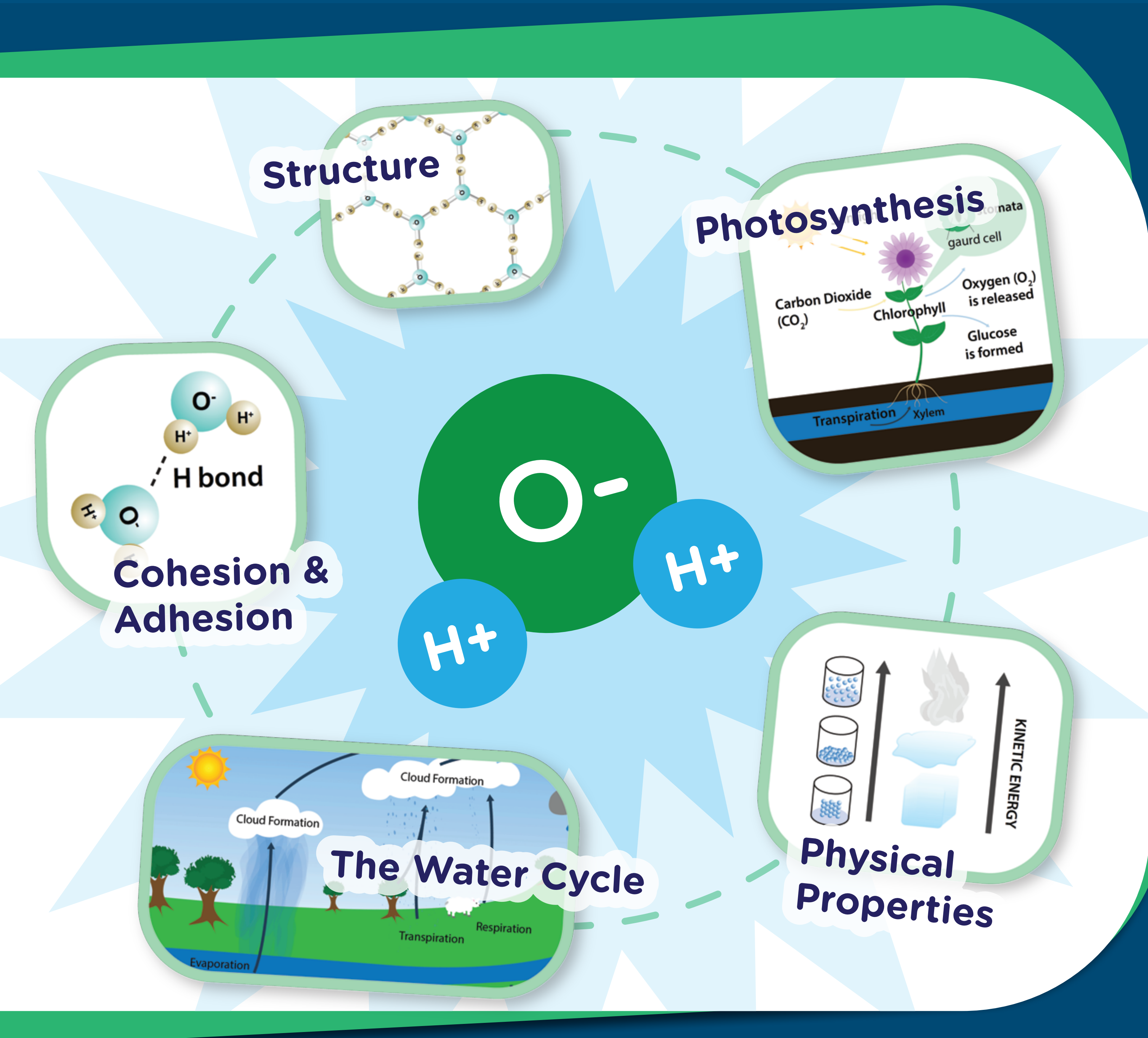
Intro to H_2O

4th Grade



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Intro to H2O

** Has an Answer Sheet*

Density and Water

Vocabulary	
density	atoms
mass	molecules
volume	

Density is the amount of particles or atoms packed into a substance. The more tightly packed together the particles are, the denser the substance is.

Density shows the relationship of an object's **mass** to its **volume**. In other words, density refers to how many particles or atoms fit into a space. The more atoms in the space, the denser the substance is.

If you have two objects of the exact same size (volume), the denser object will have a greater mass than the less dense object.

There are two things contributing to density:

- The mass of the **atoms** or **molecules** that makes up the material.
- The volume or amount of space the material takes up.

If the molecules or atoms are packed tightly, the substance will be denser.

The density of water is 1 gram per milliliter or 1 gram per cm^3.

Let's experiment so we can see how density works!

Will a can of regular soda sink or float in a tank of water? Will a can of diet soda sink or float in the same tank of water?

Supplies

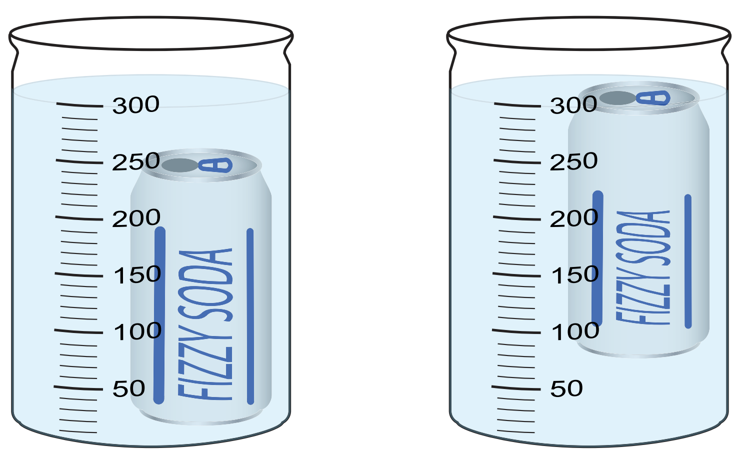
- 1 clear tank or bucket of water filled ¾ of the way to the top (it must be deep enough to submerge the soda can)
- 1 can of diet soda
- 1 can of regular soda of the same brand

Make a Prediction

What do you think will happen when you place the two soda cans in the bucket of water?

Directions

1. Examine the ingredients on the side of each can.
2. Note the volume of soda in each can.
3. Gently place the can of regular soda into the bucket of water.
4. Gently place the can of diet soda into the bucket of water.



Questions

1. What happened?

2. Why do you think this happened? (Hint: look at the nutritional values on each of the cans of soda.)

3. Can you think of where you might have seen something like this happen before?

Objects less dense than water float, and those denser than water sink.

The main difference between the two cans is the amount of sugar in the soda. The regular soda contains many sugar molecules. In fact, most regular cans of soda have about 39 grams of sugar. This makes the regular soda denser than water, causing it to sink. (Thirty-nine grams equal about 10 packets of sugar!)

Now let's check out the ingredients on the diet soda can.

The diet soda has aspartame in it. Aspartame is an artificial sweetener. Aspartame is concentrated, and only a small amount is needed to give something a sweet taste.

All things equal (including the can), there are many more molecules packed into the can of regular soda than the diet soda.

Review Questions

1. Can two objects with the same volume have different masses?

2. What two things does density depend on?

3. What do you think it means when an area is densely populated?

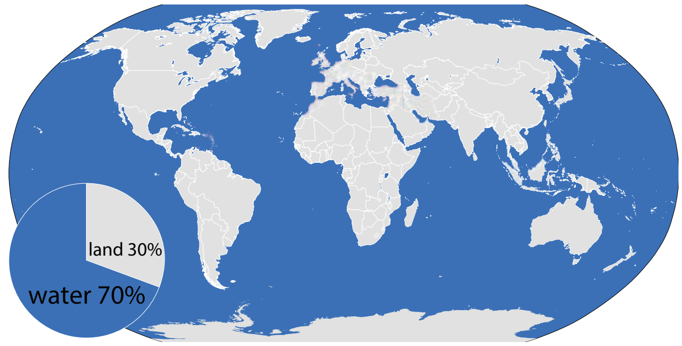
4. Fill in the definitions in the vocabulary box.

