Interdisciplinary Connections

See pages 30-36 for the complete wording of the Texas Essential Knowledge & Skills for each content area addressed in this learning experience.

Language Arts TEKS

- Critical listening
- Vocabulary development
- Reading comprehension
- Grammar and usage
- Connecting reading, writing and inquiry
- Viewing, representing, and production

Mathematics TEKS

- Number operation
- Quantitative reasoning
- Patterns, relationships, and algebraic thinking
- Problem Solving
- Measurement
- Geometry and spatial reasoning
- Mathematical tools
- Underlying processes

Properties & Patterns

Social Studies TEKS

- Critical thinking skills
- Problem-solving and decision-making skills
- Written, oral, and visual communication

Art TEKS

- Creative expression and performance
- Response and evaluation of artwork

Overview of Learning Experiences

TEKS	**5.4** The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to: (A) collect and analyze information using tools including calculators, microscopes, cameras, sound recorders, computers, hand lenses, rulers, thermometers, compasses, balances, hot plates, meter sticks, timing devices, magnets, collecting nets, and safety goggles. **5.7** The student knows that matter has physical properties. The student is expected to: (A) classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound; (B) demonstrate that some mixtures maintain the physical properties of their ingredients; (C) identify changes that can occur in the physical properties of the ingredients of solutions such as dissolving sugar in water; and (D) observe and measure characteristic properties of substances that remain constant such as boiling points and melting points.
Engage	✦ Students observe a discrepant event involving the layering of liquids based upon their relative densities. The addition of a soluble solid causes students to question their understanding of density and other properties of matter.
Explore	✦ Students explore the combinations of various substances to experience the characteristics of mixtures and solutions and the properties of their ingredients.
Explain	✦ Students further their understanding of the properties of mixtures and solutions. Various methods for separating the ingredients of a mixture are discussed and explained during various interactions with each other and the teacher.
Elaborate	✦ Students apply their new understanding of concepts to discuss a solid-solid solution such as brass. The importance of melting points and boiling points are addressed. Students practice written communication skills to reinforce their procedural knowledge about using tools to measure matter.
Evaluate	✦ Students work individually to complete a problem-solving written performance task. The many hands-on, concrete experiences culminate in an abstract paper-and-pencil assessment.

ENGAGE

1. For each group of students set up a tray with the following materials:
   - clear glass filled 1/2 with water and 1/3 with oil
   - 1 container of food coloring
   - salt shaker

MATERIALS (details p. 24)

For each group:
- ☐ clear drinking glass
- ☐ vegetable oil
- ☐ tap water
- ☐ salt
- ☐ food coloring

ENGAGE

SAFETY FIRST ALERT

Remind students to avoid putting any of the objects from the tray into their mouth.

2. Instruct students to place 1 drop of food coloring into the glass and record observations.

3. Have a student shake salt into the glass. Ask students to make careful observations and record drawings and descriptions in their journals.

4. Ask students to discuss within their group possible explanations for the changes they observed.

5. Individually, have students write a possible explanation for what they observed and generate a list of questions they have about the activity.

6. Allow students time to share their explanations and list of questions. On a class chart, record any relevant terms brought up through the students' discussion.

7. Explain to students that everything they observed in the glass was dependent upon the properties of the materials that were used. In these learning experiences, students will further expand their understanding of these properties and how they relate to each other.

EXPLORE - A

EXPLORE

Part A

1. Set up enough materials for small groups of students to rotate through four different stations. For example, in a class of 30 students set up two sets of materials at each station. This will allow groups of 3-4 to work together and move through all four of the explore stations.

SAFETY FIRST ALERT

- **Remind students to avoid putting any of the objects from the stations into their mouth.**
- **All water spills must be reported to the teacher immediately for cleanup. Wet floors can be dangerously slippery.**
- **Safety goggles are required at Station 4.**

2. Explain to students that their job is to work as a team as they explore "mixtures" at each station. Ask students what they think a mixture might be. Discuss and record their thoughts on a class chart.

3. Have students rotate through the 4 stations to explore the nature of mixtures. Allow ample time for students to manipulate materials, discuss observations, and record data. Encourage students to be as accurate as possible and use labels and units as needed.

4. Circulate through the working student groups while making formative assessments and redirecting student thinking as needed.

5. Conduct the "Explain" portion of Part A prior to beginning Part B of "Explore".

MATERIALS (details p. 24-26)

For each group:

Station 1
- ☐ Station Card 1: *Master A*
- ☐ measuring cup
- ☐ wax beads
- ☐ plastic beads
- ☐ craft stick
- ☐ triple beam balance
- ☐ small strainer
- ☐ bowl of water
- ☐ mixing bowl
- ☐ magnet

Station 2
- ☐ Station Card 2: *Master B*
- ☐ plastic beads
- ☐ metal bbs
- ☐ measuring cup
- ☐ 3 plastic cups
- ☐ craft stick
- ☐ magnet
- ☐ small strainer
- ☐ bowl

Station 3
- ☐ Station Card 2: *Master C*
- ☐ containers of pebbles, gravel, and sand
- ☐ measuring cup
- ☐ 3 bowls
- ☐ craft stick
- ☐ strainers
- ☐ magnet

Station 4
- ☐ Station Card 2: *Master D-E*
- ☐ well plates
- ☐ water
- ☐ vinegar
- ☐ containers of sugar, sand, and salt
- ☐ toothpicks
- ☐ safety goggles

Part A - Station 1 (See Master A)

white beads	yellow beads

1. On a chart in your journal, record the properties of each type of bead.

2. Measure and record the mass of 30 mL of white beads.

3. Pour the beads into the mixing bowl.

4. Measure and record the mass of 30 mL of yellow beads.

5. Pour the beads into the mixing bowl and stir until evenly mixed.

6. How have the properties of the beads changed?

7. Discuss how an object's properties of mass and volume affect its behavior in water.

8. Design and test a way to easily separate the two types of beads. You may use any of the materials at this station. ***You may not, however, touch the white beads or the yellow beads with your hands.***

