Observing and Measuring Matter: Grade 3

Lesson Overview

In this lesson, students will analyze and interpret data from observations and measurements to describe and compare the physical properties of matter (including length, mass, temperature, and volume of liquids). In addition, students will construct explanations using their data from their observations and measurements to describe how matter can be classified as a solid, liquid or gas. The lesson is designed with a purposeful integration ELA-Inquiry, Reading and writing standards as well as math so that students learn apply these standards through science content.

Alignment

Standard/Indicator Addressed

SC Academic Standards and Performance Indicators for Science

Standard 3.P.2: The student will demonstrate an understanding of the properties used to classify matter and how heat energy can change matter from one state to another.

Performance Indicator

3.P.2A.1 Analyze and interpret data from observations and measurements to describe and compare the physical properties of matter (including length, mass, temperature, and volume of liquids).

3.P.2A.2 Construct explanations using observations and measurements to describe how matter can be classified as a solid, liquid or gas.

Standards for Mathematics

3.MDA.2 Estimate and measure liquid volumes (capacity) in customary units (i.e., c., pt., qt., gal.) and metric units (i.e., mL, L) to the nearest whole unit.

Science and Engineering Practices (as appropriate)

S.1.A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

S.1.A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

ELA Inquiry Standards (as appropriate)

Inquiry-Based Literacy Standards (I)

Standard 2: Transact with texts to formulate questions, propose explanations, and consider alternative views and multiple perspectives.

Standard 3: Construct knowledge, applying disciplinary concepts and tools, to build deeper understanding of the world through exploration, collaboration, and analysis.

Reading - Literary Text (RL)

Standard 1: Demonstrate understanding of the organization and basic features of print.
Standard 2: Demonstrate understanding of spoken words, syllables, and sounds. Standard 3: Know and apply grade-level phonics and word analysis skills in decoding words.
Standard 5: Determine meaning and develop logical interpretations by making predictions, inferring, drawing conclusions, analyzing, synthesizing, providing evidence, and investigating multiple interpretations.
Standard 6: Summarize key details and ideas to support analysis of thematic development.
Standard 7: Analyze the relationship among ideas, themes, or topics in multiple media, formats, and in visual, auditory, and kinesthetic modalities.
Standard 9: Interpret and analyze the author's use of words, phrases, and conventions, and how their relationships shape meaning and tone in print and multimedia texts
Standard 11: Analyze and provide evidence of how the author's choice of point of view, perspective, and purpose shape content, meaning, and style.

Reading - Informational Text (RI)

Standard 1: Demonstrate understanding of the organization and basic features of print.
Standard 2: Demonstrate understanding of spoken words, syllables, and sounds.
Standard 5: Determine meaning and develop logical interpretations by making predictions, inferring, drawing conclusions, analyzing, synthesizing, providing evidence and investigating multiple interpretations.
Standard 6: Summarize key details and ideas to support analysis of central ideas.

Writing (W)

Standard 1: Write arguments to support claims with clear reasons and relevant evidence.
Standard 2: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
Standard 3: Write narratives to develop real or imagined experiences or events using effective techniques, well-chosen details, and well-structured event sequences.

South Carolina Computer Science and Digital Literacy Content Standards

3.DL.1.1 Create documents (e.g., essays, letters) using a word processing program.
3.DL.1.2 Edit and format a document using a word processing program to check spelling, change fonts, and change margins.
3.DL.1.3 Format a presentation using presentation software to insert an image/video, change background colors, and change text color.
3.DL.1.4 Understand that bullets are a way to organize a list.
3.DL.4.1 Demonstrate proper keyboarding technique when keying letters, numbers, and symbols at a rate of 5 words per minute. 3.DL.4.2 Use software capabilities to correct errors.