Vocabulary	
density	
mass	
volume	
atom	
molecule	

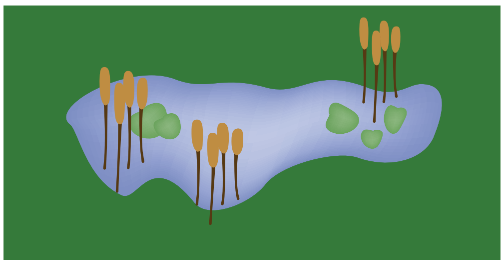
Fresh Water versus Salt Water Density

Vocabulary	
fresh water	salinity
brackish water	density
salt water	

Water takes up more than 70% of the Earth's surface. It's categorized into two groups: fresh water and salt water.



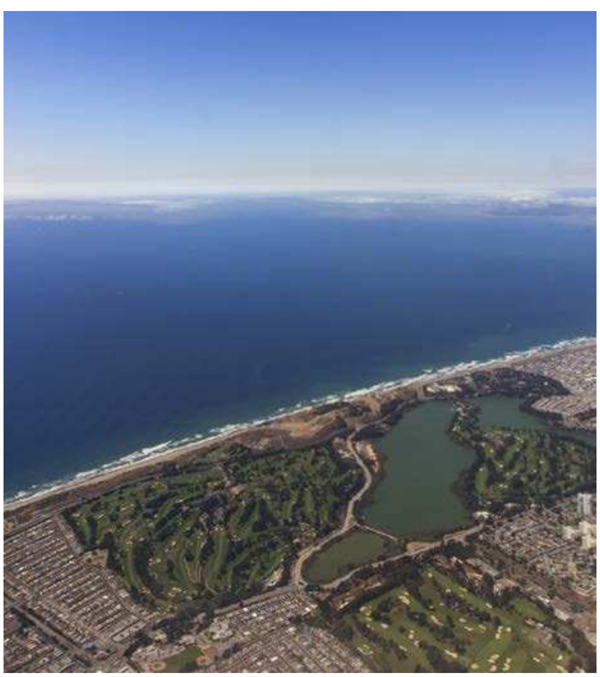
Fresh water is naturally occurring and can be found in ponds, lakes, rivers, streams, and the ground. It's characterized by having low concentrations of salts. Most fresh water comes from precipitation from the atmosphere in the form of rain and snow.



In coastal areas, windy conditions can sweep up drops of seawater into clouds that later deposit them into freshwater areas. This can elevate the levels of salts in freshwater areas.

When fresh water meets with seawater, as in an estuary, brackish water occurs. **Brackish water** is saltier than fresh water but less salty than seawater.

Ocean water typically contains 3.47% salt, depending on where you measure it. Most of the salt in the oceans came from the land. Over millions of years, as waters washed over the rocks on land, the salts contained in rocks have leeched out and been carried away to the seas. Undersea volcanoes have also contributed to the salt content in the seas. When water evaporates from the oceans, it leaves behind the salt, and over millions of years, the oceans have developed a higher concentration of salt than fresh water.



So, **salt water** is denser than fresh water. The salts add mass to the water in which they are dissolved. This produces a greater mass or a greater density. There are more atoms in salt water than in the same amount of fresh water. The amount of salt dissolved in water is called **salinity**.

What Happens When Fresh Water Meets Salt Water?

Concepts

- Water forms layers due to its different densities.
- Denser water with more dissolved salts sinks to the bottom.
- Water with the least amount of dissolved salts (less dense) usually forms the top layer.

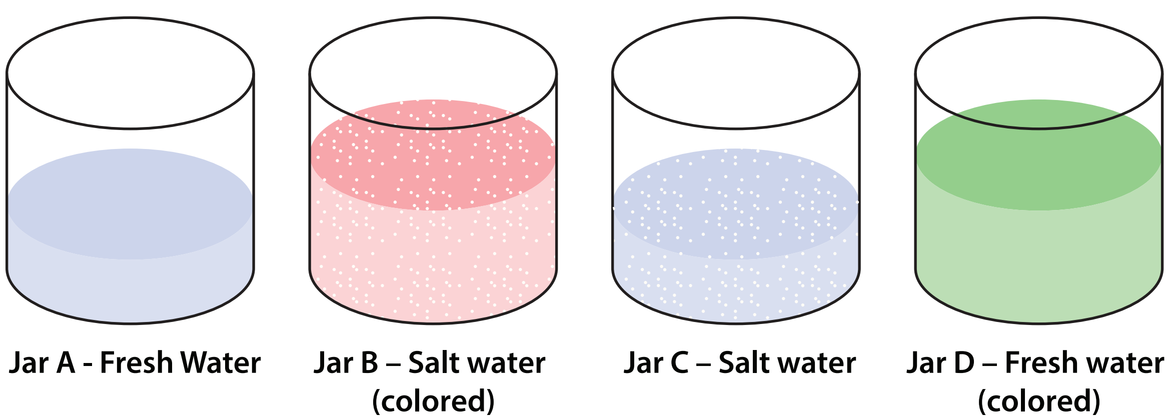
Let's investigate what happens when fresh water meets salt water.

Materials

- 1 gallon of fresh water (you can use store-bought spring water or tap water)
- 1 gallon of salt water – water with 1 cup of salt added
- 4 clear jars – it helps to label them A, B, C, and D
- 1 bottle of food coloring
- 2 siphons – clear tubes that you can get from the fish section of a pet store

Procedure

1. Make one gallon of salt water the day before by adding 1 cup of salt to a gallon of water and mixing well. Make sure you label the gallon, and then let it sit.
2. Think about what could happen when salt water meets fresh water. Write your hypothesis on the back of this sheet.
3. Fill one jar ⅓ full of fresh water (Jar A). Fill a second jar halfway with salt water and add a few drops of food coloring to it (Jar B).
4. Start a siphon by filling a plastic tube with colored water and keeping the colored salt water jar (Jar B) higher than the fresh water jar (Jar A). A colored salt solution layer will soon form.
5. Fill a third jar ⅓ full of clear salt water (Jar C). Fill the last jar halfway with fresh water and add a few drops of food coloring to it (Jar D).
6. Start a siphon by filling a plastic tube with colored water and keeping the fresh water jar (Jar D) higher than the salt water jar (Jar C). Colored fresh water will form a separate layer.
7. Record your observations and discuss it with a friend or family member.



Questions

1. How many layers formed? ____________________
2. Which layer is salty? ____________________
3. Are the layers completely separated? What happens where they meet? ____________________
4. Draw the results of the demonstration.

Review Questions

1. What is the difference between fresh water and salt water?

____

2. Why is salt water denser than fresh water?

____

3. What happens when fresh water meets salt water? What type of water is this called?

____

4. Fill in the definitions in the vocabulary box below.

Vocabulary	
fresh water	
brackish water	
salt water	
salinity	
density	

What's the Matter?

Vocabulary	
matter	quantitative
mass	qualitative
physical properties	chemical properties
property	

Matter is anything that takes up space and has mass. **Mass** is the *stuff* that matter is made of, or the amount of particles in a substance or object. Matter has physical and chemical properties and can undergo physical and chemical changes.

What are some examples of matter? Well, just look around you and everything you see, touch, smell, and breathe are examples of matter.