9. Discuss how well your plan worked and how you can improve it.

10. Discuss how you used the properties of the beads to separate the mixture. Record your ideas.

EXPLORE - A

Part A - Station 2 (See Master B)

yellow beads	silver beads

1. On a chart in your journal, record the properties of each type of bead.

2. Put 30 mL of the yellow beads into cup A.

3. Put 30 mL of the silver beads also into cup A.

4. Stir the beads with a craft stick until mixed.

5. How have the properties of the beads changed?

6. Examine the other materials at this station.

7. Design a way to easily separate the two types of beads so that the yellow beads go into cup B and the silver beads go into cup C. ***You may not touch the yellow beads or the silver beads with your hands.***

8. Discuss how well your plan worked and how you can improve it.

9. Discuss how you used the properties of the beads to separate the mixture. Record your ideas.

EXPLORE - A

Part A - Station 3 (See Master C)

pebbles	gravel	sand

1. On a chart in your journal, record the properties of the pebbles, gravel, and sand.

2. Place 50 mL of pebbles into the mixing bowl.

3. Place 50 mL of gravel into the mixing bowl.

4. Place 50 mL of sand into the mixing bowl.

5. Stir the pebbles, gravel, and sand with a craft stick until evenly mixed.

6. How have the properties of the three solids changed?

7. Examine the other materials at this station.

8. Design a way to easily separate the three types of solids so that each one goes into a separate bowl.

9. Discuss how well your plan worked and how you can improve it.

10. Discuss how you used the properties of the beads to separate the mixture. Record your ideas.

EXPLORE - A

Part A - Station 4 (See Masters D-E)

Eye Protection Required!

1. In wells # 1-3, place enough drops of water to fill them three-fourths full.
2. Add 1 level spoon of sugar to well #1, 1 level spoon of sand to well #2, and 1 level spoon of salt to well #3.
3. Use your toothpick to stir each mixture. Observe and record your results in a data table similar to the one below.
4. In wells # 4-6, place enough drops of vinegar to fill them three-fourths full.
5. Add 1 level spoon of sugar to well #4, 1 level spoon of sand to well #5, and 1 level spoon of salt to well #6.
6. Use your toothpick to stir each mixture. Observe and record your results in your data table.

#	Mixture	Observations
1.	water + sugar	
2.	water + sand	
3.	water + salt	
4.	vinegar + sugar	
5.	vinegar + sand	
6.	vinegar + salt	

7. What happened in mixtures **#1, 3, 4**, and **6** that did NOT happen in the other mixtures?

8. Compare your results to the data table below. Look for connections. In your own words, what is a **solution**?

#	Mixtures	Observations
1.	Water + sugar	☑ EXAMPLE of a solution
2.	Water + sand	NON-EXAMPLE of a solution
3.	Water + salt	☑ EXAMPLE of a solution
4.	Vinegar + sugar	☑ EXAMPLE of a solution
5.	Vinegar + sand	NON-EXAMPLE of a solution
6.	Vinegar + salt	☑ EXAMPLE of a solution

9. Discuss how Galveston beach would be different IF the mixture of "water + sand" was an example of a solution rather than a non-example. Record your ideas.

EXPLORE

Part B

1. Have students rotate through the four learning experiences as described on the Station Cards. If they have never used "Self-checking" cards, explain the process.

SAFETY FIRST ALERT

- **Remind students to avoid putting any of the objects from the stations into their mouth.**
- **All water spills must be reported to the teacher immediately for cleanup. Wet floors can be dangerously slippery.**

2. Allow ample time for students to manipulate materials, discuss observations, and record data.

3. Circulate through the working student groups while making formative assessments and redirecting student thinking as needed.

MATERIALS (details p. 25-26)

For each group:

Station 1
- ☐ Station Card 1: *Masters F-I*
- ☐ Station mat; *Masters Q-R*
- ☐ 3 jars of tea solution
- ☐ 1 jar of water
- ☐ 1 jar of dry tea
- ☐ 3 recipe cards
- ☐ 3 diagram cards

Station 2
- ☐ Station Card 2: *Masters J-K*
- ☐ 50 mL graduated cylinder
- ☐ plastic beads
- ☐ sugar
- ☐ measuring spoon
- ☐ cup
- ☐ water
- ☐ craft stick
- ☐ 3 bottles of saltwater
- ☐ 3 pencils

Station 3
- ☐ Station Card 3: *Masters L-M*
- ☐ 9 V battery
- ☐ light bulb
- ☐ 2 electrical wires
- ☐ cup
- ☐ water
- ☐ spoon
- ☐ salt
- ☐ sugar
- ☐ craft stick

Station 4
- ☐ Station Card 4: *Masters N-O*
- ☐ table salt & crystals
- ☐ Epsom salt & crystals
- ☐ magnifier
- ☐ granite
- ☐ quartz, feldspar, mica
- ☐ pumice
- ☐ bowl of water

EXPLORE - B

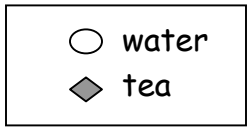
Part B - Station 1 (See Master F)

1. Observe the properties of the mixtures in the 3 jars. How are they the same? How are they different? Compare the mixtures to their two ingredients.

2. Read the 3 recipe cards for making instant tea. Match the recipe cards with the mixtures by placing them in front of the jars. Discuss your reasoning.

3. Look at the 3 diagram cards. Using the key below, discuss which of the 3 diagrams best models each of the 3 mixtures and why. Place the cards in front of the jars.

KEY



4. If you were able to taste the 3 solutions, how do you think they would compare? Did you use the words "stronger" and "weaker" in your description? Finish these statements:

- The more solid you dissolve in a liquid, the _____ the solution is.
- The less solid you dissolve in a liquid, the _____ the solution is.

5. Brainstorm a list of ways that you can make a solution become stronger.

6. Open the "Check It Out" envelope and compare your answers. Discuss what you have learned at this station.

7. Write in your journal the main ideas from this station.

Part B - Station 2 (See Master J)

1. Pour 50 mL of water into the cup. Add 10 plastic beads and stir. Observe what happens and discuss why you think it happens.

