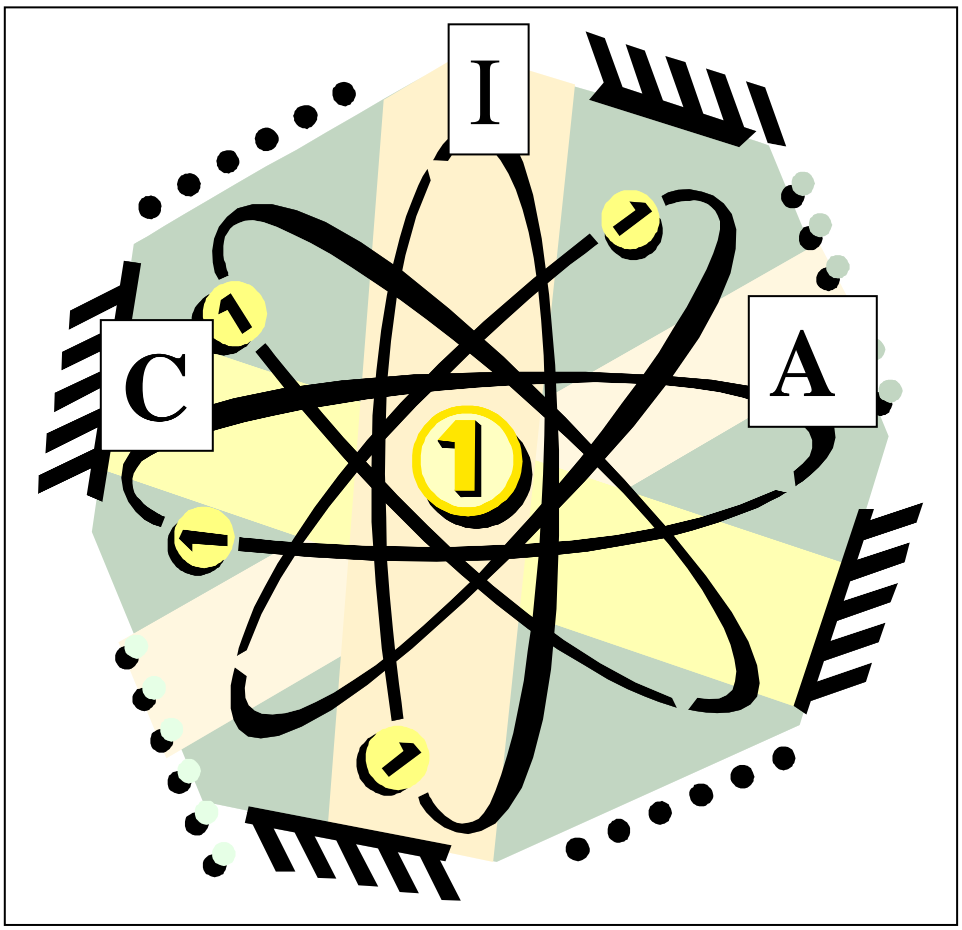
Curriculum, Instruction, Assessment (CIA) Alignment

Science, Grade 3
Unit 1: Properties of Matter

Task Analysis and Hands-on Investigations



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BLOOM'S TAXONOMY

Level 1	**Level 2**
Knowledge	Application
Comprehension	Analysis
Application	Synthesis
	Evaluation

Subject Area: Science
Strand A: The Nature of Matter
Grade: 3

Benchmarks

SC.A.1.2.1: The student determines that the properties of materials (e.g., density and volume) can be compared and measured (e.g., using rulers, balances, and thermometers).

SC.A.1.2.3: The student knows that the weight of an object always equals the sum of its parts.

SC.A.2.2.1: The student knows that materials may be made of parts too small to be seen without magnification.

