Summer 6-15-2017

Solving the Mystery of Matter: Physical Properties [5th Grade]

Aly Kirchhof
alykirchhof@gmail.com

Physical Properties UbD

Stage 1 – Desired Results

Established Goals (e.g., standards)

Content TEKS:

5.5 Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified,
changed, and used.

(A) classify matter based on physical properties, including mass, magnetism, physical state (solid, liquid, and gas), relative density (sinking and floating), solubility in water, and the ability to conduct or insulate thermal energy or electric energy

(B) identify the boiling and freezing/melting points of water on the Celsius scale

(C) demonstrate that some mixtures maintain physical properties of their ingredients such as iron filings and sand

(D) identify changes that can occur in the physical properties of the ingredients of solutions such as dissolving salt in water or adding lemon juice to water

Process TEKS

5.2

(A) ask well-defined questions, formulate testable hypotheses, and select and **use appropriate equipment and technology**

(B)

(C) collect information by detailed observations and accurate measuring;

(D) analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence;

(E)

(F)

(G) construct appropriate simple graphs, **tables**, maps, **and charts** using technology, including computers, **to organize, examine, and evaluate information.**

5.4

(A) **collect, record, and analyze information using tools, including** calculators, **microscopes**, cameras, computers, hand lenses, **metric**

Transfer

Students will independently use their learning to…

- use observations and measurements to classify
- collect, record, and analyze information

Meaning

Understandings

Students will understand that….

- We can draw conclusions from information
- Each substance has unique physical properties
- Physical properties can be measured and observed
- We can find out about materials/substances through observation and measuring

Essential Questions

- What IS the matter?
- How does knowing about the physical properties help us?
- What can I find out about this substance?

Acquisition

Knowledge

Students will know…

- mass and weight are not the same; mass is the amount of matter in a substance, and weight is the force of gravity pulling on an object
- the 3 states of matter: solid, liquid, and gas
- magnets attract and repel other magnets; magnets do not attract all materials/metals
- relative density is the ability of a material to sink or float in water
- some substances dissolve in water to create solutions
- some substances maintain physical properties when combined in a mixture
- some materials are better

Skills

Students will be able to…

- classify matter based on physical properties
- categorize information, organize information into a chart
- determine what types of materials make good conductors and poor conductors (insulators) of heat, sound, and electricity
- discover what materials will or will not form a solution in water
- record observations and conclusions in their science notebooks
- identify the boiling point of water as 100^{o} C and the freezing/melting point of water as 0^{o} C
- measure mass using a triple beam balance and measure

rulers, Celsius thermometers, prisms, mirrors, pan balances, **triple beam balances**, spring scales, **graduated cylinders, beakers, hot plate, meter sticks, magnets**, collecting nets, and notebooks ; timing devices, including clocks and stopwatches; and materials to support observations of habitats or organisms such as terrariums and aquariums ELPS c2D: Monitor understanding and seek clarification c2E: Use visual, contextual linguistic support to confirm and enhance understanding c2I: Demonstrate listening comprehension c3D: Speak using grade level content area vocabulary in context c3F: Ask and give information using high-frequency and content area vocabulary c4G: Show comprehension of English text individually and in groups c5B: Write using newly acquired vocabulary	or worse at conducting or insulating thermal, electrical, or sound energy • substances can change states of matter	weight using a scale • measure temperature using a thermometer and temperature probe