2. Add 15 mL of sugar to the cup of water and stir. Observe what happens and discuss why you think it happens.

3. Compare the properties of the sugar water solution to the properties of the water. What has changed?

4. The colored liquids in the 3 bottles are saltwater solutions with food coloring. Place one pencil with the thumbtack down into each solution. What do you observe? What is your explanation for your observation?

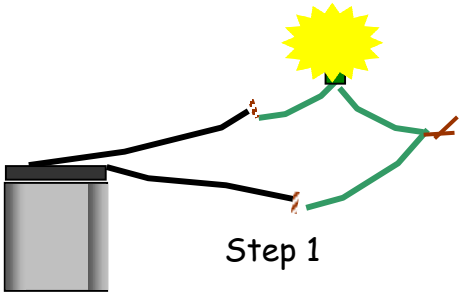
5. Open the "Check It Out" envelope and compare your answers. Discuss what you have learned at this station.

6. Write in your journal the main ideas from this station.

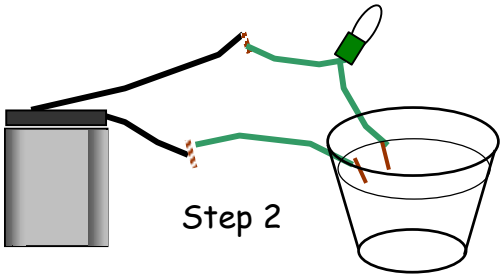
EXPLORE - B

Part B - Station 3 (See Master L)

1. Use the battery, bulb, and wires to make a complete circuit that will cause the bulb to light.


Step 1

2. Use your materials to test if plain water is a conductor of electricity. Be sure the two free ends of wire are in the liquid ***but are not touching each other.***


Step 2

3. Add 1 level spoon of salt to the water and stir. Test to see if the solution is a conductor.

4. Test to see if increasing the amount of salt makes any differences.

5. Clean out your cup and repeat the tests using a sugar water solution. Record your results in your journal.

6. Clean out your cup for the next group.

7. Write in your journal the main ideas from this station.

EXPLORE - B

Part B - Station 4 (See Master N)

1. Compare the samples of table salt and Epsom salt to the crystals found in the containers marked A and B. Which container of crystals was formed from a solution of Epsom salt? How can you tell? Where did the water go that dissolved the Epsom salt?

2. Observe the four solids on the plate. One of the samples is an example of a mixture. Which one do you think it is? Why?

3. How and where do you think this mixture was made?

4. Compare the two samples in the bowl. They are both examples of the same type of mixture. How are they alike? How are they different? What do you think caused their differences?

5. Observe the sample in container E. It was also formed from a mixture. Place it into the bowl of water. What happened and why?

6. Write in your journal the main ideas from this station.

EXPLAIN - A

EXPLAIN


Part A

1. Have students communicate their findings for **Station 1** by participating in a class discussion. Be ready to ask the following types of questions during the discussion.

Questioning Strategies

- What were the two solids that you mixed together? *(white beads and yellow beads)*
- What did you notice about the mass and volume of the two types of beads? *(white beads had mass less than volume; yellow beads had mass greater than volume)*
- Were you able to use the properties of the beads to help you separate the solids from each other? *(yes, white beads float in water; yellow beads sink in water; particle size allowed beads to be caught by strainer)*
- Did mixing the two types of solids together change their properties? *(no)* How do you know?

MATERIALS (details p. 27)

For the class:
- ☐ 1 set of materials from each of the four stations
- ☐ chart paper
- ☐ markers
- ☐ hot plate

For each group:
- ☐ tray
- ☐ sugar cube
- ☐ cup of water
- ☐ salt
- ☐ measuring spoons
- ☐ graduated cylinder
- ☐ small beaker
- ☐ aluminum pie pan
- ☐ clothespin
- ☐ hand lens or microscope

Questioning Strategies

2. Have students communicate their findings for **Station 2** by participating in a class discussion. Be ready to ask the following types of questions during the discussion.

- What were the two solids that you mixed together? *(yellow, plastic beads and silver, metal beads)*
- Were you able to use a property of matter to help you design an easy way to separate the solids from each other? *(yes, iron in the metal beads is attracted to magnet while plastic in the yellow beads is not)*
- Did mixing the two types of solids together change their properties? *(no)* How do you know?

Questioning Strategies

3. Have students communicate their findings for **Station 3** by participating in a class discussion. Be ready to ask the following types of questions during the discussion.

- What were the three solids that you mixed together? *(pebbles, sand, and gravel)*
- Were you able to use a property of matter to help you design an easy way to separate them from each other? *(only size of the particles helped; masses and volumes indicated they would all sink when placed into water; none were attracted to magnet)*
- Did mixing the two types of solids together change their properties? *(no)* How do you know?
- What do scientists call these types of combinations that you made at these stations? *(mixtures)*
- Let's add to our list of what we know about mixtures: "different kinds of matter put together but each one keeps its own properties and can be separated back into original parts"

Questioning Strategies

4. Have students communicate their findings for **Station 4** by participating in a class discussion. Be ready to ask the following types of questions during the discussion.

- When you combined the liquid water and the solid sugar, what were you making? *(a mixture)* When you combined the liquid water and the solid sand? *(also a mixture)*
- If these are both mixtures, how were they different? *(sugar dissolved; sand did not)*
- What did you find that we call this special type of mixture? *(solution)*
- What was your definition for the word solution? *(acknowledge all responses)*
- What is your definition for the word dissolve?

Questioning Strategies

(acknowledge all responses; some students will believe it means to disappear and no longer exist)

- Let's go back to our list of what we now know about mixtures. When you put the solid sugar and the liquid water together, did you make a mixture? *(yes)*
- Did the sugar and the water keep their own properties? How can we tell? *(acknowledge all responses; some will suggest taste the water)*
- How can we prove that the sugar did not really disappear? *(acknowledge all responses)*
- Have you ever carefully observed a solid as it is dissolving in a liquid?

5. Have each material manager supply their table with a tray of materials. Tell students they are going to observe a sugar cube as it dissolves in a cup of water. Have the recorder at each group write down the group's detailed observations.