What is a **property**?

A property describes how an object looks, feels, or acts. Properties can be physical or chemical. Properties can also be quantitative or qualitative. A **qualitative** property of matter is observed and generally can't be measured with a numerical result. A **quantitative** property of matter is one that can be measured numerically, such as height, length, or weight.

What are examples of **physical properties**?

Physical properties can be observed. Examples of physical properties can be color, weight, volume, size, shape, density, boiling point, or freezing point.

What are examples of **chemical properties**?

A chemical property is usually one that can only be seen when a substance undergoes a chemical change. These properties cannot be observed by touching or looking. Chemical properties become apparent when the structure of the substance is altered chemically.

An example of this would be adding baking soda and vinegar and watching it bubble and give off a gas. The bubbling is an indicator that the properties of the two initial ingredients have recombined to form a new substance or substances.

substance AB +substance CD → new substance AD + new substance BC

A simple equation of what happens when you add baking soda to vinegar:

baking soda (solid) + vinegar (liquid) → carbon dioxide (gas) + water (liquid)

What is a **chemical change**?

A **chemical change** is a change that results in a new substance (or substances) being formed. The important word to remember is ***new***. A chemical change involves the making or breaking of bonds between atoms. A chemical change makes a new substance that wasn't there before.

What are examples of chemical changes?

Some examples of chemical changes are nails rusting over time, batter turning into a cake in the oven, wood or paper burning to ashes, the digestion of food, and the baking soda and vinegar example above.

What is a **physical change**?

A **physical change** is a change in a state of matter. For example, when ice melts, the H_2O molecule is going from a solid (ice) state to a liquid (water) state of matter. The actual molecule or the arrangement of the atoms has not changed—just its state of matter. A physical change can also be a change in appearance of matter. For example, a piece of paper is made of paper molecules, and when you tear the piece of paper in half, both halves are still made of paper molecules. The atoms and molecules that make up the substance are not physically changed.

Physical or Chemical Change?

Put a check to indicate whether you think the item is a physical change or a chemical change.

	Physical Change	**Chemical Change**
1. ice melting		
2. cutting a pineapple into pieces		
3. adding vinegar to baking soda		
4. a piece of rusting metal		
5. a campfire		
6. crumbling a piece of paper		
7. sour milk		
8. shattering a drinking glass		
9. dissolving sugar in water		
10. burning paper		
11. boiling water		
12. burning a match		

Try This Experiment

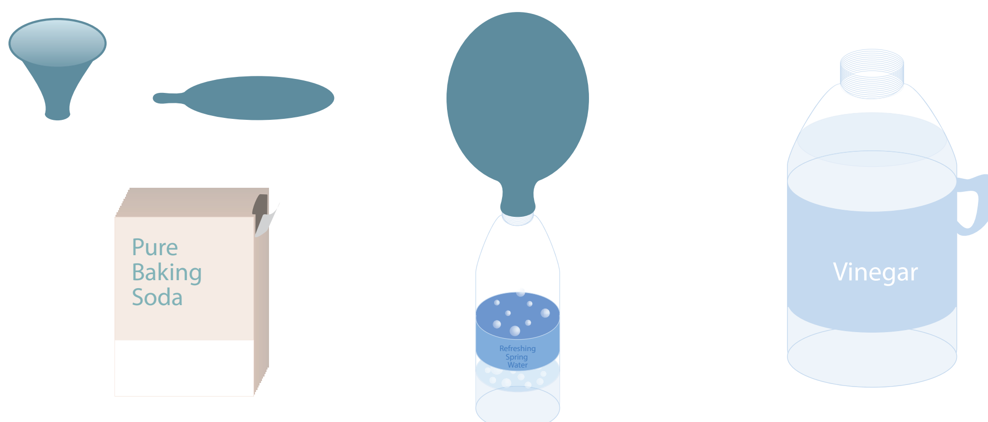
How do you know that a gas is produced as a result of mixing baking soda and vinegar?

Materials

- ¼ cup (56 grams) of baking soda
- ¼ cup (60 milliliters) of vinegar
- 1 small, empty water bottle
- 1 balloon
- 1 funnel

Procedure

1. Stretch the balloon out before using it.
2. Using the funnel, fill the balloon with the baking soda.
3. Pour the vinegar into the empty water bottle.
4. Attach the opening of the balloon to the mouth of the water bottle—be careful not to get any baking soda into the bottle.
5. Count to three and lift up the part of the balloon that contains the baking soda so that the baking soda falls into the bottle.



Questions

1. What are the physical properties of the baking soda?

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2. What are the physical properties of the vinegar?

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3. What happened inside the water bottle when you added the baking soda to the vinegar? What did you see in the bottle?

4. Did anything happen to the balloon? If so, what do you think caused it?

5. What type of change occurred inside the bottle when you added the baking soda to the vinegar?

6. Fill in the definitions in the vocabulary box below.

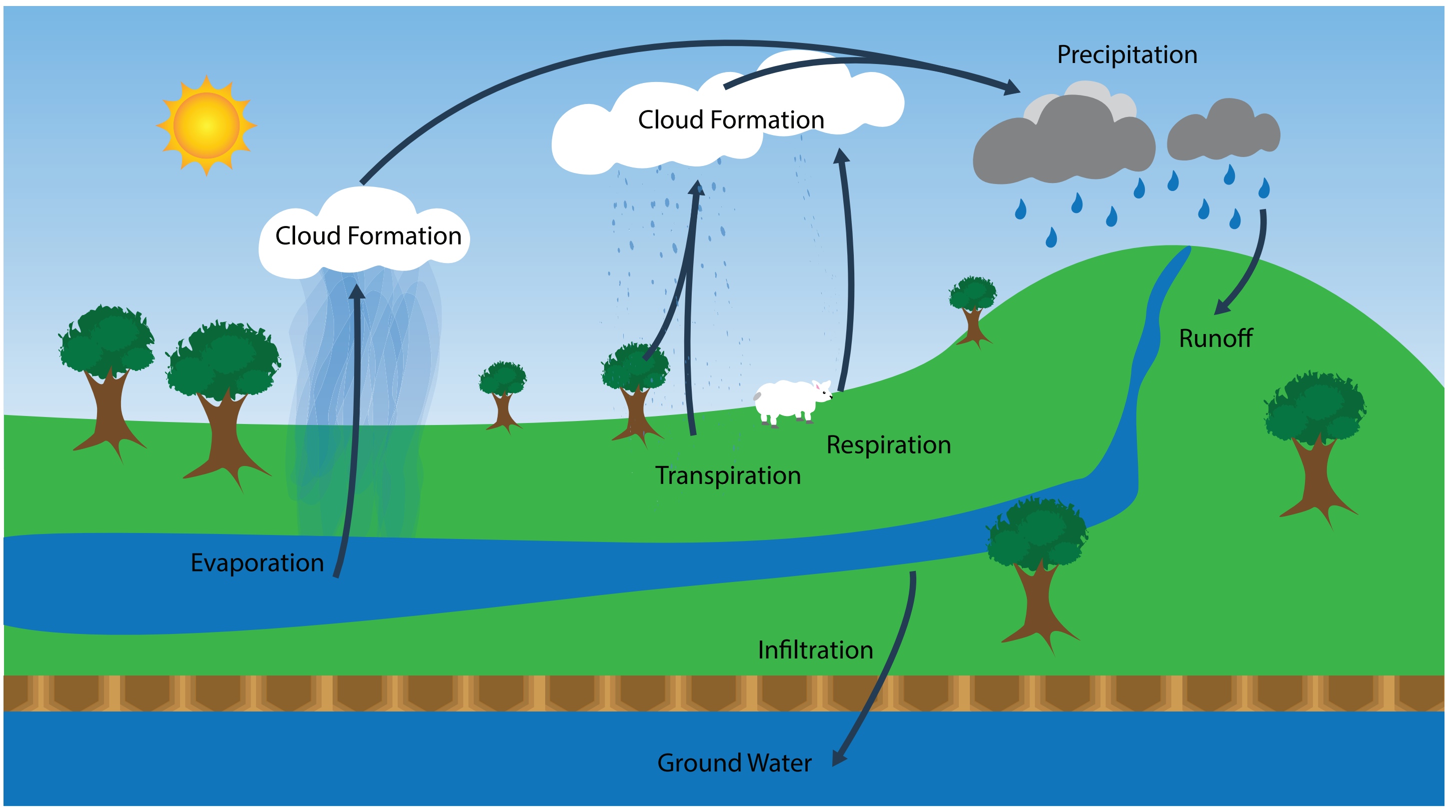
Vocabulary	
matter	
mass	
property	
qualitative	
quantitative	
physical change	
chemical change	