Disciplinary Literacy Strategies (for Purposeful Reading, Meaningful Writing, and Productive Dialogue)

Quick Write , Turn and Talk , Think-Pair-Share, Volleyball not Ping

Computational Thinking

Computational thinking (CT) is a problem-solving process that includes (but is not limited to) the following characteristics:

- Logically organizing and analyzing data
- Generalizing and transferring this problem-solving process to a wide variety of problems

These skills are supported and enhanced by a number of dispositions or attitudes that are essential dimensions of CT. These ***dispositions or attitudes*** *include:*

- Confidence in dealing with complexity
- Persistence in working with difficult problems
- Tolerance for ambiguity
- The ability to deal with open ended problems
- The ability to communicate and work with others to achieve a common goal or solution

Content Area (2 or more) Connections

ELA – Inquiry, Reading and Writing
Math
Science
Computer Science and Digital Literacy

Lesson Plan

Time Required – five to seven 60-minute class periods. Please note ELA and math standards in addition to science content are included in these daily lessons.

Disciplinary Vocabulary – Matter, solid, liquid, gas, property, observable properties, measurable properties, length, mass, temperature, volume

Materials Needed: *- See each daily plan*

Formative Assessment Strategies: See daily plan

Misconceptions:

Weight and mass are the same thing. Weight is the force that gravity applies to a mass. Your spring scale does measure weight. Mass is the amount of matter in something. The balance scale measures mass by comparing the mass of the unknown with the mass of set units. Even though your students do not need to know the difference between them try to use the term mass when we are talking about matter and using the balance.

Safety Note(s):

- *Students should use goggles*
- *Teachers should review "wafting" as the proper way to identify a smell.*
- *Do not taste any chemicals unless told to do so (In this module they will NOT be instructed to taste.)*
- *Wash hands after lessons.*
- *Keep hands away from the mouth and nose when you are touching chemicals.*

DAY 1 - Engage

Materials Needed:

- Book Ada Twist, Scientist by
- Sticky Notes
- Chart paper or board space to create anchor charts

Formative Assessment Strategies:
Turn and Talk, Think-Pair-Share

Read Aloud
Ada Twist, Scientist by
You may use these sample questions as a guide to assist students with making inferences and to pre-assess their knowledge about scientist and investigations.
(These questions align to the ELA reading expectations for third grade.)
Whole group discussion

1. What do you think this book will be about?
2. How do you know this? (what evidence do you have?)
3. Who do you think the characters will be in this story? (refer to the front and back cover)

After reading you might ask some of these questions:
Small group discussions (Turn and Talk, Think Pair, Share) – then ask one group to share.

1. Who are the characters in this story? Were your original thoughts in line? What information did you have before we read the story to make these predictions?
2. What characteristics did Ada have?
3. What was the problem Ada was trying to solve?
4. What steps did she take to solve the mystery?
5. What tools did she use? (Science equipment and safety equipment should be listed)
6. Did Ada solve the problem? (note – not all great scientist solves all of the mysteries they investigate – research examples to share with your students)
7. Do you have any ideas?
8. Do you think Ada was a great scientist? Why? Or Why Not?
9. Were Ada's parents scientist? What did they do for Ada?
10. Did Ada work alone? Do scientist work alone?
11. List characteristics of a great scientist
    a. Ask small groups to write ideas on sticky notes
    b. Put ideas on board – group like ideas
    c. Use student ideas to create a list on anchor chart

Create an anchor chart to display the characteristics of a scientist and discuss how Ada had these characteristics and ask for examples of how your students have these characteristics listing specific examples of problems they may have solved in the past.

Explain to the class they will take on the role as a scientist as we explore the properties of matter throughout the next few days. Discuss those characteristics and how they might also show those as they work. Suggested dialogue strategy to use is Volleyball not Ping pong. See attached for explanation. (p.12)

Day 2 - Explore

What do you feel? What do you see?

Students will try to identify substances based on what they feel. After they make a prediction, students will add observations on what they see.

Introduce concept "properties of matter." Matter has properties. These properties help us identify matter and predict how matter will react when mixed with other matter or if it is exposed to heat.