6. Have groups share their observations. Emphasize the details that describe the cube being broken down into smaller and smaller pieces. Ask students if they can still see the pieces of sugar in their cup. Acknowledge that the pieces have become too small to see even when using a hand lens. However, do the pieces of sugar still exist? How can we prove it other than tasting it? Can we use a strainer to separate the sugar from the water? Would a magnet help us? Let's investigate to find out.

SAFETY FIRST ALERT

Use of a hot plate requires direct adult supervision. Do not allow students to get too close or to touch any of the materials at the heating station.

7. Have students prepare a saltwater solution by dissolving 1 mL of salt in 5 mL of water. Pour the solution into an aluminum pie pan. Under direct adult supervision, heat the solution in the pie pan on a hot plate and observe. Do not allow students to touch materials at the heating station or to get too close to the hot plate. Immediately remove the pan from the hot plate when the water has evaporated. Have students use hand lenses or pocket microscopes to observe the crystals left in the pan and compare to salt crystals from a shaker. Heat one pan with 5 mL of water but no salt to use as a control for comparison.

Questioning Strategies

- What did you observe happening when the pie pan was on the hot plate? *(bubbles; white material forming)*
- What were those bubbles? *(some may believe the bubbles were heat rising or hydrogen and oxygen rising; lead students to realize that the bubbles were actually water that had turned into a gas because it had evaporated)*
- Did the salt evaporate? How do you know? *(no, the crystals left in the pan were salt)*
- Discuss in your group the different methods we have used to separate the parts of a mixture. *(should include straining or filtering, using a magnet, using water to separate floaters from sinkers, evaporation of a liquid)*
- Have students share their lists and then produce a visual that shows how the parts of a mixture can be separated by using different properties of the parts.

EXPLAIN

Part B

MATERIALS (details p . 27)

For the class:

☐ 1 set of materials from each of the 4 stations

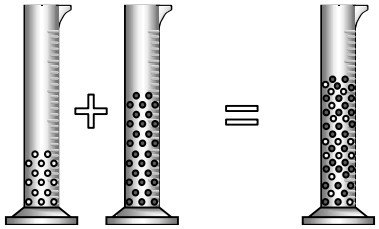
EXPLAIN - B

1. Have students communicate their findings for **Station 1** by participating in a class discussion. Ask a student to summarize what they learned at this station. Have students share their list of ways to make a solution become stronger.

2. Have students communicate their findings for **Station 2** by participating in a class discussion. Ask a student to summarize what they learned at this station. Make sure students understand that dissolving a solid in a liquid can cause a change in the liquid's density.

3. Have students communicate their findings for **Station 3** by participating in a class discussion. Ask a student to summarize what they learned at this station. Make sure students understand that dissolving some solids in water can cause a change in its electrical conductivity. Students should have found that the saltwater solution did conduct electricity but the sugar water solution did not.

4. Have students communicate their findings for **Station 4** by participating in a class discussion. Ask a student to summarize what they learned at this station. Students should understand that solids often have an identifiable shape. It is also important for students to realize that there are many naturally occurring mixtures on the earth. Other than rocks, point out that seawater is a natural mixture made of water and many other dissolved parts. Our atmosphere is also a natural mixture made of different gases.



- Adding salt to water forms a saltwater solution.
- The saltwater solution has a density greater than the density of the original water.
- The more salt that is dissolved into the solution, the greater its density. For example, seawater has a greater density than water in lakes and rivers.

ELABORATE



1. Have students go back to their original statements about mixtures. Ask students to add to their writings anything new they have learned. Share and discuss the information.

2. Hold up a brass pot and ask students to decide whether they think it is an example of a mixture. Then ask them if they think it is an example of a solution.

3. Tell students that brass is indeed a mixture and is even a solution. Remind students that solutions are a special type of mixture formed when one type of matter dissolves into another. Ask if anyone knows what the two metals are that make up brass. They are copper and zinc. How can a solid metal dissolve into another metal? The metals are heated to their melting points. In the liquid state, the zinc dissolves into the liquid copper. The mixture is then allowed to cool and become a solid solution. How hot do you think metals like copper and zinc have to get before they melt into liquids?
(copper ~ 1085 °C; zinc ~ 907 °C)

4. Tell students they are going to construct a large class bar graph that shows the melting and boiling points of five different types of matter.

5. Assign each group the task of making one of the bars for the graph. Use blue to represent melting point and red for boiling point. Label the axes. Have students glue their bar to the appropriate location on the graph.

6. Have a student read the room temperature using a thermometer. Attach a piece of yarn to the graph running horizontally across the bars to represent that temperature.

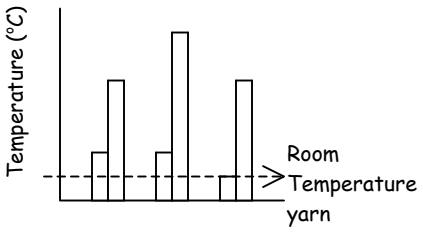
MATERIALS (details p. 28)

For the class:
- ☐ brass pot
- ☐ grid chart paper
- ☐ markers
- ☐ yarn
- ☐ tape
- ☐ data table of melting and boiling points
- ☐ example of water, aluminum, sand, salt, and glycerine
- ☐ other examples of solids, liquids, and gases

For each group:
- ☐ grid paper strip
- ☐ red or blue marker
- ☐ glue stick
- ☐ scissors

ELABORATE

Melting and Boiling Points



ELABORATE

7. Have students analyze the graph and make interpretations about the state of matter that a substance will be in at different temperatures. For example, pour a liquid other than water from one glass into another. Hold up a solid stick of butter and helium in a balloon. Ask students to explain WHY these examples of matter are all at the same room temperature but yet one is a liquid, one is a solid, and one is a gas. Direct students' attention back to the graph. Students should infer that the liquid has boiling and melting points that are higher and lower than room temperature. The butter has a melting point that is higher than room temperature and is therefore a solid. The helium has a boiling point that is lower than room temperature and is therefore a gas.

Possible Extensions:

- Raise the question: How hot can you get 300 mL of pure water? Have students design and conduct an investigation following all safety rules. Be aware that an increase in elevation causes a decrease in boiling point. Therefore, if your location is considerably above sea level, students may get data below the expected 100 °C.