The Water Cycle

Vocabulary	
evaporation	transpiration
condensation	respiration
precipitation	runoff
ground water	molecule

Our bodies are made of 70% water. It is vital for all life on Earth. Almost 75% of the earth's surface is covered with water. Water is everywhere. The same water that existed on the earth millions of years ago is still present today. This is due to the water cycle. Earth's waters are constantly moving and changing from one state to another. The water cycle has been working for millions of years.

The major processes of the water cycle are evaporation, condensation, and precipitation. The sun drives the water cycle. The sun heats the waters of the oceans, causing them to change from a liquid to a gas or water vapor. The heat energy breaks apart the bonds connecting the liquid water molecules and they easily slip into the atmosphere. This process is called **evaporation**.



Condensation is the opposite of evaporation. It is the process where water vapor in the atmosphere is changed back into liquid water. As water vapor moves to the upper atmosphere, it begins to cool off. Clouds form when the rising air and water vapor cool off and clump together. It takes millions of water vapor molecules to form a droplet of water that weighs enough to fall to the ground. When enough of these drops form, they fall to the ground in the form of rain, sleet, or snow. This process is called **precipitation**.

Transpiration and **respiration** also contribute to the water cycle. Transpiration is the release of water from plants. Water is carried from the roots of the plant throughout the plant to the underside of the leaves where it evaporates off into the atmosphere. Animals also release water vapor to the atmosphere when they breathe out. This is called **respiration**.

The earth stores some of the water that falls to the ground. It infiltrates the ground and moves horizontally into streambeds or vertically until it meets the water table. This is called **ground water**. Precipitation can also run off the surface of the land as it flows down hills into ponds, lakes, and streams. This is called **runoff**.

Review

The Word Starts with This Letter	Hint	Answer
C	the process where water vapor in the atmosphere is changed back into liquid water	
W	a substance that is very important to living things and covers almost 75% of the Earth's surface	
R	water that flows downhill into streambeds	
WC	the Earth's waters are constantly changing from one state of matter to another	
P	water droplets that fall from the sky	
S	the energy source that drives the water cycle	
C	formed in the atmosphere when water vapor cools	
E	when energy from the sun causes liquid water to change into water vapor	
R	when animals release water vapor to the atmosphere	
G W	water that infiltrates the ground	

Questions

1. What does it mean when a glass "sweats"?

2. What is dew?

3. What happens to the dew during the day?

Let's make a cloud!

Cloud in a Bottle

Materials

- 1- or 2-liter bottle
- Warm water
- Match

Procedure

1. Fill the bottle ⅓ full of warm water.
2. With a grownup, light the match and place the head of the match inside the bottle.
3. Let the bottle fill with smoke.
4. Put the cap on the bottle.
5. Squeeze the bottle hard a few times. When you release the bottle, you'll see a cloud form inside the bottle!

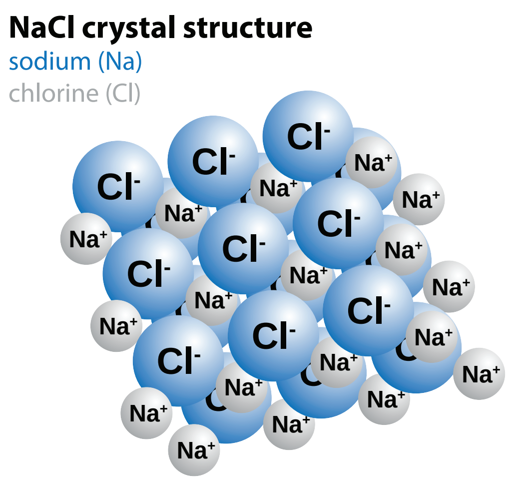
The Chemistry of Water

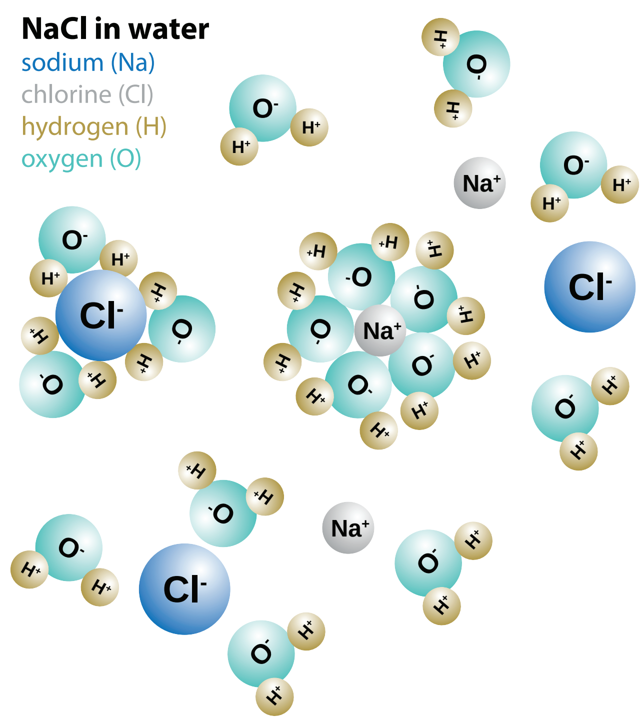
Vocabulary	
solvent	atom
molecule	bond

Water is called the universal **solvent**. It is called this because more substances dissolve in water than in any other chemical. A **molecule** of water is made up of two hydrogen **atoms** and one oxygen atom. An atom is the basic unit of a chemical element. The hydrogen and oxygen atoms of a water molecule are held together by **bonds**. In the configuration of a water molecule, the two hydrogen atoms occur on the same side of the oxygen atom. The hydrogen atoms create a positive electrical charge while the oxygen atom creates a negative charge.

When water molecules orient towards each other, they arrange themselves so that positive and negative charges meet. Since opposite electrical charges attract, water molecules tend to attract each other. This makes the water molecules clump or "stick" together and form drops or beads on smooth surfaces.

The electrical charges of the water molecule cause it to be a good solvent—a substance that allows other substances to become part of it. Look at the picture below. It shows how the NaCl (table salt) molecule breaks apart when mixed with water. The positive Na (sodium) atom is attracted to the negative O (oxygen) atom, and the negative Cl (chlorine) atom is attracted to the positive H (hydrogen) atoms.





