**Section 1: The Kinetic Theory of Matter pages 311-314**

Guiding questions:

What is the kinetic molecular theory of matter?

What is the difference between a real gas and an ideal gas?

What are some characteristic properties of gases?

Objectives to cover:

* State the kinetic-molecular theory of matter and describe how it explains certain properties of matter
* List the 5 assumptions of the kinetic molecular theory of gases. Define the terms ideal gas and real gas.
* Describe each of the following characteristic properties of gases: expansion, density, fluidity, compressibility, diffusion, and effusion.
* Describe the conditions under which a real gas deviates from “ideal” behavior.

Main idea 1 page 311-312 Kinetic molecular theory

Must include the 5 parts of theory (paraphrase them)

-explanation of new vocabulary

Idea: acting out a model of the states of matter. Have the class stand in place and wiggle their arms. Then walk slowly around the room, brushing gently against each other as they do so. Finally, get as far away as possible from one another. Return to their seats and explain how they just demonstrated the three states of matter.

Main idea 2 page 312-314 Physical properties of gases

Demo ideas: diffusion (perfume)

Main idea 3 page 314 Real gases

-review polar and nonpolar molecules (pages 187-197 for reference)

-give a few examples

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Be able to teach and answer these questions:

1. State the kinetic-molecular theory of matter and describe how it explains certain properties of matter
2. List the 5 assumptions of the kinetic molecular theory of gases
3. Describe the arrangement of particles in a gas
4. List properties of gases
5. How does a real gas deviate from ideal gas behavior? What is an example of a gas that acts more ideal? What is an example of a gas that acts more “real”?

**Section 2: Liquids pages 315-318**

Guiding question:

How does the kinetic-molecular theory apply to liquids? (may need to refer to pages 311-312)

Objectives to cover:

* Describe the motion of particles in liquids and the properties of liquids according to the kinetic-molecular theory.
* Discuss the process by which liquids can change into a gas. Define vaporization.
* Discuss the process by which liquids can change into a solid. Define freezing.

Main idea pages 315-317 Intermolecular forces

-need to review the 3 types of IMF (see pages 187-197) Ask me for help if needed

-demo ideas: food coloring in water for diffusion

To understand the kinetic-molecular theory of liquids, create diagrams to show how intermolecular forces are established between the molecules of a liquid. Include an example of each type of intermolecular force mentioned in the text. Provide students with the following three liquids to diagram: HCl (dipole-dipole forces), H2O (hydrogen bonding), and C6H14 (London dispersion forces).

Second part of main idea: evaporation, formation of solids pages 317-318

-demo ideas: hot water in beaker, cover with watch glass

-make sure to discuss movement of particles

Include a simple outline or concept map that illustrates the relationships between evaporation, boiling, and vaporization, and include examples.

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Be able to teach and answer these questions:

1. What are the three types of intermolecular forces? Which are the strongest? Weakest?
2. Describe the arrangement of particles in a liquid
3. List the properties of a liquid
4. List phase changes between liquid and gas, liquid and solid, indicate direction of energy flow, and give an example

**Section 3: Solids pages 319-323**

Guiding questions:

How does the kinetic molecular theory apply to solids?

What are crystalline solids and amorphous solids?

Objectives to cover:

* Discuss the process by which liquids can change into a solid. Define freezing.
* Describe the motion of particles in solids and the properties of solids according to the kinetic-molecular theory.
* Distinguish between the 2 types of solids.
* Define crystal structure and unit cell.

Main idea page 319-321 Solids in fixed positions

-lots of vocab (use pictures/ demos to explain)

Make students aware that melting point and freezing point have the same value for any given material.

Main idea page 321-323 3-dimensional crystal lattice and amorphous solids

-do not need to include the 7 types of crystal structures

-DO need to discuss binding forces in crystals (p. 322-323)

- 4 types of crystal samples: salt, graphite, rock candy, aluminum foil

Both cotton candy and candle wax are amorphous solids.

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Be able to teach and answer these questions:

1. List and describe the 4 types of crystals in terms of the nature of their particles, type of bonding between them, and properties they possess.
2. Describe the arrangement of particles in a solid
3. List the properties of solids
4. List phase change between solid and gas and solid and liquid, indicate direction of energy flow, and give an example
5. Which state of matter has the strongest intermolecular forces acting upon the particles?