TASK ANALYSIS **The student…**
PROPERTIES OF MATTER
• draws and records in a journal, observations of a material, such as Styrofoam, using the naked eye, a hand lens, and a microscope.
• measures matter using various tools such as rulers, thermometers, balances, and graduated cylinders.
• compares and contrasts the physical properties of matter by making both quantitative and qualitative observations.
• determines the mass of equal volumes of various materials using metric tools.
• determines the mass of a given volume of water to discover that the mass and volume of water are equal (e.g., 10 milliliters of water = 10 grams).
• compares the weight or mass of an object to the sum of its parts using a spring scale or balance.

THE APPLE OF MY EYE

BENCHMARKS and TASKS

SC.A.1.2.1 The student determines that the properties of materials (e.g., density and volume) can be compared and measured (e.g., using rulers, balances, and thermometers).

SC.A.1.2.3 The student knows that the weight of an object always equals the sum of its parts.

- The student measures matter using various tools such as rulers, thermometers, balances and graduated cylinders.
- The student compares and contrasts the physical properties of matter by making both quantitative and qualitative observations.
- The student compares the weight or mass of an object to the sum of its parts using a spring scale or balance.

KEY QUESTIONS

What observations can you make about an apple?
What attributes are measurable for an apple?

BACKGROUND INFORMATION

Mass is defined as the measure of the amount of **matter** in a **solid**, **liquid**, or **gas**. All solids, liquids, and gases have mass because they are all made of matter. Mass is recorded in units such as kilograms or grams. A balance is used to measure the mass of an object.

The amount of space that an object or substance takes up is defined as **volume**. Volume is measured in units such as liters. A liter box is one tool used to measure the volume of liquids. The buoyant apple in this activity displaces an amount of water equal to its mass.

MATERIALS

Per group
1 balance
1 gram set
1 measuring tape
1 ruler
1 liter box
1 apple
1 plastic knife
water

Teacher
Mr. Archimedes' Bath, Pamela Allen
Measuring Tools, Daronco and Presti, Benchmark Education Co.

Per student
The Apple of My Eye data sheet

TEACHING TIPS

1. Allow time for students to explore balances, gram sets, and other measurement tools before the activity.
2. Request that each student bring in an apple prior to the lesson, but have some extras on hand, just in case. Use a variety of kinds and sizes of apples.

ENGAGE

1. Before distributing the apples, ask students what they know about apples. Record their responses on a Circle Map.
2. Tell students that they will be using their senses and scientific tools to make observations about apples. Share the book, *Measuring Tools,* and ask students to think about which of the tools mentioned might be useful when observing apples.

EXPLORE (Part 1)

1. Have students form several groups.
2. Ask: *Using your senses and scientific tools (e.g., balance, measuring tape, ruler), what observations can you make about apples?*
3. Demonstrate how to use the balance and gram set to measure the mass of an apple.
4. Demonstrate how to use the measuring tape to measure the circumference of an apple.
5. Distribute all materials, including the *Apple of My Eye Data Sheet* to each student.
6. Tell students they will have time to observe their apples using their senses, as well as other appropriate tools.
7. Monitor students as they observe, measure, and record.
8. When observations are complete, tell students to discuss their findings within their groups.

EXPLAIN (Part 1)

What unit of measurement did you use for the mass of your apple?
Why did the apples not all have the same measurements?
How tall (high) is your apple?
Why would it not be appropriate to try to find the width of the apple? (The apple's shape makes it difficult.)
How were you able to measure the distance around your apple – the circumference?

EXPLORE (Part 2)

1. Ask: *How can we determine the amount of space taken up by an apple?* Explain that this is the volume of the apple.
2. Have students fill a liter box with enough water to cover the apple.
3. Students should observe and record the level of the water in the box.
4. Students should place the apple in the water and again, observe and record the level of the water.
5. Ask students to compare the two measurements.

EXPLAIN (Part 2)

Discuss:
How did the level of the water change after the apple was placed in the liter box? (The level of the water got higher.)

What do you think caused the level of the water to change? (The apple takes up space and has volume.)