Review Questions

1. How many atoms are in a water molecule?

2. Draw a picture of a water molecule.

3. Describe the structure of a water molecule.

4. How do water molecules form droplets of water?

5. Why is water called the universal solvent?

6. Explain how NaCl or table salt dissolves in water.

7. Write the definitions of the following words.

Vocabulary	
solvent	
molecule	
atom	
bond	

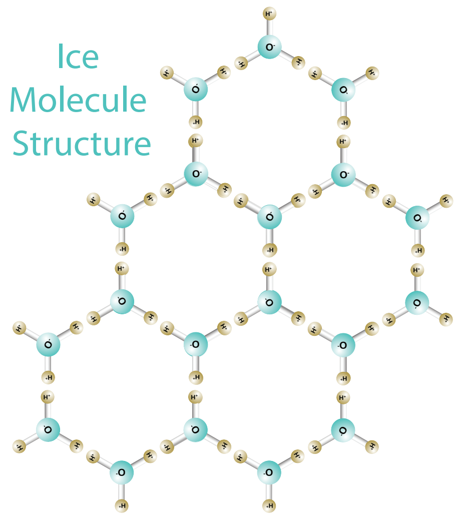
Physical Properties of Water

Vocabulary	
specific heat	coolant
kinetic energy	

Water is the only natural substance that is found in all three states: solid (ice), liquid, and gas (steam). It **boils** at 212°F or 100°C and **freezes** at 32°F or 0°C. Water has a high **specific heat** index. Specific heat is the amount of energy required to change the temperature of a substance. Water can absorb a lot of heat before it begins to get hot, which is why the sand at the beach always feels hotter than the ocean water. Land absorbs heat faster than water.

Water's high specific heat index makes it valuable, especially to manufacturing companies. It is used as a **coolant** because it can absorb a lot of heat before it begins to get hot. Water can move over heated elements in a factory, absorbing the heat from machines. In a car, water is a coolant in the radiator that absorbs heat put out by the engine.

Ice Molecule Structure



When water molecules make a change in phase or state, their molecules rearrange themselves into different patterns. In the liquid phase, water molecules are closer together with no regular arrangement. The particles of a liquid vibrate, move about, and slide past each other. A solid has tightly packed particles that are usually in a regular pattern. There is very little vibration or movement of the particles of a solid. In the gaseous phase, water molecules are widely spaced apart and very active with no regular arrangement. Generally, as the temperature rises, matter moves to a more active state. This movement of molecules is called **kinetic energy.**

Most substances are the densest in their solid form. However, water is different. Solid water, or ice, floats on top of liquid water. Why is this? In order to float on water, a substance must be less dense than water. When ice is formed, the water molecules are tightly packed together, preventing them from changing shape. Ice has a regular pattern with the molecules held rigidly apart by their bonds. This causes ice to form a crystalline lattice structure. These crystals have many open spaces throughout their structure, making ice less dense than liquid water.

	Gas	Liquid	Solid
particle arrangement	well separated — no regular arrangement	close together — no regular arrangement	tightly packed — a regular pattern
shape	assumes the shape of its container - no shape	assumes the shape of its container - no shape	retains a fixed volume and shape
kinetic energy — movement	very active	slide past each other	rigid
fluid	fluid — flows easily	fluid — flows easily	not a fluid — does not flow easily
volume	volume of container	fixed volume	fixed volume

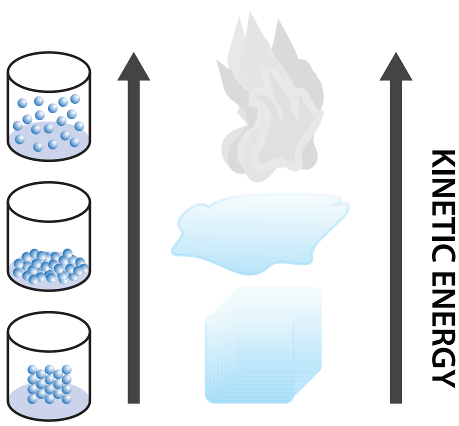
Questions

1. Why does water's high specific heat make it a good coolant for car radiators?

2. Which state of matter has the most kinetic energy? the least kinetic energy?

3. How does heat affect water and its state of matter?

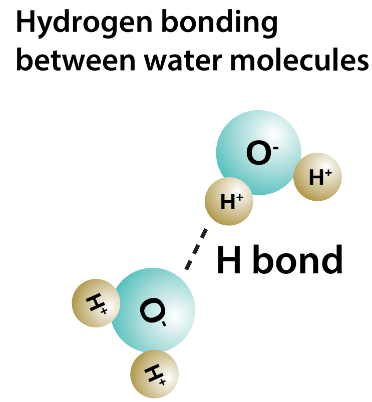
4. What is the picture below showing? Please explain.



5. Fill in the definitions of the vocabulary words.

Vocabulary	
specific heat	
kinetic energy	
coolant	

Roll or Slide?
Cohesion and Adhesion of Water



The bonds that connect water molecules are special types of bonds called **hydrogen bonds**. These are weak bonds and connect water molecules in the liquid state.

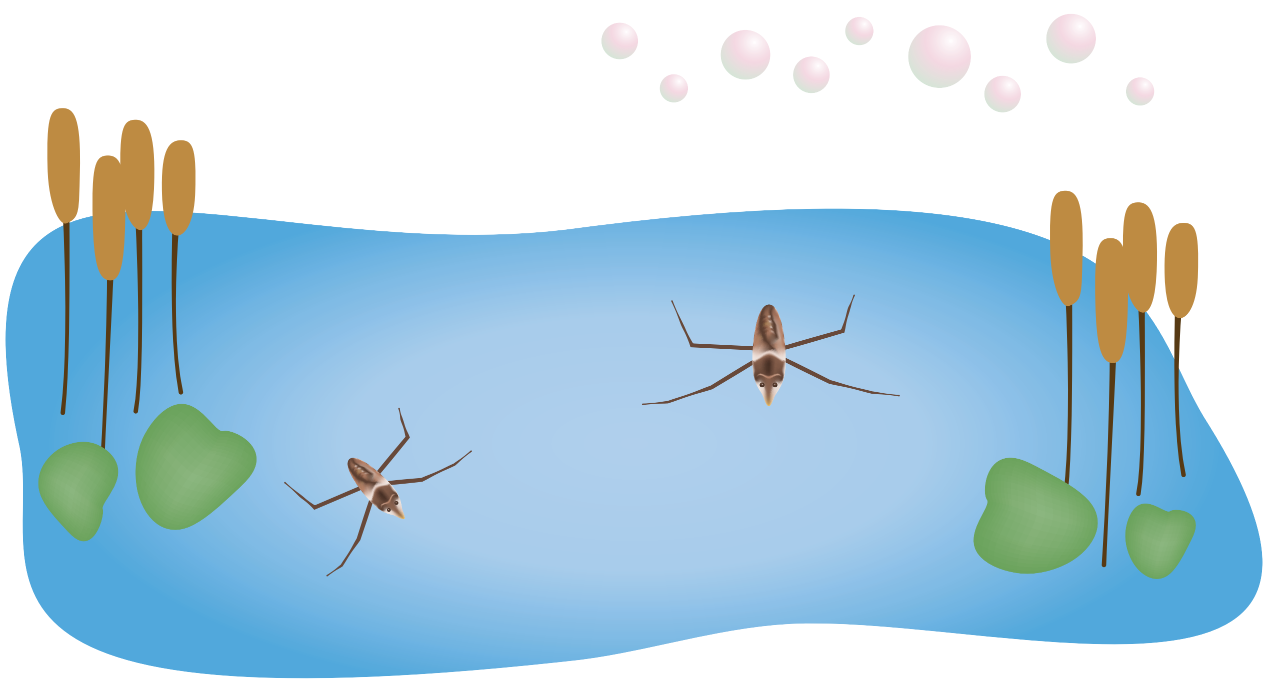
The hydrogen bonds between water molecules are the reason for two of water's unique properties: **cohesion** and **adhesion**. Cohesion refers to water molecules easily sticking to other water molecules. Adhesion refers to water molecules sticking to other things, which is why water forms a thin film and spreads out on surfaces such as glass.

