answering questions.

C. Ask "Who has ever been to the ocean?"

D. Ask "What is special about seawater?" ...It is a salty solution.

3. Wall chart discussion (separate discussions for water cycle and salt cycle)

A. Water Cycle: Note proportion of water and land (70–30%). Blue planet.

B. Note undersea mountain chains (on Map of the Ocean Floor poster).

C. Talk about water cycle. Ask students what they know about the water cycle and thoroughly review this as some children still don't understand this. Clarify vocabulary.

D. Salt Cycle: Note that just like the water cycle there are salt cycles for the Earth.

1. Define input and output.
2. Ask children for some ways salt might be put into the ocean. (Cover the ways they don't bring up—give local examples where possible.)
3. Ask children for some ways salt might be taken out of the ocean. (Cover the ways they don't bring up—give local examples where possible.)
4. Review inputs and outputs by asking class to list them
5. Tell children that the amount and type of salt has been the same for 100s of millions of years. Ask why (don't expect clear answer). Suggest we now do some experiments to explore why it stays constant.

4. Ping-pong ball ocean chemistry experiments

A. Talk about rates. Bring up the analogy of filling a bathtub with the drain left open.

B. Note if input rate = output rate, system won't change. Carry out experiment 1 (input = 2, output =2).

1. Explain that we will take an engineer's view of the ocean and do some experiments on our imaginary ocean box. The ping-pong balls are salt; they can imagine water too. Explain that scientists use "models" to understand processes, and this is our "model ocean."
2. Physically show how evaporation would leave behind salt and leave an evaporate by pulling some ping-pong balls out of the box and holding them along the edge
3. Have one demo person be "inputs" another is "outputs" (could use students for this)
4. Have children fill in their names and date; input rate = 2; output rate =2; starting at time 0 balls = 40; explain that they have to fill in data in this experiment and that it has to be done quickly
5. Speak out loud at each time step: Instructor says "Input 2, output 2-How many balls are now in the box? Record that number." Ask class what the next time step. Repeat until data box filled.
6. Explain to children how to plot the data as points on the graph and then have them draw a line through the points.
7. Walk around the class to make sure the children are graphing the data correctly. After a few minutes ask the students to hold up the graphs to see what they did
8. Ask about the consequences of input=output for longer periods of time. ("What if we carried this experiment out for another hour? How many balls would be in the box? How about 500 million years?")

C. Carry out experiment 2 (input =2, output = 1).

1. Interpolation required for graph scale. Demonstrate this.
2. Ask what this would mean for the salt in the system; bring up Great Salt Lake as an example.
3. Make sure you convey the concept of slope: a rising line means the sea is getting saltier

D. Carry out experiment 3 (input = 2, output = 5).

1. Ask, "What would happen if we kept going?" Note that students could figure out how long it would take for all the "salt" to be gone

E. Note that the amount and type of salt has stayed constant in the oceans.

1. Ask what that means about the input and output of salt in the oceans.
2. Ask the students to show with their thumbs if the line is going up or down, and review slope concept. Have students state the graph trend and its meaning.
3. Note that constancy is true for the system but isn't always the case from place to place.
   a. Evaporation-precipitation can change <u>concentrations</u> from place to place.
   b. Illustrate by tipping box of ping-ping balls and showing amount of balls stays constant but concentration greater at one end then the other.

c. Freezing and melting can also cause salts to separate from water-tell kids that they could experiment with this at home. Try freezing salty water and see what happens to the ice and water before the whole thing is frozen.

4. Make sure to tell the students this is a "model" of the ocean. We use models to understand processes. Remind them that the balls represent the salt.

4. Measuring salinity

A. Note that small changes in salt from place to place affects how the ocean water moves or its currents.

B. Note scientists study salt and temperature which change with depth and place in the ocean.

C. Demo Niskin closure for taking water samples from a chosen depth.

D. Note that film shows scientists taking water samples from the Wecoma.

1. Wecoma is operated by Oregon State University, Newport.
2. Warn students the film is from 1983.

5. Lesson recap: Why is the ocean salty?

A. Prompt students for inputs and outputs; they write on the final page of graph booklet, you point out on wall chart.

B. Remind students that the total amount and type of salt in the oceans isn't changing; tell them to write why on their graph booklet. Remind them to think about the results of their experiments.

C. Collect graph booklets and pre-lesson sheets for assessment.