In this inquiry activity students will observe. Observations from our senses represent qualitative data. Students may suggest measuring the substances. Data collected from measurement is quantitative data. These observations and measurements are also known as properties of matter.

Materials Needed:

- Balloons – 4 colors one of each for each student group
- Jars/container/plastic bag – see teacher preparation
- Matter – (solid – powder, solid-hard, liquid, gas) see Substance list in teacher preparation
- Student Observation Sheet (p.13)
- Anchor chart – Characteristics of Scientist
-

Formative Assessment Strategies:

Teacher dialogue with groups, completion of observation inquiry sheet, Quick Write

Teacher preparation

For **each group of students**, you need four substances.
Substance A – a small hard solid such as rice, beans, corn, beads
Substance B – a powder such as corn starch, baby powder, flour
Substance C – a liquid such as water, vegetable oil, dish detergent, corn syrup
Substance D – a gas, teacher blow up balloon, capture room air with pump, fill with Helium *note to teacher, students will touch and squeeze the balloon so don't fill too full.

1. Fill a specific color balloon with substances from each group. All groups should have four different color balloons with the same color balloon representing the same substance for each group.
   Example:
   Blue balloon=rice
   Red balloon=flour
   Yellow balloon=vegetable oil
   Green balloon=CO2 -teacher blows up the balloon

   Use a funnel to fill the balloons. The top of a 2-liter drink bottle may be used as a funnel as well.

2. Sample of these same substances should also be contained in a plastic bag or clear container with a lid. (Students must be able to see the substance to make observations.)

3. Need copies of What do you feel? What do you see? data collection sheet for each student.

Procedure:

1. Student groups are given the set of four balloons and instructed to use their senses of touch, sight, smell and hearing to record and complete the observation table. They cannot open the balloons and they cannot taste the balloons!
2. Teacher should circulate and ask questions to elicit discussion and citing of evidence to support their claims. Be careful not to direct student thinking. Allow discrepant ideas to remain. Relate their inquiry to Ada Twist. Are they demonstrating the skills of a scientist?
3. After groups have discussed and completed their observation table, give each group the samples in the containers. Students should match up the substance with the balloon. Discuss WHY they think the substances are the ones in the balloons.
4. Open one set of balloons so the students SEE for themselves the contents and have them correctly identify the substances on their data table.

5. Ask students if there are other observations they can make? Could they use tools to collect data? (add any measurements they may suggest under other data.)
6. How were they like Ada Twist the Scientist? (refer to anchor chart)
7. Students should use the Quick Write Strategy to write a response to this prompt: In my opinion, the _____ observation is the most useful because -----. Students should support their claim with specific evidence from their experience. Which observation do they think helped them identify matter in the balloon? It can be more than one.

Day 3-4 - Explore

How do we use our observations to classify matter?

Students will explore additional objects of matter. They will collect both qualitative and quantitative data. They will use their observations to **classify** matter.
Note – these measurements are designed to teach or reinforce through application the math standard 3MDA.3.

Materials needed:

- Materials – measurements to align with math standards
- Materials should represent two examples of each solid, liquid, gas
- Tools to measure – ruler, scale, beaker, syringe
- Student copies of Using Observable and Measurable Properties to Classify Matter Data Table (p.14-15 print two-sided)

Teacher Preparation:
Use materials you have available in your classroom. Prepare one set of materials for each group of students.

Suggestions include:

- ✓ Solids – 3D solids available such as cubes, rectangles, plastic or wooden, jumbo paperclip
- ✓ Liquids – Vinegar, apple juice, water, soda
- ✓ Gas – exhale into container (CO2), helium filled balloon, air in syringe, air in plastic bag

Teachers will need to select items where the measurable properties will reflect Math Standard 3.MDA.2 where students estimate and measure liquid volumes(capacity) in metric units (mL, L) to the nearest whole unit.