When water comes into contact with surfaces such as glass or wax paper, the adhesive forces are stronger than the cohesive forces. Instead of the droplets sticking together in a ball or sphere, they spread out.

Water molecules in a glass of water are attracted to each other on all sides by cohesion. The molecules at the surface of the water in the glass are not exposed to other water molecules on all sides. They are exposed to air on the top. This causes them to form a stronger attraction to the water molecules on the sides of them and below them. Because of this stronger attraction, the surface of the water acts like a film. This film becomes somewhat visible when you fill a glass with water to the very top. This "film" is called surface tension.

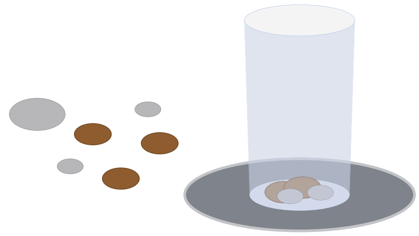
Some examples of surface tension are:

- Small insects whose mass is not great enough to penetrate the water surface will be able to walk on water.
- Soaps and detergents help to lower the surface tension of water while washing clothes, allowing the water to more readily soak into the pores of dirty areas.
- A carefully placed sewing needle can be made to float on the surface of water even though it is several times denser than water.
- The mixture of water and other ingredients in bubbles minimizes the tension between molecules, allowing them to be pulled into a spherical shape.



Try this!

Materials



- Glass of water
- Saucer
- A bunch of coins

1. Place the glass on the saucer.
2. Fill the glass of water all the way to the top. The water will form a slight dome over the top of the glass and not spill over.
3. Now, add one coin at a time to the glass, slowly slipping the coin in on the rim.

Guess how many coins you can add to the glass before the water starts to overflow!

What's the science behind it?

The glass was initially filled to the brim without the water spilling over. This is because the surface tension holds the water molecules together and prevents them from spilling down the side of the glass. As coins are added, the surface begins to bulge. Eventually, the coins push the water level too high for the surface tension to hold it in place and the water spills over.

How Many Drops of Water Can Fit on a Penny?

Now let's try something that interferes with the cohesion of water.

Materials

- A clean penny
- Paper towel
- Dropper
- Water
- Liquid soap
- Tweezers

Directions

1. Place a penny on a piece of paper towel.
2. Use the dropper to place one drop of water at a time on the penny.
3. Count the drops as you go along.
4. Stop adding drops when any water runs over the edge of the penny.
5. Repeat steps 1-4 three more times and fill in the number of drops on the chart.
6. Calculate the average when you are finished.

No Soap	Trial 1	Trial 2	Trial 3	Trial 4	Average

7. Using a pair of tweezers, dip the penny into the liquid soap.
8. Repeat steps 1-4 four times and fill in the number of drops on the chart. Dip the penny in liquid soap before beginning each trial.

Soap	Trial 1	Trial 2	Trial 3	Trial 4	Average

Questions

1. Compare the results from the trials with soap and without soap.

2. Explain your results in terms of cohesion and surface tension.

3. How does adding soap to a penny affect how many drops can fit on it?

Roll or Slide?

From this simple, one-step experiment, we'll see cohesion in action.

Materials

- Dropper
- Water
- Wax paper

Directions

1. Drop 4 drops of water on a piece of wax paper. Try to put one drop directly on top of another.

Questions

1. What happens to the droplets of water?

2. What shape do they take on?

3. Do they move across the wax paper?

4. Is this an example of cohesion or adhesion?

5. If you keep adding more drops of water, the sphere will eventually flatten out. What force causes the sphere to flatten out?

Water's Part in Photosynthesis

Vocabulary	
photosynthesis	stomata
chlorophyll	guard cells
chloroplast	transpiration

Photosynthesis is the process in which plants use water, sunlight, and carbon dioxide (CO_2) to make food for themselves. Plants, algae, and certain bacteria contain a compound called **chlorophyll**—it is the pigment that gives plants their green color. This compound is located in the **chloroplast** of plant cells. Chlorophyll absorbs sunlight and uses its energy to make food carbohydrates from CO_2 and water. This food is called **glucose**. In the process of making food, plants give off or release oxygen (O_2) to the atmosphere.

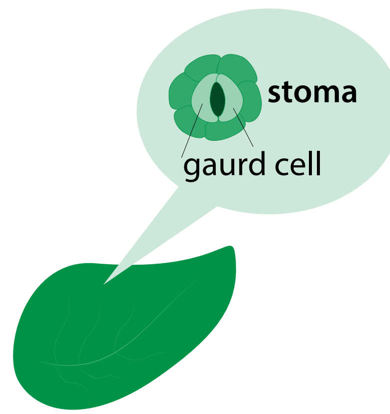
The equation for the process of photosynthesis is:

$$\text{Sunlight} + 6CO_2 + 12H_20 \text{ --> } C_6H_{12}O_6 + 6O_2 + 6H_2O$$

Humans breathe out CO_2 during respiration, and plants use this in the process of making food for themselves. In turn, plants give off O_2 during this process, and the O_2 is breathed in by humans.

Water's Involvement

Water (H_2O) enters the plant through its roots via a special plant tissue called **xylem**. The xylem carries the water up to the leaves. The leaves have specialized structures called **stomata** that allow CO_2 to pass into the leaf. A pair of **guard cells** surrounds the stoma (the singular term for stomata). The guard cells control the opening and closing of the stoma. The stomata also allow O_2 to pass out. While these gases are moving in and out of the leaf, a great deal of water is also lost. This loss of water is called transpiration.



Transpiration is the process in which water travels from the roots of the plant, through the plant, and to the leaves. Water is lost through the stomata of the leaves. The guard cells contract and expand depending on the circumstances of the plant.

During the night, the stomata close because without the sun, there's no demand for CO_2 for photosynthesis. Transpiration rates vary depending on weather conditions. The more humid it is, the less a plant will transpire. The drier the atmosphere, the greater the transpiration rate will be. It's easier for water to evaporate into drier air than into humid air. Warmer air holds less moisture so the transpiration rate will increase in higher temperatures. When stomata are open, transpiration rates increase; when they are closed, transpiration rates decrease.

Since animals and humans obtain their food by eating plants, photosynthesis is also the source of our lives.

Questions

1. Draw a picture on the back of this paper of photosynthesis and label the parts: plant, sunlight, CO_2, O_2, transpiration, xylem, stomata, and guard cell. Use arrows to indicate whether a gas and/or water vapor is entering or leaving the plant leaf.

2. What are the ingredients used to make glucose for plants?

3. What is the name of the pigment that absorbs sunlight in plant cells?

4. What is the function of xylem?

5. What causes stomata to open?

6. What causes the rate of transpiration to increase in a plant?

7. Fill in the definitions for these vocabulary words.

Vocabulary	
photosynthesis	
chloroplast	
chlorophyll	
glucose	
xylem	
stomata	
guard cells	
transpiration	

Great job!

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Answer Sheets

Intro to H2O

Answer Sheet

Answers

1. What happened?

The can of regular soda will sink to the bottom of the bucket.

The can of diet soda will float in the bucket of water.

2. Why do you think this happens? (Hint: look at the nutritional values on each of the cans of soda.)

This happens because the regular soda has a lot of sugar that increases the mass of the soda while the volume stays the same.

3. Can you think of where you might have seen something like this happen before?

You may have seen a situation similar to this at a picnic or a party. If you look at the contents of a cooler after the ice has melted, you will notice that the diet sodas are floating on the top of the water and the regular sodas are at the bottom of the cooler.

Objects less dense than water float, and those denser than water sink.