EXTEND/APPLY

1. Ask:
   What happens to the level of the water when you get in the bathtub?
   What happens to the level of the water when you get out of the bathtub?
2. Read *Mr. Archimedes' Bath.*
3. Ask: *Will the mass of your apple change when it's cut into quarters?*
   Help students cut their apples into quarters and use the balance and the gram sets to find out if the mass of the four pieces approximately equals the mass of the whole apple.
   Discuss observations and conclusions.

EXTENSIONS

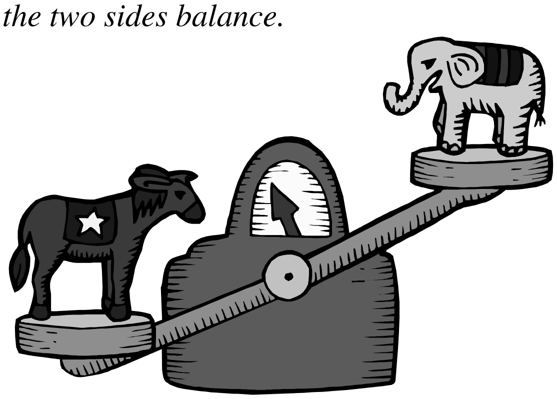
1. Compare the mass of all the apples by collecting data from each group. Create a line plot to determine the **range**, **median,** and **mode**.

X			
X	X		
X	X	X	
X	X	X	X
34 g	42 g	48 g	60 g

   Range: 34 g – 60 g, a difference of 26 g
   Median: 42 g
   Mode: 34 g
2. Use oranges to complete a similar investigation. Compare the mass of the whole orange to the mass of the peeling plus the fruit.

ASSESSMENT

Use the picture below to answer these questions:
Why is the balance tilted to one side?
Which animal has the most mass? How do you know?
Explain how you could make the two sides balance.



NAME____DATE________________

THE APPLE OF MY EYE
DATA SHEET

Part 1
Directions: Using scientific tools and your five senses, observe your apple and record your findings.

COLOR	
SHAPE	
OTHER CHARACTERISTICS	
MASS	
HEIGHT	
CIRCUMFERENCE	

Part 2
What is the measurement of the level of the water in the liter box without the apple?

What is the measurement of the level of the water after the apple is placed in the water?

How did the level of the water change?

MEASURING MASS

BENCHMARK and TASKS

SC.A.1.2.1 The student determines that the properties of materials (e.g., density and volume) can be compared and measured (e.g., using rulers, balances, and thermometers).

- The student determines the mass of equal volumes of various materials using metric tools.
- The student determines the mass of a given volume of water to discover that the mass and volume of water are equal (e.g., 10 mL of water = 10 g)**.**

KEY QUESTION

Do materials with equal volume also have equal mass?

BACKGROUND INFORMATION

Mass is defined as the measure of the amount of **matter** in a **solid**, **liquid**, or **gas**. All solids, liquids, and gases have mass because they are all made of matter. Mass is recorded in units such as kilograms or grams. The amount of space that an object or substance takes up is defined as **volume**. Volume is measured in units such as liters. The mass and volume of water are equal (e.g., 1 mL = 1 g).

The materials in this activity all have the same volume. They take up an equal amount of space, but they have a different mass. This is because they have different **densities.** This beginning investigation can help students build their background knowledge for understanding density.

MATERIALS

Per group

1 graduated cylinder
4 baby food jars
1 balance with gram set
paper towels
masking tape
1 permanent marker

3 oz. cup of each solid
macaroni
popcorn kernels
sand
pinto beans

100 mL of each liquid
water
orange juice
milk
liquid soap

Per student

activity sheets

Teacher

tray

Per class

4 large containers of each of the liquids
4 large containers of each of the solids
4 index cards for leveling the solids

TEACHING TIP

Have students measure the liquids they will need for Part 2 of the activity:

- Use a graduated cylinder to measure 100 mL of water.
- Pour 100 mL of water into each of the four baby food jars.
- Mark the 100 mL level with masking tape.
- Empty the water.
- Use masking tape and a permanent marker to label the four containers with the names of the liquids.
- Pour 100 mL of each liquid into the labeled jar.

