

Lab Investigations: Physical Science

Oak Meadow Lab Manual

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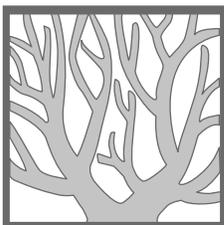


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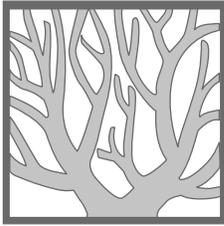
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Lab Investigation: Sink or Float?

We all know light things float and heavy things sink. But some heavy things, such as ships, also float. How does the shape of an object influence its ability to sink or float? Your job is to design an experiment that tries to answer this question.

Materials

- clay (about the size of a baseball)
- bucket of water

Procedure

1. Write your hypothesis. This is written as a statement about what you think will happen when you test how the shape of an object influences its buoyancy. Remember, your hypothesis must be testable and written clearly to indicate which variable you will be testing.

2. Consider the variable factors that might influence whether an object floats or sinks. List all the factors you can think of.

3. In this experiment, your variable factor is the shape of the object. How will you control all the other factors? For each factor listed above, write down how you will keep it constant during the experiment. Include exact details about where that constant will be set. The first one is done for you.

Weight or mass: each shape tested will be made from the same ball of clay, with no clay added or subtracted. This will control the weight and mass of the object.

4. Now you need to decide on five or more shapes that you will test. For instance, you might first test whether the ball of clay will float as is (in a ball shape). Then you might test it as a flat pancake shape, a round bowl shape, a boat shape, or any other shape. You might even test a shape with one or more holes in it! The more shapes you try, the more data you will collect. Write down a general description of the shapes you will test.

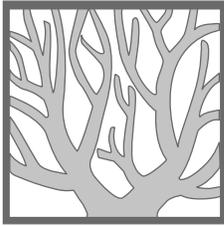
5. Now you will design your experiment, making sure to control all factors but the shape of the object. Explain in detail how you will conduct the experiment. Be as precise as you can. How much water will you use? What will the water temperature be? (Remember, it has to be held constant.) How long will you let each shape sit in the water? Will you drop the shape from above or carefully lower it into the water? (You have to do it the same way each time to get really accurate data.) Clearly state the variables involved and how you will control all the variables except for the shape of the object. Write down the procedure you will follow, step by step.

Conclusions

1. Based on the results of your experiment, form a conclusion. Was your hypothesis correct? How does your data prove (or disprove) it?

2. List any questions that arise from your results. What else might you test to help shed more light on this question? Are there other variables you might want to test that may affect whether an object floats or sinks?

3. Do you feel your experiment was successful? Why or why not? If you were to do it again, how might you do it differently?



Scientific Inquiry: Modeling an Element or Molecule

The goal of this scientific inquiry is to create a three-dimensional model of an atom or molecule. You can be as creative as you like, as long as your model is scientifically accurate. After you have finished your project, complete the project reflection.

Here are the basic steps of your scientific inquiry (these are more fully explained below):

- Question:** Identify a question or pose a hypothesis.
- Research:** Investigate your topic by gathering data.
- Design:** Plan your project and what you'll end up with when it is finished.
- Discuss:** Discuss your project idea with others and refine your design.
- Create:** Create something you can share with others.
- Share:** You might share your project at home with friends and family, in the community, or online.
- Reflect:** Assess your project design and reflect on the learning experience.

Scientists often work in groups, so you might consider working with one or more partners on your project. Feel free to collaborate with others on any phase of your project.

Project Design and Implementation

The following procedure will lead you through your project step by step. Of course, you are free to go in another direction and create your own project steps, if you have other ideas. This project is designed to be done in one week, but you may choose to do a longer, more complex project. One week may sound like a long time to create a model but modeling projects can present surprises and design elements that are trickier to construct than first imagined. You'll want to start on your project right away so you have plenty of time to work on and refine your design.

If you have questions or need help for any of these stages, ask an adult to guide you. **Read through all the steps before you begin** so you have an idea of the scope of the project from beginning to end.

Question: For this project, the initial question has been posed: “How can I create a three-dimensional model of an element or molecule of multiple elements?”

What element or molecule will you model? (You may need to do some research before deciding—you don’t want to pick something too complicated, or too simple.) _____

Research: Think about what you will need to know in order to choose and model an element or molecule.

For each element you will be modeling, you will need to know the following:

- Element name and symbol
- Number of protons and neutrons in the nucleus
- Number of electrons
- Number of electron shells
- For molecules of two or more elements, number of atoms of each element (if you are modeling a molecule, you don’t have to represent the electrons)

Design: Once you have decided on what you will be modeling, you can start to think about how you will create your model. You might use materials from nature, food, clay, balls, beads, toothpicks, wire, cloth, or other craft items.