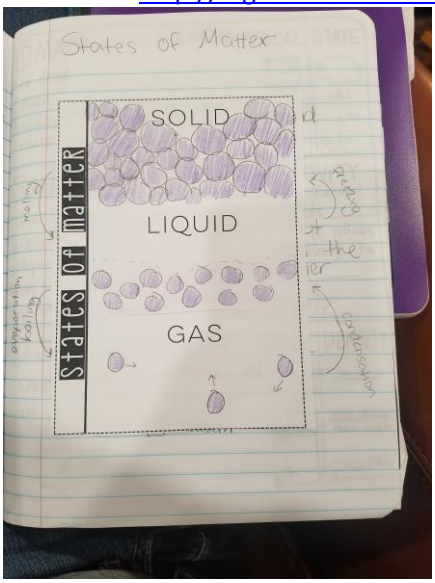
Stage 2 – Evidence

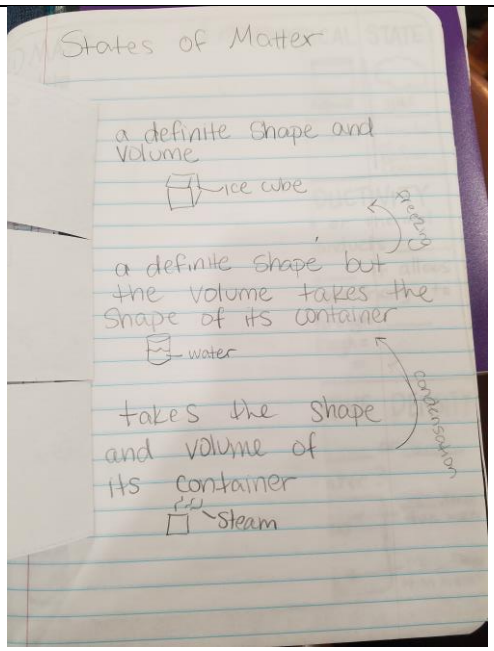
CODE (M or T)	**Evaluative Criteria** (for rubric)	
		Performance Task(s) *Students will demonstrate meaning-making and transfer by…* Students will use physical properties to identify 10 mystery materials (attached) --- Other Evidence (e.g., formative) Conductors and Insulators labs Magnetic/nonmagnetic sort (attached) More or less dense sort (attached) Check-ins: what is ____? Mixtures and Solutions project Breakout (attached) Physical Properties Multiple Choice (attached)

Stage 3 – Learning Plan

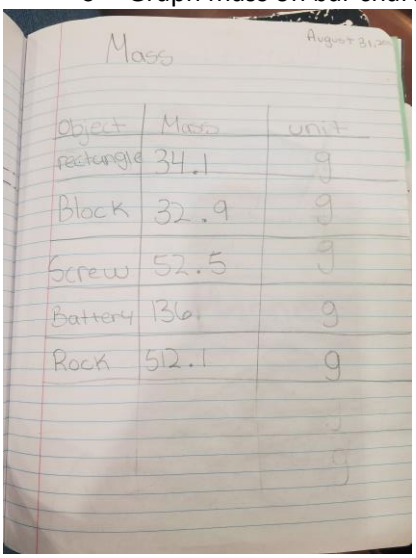
CODE (A, M, T)	Pre-Assessment *How will you check students' prior knowledge, skill levels, and potential misconceptions?* On a sticky note describe everything you can about ____. (An object)	
	Learning Activities General notes: • use anchor charts as a model for student notes in science notebook	Progress Monitoring (e.g.,

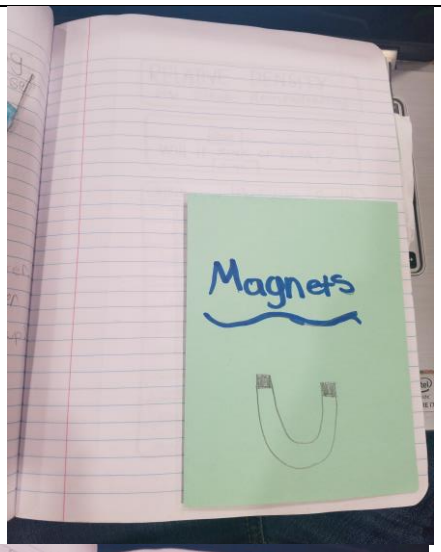
	• If necessary, print a small copy of anchor chart for students to put in science notebook • On science word wall include vocabulary with a picture (from your classroom) of students • Use applicable released STAAR questions as turn-and-talk or exit ticket opportunities	formative data)

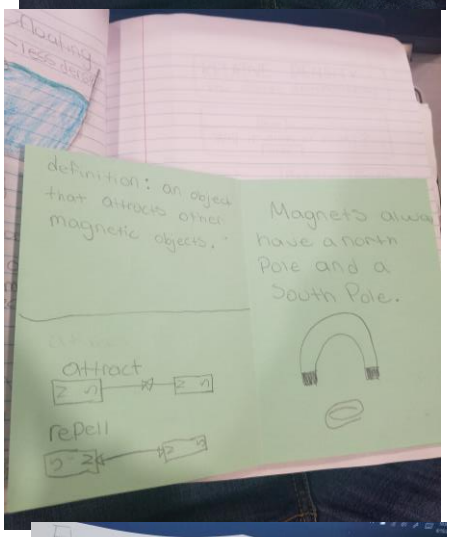
Week 1:
EQ: Why does knowing about physical properties help us?
 	