- Have groups of students repeat their investigations using varying concentrations of saltwater and sugar water solutions.

Melting and Boiling Points

Substance	Melting Point	Boiling Point
pure water	0 °C	100 °C
aluminum	660 °C	2520 °C
salt	800 °C	1400 °C
sand	1600 °C	2200 °C
glycerin(e)	18 °C	290 °C

EVALUATE

MATERIALS (details p. 28)

For each student:
- ☐ Performance Task, *Master O*
- ☐ metric ruler
- ☐ Performance Task Scoring Rubric, *Master P*

EVALUATE

1. Students work individually to complete the written performance task "All Mixed Up".

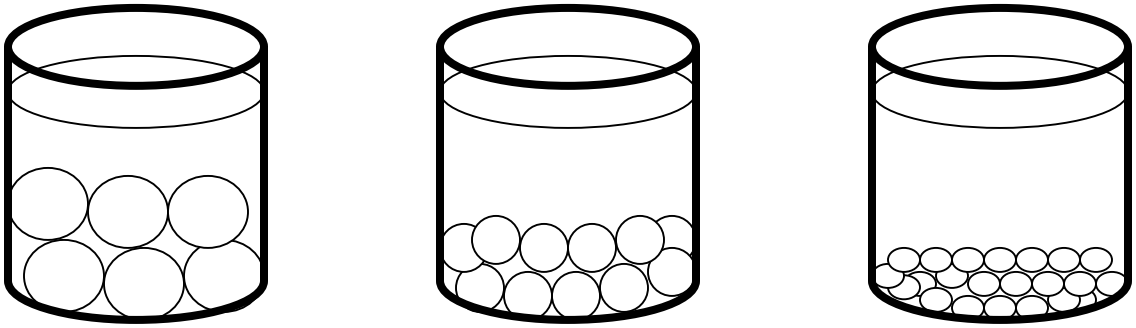
2. Encourage students to be thorough and detailed with their work. Explain that this is their opportunity to prove how much they have learned during the hands-on group activities and discussions. They should make drawings with labels, charts with data, and write in complete sentences. The more details and thought they include, the clearer you will know how much they have learned.

3. A suggested rubric is provided as *Master P*.

EVALUATE

All Mixed Up (See Master O)

MIXTURES: Each of these containers holds a mixture made of water and solid beads.

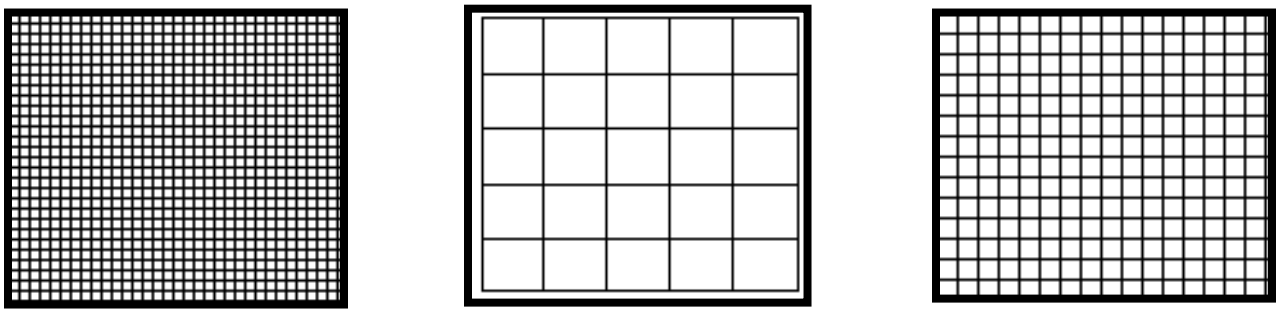


A B C

1. Study the diagrams carefully. What can you tell about the properties of the 3 sizes of beads in the mixtures? Include information about their masses, volumes, densities, and buoyancy in water. Use labeled drawings, sentences, and charts to organize your information.

2. Do these mixtures appear to be solutions? What evidence do you have to support your answer? Use labeled drawings and sentences to explain your answers.

STRAINERS: Each of these screen strainers allows water to be poured through it.



1 2 3

3. Develop a plan for separating each of the 3 mixtures by using the strainers. Use a ruler to collect data about the beads and the holes in the strainers. Organize the data into a table and communicate which strainers can be used to separate the parts of which mixtures.

4. Which of these strainers can you use to separate the parts of a saltwater solution? Use labeled drawings and sentences to explain how you would separate the salt from the water.

All Mixed Up (See Master P)
Performance Task-Scoring Rubric

	4	3	2	1
Understands properties of matter including mass, volume, density, and buoyancy	Correctly identifies information about 4 of the 4 listed properties	Correctly identifies information about 3 of the 4 listed properties	Correctly identifies information about 2 of the 4 listed properties	Correctly identifies information about less than 2 of the listed properties
Understands relationship between solutions and mixtures	Correctly identifies relationship and provides strong supporting evidence	Correctly identifies relationship but provides limited supporting evidence	Correctly identifies relationship but provides no supporting evidence	Does not correctly identify relationship
Collects and organizes data	Constructs a well-organized data table; makes reasonably accurate measurements with appropriate units	Constructs a somewhat organized data table; makes reasonably accurate measurements with appropriate units	Constructs a somewhat organized data table; makes errors in measurements and uses inappropriate units	Does not include a usable data table and measurements
Draws conclusion	Correctly matches all 3 mixtures with the appropriate strainers that can separate the parts	Correctly matches 2 of the 3 mixtures with the appropriate strainers that can separate the parts	Correctly matches 1 of the 3 mixtures with the appropriate strainers that can separate the parts	None are correctly matched
Applies knowledge	Explanation is accurate, demonstrates clear understanding of a solution, and includes exceptional details	Explanation is accurate and demonstrates clear understanding of a solution	Explanation is partially accurate and demonstrates some understanding of a solution	Explanation is missing or inaccurate

Materials Detail Sheet

ENGAGE

For each group of students:

- ☐ clear drinking glass; use plastic for safety purposes
- ☐ vegetable oil
- ☐ tap water
- ☐ salt
- ☐ food coloring

EXPLORE – Part A

For each group of students:

Station 1

- ☐ Station Card 1: *Master A*
- ☐ measuring cup
- ☐ wax beads; sold as a candle making supply in craft departments
- ☐ plastic beads; sold as ammunition for pellet guns in sporting goods departments
- ☐ craft stick
- ☐ triple beam balance
- ☐ small strainer; sold as kitchen utensil in discount stores
- ☐ bowl of water; use plastic for safety purposes
- ☐ mixing bowl; use plastic for safety purposes
- ☐ magnet

Station 2

- ☐ Station Card 2: *Master B*
- ☐ plastic beads; sold as ammunition for pellet guns in sporting goods departments
- ☐ metal bbs; sold as ammunition for pellet guns in sporting goods departments
- ☐ measuring cup; use plastic for safety purposes
- ☐ 3 cups; use plastic for safety purposes
- ☐ craft stick
- ☐ magnet
- ☐ small strainer; sold as kitchen utensil in discount stores
- ☐ bowl; use plastic for safety purposes

Station 3

- ☐ Station Card 2: *Master C*

- ☐ pebbles
- ☐ gravel
- ☐ sand
- ☐ measuring cup; use plastic for safety purposes
- ☐ 3 bowls; use plastic for safety purposes
- ☐ craft stick
- ☐ strainers; various sorting sizes needed; sold as "sorting sieves" in the Earth Science section of catalogs from most vendors of science teaching supplies
- ☐ magnet

Station 4

- ☐ Station Card 2: *Master D-E*
- ☐ well plates; small plastic cups can be substituted
- ☐ water; place in dropper bottles or in small cups with pipettes
- ☐ vinegar; place in dropper bottles or in small cups with pipettes
- ☐ sugar
- ☐ sand
- ☐ salt
- ☐ toothpicks
- ☐ safety goggles

EXPLORE – Part B

For each group of students:

Station 1

- ☐ Station Card 1: *Master F-I*
- ☐ 3 jars of tea solution; mix water and dry tea to make 3 solutions on differing concentrations; exact amounts are not critical but the solutions should have noticeable differences in color from light to dark brown; use plastic for safety purposes
- ☐ 1 jar of water; use plastic for safety purposes
- ☐ 1 jar of dry tea; use plastic for safety purposes
- ☐ 3 recipe cards
- ☐ 3 diagram cards

Station 2

- ☐ Station Card 2: *Masters J-K*

- ☐ 50 mL graduated cylinder; use plastic for safety purposes
- ☐ plastic beads; sold as ammunition for pellet guns in sporting goods departments
- ☐ sugar
- ☐ measuring spoon
- ☐ water
- ☐ cup; use plastic for safety purposes
- ☐ craft stick
- ☐ 3 bottles of saltwater; make saltwater solutions that vary in density by altering the amount of salt in each; add different food coloring to each
- ☐ 3 pencils; firmly insert metal thumbtack into the eraser of each

Station 3

- ☐ Station Card 3: *Masters L-M*
- ☐ 9 V battery
- ☐ light bulb; remove sections from a strand of holiday lights stripping the plastic insulation from each end
- ☐ 2 electrical wires
- ☐ water; some sources of water contain enough dissolved minerals to conduct an electrical current; test your source first or use a bottle of distilled water to avoid the problem
- ☐ cup; use plastic for safety purposes
- ☐ spoon
- ☐ salt
- ☐ sugar
- ☐ craft stick

Station 4

- ☐ Station Card 4: *Masters N-O*
- ☐ table salt & crystals; dissolve table salt into water, pour into shallow dish such as a plastic petri dish, and allow water to evaporate and leave behind crystals of salt
- ☐ Epsom salt & crystals; dissolve Epsom salt into water, pour into shallow dish such as a plastic petri dish, and allow water to evaporate and leave behind crystals of Epsom salt
- ☐ magnifier; use hand lenses, microscopes, or tools to magnify
- ☐ granite
- ☐ quartz, feldspar, mica
- ☐ pumice
- ☐ bowl of water; use plastic for safety purposes

EXPLAIN – Part A

For the class:

- ☐ 1 set of materials from each of the four stations
- ☐ chart paper
- ☐ markers
- ☐ hot plate; used under direct adult supervision; read Safety First Alert

For each group of students:

- ☐ tray
- ☐ sugar cube
- ☐ cup of water; use plastic for safety purposes
- ☐ salt
- ☐ measuring spoons
- ☐ graduated cylinder
- ☐ small beaker
- ☐ aluminum pie pan; small 4" diameter; available in disposable bake ware section of grocery store
- ☐ clothespin; plastic or wooden
- ☐ hand lens or microscope

EXPLAIN – Part B

For the class:

☐ 1 set of materials from each of the 4 stations

ELABORATE

For the class:

- ☐ brass pot or other brass object
- ☐ grid chart paper
- ☐ markers
- ☐ yarn
- ☐ tape
- ☐ data table of melting and boiling points
- ☐ example of water, aluminum, sand, salt, and glycerine; use aluminum soda cans, pull tabs, wire, or other aluminum example; purchase a bottle of glycerin at a drugstore
- ☐ examples of solids, liquids, and gases at room temperature
    - examples of solids: butter, vegetable shortening, lard, crayons, wax, etc.
    - examples of liquids: vinegar, rubbing alcohol, etc.
    - example of gases: air, helium in ballon, etc.

For each group of students:

- ☐ grid paper strip
- ☐ red or blue marker
- ☐ glue stick
- ☐ scissors

EVALUATE

For each student:

- ☐ Separating Mixtures, *Master O*
- ☐ metric ruler
- ☐ Rubric, *Master P*

Background Information for Teachers

This set of learning experiences continues to build on the student's conceptual understanding of the properties of matter. Students begin the engagement by observing a discrepant event that revisits the concept of density focused upon at Grade 4. Students add a drop of food coloring to a glass containing a distinct layer of cooking oil floating on water. The drop of color passes through the oil and comes to rest in a perfect sphere on top of the water layer. Students then sprinkle table salt into the glass and are amazed by the results. The more dense salt crystals sink to the bottom of the glass taking some of the oil and food coloring with them. As the salt dissolves in the water, the less dense oil floats back to the top of the water and the food coloring is dispersed. Thus begins the students' exploration of the new concepts of mixtures and solutions.

