Khaled bin Sultan Living Oceans Foundation

STANDARDS

- **CCSS**: RST.9-10.1, 2, 3, 4, 5, 7, 8, 10; RST.11-12.1, 2, 3, 4, 8, 10; SL.9-10.1, 6; SL.11-12.1, 6; HSN.Q.A.1; HSA.CED.A.1, 4
- **NGSS**: ESS 2.A, ESS 2.C, ESS 2.D, HS-LS2-2, HS-LS2-6
- **OLP**: 1.B.1, 1.C.1, 1.C.7, 1.C.8, 1.C.9, 1.C.11

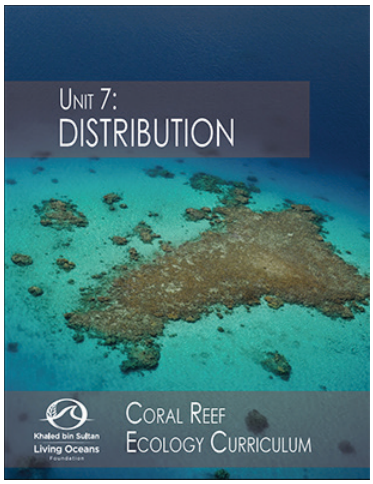
ONLINE CONTENTS

- Distribution Quiz
- *Where Are Coral Reefs Found?* Video Although corals are found throughout the planet, most reef-building corals are found in the tropics and subtropics where thousands of animals make these reefs their home.

DISTRIBUTION

This lesson is a part of the *Distribution* unit, which explains the two major drivers of coral distribution: salinity and temperature. Below is a summary of what is included in the entire unit.

UNIT CONTENTS



A. Background Information
   - Where are Corals Found?
   - What is a Current?
   - What is Density?
   - Salinity, Temperature, and Ocean Circulation

B. Lessons

Watch it! Where are Corals Found?
- A worksheet to accompany the *Where are Corals Found?* video

Density 101
- A lab to calculate and compare densities of liquids

Inquiring about Density 1
- A lab to create a procedure to determine relative densities

Inquiring about Density 2
- A lab to create a procedure to determine actual densities

Go With the Flow
- A worksheet to accompany a teacher demonstration on how salinity and temperature affect water density

Read it! Galapagos Ocean Currents
- A worksheet to accompany the *Galapagos Ocean Currents* field blog

Khaled bin Sultan Living Oceans Foundation

LESSON 2A

TEACHER'S NOTES

AUTHOR

- Amy Heemsoth, Khaled bin Sultan Living Oceans Foundation

LEARNING OBJECTIVE

- Determine the density of the unknown liquids without using a scale.

KEYWORDS

- Density
- Inference
- Mass
- Methodology
- Observation
- Volume

MATERIALS

- 4 unknown salt water solutions (salt and water)
- Food coloring (4 colors)
- 4 Two-liter bottles
- Safety goggles
- Beakers
- Pipettes
- Test tubes
- **Lesson 2A: Inquiring About Density 1** student worksheet

INTEGRATING SUBJECTS

- Math

PRIOR KNOWLEDGE

- Students will have prior knowledge of calculating and finding density, how to write a methods section, and understanding the difference between inference and observation.

EVALUATION

- Students will evaluate whether their methodology worked or not.

REFERENCE

- Adapted from: Sleep, J. M. & Johnson, L. (2010). Exploring the Depths: Inquiring to apply and deepen students' understanding of density. *The Iowa Science Teachers Journal*, 37(2): 5-10.

STANDARDS

- CCSS: RST.9-10.4, 5; RST.11-12.4; SL.9-10.1, 6; SL.11-12.1, 6
- NGSS: HS-LS2-2
- OLP: 1.B.1, 1.C.7

PROCEDURE

- See next page.

PROCEDURE

The educator will moderate the activity.

1. Teach *Background Information* section *C) What is Density?*
2. Recap what the students learned from **Lesson 1: Density 101**.
3. Before class, prepare solutions in labeled (Unknown 1-4) two-liter bottles. Here is how to make the solutions:
    1. 1 cup of table salt to water
    2. ¾ cup of table salt to water
    3. ½ cup of table salt to water
    4. Water with no salt
4. Add different colored food coloring to each unknown solution.
5. Begin the activity by explaining to the students that there are four colored, salt water solutions each with a different density.
6. Hand out **Lesson 2A: Inquiring About Density 1** student worksheet.
7. Prompt students with the following questions:
    a. *What are some ways that we can measure the density of these solutions?* Ask students to write down their ideas and then have a brainstorming session with the class. Write the responses on the board. Potential responses:
        - Since students just completed **Lesson 1: Density 101**, they will likely say to measure the mass and the volume of each sample using a scale and a graduated cylinder. Then calculate the density using D = m/V equation.
8. Next, prompt students with a second question:
    a. *How could you do this* **without** *a balance or a scale?* Again ask students to write down their ideas and then have a brainstorming session with the class. Write the responses on the board. Potential responses:
        - Mix all of the liquids to see what happens.
        - Liquids that are less dense will float on top of more dense liquids. Mix all the liquids together to see if they will all separate.
        - Use an object with a known density to see if it floats in the liquid. If it sinks, the object is more dense than the object. If the object floats, it is less dense than the liquid.
9. After the discussion, have students come up with their own methodology. Remind them that they are not allowed to use a scale or balance.
10. Before the students can begin testing their methodology, they must have the teacher's approval.
11. While students are testing their methods, walk around asking questions about their procedure.
12. After all of the students have completed testing, ask students: *What conclusion did you reach about the densities of the solutions?*
13. If students disagree on the results, encourage students to discuss.