A
	Week 1: Introduction and States of Matter
	Day 1:
	• Engage: Turn and talk - why is ___ the best for ___?
	  ○ Football, throwing
	  ○ Ice, keeping drinks cold
	  ○ Play-doh, making shapes
	  ○ Coffee mugs, keeping drinks warm
	  ○ Their physical properties make them perfectly suited for their task
	• Engage: Flubber physical properties clip (https://www.classhook.com/resources/431)
	• Introduce EQ: Why does knowing about physical properties help us?
	  ○ KWL: what do we already know? What do we still have questions about?
	
	Day 2:
	• States of Matter: anchor chart
	  ○ Interactive word wall: 3 sections with definition, model, and examples for each state of matter
	  ○ Extension questions: Is a football a solid or a gas? Are clouds really a gas? Is shaving cream a solid, liquid, or gas? Is butter a solid or a liquid? Jelly? (from Physical Properties of Matter UbD, Perez, Eloisa <http://digitalcommons.trinity.edu/educ_understandings/272/>)
	 	

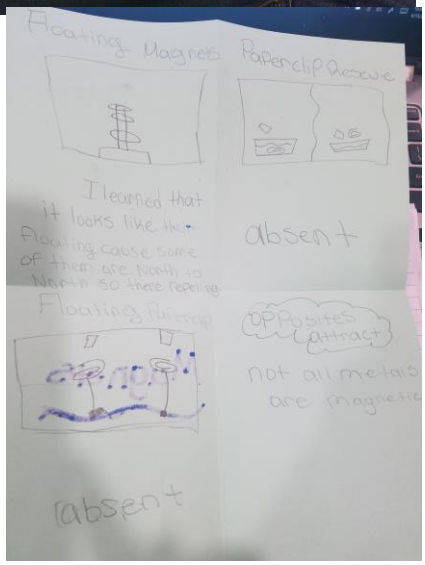
	
	Day 3:
	• Sorta Sorted activity
	  ○ Give students a collection of objects (at least 10) and have them sort into categories
	  ○ How did you sort your objects?
	  ○ Observe how other groups sorted their objects.
	  ○ How else could you have sorted them?
	
	Day 4: Introduce the CER (Claim, Evidence, Response) Framework
	• Pose the question: Who had an awesome dinner?
	• Focus on one students claim, record their claim on an anchor chart
	• Have them describe what make the dinner good, record this as their evidence, and add to anchor chart
	• Discuss with that class what makes a dinner good (i.e. tasty food, good people to be around, a lot of food, etc.) and record this as the reasoning
	• Collect into one final response
	Day 5: Continue discussion of SER framework
	• Practice using a high interest topic, and sentence stems	

Week 2:
EQ: What IS the matter?
 	
A, M
	Week 2: Mass, Weight, and Magnetism
	Day 1:
	• Engage: Do you matter? Mass v. weight
	  ○ Have each student measure their mass and weight, record in science notebook
	  ○ Demonstrate how gravity effect weight and mass: Trip to the Moon, Mercury, and Jupiter
	  ○ Moon (weight divided by 6), Mercury (multiply Earth's weight by 2/5), Jupiter (multiply Earth's weight by 2.3)	

	○ Record in a chart in science notebook • Explain: Science Notebook – what is mass? ○ CER response: Does a cloud have mass? Day 2: • Explore: Using a triple beam balance ○ Demonstrate how to calculate mass, model to demonstrate, individual practice with objects throughout the room ○ Graph mass on bar chart  Day 3: • Explore: Measuring Volume using graduated cylinders ○ Reading a graduated cylinder measurement ○ Using displacement to calculate volume Day 4: • Evaluate (Formative Assessment): measuring matter (mass and volume) ○ Collect pictures of triple beam balances and graduated cylinders, have students record measurements and units shown in the pictures • Add mass, weight, volume, and states of matter to KW**L** Day 5: • Magnetism (review 3rd and 4th grade concepts) ○ Magnetic and non-magnetic sort (attached)	Magnetic/ non-magnetic sort