Procedure:

1. Students will complete the data collection sheet recording both observations (quantitative data) and measurements (quantitative data).
   Write the items on the board so students can fill in the form.

2. Teacher may want to remind students of the observable properties explored the prior day and write a list on the board to help guide their explorations.

   Observations – uses senses
   Color, size, shape, shininess, luster, texture (rough/smooth), temperature (hot/cold to touch), odor (present/not present)

   Measurements – using tools
   Length, mass, volume, temperature (Fahrenheit/Celsius)

3. Students will classify the matter according to their properties.
   What do all solids have in common?
   What do all liquids have in common?
   What do all gasses have in common?

   Create a definition of solid, liquid and gas using your data.

Day 5 - Explain

Building Vocabulary and Informational Text Read Aloud

Students will use their experiences to define the vocabulary words for this unit. A cut and paste activity is provides. They will cut the definitions and match to the terms. Students will be asked to provide examples of each of the words from the inquiries they have done. They will be instructed to listen as you read the book, *Matter by Abbie Dunne*

Materials needed:

- *Matter by Abbie Dunne*
- *Vocabulary Word Sheet (p.16)*
- *Vocabulary Activity Sheet (p.17)*

Procedure:

1. Instruct students to cut the vocabulary words apart. (or you may give them cards precut) Vocabulary Words are: Gas, Liquid, Property, Volume, Solid, Matter, mass
2. Students should read each word aloud and discuss with their partner what they think the word means. Match it with the definition on the activity sheet. Do not glue the words to the page yet. As the book is read, they will have an opportunity

to move the word. Note the definitions are aligned with the 2015 SC Science Standards.

3. Ask students to give examples of each word from the explore inquiry lab.
4. Ask students to listen for examples as you read the book aloud.
5. As you introduce and read the book, you should point out the various text features as outlined in the SC ELA information text standards.
6. Stop after each page and allow students time to add information to their data table.
7. Make sure everyone has the correct definitions and have added examples from the text once you have finished.
8. Look at all the information students have discovered. Ask them if they feel like scientist. Elicit a discussion to highlight they may not have understood at everything at the beginning and that is ok. Some of the questions we asked led to asking other questions and that is ok.

Day 6-7 - Extend

Students will create an informational text book under the premise their book will be used in place of the ***Matter*** *by Abbe Dunne* book read to them.

All text features should be represented as outlined in the SC ELA standards.

- https://ed.sc.gov/scdoe/assets/File/instruction/standards/ELA/Units/Elementary/Grade-3-I-E-Writing-Writing-An-Informational-Book.pdf

Teachers may also include the computer science standards and have students or student groups create their books in a digital format.

Other information on this indicator(s) can be found in the support documents/resources on the SC State Department website.

- ***www.ed.sc.gov (Instruction → Standards and Learning → Mathematics or Science → Support Documents and Resources)***

Content Area (Disciplinary) Literacy strategies and descriptions can be found on the S2TEM Centers SC website:

s2temsc.org (Resources → Disciplinary Literacy Virtual Library → Strategy Warehouse)

Computational Thinking Reference:

https://csta.acm.org/Curriculum/sub/CurrFiles/CompThinkingFlyer.pdf
https://csta.acm.org/Curriculum/sub/CompThinking.html

IQ-MS Research Project
Disciplinary Literacy Strategies –Volleyball, Not Ping Pong

Volleyball, Not Ping Pong

Volleyball, Not Ping Pong is a group dialogue strategy that assists teachers in engaging more students in productive dialogue to share their ideas, thoughts, opinions, beliefs, and assertions about the topic of study with their peers. Teachers facilitate this strategy by encouraging students to share their thinking and respond to the comments and questions of their peers, rather than talking only to the teacher or looking to the teacher to validate their thinking or ensure their responses are correct.

