Investigating the Relationship of Mass to Volume
By Juanita Richardson

Grade: 3

Subject: Physical Science

Secondary: Economics—Relate importance of taconite pellet shipping to economy of the Great Lakes regions

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Lesson Overview

Topic: Properties of Matter

Big ideas(s):
Two materials can have the same mass and yet have different volumes.
Science progresses by asking meaningful questions and conducting careful investigations.
Scientists share their findings with other scientists to create a shared body of knowledge.

Vocabulary words:
Before lesson: matter, mass, volume weight, graduated cylinder, balance scale
During lesson: testable question/hypothesis, prediction, procedure, data, conclusion

What you need:

Overhead projector/ELMO projector
Investigation sheet overhead
Copies of investigation sheet for each student,
Balance scales for each pair of students
Ounce (or substitute gram weights throughout instead)
Graduated cylinders or small plastic cups to measure volume
Matter – Bags of Skittles and Jolly Ranchers equally divided ahead of time to pass out to students
   one container of Skittels and one container of Jolly Ranchers for each group of students

Extension: Video—Taconite Rocks
   Prior Art Project: Make a Freighter from a Cardboard Egg Carton

Grouping: 2-4 students per group

Setting: regular classroom

Time needed: Part 1 - planning investigation - 40 minutes
   Part 2 – doing investigation and collecting data – 30 minutes
   Part 3- Sharing results and drawing conclusions – 20 minutes
   Extension activity – 60 minutes

Summary:
Science: Students practice the process of doing investigative science through team investigations. They investigate two materials that weigh the same amount. The testable question: If I have an amount of Skittels and an amount of Jolly Ranchers of the same weight, will they take up the same amount of space? Together, the class makes predictions, and decides on materials and procedures. Then in groups, students do the investigation,
collect data and draw conclusions. After this activity, students will be better able to develop independent investigations in this and other subject areas.

Social Studies/Economics: Students will become aware of importance of the Iron Ore shipping industry to the Great Lakes region and how the technology of producing taconite pellets has improved the efficiency of shipping iron ore.

Prerequisites for students: Students have learned how to measure using a scale and/or weights.
– Parts 2 and 3 (measuring mass and volume and recording their results. They will have experience observing properties of matter.

Learning goals/objectives for students:

Investigation and experimentation
Students will be able to collect and use numerical data to describe and compare measurements.
Students will be able to predict the outcome of a simple investigation and compare the result with a prediction.

Physical Science
Students will be able to collect data in an investigation of the relationship of mass to volume and analyze the data to develop the conclusion that different materials with the same mass do not necessarily have the same volume. This will lead to further investigations about density as it relates to states of matter.

Getting ready:
Have students decide who will get and return the supplies and who will be the recorder. The whole group can help in the weighing and measuring process.

Lesson Implementation / Outline

Introduction:
When I watched you use the balance scales to measure the weight of matter and the graduated cylinder/small cup to measure the volume, I thought of this question. If two kinds of matter weigh the same, will they take up the same amount of space? For instance, if I have 4 ounces of Skittles and 4 ounces of Jolly Ranchers, will they take up the same amount of space when I pour them into the graduated cylinder or small cups? What do you think? Take a minute to talk about it with your desk partner. (After a couple minutes, partners share their ideas with whole class.)
Today we’re going to work together to create a science experiment that will help us find an answer to this question. Then we’ll work as scientists and do the experiment.

Activity:

Part 1 - Planning the investigation
1. Review how the balance scale and gram weights are used as tools to measure mass by measuring the weight of about 4 ounces of a particulate solid (cornmeal, salt, or flour). Then demonstrate how the graduated cylinders/small cups are used to measure volume by measuring the volume of the particulate solid.
2. Show investigation sheet on overhead.
3. Introduce testable question: Scientists often start with a question that they want to answer by doing an experiment. Here is the question that I want to test.
If I take two kinds of matter, for instance- gravel and sand, that weigh the same, will they also take up the same amount of space?
4. Ask students what they predict is the answer to the question.
5. Ask for their ideas on how we could do an experiment to find out the answer to the question. Discuss and come to consensus on procedure and materials and write down on overhead.