List the materials you’d like to use:

Describe how you will use these materials to make your model. Explain how you will hold the atoms together for a molecule or connect the orbiting electrons for an atom.

Discuss: Discuss your project idea with others. Ask them for their ideas on refining your design. You might use some of their ideas, or their ideas might help you discover a new way of improving your design.

Feedback from others:

Write a new materials list and description of your project, based on your discussions.

Create: Construct your design. You may have to create more than one model, especially if the model doesn't hold together or it turns out to be too difficult to create as originally designed. Make adjustments and keep trying!

When creating your model, was it successful the first time? If not, what went wrong?

What did you do to fix it?

Share: This project can be shared in person (show it to a friend or relative and explain what the model shows) or you can take a photo of it to share with friends, family members, or the online community. If your model came out quite successfully, you might want to recreate how you made it on video and upload it so other students can have a clear procedure to follow.

How will you share your model? _____

Reflect: Fill out the project reflection below to assess your project design and reflect on the learning experience.

Project Reflection

After you have completed your project, complete this self-assessment. Consider each question carefully. Take the time to reflect on the experience before answering.

Thinking back on the process of creating your project, what worked out better than expected?

What didn't work out as planned?

Were you able to find enough helpful, reliable resources? Did you use a variety of resources?

Once you began creating your project, did your plans change? If so, how and why?

Did you have enough time to complete your project to your satisfaction? If not, what do you feel you could have done better or differently if you had more time?

Would you like to try planning and implementing a longer project next time?

What might you do differently if you were to do this project again?

What advice would you give other students who undertake a project like this?

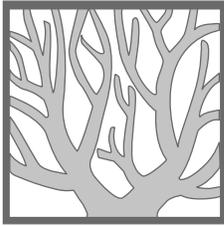
Fill in the blanks for the following statements.

The most interesting aspect about this project was _____

The most difficult part for me was _____

I'd like to improve my skills in the following areas: _____

I'm happy with the way I _____



Lab Investigation: Oxidation and Combustion

For this investigation of oxidation and combustion, you will be covering a lit candle with a glass jar to see how long it burns before going out. Then you will allow different amounts of air into the jar to see how it affects burn time.

Note: This lab involves fire and adult supervision is required.

Materials

- glass jar
- candle (small enough to fit inside the jar)
- matches or lighter
- toothpick
- butter knife
- metric ruler or tape measure
- clock, watch, or stopwatch

Hypothesis

Read through the procedure you will be performing. Predict what you think will happen. Write your prediction as a hypothesis.

Explain why you made this prediction.

Procedure

1. Place the jar upside down on the toothpick so that the jar is tilted slightly with the toothpick holding one side up. Measure the gap created by the toothpick. (If your measuring tool doesn't have small enough increments, you can use the following estimate: width of toothpick = $\frac{1}{16}$ inch = 0.0625 inch = 1.6 mm or .16 cm.) Record this measurement in the left-hand column of the data chart. Make sure to include the unit of measure you are using and use the same unit for all your measurements.
2. Remove the toothpick and replace it with the handle of the butter knife, so the knife handle is propping up one side of the jar. Measure the gap and record the measurement.
3. Light the candle (use adult supervision for safe handling of fire).
4. Place the glass jar upside down on top of the candle. Use a stopwatch or clock with a second hand to time how long the flame burns before extinguishing. Record the time on the data chart.
5. Relight the candle. Place the glass jar upside down on top of the candle with the toothpick underneath one edge of the jar. Count the number of seconds the flame stays lit and record the data from your observation.
6. Repeat the process using the butter knife to create a larger gap under the edge of the jar. Record how much time the candle stays lit before going out.
7. Repeat the experiment two more times using different objects to change the size of the gap each time. Record the type of object and the gap measurement on the data table before you light the candle.

Data Table: Oxidation and Combustion

TOTAL BURN TIME	
Upside-down jar (no gap)	
Jar with toothpick Gap measurement: _____	

TOTAL BURN TIME	
Jar with butter knife Gap measurement: _____	
Jar with _____ Gap measurement: _____	
Jar with _____ Gap measurement: _____	

Conclusions

1. Based on your knowledge of oxidation and the process of combustion, explain what is happening in this experiment.

2. What was the purpose of changing the size of the gap? What effect did it have?

3. Was your original hypothesis correct or incorrect? Use your data as evidence to support your answer.