This strategy changes the landscape of traditional classrooms in which the teacher and students engage in "ping pong" question-and-answer interactions. In Volleyball, Not Ping Pong, students move from the back-and-forth teacher-to-student exchange to student-to-student exchange by building on the ideas of their peers. Students "set up" the conversation for others in the classroom to participate. As students share their ideas, agreements and differences are noted and considered. This allows students to critically consider the information they share in light of what their peers share. Students are able to adjust and reshape their thinking to take into account this new information or insight. This strategy is very effective in helping students consider multiple perspectives and viable solutions or suggestions that differ from their own.

How to implement the strategy:

1. Explain the classroom expectations regarding whole group dialogue to the students by sharing the volleyball and ping pong metaphor with the students.
2. Practice "serving" a question and have students respond to the prompt as if they were setting the ball up for the next student and hitting it over the net.
3. Provide sufficient time for the students to engage in dialogue and monitor the students as they interact.
4. Encourage the students to look at each other when they talk rather than the teacher since they are putting their ideas forth to the class and not just to the teacher.
5. Reflect with the students about what they noticed about their own behaviors and their peers as they engaged in productive dialogue.
6. Have students think about what they might want to be mindful of the next time they engage whole group dialogue.
7. Provide multiple opportunities for the students to use and practice Volleyball, Not Ping Pong to discuss topics being studied.

Adapted from:

- Keeley, Page. (2008). Science formative assessment: 75 practical strategies for linking assessment, instruction and learning. Thousand Oaks, CA. Corwin.

What do you feel? What do you see?

Name: _____

	Balloon 1 Color _____ 	Balloon 2 Color _____ 	Balloon 3 Color _____ 	Balloon 4 Color _____ 
Look – What you see? Color-size				
Listen – What do you hear when you squeeze the balloon?				
Touch – How does it feel when you touch the surface and squeeze the balloon?				
Smell – Waft the balloon – does it have a smell?				
Other data				
Prediction – What is inside the balloon? How do you know?				
Actual Contents				

Using Observable and Measurable Properties to Classify Matter

Name: _____

Item	Observations (Use Senses)	Measurements (Use Tools)	Draw the Item	Classification (solid-liquid-gas)
	Color **Size** **shape** **Shiny** **Texture** **Hot/cold** **odor**	**Length** **Temperature** **Mass** **Volume**		
	Color **Size** **shape** **Shiny** **Texture** **Hot/cold** **Odor**	**Length** **Temperature** **Mass** **Volume**		
	Color **Size** **shape** **Shiny** **Texture** **Hot/cold** **odor**	**Length** **Temperature** **Mass** **Volume**		

Item	Observations (Use Senses)	Measurements (Use Tools)	Draw the Item	Classification (solid-liquid-gas)
	Color Size shape Shiny Texture Hot/cold odor	Length Temperature Mass Volume		
	Color Size shape Shiny Texture Hot/cold odor	Length Temperature Mass Volume		
	Color Size shape Shiny Texture Hot/cold odor	Length Temperature Mass Volume		

Properties of Matter Vocabulary Word

GAS	SOLID	PROPERTY	LIQUID	MATTER	MASS	VOLUME

GAS	SOLID	PROPERTY	LIQUID	MATTER	MASS	VOLUME

GAS	SOLID	PROPERTY	LIQUID	MATTER	MASS	VOLUME

GAS	SOLID	PROPERTY	LIQUID	MATTER	MASS	VOLUME

GAS	SOLID	PROPERTY	LIQUID	MATTER	MASS	VOLUME

Properties of Matter Vocabulary

Name: _____ Date: _____

Vocabulary Word	What does it mean?	How do I know? Example from inquiry lab	How do I know? Example from Informational Text
	Anything that has mass and takes up space		
	Characteristics that can be used to describe matter		
	Have a definite size and shape		
	Has a definite volume but takes the shape of their containers		
	Do not have a definite shape nor volume and they take the size and shape of their container		
	How much matter in in an object		
	How much space an object takes up		