Khaled bin Sultan Living Oceans Foundation

LESSON 2A Inquiring About Density 1

OBJECTIVE: There are four colored salt water solutions. What are some ways that you can measure the density of these solutions?

BRAINSTORMING IDEAS:

OBJECTIVE: How can you do this without a balance or a scale?

BRAINSTORMING IDEAS:

METHODOLOGY:

Teacher Approval: _____

RESULTS: Once you have been given approval, test your methods and fill in the results in the table below.

Liquid	Observations	Inferences
Unknown 1		
Unknown 2		
Unknown 3		
Unknown 4		

CONCLUSIONS: Write you conclusions based on your results in the space below.

Khaled bin Sultan Living Oceans Foundation

LESSON 2B

TEACHER'S NOTES

AUTHOR

- Amy Heemsoth, Khaled bin Sultan Living Oceans Foundation

LEARNING OBJECTIVES

- Determine density by measuring the mass and volume of the unknown liquids.
- Calculate the density using the mass and volume measured.

KEYWORDS

- Density
- Mass
- Molecule
- Volume

MATERIALS

- 4 unknown salt water solutions (salt and water)
- Food coloring
- Two-liter bottles
- Safety goggles
- Graduated cylinders
- Scales
- **Lesson 2B: Inquiring About Density 2** student worksheet

INTEGRATING SUBJECTS

- Math

PRIOR KNOWLEDGE

- Conduct **Lesson 2A: Inquiring about Density 1**.

EVALUATION

- Students will evaluate whether their methods worked or not.

REFERENCE

- Adapted from:
  Sleep, J. M. & Johnson, L. (2010). Exploring the Depths: Inquiring to apply and deepen students' understanding of density. *The Iowa Science Teachers Journal*, 37(2): 5-10.

STANDARDS

- CCSS: RST.9-10.4, 5, 7; RST.11-12.4; SL.9-10.1, 6; SL.11-12.1, 6; HSN.Q.A.1; HSA.CED.A.1
- NGSS: HS-LS2-2
- OLP: 1.B.1, 1.C.7

PROCEDURE

The educator will moderate the activity.

1. Use the same unknown liquids from **Lesson 2A: Inquiring About Density 1**. Before class, prepare more solution if necessary.
2. Prompt students with:
   a. *Now that you know the relative densities of each solution, how can you be more precise in your comparison of the solutions' densities?*
   b. Ask students, *How can we get these values?* The students will have to use their knowledge from the previous density experiments (**Lesson 1: Density 101** and **Lesson 2A: Inquiring About Density 1**).
3. Hand out **Lesson 2B: Inquiring About Density 2** student worksheet.
4. After the discussion, have students come up with their own methodology.
5. Before beginning the activity, ask students,
   a. *How many times do you think that you should measure each of the liquids to be confident in your results?*
   b. *As long as you get the data, do you think it matters if you use a different methodology to get it?*
6. Have each group write their data on a white board. Once all the data is on the board ask:
   a. *Is your data consistent or are there any outliers?*
   b. If there is inconsistent data ask: *What should we do with the inconsistent data?*
7. Ask the students to write a conclusion about the density of their solutions.

Name: _____ Date: _____

Khaled bin Sultan Living Oceans Foundation

LESSON 2B

Inquiring About Density 2

OBJECTIVE: Now that you know the *relative* densities of each solution (**Lesson 2A**), how can you be more precise in your comparison of the solutions' densities?

BRAINSTORMING IDEAS:

METHODOLOGY:

RESULTS: Once you have been given approval, test your methods and fill in the results in the table below.

Liquid	Density
Unknown 1	
Unknown 2	
Unknown 3	
Unknown 4	

CONCLUSIONS: Write your conclusions based on your results in the space below.

DRAW: Draw a diagram of how each of these solutions would look at a molecular level.

UNKNOWN 1

UNKNOWN 2

UNKNOWN 3

UNKNOWN 4

1. Were your results the same in Part 1 and Part 2? If they were not, why do you think they were different?

2. Would you do anything differently in Part 1?

3. Would you do anything differently in Part 2?

4. Do you think it's important for scientists to use the same methodology? Why or why not?