ENGAGE (Part 1)

Display a tray holding the 3 oz. cups containing the solid materials the students will be exploring. Show them that each material takes up exactly the same amount of space – 3 oz., so they are all equal in volume. Ask students if they think the substances are also equal in mass.

EXPLORE (Part 1)

1. Have one student from each group go to a designated table and fill four 3 oz. cups to the brim with each of the four substances: popcorn kernels, sand, pinto beans, and macaroni. Use an index card to level each material.
2. Ask students to heft (lift) the materials, predict their order from heaviest to lightest, and record.
3. Distribute the balances and gram sets and direct students to predict the mass of the first material and record on the data sheet. Then have them find the actual mass and record this on the data sheet.
4. Have students continue this process - predict and then measure each material - until they have found the estimated and actual mass for each of the four materials.

EXPLAIN (Part 1)

How did the order for mass determined by hefting compare with the actual order after measuring?
How did you know that all the materials had the same volume? (Each one occupied the same amount of space in the 3 oz. cups.)
Did all the materials have the same mass? (no)
Why do you think the materials had different masses?
Which solid had the most mass?
Which solid had the least mass?
What can you conclude about the masses of solid materials when their volumes are equal? (The masses are not likely to be equal, even though the volumes are.)

ENGAGE (Part 2)

We measured different kinds of solid materials earlier, and learned that even though they had equal volumes, they did not have equal masses. Ask: *What else could we measure in the same way?* (liquids)

EXPLORE (Part 2)

1. Tell students they are going to repeat the activity they did earlier, but this time they will be exploring the mass of equal volumes of different liquids: milk, orange juice, water, and liquid soap.
2. Have students use the graduated cylinder and the baby food jars to measure exactly 100 mL of each liquid. Label the jars with masking tape.
3. Have students estimate the mass of each liquid and then find the actual mass and record.
4. Have students continue this process – predict and then measure each material - until they have found the estimated and actual mass for each of the four materials.

EXPLAIN (Part 2)

Did all the liquids have the same volume? (yes)
Did all the liquids have the same mass? (no)
Why do you think the liquids had different masses?
Which liquid had the most mass?
Which liquid had the least mass?
What can you conclude about masses of liquids when their volumes are equal? (The masses are not likely to be equal, even though the volumes are.)
How does this investigation compare with the investigation of the solid materials?

EXTEND/APPLY

Student instructions:

- Find the mass of the empty graduated cylinder.
- Pour 20 mL of water into the graduated cylinder.
- Find the combined mass of the graduated cylinder and the water.
- Subtract the two measurements to find the mass of the 20 mL of water.
- Observe that the 20 mL of water has a mass of *approximately* 20 g because the mass and volume of water are equal.
- Predict in grams the mass of 10 mL of water.
- Repeat the above procedure. (The 10 mL of water has a mass of 10 g.)
- What would the mass of one mL of water be? (1 mL of water has a mass of 1g.)

ASSESSMENT

Have students respond in their journals about what they would expect to find if they investigated to find the mass of four different substances of equal volume: 5 oz. each of pasta, salt, sugar, and dirt.

NAME ___________________________

MEASURING MASS

VOLUME AND MASS OF LIQUIDS

LIQUID	WATER	MILK	JUICE	LIQUID SOAP
VOLUME				
PREDICTED MASS				
ACTUAL MASS				

NAME ________________________

MEASURING MASS

VOLUME AND MASS OF SOLIDS

Heft (lift) the four solids and predict their order according to mass by writing the name of each solid on the lines in order from heaviest to lightest.

__________________ __________________ __________________ __________________

SOLID	POPCORN KERNELS	SAND	PINTO BEANS	MACARONI
VOLUME				
ESITMATED MASS				
ACTUAL MASS				

DOES IT ADD UP?

