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| **TEAM Lesson Plan Template** | |
| Teacher: Dr. Jason Alexander | |
| Subject/Grade: 8th grade science | |
| Lesson Title: Modeling Kinetic Theory | |
| **STANDARDS** | **Identify what you intend to teach.** State, Common Core, ACT College Readiness Standards and/or State Competencies; Enduring Understandings and Essential Questions. |
| 7.PS1.6 Create and interpret models of substances whose atoms represent the states of matter with respect to temperature and pressure.  This lesson emphasizes  Science and Engineering practice: Using Models  CCC: Energy  Learning performance: Students will use a model to interpret the kinetic theory of matter in a gas emphasizing energy. | |
| **OBJECTIVE(s)/Sub-Objectives** | **Connect prior learning to new learning.** Clear, Specific, Observable, Demanding, High Quality, Measurable, Aligned to Standard(s), and Integrated with other subjects, build on prior student knowledge  Student-Friendly (I Can Statement) |
| I can describe the properties of solids, liquids, and gasses.  I can draw representations of gas molecules in a container.  I can observe changes in temperature and pressure in a gas using a balloon. | |
| **MATERIALS AND RESOURCES** | **Content-related:** Clearly supports lesson objective(s); rigorous & relevant; Incorporates multimedia & resources beyond the textbook. |
| **Activities & Materials**  **For class:** Water and a means to heat it such as electric kettle, microwave oven or Bunsen burner. Ice. Beaker. Balloon. Computer/Projector/Screen or Whiteboard.  **What if the technology is not working?** Do the activity another day.  **Routine for distributing materials:** Whole group demonstration. | |
| **ACCOMMODATIONS/ADAPTATIONS** | **Learning styles and interests.** Anticipate learning difficulties, regularly incorporate student interests & cultural heritage; differentiate instructional methods. |
| **Modifications/Plans for Diverse Learners *(NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  **Differentiation**  **\_\_\_\_ Other**.  **Accommodations**  **\_\_\_ Preferential Seating \_\_\_ Extended Time \_\_\_ Small Group \_\_\_ Peer Tutoring**  **\_\_\_ Modified Assignments \_\_\_ Other**  **Early Finishers:** This is a whole-group activity. | |

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| **MOTIVATING STUDENTS/ANTICIPATORY SET** | **“Hook”: Engage students’ attention and focus on learning.** Personally meaningful and relevant. |
| Play a few bars of Queen’s “Under Pressure.”  Have a volunteer post the “I can” statements. | |
| **INSTRUCTIONAL PROCEDURES** | **Step-by-Step Procedures-Lesson Sequence: Basic to Complex.** Lesson includes visuals, modeling, logical sequencing and segmenting (beginning, middle, ending); essential information; concise communication; grouping strategies; differentiated instructional strategies to provide intervention & extension; seamless routines; varied instructional strategies; key concepts & ideas highlighted regularly. |
| ***Introductio*n**  What does pressure have to do with states of matter? For that matter, what are the states of matter?  There are four states, solid, liquid, gas, and plasma. Today we will discuss solids, liquids and gasses.  Someone give an example of a something we typically experience as a solid. ( Wait for a response such as paper, plastic, “my desk,” “a book.” ) Write “Solid” and some examples on a board.  Someone give an example of something we typically experience as a liquid. ( Wait for a response such as water, gasoline, juice, milk ) Write “Liquid” and some examples on a board.  Someone give an example of something we typically experience as a gas. ( Wait for a response such as air, oxygen, water vapor, helium ) Write “Gas” and some examples on a board.  Can the same substance exist in more than one of these states? ( Wait for a response. Yes, water can be ice, liquid water, or water vapor. Helium can be a gas or a liquid – liquid helium we use to make MRI machines work).  What determines the state of matter? The substance, temperature, and pressure.  **Middle**  Display the beaker. This beaker is made of glass, which is a solid at room temperature. It maintains its shape. What would happen if the glass got really hot? [ The glass would melt and lose its shape, becoming a puddle on the table ]. Pour a bit of water beside the beaker. The water is liquid and does form a puddle. Pour some water in the beaker. Notice that the water assumes the shape of the beaker. Pour out the water and put a piece of ice in the beaker. Notice that the substance is the same, water, but the state of matter is different. The ice is solid and maintains it’s shape. Remove the ice.  Display an uninflated balloon. What is its state of matter? Solid. We can stretch it, but it generally maintains its shape. Inflate the balloon to about atmospheric pressure and tie it. What is keeping the balloon stretched out? [Gas inside it]. Allow a student to hold the balloon. What is its temperature? [roughly room temperature]. Pour boiling water into a beaker. Ask students about the temperature of the water. [ it is hot ] Place the balloon in the beaker and ask students to observe. The balloon should get larger. Remove the balloon, pour out the hot water, and fill the beaker with ice water. Place the balloon in the ice water and ask students to observe. The balloon should shrink.  How can we account for these different behaviors of the glass, the balloon, and the water?  Discuss and display the following:  **Atom**: The smallest particle of an element that has all the element’s chemical properties, composed of a nucleus and a number of surrounding electrons. Atoms join to form molecules, the smallest particle of a compound.  Temperature is a measure of the random motion of atoms/molecules. More specifically, it measures the average thermal energy (KE) of atoms and molecules in a body. In other words, temperature is directly proportional to the KE of the particles that are in the body. The state of matter depends on the atoms/molecules, the temperature, and the pressure.  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  **Solid** matter tends to keep its shape, it will deform slightly if squashed or stretched. Atoms/molecules are constantly in vibrational motion around their fixed sites, but stay on the average around the same fixed point. If heated, the atoms/molecules vibrate more. Strong forces exist between the particles. Atoms/molecules are close to each other.  