The main difference between the two cans is the amount of sugar in the soda. The regular soda is made up not only of the soda molecules but also of sugar molecules. In fact, most regular cans of soda have about 39 grams of sugar. This makes the regular soda denser than water, causing it to sink. (Thirty-nine grams equal about 10 packets of sugar!)

Now let's check out the ingredients on the diet soda can.

The diet soda has aspartame in it. Aspartame is an artificial sweetener. Aspartame is concentrated, and only a small amount is needed to give something a sweet taste.

All things equal (including the can), there are many more molecules packed into the can of regular soda than the diet soda.

Answer Sheet

Review Answers

1. Can two objects with the same volume have different masses?

Yes, our two soda cans are an example of this scenario. If both cans are placed on a scale, the regular soda will weigh more (due to the sugar) than the diet soda, yet the cans take up the same amount of space and contain the same amount of soda.

2. What two things does density depend on?

Mass and volume.

3. What do you think it means when an area is densely populated?

There are a lot of people living in that particular area.

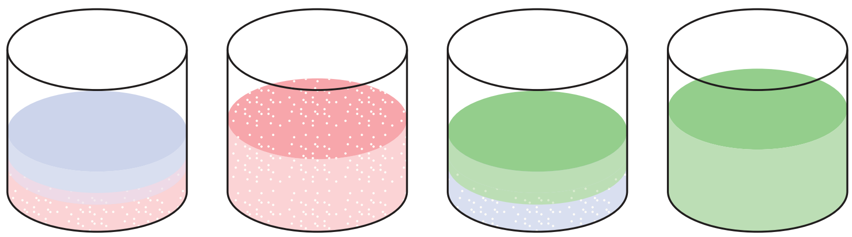
4. Fill in the definitions in the vocabulary box.

Vocabulary	
density	How close together the molecules of a substance are.
mass	Mass is a measure of the number of **atoms** in an object.
volume	The amount of space something takes up.
atom	The basic building block of all matter.
molecule	Two or more atoms attached together.

Answer Sheet

Answers

1. How many layers formed? *2 layers*
2. Which layer is salty? *the bottom layer*
3. Are the layers completely separated? What happens where they meet? *they mix*
4. Draw the results of the demonstration.



Jar A - Fresh Water | Jar B – Salt water (colored) | Jar C – Salt water | Jar D – Fresh water (colored)

Review Answers

1. What is the difference between fresh water and salt water?

Fresh water is naturally occurring with only a small amount of salt. Salt water contains over 3.47% dissolved salts.

2. Why is salt water denser than fresh water?

Salt water is denser than fresh water because the extra salt results in a greater mass.

3. What happens when fresh water meets salt water? What type of water is this called?

When fresh water meets salt water, they mix and this is called brackish water.

4. Fill in the definitions in the vocabulary box below.

Vocabulary	
fresh water	Fresh water is naturally occurring **water** with low salt levels.
brackish water	When fresh water meets with ocean or seawater, as in an estuary, brackish water occurs.
salt water	Water containing 3.47% or more of dissolved salts.
salinity	The amount of salt dissolved in water.
density	The amount of particles in a given substance or space. Density = mass/volume

Answer Sheet

Answers with explanations

	Physical Change	Chemical Change	Explanation
1. ice melting	√		This is a physical change because H_2O is changing from a solid state to a liquid state. The H_2O molecule remains the same, just in a different state of matter.
2. cutting a pineapple into pieces	√		This is a physical change. The molecules that make up the pineapple are not being changed—just their size is being changed.
3. adding vinegar to baking soda		√	This is a chemical change because a new substance is being produced—the carbon dioxide gas and atoms are being rearranged.
4. a piece of rusting metal		√	This is a chemical change because the iron in the nail is being changed into a new substance: rust.
5. a campfire		√	This is an example of a chemical change because the burning wood is being changed into new substances: smoke and ash.
6. crumbling a piece of paper	√		This is an example of a physical change because the paper molecules are the same. The appearance of the paper is the only thing changing.
7. sour milk		√	This is an example of a chemical change because the atoms of the milk have been rearranged to form a new substance: sour milk. You cannot do anything to the milk to get rid of the sour part.
8. shattering a drinking glass	√		This is an example of a physical change because the actual pieces of glass are not being changed. They are just being broken into smaller pieces.
9. dissolving sugar in water	√		This is a physical change because there is NO new substance being formed. When you mix sugar with water, you simply get sugar water.
10. burning paper		√	This is an example of a chemical change because two new substances are formed: smoke and ash.
11. boiling water	√		This is an example of a physical change because the H_2O is changing to another state of matter (liquid to gas). No new substance is formed. The molecules of water are just spaced out more.
12. burning a match		√	This is an example of a chemical change. The match head changes into ash and smoke and you cannot use the match again.

Answer Sheet

Answers

1. What are the physical properties of the baking soda?

White, odorless, solid, crystalline solid.

2. What are the physical properties of the vinegar?

Clear liquid, characteristic smell, acidic taste.

3. What happened inside the water bottle when you added the baking soda to the vinegar? What did you see in the bottle?

Foam and bubbles began to appear. The bubbles indicate that a gas is being formed.

4. Did anything happen to the balloon? If so, what do you think caused it?

As the gas formed, it had nowhere to go so it went up and into the balloon, making it inflate.

5. What type of change occurred inside the bottle when you added the baking soda to the vinegar?

A chemical change.

6. Fill in the definitions in the vocabulary box below.

Vocabulary	
matter	anything that takes up space and has mass
mass	the amount of stuff in a substance
property	how an object looks, feels, or acts
qualitative	a property of matter that can be observed and generally cannot be measured with a numerical result
quantitative	a property of matter that can be measured numerically
physical change	a physical change is a change in a state of matter or appearance
chemical change	a chemical change is a change that results in a new substance(s) being formed

Answer Sheet

Review Answers

The Word Starts with This Letter	Hint	Answer
C	the process where water vapor in the atmosphere is changed back into liquid water	condensation
W	a substance that is very important to living things and covers almost 75% of the Earth's surface	water
R	water that flows downhill into streambeds	runoff
WC	the Earth's waters are constantly changing from one state of matter to another	water cycle
P	water droplets that fall from the sky	precipitation
S	the energy source that drives the water cycle	sun
C	formed in the atmosphere when water vapor cools	condensation
E	when energy from the sun causes liquid water to change into water vapor	evaporation
R	when animals release water vapor to the atmosphere	respiration
G W	water that infiltrates the ground	ground water

Answers

1. What does it mean when a glass "sweats"?

The water vapor surrounding the glass is condensing on the outside of the cooler glass.

2. What is dew?

Dew happens when water vapor close to the ground condenses on cooler surfaces. You usually see dew on grass in the morning.

3. What happens to the dew during the day?

During the day, as the atmosphere heats up, the dew evaporates.

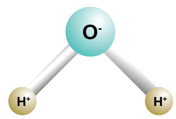
Answer Sheet

Review Answers

1. How many atoms are in a water molecule?

3

2. Draw a picture of a water molecule.



3. Describe the structure of a water molecule.

A water molecule is made of 2 hydrogen (H) atoms and 1 oxygen (O) atom. The 2 hydrogen atoms are on one side of the oxygen atom, causing this side to have a net positive electrical charge and the oxygen side to have a negative charge.

4. How do water molecules form droplets of water?

The opposite sides of the water molecules are attracted to each other.

5. Why is water called the universal solvent?

Water is called a universal solvent because more substances dissolve in water than in any other substance.

6. Explain how NaCl or table salt dissolves in water.

When salt is placed into water, the sodium (Na) separates from the chlorine (Cl). The positive sodium is attracted to the negative oxygen of the water molecule, and the negative chlorine is attracted to the positive hydrogen atoms of the water molecule.