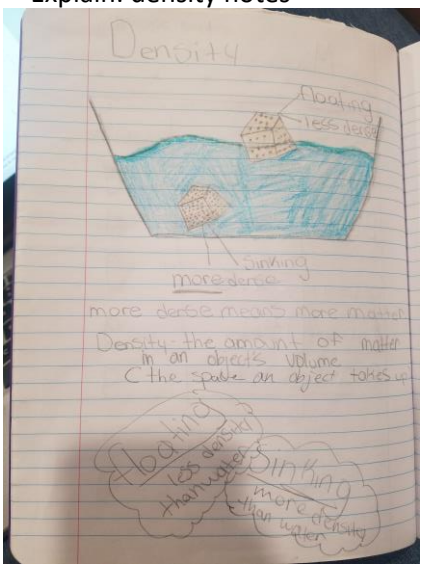
Week 3: Density and Changing States of Matter

Week 3:
EQ: What's the matter? What can I find out?

A

Day 1:

- Engage: chocolate cake and clay ball/candle
    - Chocolate cake activity: Measure mass as a class, then smoosh cake into smaller container
        - Ask: Is there the same amount of cake? (yes), What has changed? (the amount of matter taking up a smaller amount of space, the density)
    - Clay/play-doh ball and candle activity: measure mass and make predictions about which one will float/sink
        - Mass of the candle should be greater than the mass of the ball
        - Record predictions in science notebook
- Explain: density notes



Day 2:

- Explain and Explore: Relative density - sink or float lab
    - Collect about 10 items and a clear bucket of water
    - Have students make a prediction about if the item will sink or float
    - Record prediction and outcome in science notebook (data chart)

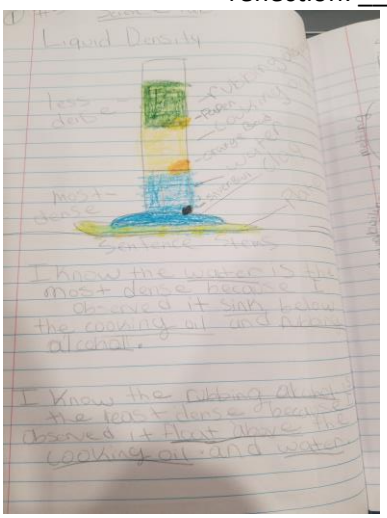
Relative Density Lab

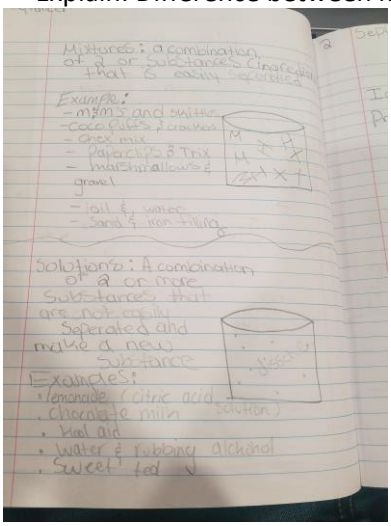
Object	Prediction	Outcome

Day 3:

- Explore: Liquid Density Lab
    - Use play-doh to secure a straw in an upright position, use a dropper to slowly add rubbing alcohol (dyed for easy identification), cooking oil, and water
    - Extension: add objects like a small scrap of paper, pony bead and

Liquid Density Lab

	observe how they float between layers ○ Science notebook ▪ Draw and label diagram in science notebook ▪ reflection: ___ is more/less dense than ___  Day 4: • Evaluate: Formative assessment: more/less dense sort (attached) • Add density to KW**L** • Peer tutoring and teacher intervention Day 5: • Engage: put SMART water in freezer for several hours, or even over-night of possible (it will stay a liquid), remove and shake vigorously and it will turn to a solid before your eyes • Explore: Ice on hot plate, use thermometers, written observations in science notebook ○ Review states of matter ○ Boiling, melting, freezing points of water ○ Do solids have temperatures? Use temperature probe ○ Crayon and chocolate ○ Record temperature in science notebook	More/less dense sort
Week 4: EQ: What can I find out? A	Week 4: Conductors and Insulators Day 1: • Explore: Thermal energy conductors and insulators lab: hot chocolate and keeping ice cold ○ Part 1: keeping your hot chocolate warm ▪ paper cup (control), Styrofoam cup, lid, cup of their design ▪ Collect temperature data: initial, after 5 minutes ▪ Draw and label diagram in science notebook ○ Part 2: Keeping ice cold	Conductors and Insulators Labs