Mixtures are formed when two or more materials are physically combined. The mixtures may be made of combinations of liquids, solids, and gases. These learning experiences focus on mixtures of solids + solids, liquids + liquids, and liquids + solids. The parts of a mixture can be separated by various means. For example, a magnet can be used to extract parts that are attracted to it versus parts that are not. Straining and filtering can also be used to separate some mixtures. However, there are special types of mixtures called solutions that cannot be separated by any of these methods.

A process called dissolving forms solutions. When a solid such as sugar is placed into water, the solid is pulled apart by the liquid into small pieces that are too tiny to see. Many students believe that when solids dissolve, they disappear and thus cease to exist. However, solutions can be separated back into their parts by a process called evaporation. If a container of sugar water solution is left on a windowsill, the water will evaporate by changing into a gas while the original solid sugar crystals will remain behind in the container. Students will find however, that not all substances dissolve in water.

Melting points and boiling points are also characteristic properties of matter introduced in this set of learning experiences. These points represent temperatures at which substances change from one phase or state to another. For example, water melts from ice to liquid at 0°C. Liquid water boils to change into water vapor at 100°C. The change in phase or state does not affect the identity of the substance. Only the distances and interactions between the particles that make up the substance have changed.

Targeted Texas Essential Knowledge & Skills

Science TEKS

5.1 The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations

5.2 The student uses scientific methods during field and laboratory investigations. The student is expected to:

(A) plan and implement descriptive and simple experimental investigations including asking well-defined questions, formulating testable hypotheses, and selecting and using equipment and technology;

(B) collect information by observing and measuring;

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;

(D) communicate valid conclusions; and

(E) construct simple graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate information.

5.4 The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:

(A) collect and analyze information using tools including calculators, microscopes, cameras, sound recorders, computers, hand lenses, rulers, thermometers, compasses, balances, hot plates, meter sticks, timing devices, magnets, collecting nets, and safety goggles; and

(B) demonstrate that repeated investigations may increase the reliability of results.

5.7 The student knows that matter has physical properties. The student is expected to:

(A) classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound;

(B) demonstrate that some mixtures maintain the physical properties of their ingredients;

(C) identify changes that can occur in the physical properties of the ingredients of solutions such as dissolving sugar in water; and

(D) observe and measure characteristic properties of substances that remain constant such as boiling points and melting points.

Language Arts TEKS

5.1 Listening/speaking/purposes. The student listens actively and purposefully in a variety of settings. The student is expected to:

(A) determine the purposes for listening such as to gain information, to solve problems, or to enjoy and appreciate;

(B) eliminate barriers to effective listening; and

(C) understand the major ideas and supporting evidence in spoken messages.

5.2 Listening/speaking/critical listening. The student listens critically to analyze and evaluate a speaker's message(s). The student is expected to:

(A) interpret speakers' messages (both verbal and nonverbal), purposes, and perspectives; and

(D) monitor his/her own understanding of the spoken message and seek clarification as needed.

5.7 Reading/fluency. The student reads with fluency and understanding in texts at appropriate difficulty levels. The student is expected to:

(B) read regularly in instructional-level materials that are challenging but manageable (texts in which no more than approximately 1 in 10 words is difficult for the reader; a "typical" 5th grader reads approximately 100 wpm).

5.9 Reading/vocabulary development. The student acquires an extensive vocabulary through reading and systematic word study. The student is expected to:

(B) draw on experiences to bring meanings to words in context such as interpreting figurative language and multiple-meaning words; and

(E) study word meanings systematically such as across curricular content areas and through current events.

5.13 Reading/inquiry/research. The student inquires and conducts research using a variety of sources. The student is expected to:

(A) form and revise questions for investigations, including questions arising from interest and units of study;
(D) interpret and use graphic sources of information such as maps, graphs, time lines, tables, or diagrams to address research questions;
(E) summarize and organize information form multiple sources by taking notes, outlining ideas, and making charts;
(G) draw conclusions from information gathered from multiple sources; and
(H) use compiled information and knowledge to raise additional, unanswered questions.

5.15 Writing/purposes. The student writes for a variety of audiences and purposes, and in a variety of forms. The student is expected to:
(A) write to express, discover, record, develop, reflect on ideas, and to problem solve; and
(C) write to inform such as to explain, describe, report, and narrate.

5.16 Writing/penmanship/capitalization/punctuation. The student composes original texts, applying the conventions of written language, including capitalization, punctuation, and penmanship, to communicate clearly. The student is expected to:
(A) write legibly by selecting cursive or manuscript as appropriate; and
(B) capitalize and punctuate correctly to clarify and enhance meaning such as capitalizing titles, using possessives, commas in a series, commas in direct address, and sentence punctuation.

5.18 Writing/grammar/usage. The student applies standard grammar and usage to communicate clearly and effectively in writing. The student is expected to:
(B) write in complete sentences, varying the types such as compound and complex to match meanings and purposes;
(C) employ standard English usage in writing for audiences, including subject-verb agreement, pronoun referents, and parts of speech;
(D) use adjectives (comparative and superlative forms) and adverbs appropriately to make writing vivid or precise; and
(F) use conjunctions to connect ideas meaningfully.

5.21 Writing/inquiry/research. The student uses writing as a tool for learning and research. The student is expected to:
(A) frame questions to direct research;

(D) summarize and organize ideas gained from sources in useful ways such as outlines, conceptual maps, learning logs, and timelines;
(E) present information in various forms using available technology; and
(F) evaluate his/her own research and raise new questions for further investigation.

5.23 Viewing/representing/interpretation. The student understands and interprets visual images, messages, and meanings. The student is expected to:
(B) interpret important events and ideas gleaned from maps, charts, graphics, video segments or technology presentations.