BENCHMARKS and TASKS

SC.A.1.2.1 The student determines that the properties of materials (e.g., density and volume) can be compared and measured (e.g., using rulers, balances, and thermometers).

SC.A.1.2.3 The student knows that the weight of an object always equals the sum of its parts.

- The student measures matter using various tools such as rulers, thermometers, balances, and graduated cylinders.
- The student compares the weight or mass of an object to the sum of its parts using a spring scale or balance.

KEY QUESTION

Does the mass of an object always equal the sum of its parts?

BACKGROUND INFORMATION

People often refer to **mass** and weight as if they are the same thing, BUT THEY ARE NOT!

Mass is a measure of the amount of **matter** in an object. We use a balance to measure mass. A balance compares the mass of an object to objects with known masses (e.g., gram sets). An object's mass always stays the same unless part of the object is removed.

Guide students to use the word mass and not weight during this activity. Weight is the measure of the force of gravity on an object and is found by using a spring scale. The weight of an object will change depending on the **force** of **gravity** acting upon it. That's why astronauts weigh less on the moon than on earth.

MATERIALS

Teacher

1 Hershey bar

Per student

journal
pencil

Per group

1 balance and gram set
1 small box of unused crayons (8 count)
paper (for recording data)
pencil
1 stick of clay
wax paper

TEACHING TIPS

1. Make sure all boxes of crayons are identical and unused.
2. Measure the mass of the clay ahead of time to ensure groups have equal amounts.
3. Have enough chocolate to share with everyone at the end of the lesson.
4. Provide a table/chart for student data if necessary.

ENGAGE

1. Show the students a wrapped Hershey bar. Place it on a balance, find the mass, and write it on the board.
2. Unwrap the Hershey Bar and break it into its individual pieces. Ask: *What do you think the mass of these pieces and the wrapper together will be?* Record their predictions. Tell them you will find the actual mass at the end of the lesson.

EXPLORE

1. Distribute materials to groups.
2. Students should create a chart for recording data from the activity. The chart should include:
    - total mass of the box of crayons
    - mass of each crayon (identify by color)
    - mass of empty box
    - sum of individual crayons + empty box
3. Have students measure the mass of the whole box of crayons. (They should take turns within the group so everyone has an opportunity to use the balance.)
4. Have students record the mass of the box of crayons on their charts.
5. Ask:
   What is the mass of the box of crayons?
   If we find the mass of each crayon separately and then find the total sum of all the single crayons, will the mass equal that of the whole box of crayons?
6. Have students explore this question by measuring and recording the mass of each crayon.
7. Next, they should find the total mass of the eight crayons, record the measurement, and see if it equals the mass of the whole box of crayons.
8. Discuss why it is necessary to also find the mass of the empty box and include this measurement in the total sum. *Why not find only the sum of the eight crayons?* (The box has its own mass and was part of the total mass when they measured the full box.)

EXPLAIN

1. Write on the board: **The mass of an object is equal to the sum of its parts.**
2. Ask:
   What does this statement mean?
   What is a sum?
   What was the mass of the whole box of crayons?
   Did the parts measured separately (the 8 crayons and the box) have the same mass as the whole box?
   Can you give any other examples that demonstrate that the mass of an object is equal to the sum of its parts?

EXTEND/APPLY

1. Show students the Hershey bar from the Engage section. Ask if they would like to change their predictions based on what they have learned. Find the mass of the Hershey bar pieces and the wrapper together and compare that measurement to the mass of the whole bar and wrapper. The two measurements should be very close since the mass of an object is equal to the sum of its parts.
2. Repeat the procedure using clay:

- Have students make a shape (e.g., person, animal) with the clay on a piece of wax paper.
- Have students measure and record the mass of their clay object.
- Next, they should break their clay object into 5 or 6 small pieces.
- Explain that students must show within their group that the sum of all the parts is equal to the original mass of the object. (They should follow the same procedure as in the Explore section.)

