States of Matter & The KMT: Gases

Teacher Notes, Tips, & Hints

Note for PowerPoint: The PowerPoint included is an editable, animated PowerPoint. This means that some slides may appear overlapping or jumbled in the slide edit mode, but will be just fine in the slide show mode. **Please don't make changes to the PowerPoint until you have viewed it in slide show mode.** The PowerPoint is editable. The last slide is for you should you want to add a slide (gives you the same background). Just type in your text, add pictures if you want, and drag it to its place in the lesson. If everything is okay as it is, delete this slide.

The Lesson:

The basic assumption behind the Kinetic-Molecular Theory is that all particles of matter are in constant motion. In this lesson, students will use the Kinetic-Molecular Theory for Gases to describe the properties of gases. Each of the basic properties of gases are compared to the KMT—expansion, compressibility, density, and diffusion. The difference between diffusion and effusion is presented. These are discussed in greater detail during the Gas Laws Unit.

The lesson itself usually runs a class period. The exit ticket (Check for Understanding) restates concepts introduced during the lesson. The homework assignment applies concepts from the lesson in different terms. For this particular assignment, I like to let partners work on it together during class. The discussions produced are wonderful. It is not an assignment that should be worked on individually at home.

PowerPoint- States of Matter & The KMT: Gases

Slide 2: Kinetic refers to the energy of motion

Slide 3: The basic assumption of the KMT. There is a place in student notes for them to draw the three phases of matter.

Slide 5: Discuss the meaning of postulates. There is a place on student notes for them to define postulates—A self-evident fundamental principle—or something along those lines. Whatever you like!

Slide 8: Temperature, in Kelvin, and kinetic energy are directly proportional. Larger particles move slower than smaller particles. (more mass)

Slide 9: Gases are mostly empty space.

Slide 10: Partner Challenge: At a high pressure, gas particles are pushed closer together, and forces of attraction are stronger. At a low temperature, gas particles loose kinetic energy also causing them to come closer together. The closer gas particles are to one another, the more they deviate from the KMT description of the ideal gas.

Slide 11: What keeps gases from heading on out towards Pluto? The force of Gravity!

Slide 12: Gases flow just as liquids do. They are both considered fluids. Gases can even have currents.

Slide 13: Since gases are spread out as far as possible under the conditions of temperature and pressure, the density of gases is a fraction of the densities of liquids and solids. Why does compressibility increase pressure? If you increase the pressure by decreasing the volume of the gas, they are still traveling at the same speeds—more collisions equals higher pressure.

Slides 14 & 15: This is the first time students will encounter the difference between diffusion and effusion. This will be studied in greater detail during the gas laws unit. For now, we just want them to be able to describe the difference, and understand that this is a spontaneous process. Open a bottle of perfume, spray some air freshener, or something along those lines, ask students to think about the wonderful smell of cookies baking in the kitchen. Different gases diffuse at different rates. Effusion: the helium balloon eventually sinks and deflates as helium moves out of the balloon, and air gas particles move into the balloon. There is a place on the student notes for them to draw representations of diffusion vs. effusion.

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Slide 16: In flask #4, the gas particles will be moving slower because krypton is the larger, more massive particle. At equal conditions, the largest gas particles will move the slowest.

Slide 17: Everything is equal is this situation except for the masses. Each container will have its own mass depending on the substance that it contains.

Slide 18: It is important for consumers to know that the container could explode, and that it is not rated to contain the pressure that results from an increase over a certain temperature. With an increase in temperature, kinetic energy increases, collisions increase, and pressure increases. If the container is not strong enough to contain the amount of pressure, it will explode.

Slide 19: This is an example of diffusion. All KMT statements 1-5 explain why diffusion occurs spontaneously in gases.

1. Gas particles are in constant, rapid, straight-line motion. (moving)
2. Collisions are elastic. (energy is not lost, therefore the particles keep moving in a straight-line motion—diffusing)
3. If temperature is increased, kinetic energy increases—diffusion occurs quicker.
4. There are no forces of attraction between gas particles. (No forces to keep gas particles from moving on—expanding and diffusing!
5. This one is a challenge to apply to diffusion. But some students may get creative. Such as: since the volume of individual gas particles is nearly zero, it is easy for them to spread out quickly—diffuse!

Lesson Duration: One class period plus time to work on assignment in class.

NGSS:

HS-PS2 Structure & Properties of Matter

HS-PS1-1: Describe and classify different kinds of materials by their observable properties.

DCI: PS1.A: Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

Science & Engineering Practices—Constructing Explanations: Make observations to construct an evidence-based account for natural phenomena.

Cross-Cutting Concepts—Patterns: Patterns in the natural and human designed world can be observed.

Lesson Objectives:

State the Kinetic-Molecular Theory of Matter.
Relate the five postulates of the Kinetic-Molecular Theory of Gases to the particular properties of gases.
Define the Ideal Gas, and discuss why "real" gases are not ideal gases.
Give two examples of conditions that cause gases to deviate the most from the ideal gas.
Describe the basic properties of gases including expansion, fluidity, compressibility, density, diffusion and effusion.

Prior Knowledge:

None

Assessment:

Check for Understanding Exit Ticket
Homework

Suggested Lesson Order for the States of Matter Unit:

States of Matter–Gases & the Kinetic-Molecular Theory
States of Matter—Liquids & the Kinetic-Molecular Theory
States of Matter—Solids & the Kinetic-Molecular Theory
States of Matter—Phase Changes, Phase Diagrams, & Heating/Cooling Curves

I hope you find much success with this lesson in your classroom! And, should you ever have any questions, or need a custom resource, please feel free to email me at beth@chemistrycorner.com

~Beth
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