**Section 4 Changes of state pages 324-329**

Guiding questions:

How do changes of state establish an equilibrium?

How does vapor pressure affect phase diagrams?

Through what processes do substances change state?

Objectives to cover:

* Explain the relationship between equilibrium and changes of state.
* Interpret phase diagrams
* Explain what is meant by equilibrium vapor pressure
* Describe the processes of boiling, freezing, melting, and sublimation.

A concept map might be helpful here to show the relationships between the states of matter and phase changes that occur between them

Main idea page 324-326 Equilibrium vapor pressure

-It’s important that you explain this thoroughly

Demo: To understand the concept of equilibrium, divide the class so that a few more students are on one side of the classroom than on the other side. Tell one student from each side to exchange places. Then have two students from each side do the same. Point out that the class is said to be in equilibrium because the two opposing changes occur at equal rates. Students should notice that at equilibrium there is a different number of particles (students) on either side. Therefore, an equilibrium can be established without having an equality. Ask the class to upset the equilibrium by having more students move to one side.

Main idea page 326-327 Boiling

-Make sure to explain the definition of boiling

-Boiling point is dependent on atmospheric pressure (look at graphs page 326-327)

-Boiling point is constant temp (that’s why we can use it to identify unknown liquids)

-Make sure to include that this process is absorbing energy

at high elevations, where atmospheric pressures are lower than at sea level, a cooking liquid boils at a lower temperature and foods take longer to cook

Main idea page 327-329 Solidification

-Make sure to include which process is losing heat to surroundings (molecules SLOW down) and which are absorbing heat from surroundings (molecules speed up)

-include formula for molar heat of fusion (fusion is scientific term for melting)

explain why the temperature does not increase as a solid is melting. Be sure that students understand that the average kinetic energy of the particles is not increasing.

sublimation of ice into water vapor accounts for the fact that wet clothing hung outside on a clothesline eventually dries, even if the temperature is below freezing.

Main idea page 329 Phase diagram

-visual representation of phase changes

-compare phase diagram of carbon dioxide to one for water (what do you notice)

-make sure to include what is happening on each curve (read the text, it tells you in the first few sentences)

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Be able to teach and answer these questions:

1. Describe boiling. What conditions must be present for a liquid to boil? How can you change the boiling point of a liquid?
2. List each phase change, indicate direction of energy flow, and give an example
3. Be able to interpret and identify parts of a phase diagram

**Section 5: Water pages 331-333**

Guiding questions:

How does the structure of water affect its properties?

How does energy change when water changes state?

Objectives to cover:

* Describe the structure of a water molecule
* Discuss the physical properties of water and explain how they are determined by the structure of water.
* Calculate the amount of energy absorbed or released when a quantity of water changes state.

Main idea page 331-332 properties of water

-reinforce the idea of hydrogen bonding between water molecules Students sometimes think that any bond involving hydrogen is a hydrogen bond. Remind them that an intramolecular bond, such as the bond that exists between a hydrogen atom and an oxygen atom within a water molecule, is a covalent bond. True hydrogen bonds are intermolecular attractions between a hydrogen atom on one molecule and a highly electronegative atom on another molecule.

-use pictures to show some properties

Main idea page 332 Physical characteristics of water

-use something similar to sample problem on page 333 to calculate molar enthalpy of vaporization or of fusion

-emphasize that water’s molar enthalpy is much higher than other comparable substances with similar molar mass because of hydrogen bonding

Discuss the importance of the properties of water in relation to life. For example, significance of water being liquid over such a wide range of temperatures so that many areas of Earth are habitable. Find pictures that focus on the importance of water in daily life.

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Be able to teach and answer these questions:

1. List at least 8 physical properties of water and explain how they are determined by the structure of water.
2. Compare and contrast water and a nonpolar molecule like methane or methanol. Which has a high BP? MP? Which is more volatile?
3. How much energy (in KJ) is absorbed when 300.0 grams of water is boiled? (Molar enthalpy of vaporization: 40.79 KJ/mol)