ASSESSMENT

Have students explain in their journals how the mass of an object is equal to the sum of its parts.
Solve:
What is the **total mass** of John's pencil case if his pencils are 5g each, his erasers are 10g each, and his ruler is 15g? The pencil case itself has a mass of 20g. John has 3 pencils, 2 erasers, and 1 ruler.

INVISIBLE WORLDS

BENCHMARK and TASK

SC.A.2.2.1 The student knows that materials may be made of parts too small to be seen without magnification.

- The student draws and records in a journal observations of a material, such as styrofoam, using the naked eye, a hand lens, and a microscope.

KEY QUESTION

Why are a hand lens and a microscope important tools for observing matter?

BACKGROUND INFORMATION

A simple microscope uses a single convex lens that provides a magnified view of an object. A hand lens is an example of a simple microscope. The magnifying power of a single lens is defined by the number of times an object viewed through the lens is magnified. If the lens is 3X, then the object viewed will appear to be three times larger than the actual object.

A compound microscope, like the Magiscope, uses two magnifying lenses – an objective lens placed near the object being viewed and an eyepiece lens placed near the eye of the viewer. The magnifying power of a compound microscope is found by multiplying the power of the objective lens times that of the eyepiece lens. For example, if the objective lens is a 4X lens and the eyepiece lens is a 5X lens, then the magnification will be 20X, and the object viewed will appear to be 20 times larger than the actual object.

MATERIALS

Per group

1 piece of light-colored fabric (sweatshirt fabric works well)
1 thin shaving of styrofoam
grains of sand on a slide
1 microscope

Per student

colored pencils or crayons
1 hand lens
drawing paper

Teacher

What Is It? David Drew, Rigby Informazing book
Close, Closer, Closest, Shelley Rotner and Richard Olivo

ENGAGE

Share some pictures from the book *What Is It*? by David Drew. Have students try to guess what the greatly magnified objects are. Tell students they will be doing an investigation to help them better understand why we sometimes need to use scientific tools to help us more closely observe matter.

EXPLORE

1. Distribute drawing paper, fabric, a piece of styrofoam, and some sand on a slide to each group.
2. Have students divide the drawing paper into four sections as shown below.

	What I saw using the NAKED EYE	What I saw using a HAND LENS	What I saw using a MICROSCOPE
FABRIC			
STYROFOAM			
SAND			

3. Instruct students to look closely at each object and *carefully* draw what they see using only the naked eye. Colored pencils or crayons can be used to enhance the drawings. Students should also write a detailed description of each object viewed.
4. Next, distribute a hand lens to each student.
5. Have students observe each object with the hand lens, carefully draw and color each object, and write a detailed description.
6. Finally, give each group one microscope or Magiscope, if enough are available. (If necessary, set up one Magiscope and have groups rotate to use it.) Demonstrate the proper technique for using the Magiscope before students begin to explore.
7. Have students view each of the objects with the microscope, *carefully* draw each object, and write a detailed description.

EXPLAIN

How did your drawings differ?
What did the hand lens allow you to see that the naked eye did not?
What did the microscope allow you to see that the hand lens did not?
Which drawings have the most detail? Why do you think so?
Which tools allowed you to make the most detailed observations?
Why are scientists concerned about making careful observations?
Why do we sometimes need to extend our limits of observation? (Some materials have parts too small to be seen without magnification.)

EXTEND AND APPLY

1. Discuss with the students how hand lenses and microscopes work – how they magnify an object, making it seem larger than it really is. If possible, determine the magnification of the hand lens and the microscope that were used during the investigation, and explain the magnification power of each. (See Background Information)
2. Share the book, *Close, Closer, Closest*.

EXTENSION

Have students use the hand lens and a microscope to study the details of other objects: newspaper, other kinds of fabric, leaves, salt and sugar crystals, and other items they bring to class and wish to observe.

ASSESSMENT

Have students explain in their journals how magnification can help us learn more about objects we want to observe.