	▪ Each group gets 3 ice cubes, measure amount of time the ice takes to melt ▪ On paper plate (control), in a cup, their own design ▪ Draw and label diagram in science notebook Day 2: • Explore: Simple circuit with conductors and insulators o For each table group set up a simple circuit to test if electricity can flow through sample objects o Materials: circuit, iron nail, penny, copper wire, cotton ball, bouncy ball, water, salt-water o Record results in a t-chart in science notebook Day 3: • Explore: Demo lab: Can You Hear Me Now? o Place speaker on table (control), cover speaker with Styrofoam cooler, and place speaker in a glass cup o Record observations in and conclusions in science notebook ▪ Draw and label diagram in science notebook Day 4: • Concept check-in: brain map of materials as conductors and insulators (for sound, electricity, and heat) • Add conductors and insulators to KW**L** • Peer tutoring and teacher intervention	
Week 5: What can I find out? A	Week 5: Mixtures and Solutions Day 1: • Engage: picture analysis (show a picture of a mixture and solution side by side) o What do you see? o What science topic do you think this picture shows? • Explain: Difference between mixtures and solutions  	

	Day 2:
	• Separating mixtures and solutions lab
	  ○ Set of 3 mixtures and 1 solution
	  ▪ Rice Crispies and gravel
	  ▪ Cheerios and paperclips
	  ▪ Coco Puffs and Kitty Litter
	  ▪ Water and Kool-aid
	  ▪ Tools: strainer, magnet, tub of water, and a sunny window
	  ▪ Give students a chance to explore with each of the mixtures, letting them know that one tool separates each mixture (i.e. they will match up like pairs)
	  ▪ Have students use the CER framework to respond to the question: How would you separate the ___ and ___ mixture?
	
	Day 3:
	• Elaborate: Lemonade (citric Acid solution)
	  ○ Materials (for each group, group size 3-5):
	  ▪ Pitchers with water
	  ▪ Spoons
	  ▪ 5-10 Halved lemons
	  ▪ Sugar
	  ▪ Tasting cups
	  ○ Have each group choose a name and plan how they will make their lemonade
	  ○ Give each group about 10 minutes to craft their perfect lemonade
	  ○ Give each group the opportunity to sample other groups lemonade and vote for the winner
	
	Day 4 and 5:
	• Evaluate: Mixture and solutions project
	  ○ Students draw from a set of materials cards (I include materials like sand, pony beads, salt, marbles, water, gravel, etc.)
	  ○ Have students draw 3 sets (make sure one card is water)
	  ○ Students can combine the materials in any set of combinations they want
	  ○ Students need to identify if their combination is a mixture or solution and how they would separate it
	  ○ A small poster divided into 3 sections would be a great medium because it allows students to include a diagram and space for their claims and evidence
	• Add mixtures and solutions to KW**L**
	• Peer tutoring and teacher intervention
		Mixtures and Solutions Project

Week 6: What can I find out about this substance/ material? M Week 7: M, T	Week 6: Physical Properties Wrap up/Bringing it all together Day 1: • Physical Properties interactive word wall (I could not find my example, but there are several examples available on Pinterest) ○ Whole group activity, gather around a large sheet of butcher paper, or whiteboard (if you have the space) ▪ Divide butcher paper into sections: sates of matter, relative density, solubility, mass, weight, magnetism, and conductor and insulator ▪ As a class, discuss what materials should go in which section, encourage students to use claims and evidence when justifying which physical property an object should go in ○ Materials: ▪ Butcher paper ▪ Tape ▪ Cube (any solid substance) ▪ Bag of water ▪ Bag filled with air ▪ Bag with water and marble ▪ Bag with water and twig ▪ Bag of sand ▪ Bag of salt or Kool-aid ▪ Picture of scale ▪ Picture of triple beam balance ▪ Different types of magnets ▪ A collection of magnetic and non-magnetic materials ▪ A collection of conductors and insulators Day 2: Intervention small groups and peer tutoring Day 3: Finalize KWL and concept shirts • Revisit and reflect on KWL ○ How can knowing the physical properties of an object help us? • Concept shirts: use blank t-shirts to design "billboards" that include definitions, diagrams, and important vocabulary ▪ Split into 6 groups (state of matter, mass/weight, density, magnetism, conductor/insulator, and solubility) Day 4: • Physical properties poster mini-project: select an object and answer the EQ: What can I find out about this substance/material? ○ A mind web is the most effective organization Day 5: • Review with a partner or finish mini-project	Physical properties poster and concept shirts Breakout, multiple choice