7. Write the definitions of the following words.

Vocabulary	
solvent	a substance that can dissolve (or incorporate) another substance
molecule	2 or more atoms bonded together
atom	the basic unit of a chemical element
bond	attaches atoms to one another

Answer Sheet

Answers

1. Why does water's high specific heat make it a good coolant for car radiators?

Water can absorb a lot of heat before it begins to get hot.

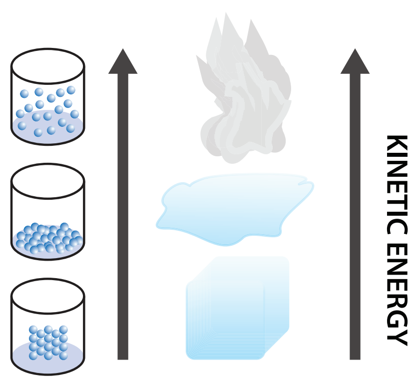
2. Which state of matter has the most kinetic energy? the least kinetic energy?

The gaseous state has the most kinetic energy and the solid state has the least kinetic energy.

3. How does heat affect water and its state of matter?

The greater the heat, the more the molecules move. When there is a little heat, the molecules move a little — liquid. When there is a lot of heat, there is a lot of molecular movement — gas.

4. What is the picture below showing? Please explain.



The picture is showing that the more heat energy added to a system/substance, the more the molecules move, or the greater the kinetic energy.

5. Fill in the definitions of the vocabulary words.

Vocabulary	
specific heat	the amount of energy required to change the temperature of a substance
kinetic energy	energy of motion
coolant	a liquid or gas that removes heat from a substance

Answer Sheet

Answers to: How Many Drops of Water Can Fit on a Penny?

1. Compare the results from the trials with soap and without soap.

More drops can be placed on the penny with no soap.

2. Explain your results in terms of cohesion and surface tension.

On the penny without soap, the water molecules stick together due to cohesion. The surface tension keeps the water from sliding off the penny.

3. How does adding soap to a penny affect how many drops can fit on it?

Because soap reduces the cohesion of water, surface tension decreases and water molecules break apart and can't stay on the penny.

Answers to: Roll or Slide?

1. What happens to the droplets of water?

They stick to each other.

2. What shape do they take on?

Round or sphere.

3. Do they move across the wax paper?

No.

4. Is this an example of cohesion or adhesion?

Cohesion.

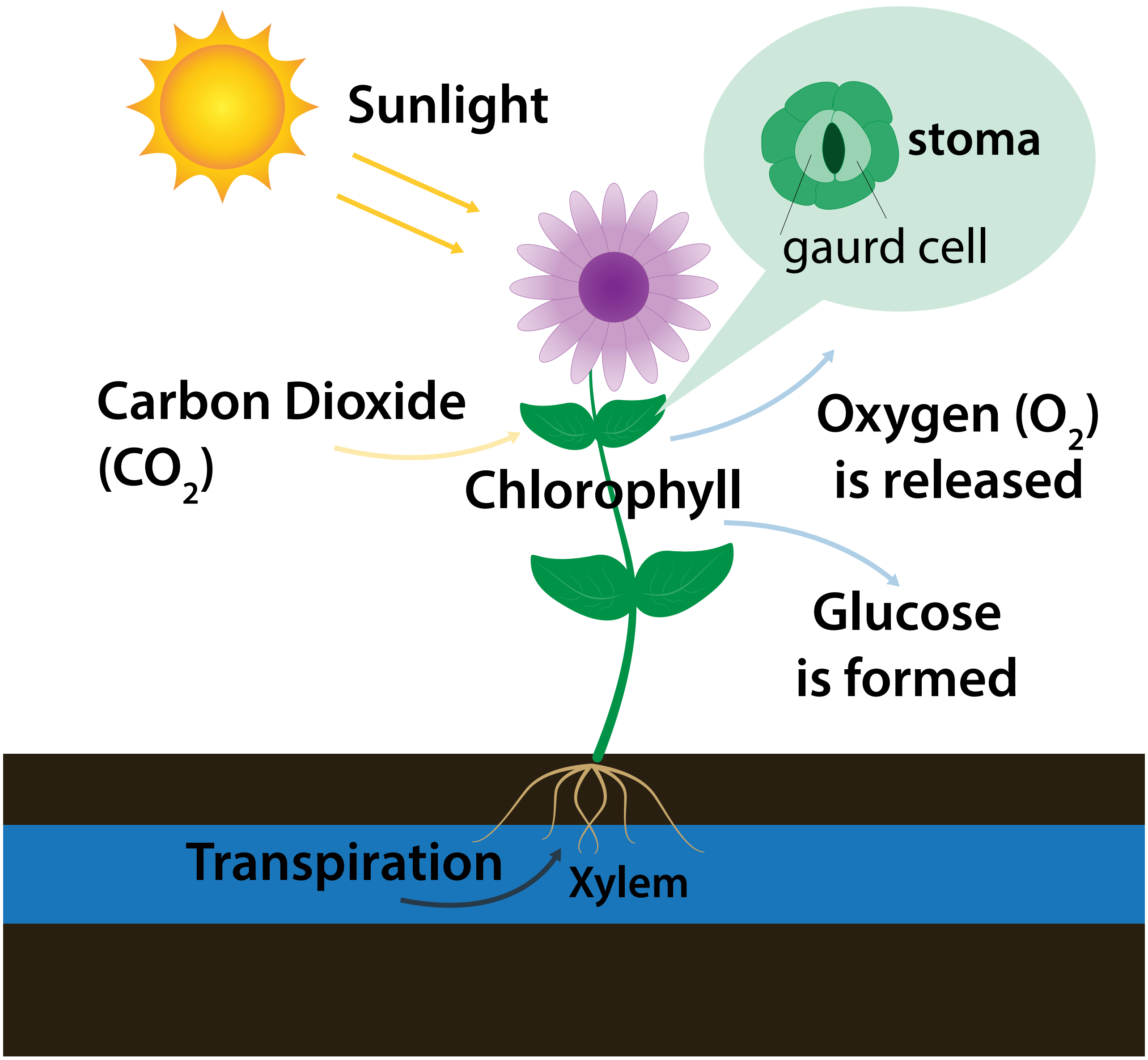
5. If you keep adding more drops of water, the sphere will eventually flatten out. What force causes the sphere to flatten out?

The force of gravity.

Answer Sheet

Answers

1. Draw a picture on the back of this paper of photosynthesis and label the parts: plant, sunlight, CO_2, O_2, transpiration, xylem, stomata, and guard cell. Use arrows to indicate whether a gas and/or water vapor is entering or leaving the plant leaf.



Answer Sheet

2. What are the ingredients used to make glucose for plants?

sunlight + carbon dioxide + water

3. What is the name of the pigment that absorbs sunlight in plant cells?

chlorophyll

4. What is the function of xylem?

Xylem transports water from the roots of a plant through the stem and to the leaves.

5. What causes stomata to open?

Stomata open when the air is warm and dry.

6. What causes the rate of transpiration to increase in a plant?

Transpiration increases when the air is warm and dry, like during the day.

7. Fill in the definitions for these vocabulary words.

Vocabulary	
photosynthesis	the process in which plants use CO_2, water, and sunlight to make food for themselves
chloroplast	the part of the plant cell that contains chlorophyll
chlorophyll	the green pigment in plants that gives them their green color and absorbs sunlight for photosynthesis
glucose	the food produced by plants through photosynthesis
xylem	a plant tissue that carries water from the roots to the leaves of the plant
stomata	structures in the leaf of a plant that allow gases and water to move in and out of the leaf
guard cells	a pair of cells that surround a stoma and allow for the opening and closing of the stoma
transpiration	the evaporation of water from plant leaves