**Part 2 - Doing the investigation**
6. Hand out photocopied Investigation Plan overhead or display overhead.
7. Have student pick up materials
8. Students do investigation and write down results including measurements.

**Part 3 - Sharing Data and Drawing Conclusions**
9. Make a chart of group data
10. Discuss results.
Have student groups share their conclusions (answer to the testable question) and give evidence that supports their conclusions.

Checking for student understanding: See sharing data and drawing conclusions

Wrap-up / Closure: Have students explain why it would be more beneficial for a freighter to carry taconite pellets rather than iron ore rocks to take to steel mills.

Evaluations: Participation in experiment, Sharing data and Completed Data sheets.

**Extensions and Reflections**

Extensions and connections:
Watch YouTube videos: 1) taconite ore processing
   2) hibbing taconite mine pit activity
   3) loading taconite into the Michipicoten at LS&I docks, Marquette, MI

Physical Sciences:
1. Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept:
   h. Students know all matter is made of small particles called atoms, too small to see with the naked eye.

Investigation and Experimentation:

5. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

   a. Repeat observations to improve accuracy and know that the results of similar scientific investigations seldom turn out exactly the same because of differences in the things being investigated, methods being used, or uncertainty in the observation.
   b. Differentiate evidence from opinion and know that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.
   c. Use numerical data in describing and comparing objects, events, and measurements.
   d. Predict the outcome of a simple investigation and compare the result with the prediction.
   e. Collect data in an investigation and analyze those data to develop a logical conclusion.

Social Studies/Economics: Interdependence
**People helping one another to meet needs and wants (e.g., recycling and conservation projects).** People rely on each other for goods and services in families, schools, and the neighborhood. People make economic decisions and choices.
Testable Questions: What do I want to find out?
If I take two substances (Skittels and Jolly Ranchers) that both weigh the same amount, will they also take up the same amount of space?

Hypothesis: Two substances that weigh the same will also take up the same amount of space.

Prediction: What do I think will happen? ______________________________
________________________________________________________________________
________________________________________________________________________

Materials needed: ___________________________________________________
________________________________________________________________________
________________________________________________________________________

Procedure: How to do the experiment
1.______________________________________________________________________
______________________________________________________________________
2.______________________________________________________________________
______________________________________________________________________
3.______________________________________________________________________
______________________________________________________________________
4.______________________________________________________________________
______________________________________________________________________
5.______________________________________________________________________
______________________________________________________________________

Carefully write down your measurements and information that you collected on another page (Data Page)

Conclusion: What did you find out?__________________________________________
________________________________________________________________________
________________________________________________________________________
StUDENT NAME___________________

Experimental Plan

Testable Questions: What do I want to find out?

Hypothesis: Two substances that weigh the same will also take up the same amount of space.

Prediction: What do I think will happen? ______________________________
________________________________________________________________________
________________________________________________________________________

Materials needed: ___________________________________________________
________________________________________________________________________
________________________________________________________________________

Procedure: How to do the experiment
1.______________________________________________________________________
______________________________________________________________________

2.______________________________________________________________________
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3.______________________________________________________________________
______________________________________________________________________

4.______________________________________________________________________
______________________________________________________________________

5.______________________________________________________________________
______________________________________________________________________

Carefully write down your measurements and information that you collected on another page (Data Page)

Conclusion: What did you find out?______________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
Make a Freighter Art Project
(A Recycling Project)

Materials:
Cardboard egg carton
White (Elmer’s) glue
Acrylic paints
Scissors
Cut 2/3 (4/6) of the top of the carton off. (May need adult help.)
Glue the remaining part to the bottom part of the carton. This will be the cabin.
Draw windows in the cabin.
Paint the freighter.
Students may add more décor (such as a smokestack) if desired.
As students are painting the freighter, discuss what the freighter could be carrying and where it came from and what body of water it could be on.