	Week 7: Day 1: • Breakout (attached) Day 3 • Physical Properties Multiple choice (attached) Day 4 and 5: • Performance Task (attached)	

Name:_____

Performance Task

You are a scientist in a lab. Poor lab safety led to a terrible explosion! After the firemen put out the fire you are allowed back in the lab, but you find that all labels have came off or your materials and substances. Keep your lab safe by identifying each of these 10 substances. Use observation and measurement to make conclusions about how to label each substance. Record your findings in the chart below.

	Substance name	Color, texture, shape	State of Matter	Mass	Weight	Relative density	Magnetism	Conductor or insulator	Solubility	Other
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Which substance do you think is sugar? Use the Claim, Evidence, Response framework.

_____

_____

_____

_____

Which substance do you think is made of Iron? Use the Claim, Evidence, Response framework.

_____

_____

_____

_____

Mystery substances: (number all substances and place substances in small, sealable baggies if necessary, depending on class it might be beneficial to have multiple sets of mystery substances)

- Flour
- Playground sand
- Sugar
- Salt
- Gravel/pebbles
- Aluminum block
- Bronze block
- Iron block
- Dish Soap
- Gatorade

Materials made available to students:

- Triple beam balances
- Graduated cylinders
- Magnets
- Tub of water
- Circuit
- Meter stick or metric ruler
- Scale
- Beaker of water

Note for teachers: You can modify this performance task for ELLs and SpEd by eliminating mystery substances, and by providing a template to answer last question.

	Does not meet expectations	Approaches Expectations	Meets or exceeds expectations
Students demonstrates understanding that each substance has unique physical properties	Only limited physical properties are tested	Some substances are tested for physical properties	Each substance is tested for all physical properties
Student measures mass using a triple beam balance	Student has great difficulty measuring and recording mass	Student has some difficulty measuring mass	Student demonstrates understanding of tool and uses grams when recording mass
Student uses evidence to determine if materials will or will not form a solution in water	Student does not check for solubility using water	Student adds material to water, but does not look for even distribution in water	Student adds material to water to test for solubility, and determines it is soluble by observing even distribution of substance in water
Students will use evidence to determine if materials make good conductors and poor conductors (insulators) of heat, sound, and electricity	Student does not test for conductivity using appropriate tools	Student tests for some areas of conductivity using appropriate tools	Student tests material for electrical, sound, heat conductivity using appropriate tools
Student collects information to classify matter based on physical properties	Student does not record measurements or information on chart, or is illegible Student's measurements and information is not accurate	Student records information in chart, but it is inconsistent or unorganized Student's measurements and information are mostly accurate	Student clearly records measurements on data chart Student's measurements and information are accurate

Magnetic and non-magnetic sort

Magnetic	**Non-magnetic**
Paper	Aluminum cookie sheet
Aluminum Can	Cotton Ball
Penny	Plastic Shopping Bag
Iron Nail	Pencil Lead
Gold Ring	Bolt
Paperclip	Safety Pin
Plant	Flip Flop

More/Less Dense Sort

More dense than water	**Less dense than water**
Staple	Large wooden block
Bouncy ball	Pen
Plastic Easter Egg	Marble
Small wooden cube	Ice
Dead Leaf	Rock
Styrofoam cup	Silver Ring
Play-doh	Rubber Duck

Name: _____

Physical Properties Multiple Choice

1. What tool measures in grams?
    a. Beaker
    b. Graduated cylinder
    c. Triple beam balance
    d. Scale

2. Which of these items would be attracted to a magnet?
    a. Balloon
    b. Iron nail
    c. Plastic cup
    d. Science book

3. Which of these items contains a gas?
    a. Balloon
    b. Iron nail
    c. Plastic cup
    d. Science book

4. Which of these items do you think would have the greatest mass?
    a. Balloon
    b. Iron nail
    c. Plastic cup
    d. Science book

5. An empty 250 mL beaker has a mass of 60 grams. When 100 mL of oil is added to the beaker, the total mass is 140 grams. What is the mass of the oil?
    a. 350 grams
    b. 80 grams
    c. 160 grams
    d. 40 grams