5.25 Viewing/representing/production. The student produces visual images, messages, and meanings that communicate with others. The student is expected to:
(A) select, organize, or produce visuals to complement and extend meanings.

Mathematics TEKS

5.1 Number, operation, and quantitative reasoning. The student uses place value to represent whole numbers and decimals. The student is expected to:
(A) use place value to read, write, compare, and order whole numbers through the billions place; and
(B) use place value to read, write, compare, and order decimals through the thousandths place.

5.3 Number, operation, and quantitative reasoning. The student adds, subtracts, multiplies, and divides to solve meaningful problems. The student is expected to:
(A) use addition and subtraction to solve problems involving whole numbers and decimals.

5.5 Patterns, relationships, and algebraic thinking. The student makes generalizations based on observed patterns and relationships. The student is expected to:
(B) use lists, tables, charts, and diagrams to find patterns and make generalizations such as a procedure for determining equivalent.

5.6 Patterns, relationships, and algebraic thinking. The student describes relationships mathematically. The student is expected to select from and use diagrams and number sentences to represent real-life situations.

5.7 Geometry and spatial reasoning. The student generates geometric definitions using critical attributes. The student is expected to:

(B) use critical attributes to define geometric shapes or solids.

5.11 Measurement. The student applies measurement concepts. The student is expected to:

(A) measure to solve problems involving length (including perimeter), weight, capacity, time, temperature, and area; and

(B) describe numerical relationships between units of measure within the same measurement system such as an inch is one-twelfth of a foot.

5.13 Probability and statistics. The student solves problems by collecting, organizing, displaying, and interpreting sets of data. The student is expected to:

(C) graph a given set of data using an appropriate graphical representation such as a picture or a line.

5.14 Underlying processes and mathematical tools. The student applies Grade 5 mathematics to solve problems connected to everyday experiences and activities in and outside of school. The student is expected to:

(A) identify the mathematics in everyday situations;

(B) use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness;

(C) select or develop an appropriate problem-solving strategy, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem; and

(D) use tools such as real objects, manipulatives, and technology to solve problems.

5.15 Underlying processes and mathematical tools. The student communicates about Grade 5 mathematics using informal language. The student is expected to:

(A) explain and record observations using objects, words, pictures, numbers, and technology; and

(B) relate informal language to mathematical language and symbols.

5.16 Underlying processes and mathematical tools. The student uses logical reasoning to make sense of his or her world. The student is expected to:

(A) make generalizations from patterns or sets of examples and nonexamples; and

(B) justify why an answer is reasonable and explain the solution process.

Social Studies TEKS

5.25 Social studies skills. The student applies critical-thinking skills to organize and use information acquired from a variety of sources including electronic technology. The student is expected to:

(B) analyze information by sequencing, categorizing, identifying cause-and-effect relationships, comparing, contrasting, finding the main idea, summarizing, making generalizations and predictions, and drawing inferences and conclusions; and

(C) organize and interpret information in outlines, reports, databases, and visuals including graphs, charts, timelines, and maps.

5.26 Social studies skills. The student communicates in written, oral, and visual forms. The student is expected to:

(C) express ideas orally based on research and experiences;

(D) create written and visual material such as journal entries, reports, graphic organizers, outlines, and bibliographies; and

(E) use standard grammar, spelling, sentence structure, and punctuation.

5.27 Social studies skills. The student uses problem-solving and decision-making skills, working independently and with others, in a variety of settings. The student is expected to:

(A) use a problem-solving process to identify a problem, gather information, list and consider options, consider advantages and disadvantages, choose and implement a solution, and evaluate the effectiveness of the solution; and

(B) use a decision-making process to identify a situation that requires a decision, gather information, identify options, predict consequences, and take action to implement a decision.

Art TEKS

5.1 Perception. The student develops and organizes ideas from the environment. The student is expected to:

(A) communicate ideas about feelings, self, family, school, and community, using sensory knowledge and life experiences.

5.2 Creative expression/performance. The student expresses ideas through original artworks, using a variety of media with appropriate skill. The student is expected to:

(A) combine information from direct observation, experience, and imagination to express ideas about self, family, and community.

Reading Connections

The following books are recommended as literary resources for teachers to share with fourth grade students. **Teachers are cautioned, however, to remember that "reading about science" is not "doing science."** These books can enhance students' study of scientific concepts but cannot replace the learning that occurs by active engagement in the learning experiences.

Aragon, Jane C. *Salt Hands*. E.P. Dutton, New York, 1989.

Cole, Joanna. *The Magic School Bus at the Waterworks*. Scholastic, New York, 1986.

Selsam, Millicent. *Greg's Microscope*. Harper & Row, New York, 1963.

Van Allsburg, Chris. *Two Bad Ants*. Houghton Mifflin Company, Boston, 1988.
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Bransford, John D. *How People Learn*. National Academy Press, 2000.

Bybee, Rodger W. *Learning Science and the Science of Learning*. NSTA Press, 2002.

Hewitt, Paul G. *Conceptual Physical Science*. Scott Foresman-Addison Wesley, Glenview, Illinois, 2003.

Howe, Christine J. *Conceptual Structure in Childhood and Adolescence*. Routledge, London, 1998.

Jensen, Eric. *Brain Compatible Strategies*. The Brain Store, Inc., 1997.

Kellough, Richard D. *Integrating Mathematics and Science*. Prentice Hall, Englewood Cliffs, New Jersey, 1996.

Levenson, Elaine. *Teaching Children about Physical Science*. McGraw-Hill, New York, 1994.

Llewellyn, Douglas. *Inquire Within: Implementing Inquiry-Based Science Standards*. Corwin Press, Inc., 2002.

Main, June, and Eggen, Paul. *Developing Critical Thinking Through Science*. Critical Thinking Books and Software, Pacific Grove, California, 1991.

Martin, David Jerner. *Elementary Science Methods: A Constructivist Approach.* Delmar Publishers, New York, 1997.

McIntyre, Margaret. *Early Childhood and Science*. National Science Teachers Association, Washington D.C., 1984.

National Science Education Standards. National Academy Press, Washington, D.C., 2001.