6. Which characteristic of an object will always change as the object travels from the Earth to the Moon?
    a. Volume
    b. Density
    c. Weight
    d. Mass

7. Based on what you have learned about conductors and insulators, which of these will be the best conductor of heat?
    a. Metal
    b. Wood
    c. Oven Mitt
    d. Styrofoam

8. Which force causes a marble to sink to the bottom of a glass of water?
    a. Gravity
    b. Friction
    c. Magnetism
    d. Electricity

9. Which would best complete the chart above?

Conducts Heat	Does Not Conduct Heat
Metal Spoon	Plastic Straw
Glass Baking Dish	Foam Cup
?	Newspaper

   a. A Cotton T-shirt
   b. Aluminum can
   c. Rubber eraser
   d. Wooden toothpick

10. If you want to change the state of matter, what must you do?
   a. Use a conductor of heat
   b. Cause evaporation to happen
   c. Add or remove heat
   d. Place the matter in a freezer

Physical Properties Breakout

Ideal Group Size:
2 groups, 10-18 students total

Suggested Time:
30 minutes

Story:
Something very important is locked away and we need to get it

Steps	Setup
1	Set locks • 4-digit lock: • 3-digit lock: • Word lock: sugar • Directional lock: ↓↓↑↑
2	Print: QR code, and 5 clues
3	Put prize in small box and lock with 4-digit
4	Put small box in larger box with alpha code, and use hasp to lock with 3-digit lock and directional lock
5	Put duckie in medium box, and lock with word lock
6	Post clues around room
7	Hide clue about solubility somewhere relatively easy to find
8	Place golf ball, ping pong ball, tennis ball, and marble in room
9	In a separate part of the room place triple beam balance, graduated cylinder, tub of water, scale, magnet, and beaker of water
10	Get ready!

Reflection Questions
What do you think you did well when solving this challenge? / How did you push through challenges/show growth mindset?
What could you have done better? / What could you improve for next time?
How did your knowledge of physical properties help you?

Materials List:

- 3 lockable boxes: small, medium, and large
- 4-digit lock
- 3-digit lock
- Word lock
- Directional lock
- Hasp
- 5 clues (included)
- Rubber duckie (it does not have to be a duckie, just something you can lock in the medium box, that has a mass greater than 100g. The mass will be your 3 digit code, do not include decimals)
- triple beam balance
- graduated cylinder
- tub of water
- scale
- magnet
- beaker of water
- golf ball
- ping pong ball
- tennis ball
- marble

Digital Files: Google Drive Link to any printouts or papers that are required.

QR code

LOCK TYPE	LOCK COMBINATION	HOW WILL THEY KNOW THE COMBO?	WHERE WILL IT LEAD?
4-Digit Lock		Alpha-numeric code for: mass	Victory!

		• Scan QR code for code key • Clue for mass	
3-Digit Lock		Mass of the ___ duckie	Opens hasp to reveal Clue #1 and small box
Word Lock	sugar	Clue for solubility: Substance that dissolves in water	Opens medium box to get 3-digit lock on the large box
Directional Lock	↓↓↑↑	Ordering the materials in the correct order and determining their relative density • Clue for order • Clue for density	Opens hasp to reveal Clue #1 and small box

ITEM TYPE	PURPOSE/INFORMATION	WHAT WILL THEY DO WITH IT?
Large Lock Box	Hasp with: • 3-Digit Lock • Directional Lock	Unlock to receive small box and alpha code
Small Lock Box (inside Large Lock Box)	Locked with 4-Digit Lock	Win!
Medium Lock Box	Locked with Word Lock Duckie inside	Duckie necessary to unlock 3-digit lock on medium box

Alphacode (inside large box)	Alphanumeric cypher a=1, j=1	Code necessary to unlock 4-digit code on small box
Clue for mass and 4-digit code (posted in room)	Physical property _ _ _ _	Necessary to unlock 4-digit lock on small box to win!
Clue for solubility (hidden in room)	Sweet! You found it!	Clue necessary to find word to unlock word lock on the medium box
Clue for order of substances for directional lock (posted in room)	Alphabetical order	Necessary to unlock directional lock on large box
Clue to check 4 substances for density (posted in room)	Some things go up and down in water	Necessary to unlock directional lock on large box