FLUIDS (Liquids and gases)  **Liquid** matter can flow, while maintaining a constant total volume. Liquid fills a container from bottom up and takes up the shape of the container. Particles (atoms, molecules) are in vibrational motion as well as free to move around. There are not as close together as they are in solid state. There are moderately strong forces between the particles. The particles are grouped together in small groups. If heated, particles move faster, further heating may result in breakage of the bonding between the particles (boiling).  **Gas** takes up the shape of the container. Volume of the gas depends on the container volume. Particles freely move around and have hardly any force on each other except during collisions. Collisions with the container exert pressure on the container. If heated the particles move quicker and collide harder against the container, exerting greater pressure.  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  **Thermal Energy**: The molecules of substances are constantly jiggling (random translational motion) in some sort of back-and-forth vibratory motion. This overall energy of the molecules is called motional energy (KE). When you add all of the molecules’ kinetic energies, the sum is called THERMAL ENERGY.  **Internal Energy**: In addition to thermal energy (KE), molecules have also energy due to their position with respect to each other (Potential energy (PE)). The grand total of all KE and PE of all molecules of a substance is called Internal Energy. A substance doesn’t contain heat, it contains internal energy.  **Temperature:** The quantity that tells how warm or cold something is with respect to a standard is called TEMPERATURE. Temperature is a measure of the random motion of atoms/molecules. More specifically, it measures the average KE of atoms and molecules in a body. In other words, temperature is directly proportional to the KE of the particles that are in the body.  **Heat** is thermal energy that is transferred from one body to another because of a temperature difference between the bodies.  **End/Closure**:    The molecules in the glass beaker are strongly connected to each other. It is a solid. Water just below 100 degrees Celsius is a liquid. When I poured hot water into the beaker, heat was transferred from the water to the beaker raising it to the same temperature. However, the beaker remained a solid. The state of matter depends on the type of molecules, not just the temperature.  The molecules of gas inside the balloon are not strongly connected to each other. They are free to move around in any direction. When they collide with the inside of the balloon, the push on it, keeping it inflated. When heat was transferred from the hot water to the air in the balloon, the molecules of air moved faster, pushed harder on the inside of the balloon and made it bigger. When the balloon was in the ice water, heat transferred from the gas to the water. The gas got cooler, and the particles slowed down. The balloon shrank due to lower pressure.  **Motivating Students**  \_x\_ Relate to Real World Controlling and using states of matter is an important process. Converting water to steam allows us to convert thermal energy to mechanical energy in a steam engine. Cooling and putting pressure on helium gas allows us to create liquid helium, which allows us to build MRI machines for medical diagnoses. The natural conversion of water between solid, liquid, and gas drives much of our climate: evaporation and rain and snow make up the water cycle.  **Presenting Instructional Content**  \_x\_ Lecture/notes There is extensive vocabulary to display during the lesson  \_x\_ Discussion Even though this lesson is largely a demonstration, there should be a lot of discussion. Ensure that all students get a chance to answer questions.  ***Instructional strategies:***  ***Input -* Hook (Set)**  **Modeling and Guided Practice *–*** The teacher will demonstrate the kinetic theory of gasses with a balloon, hot water, and ice water.  **Check for Understanding (CFU) –**  ***What am I doing for students that progress at different rates?***  ***What do I do if they get it?***  ***What do I do if they don’t get it?*** | |
| **QUESTIONING/THINKING/PROBLEM SOLVING (embedded throughout)** | **Balanced mix of question types.** Utilizes Blooms Taxonomy/Webb’s Depth of Knowledge; high frequency; purposeful & coherent; require active responses; balance based on volunteers/non-volunteers, ability, & gender; lead to further inquiry & self-directed learning.  **Implement four types of thinking (Analytical, Practical, Creative, & Research-based) & Teach/Reinforce problem-solving types**. Provide opportunities for students to generate ideas & alternatives; analyze, evaluate & explain information from multiple perspectives& viewpoints. |
| **Questioning** These questions will occur throughout the activity as prompts based on groups’ or individual students’ progress.  **Knowledge:**  **Comprehension:**  **Application:**  **Analysis:**  **Synthesis:**  **Evaluation:**  **Thinking**  **\_x\_ Practical –.**  **\_x\_ Creative–.**  **\_x\_ Analytical –.**  **\_x\_ Research-based –.**  **\*What am I going to do to give Students an opportunity to?**  **1. Generate variety of ideas:**  **2. Analyze problems from multiple viewpoints:**  **Problem Solving *Note: Teach 2 or more types of problem solving (NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  **\_x\_\_** **Abstraction** Kinetic theory of molecules is an abstract explanation of observed behavior. We do not actually see the molecules, but the idea does provide an explanation for what we directly observe.  **\_x\_\_ Observing and experimenting** Students observe the behavior of solids, liquids, and gasses at different teperatures. | |

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| **GROUPING** | **Maximize student understanding & learning** Varied group composition (race, gender, ability, & age); clearly understood roles, responsibilities & group work expectations; accountability for group & individual work; student opportunities for goal setting, reflection & evaluation of learning. |
| * Whole group discussion/demonstration | |
| **ASSESSMENT** | **Formative and/or summative assessment.** A variety of assessments, including rubrics, measure achievement of objectives and informs instruction. |
| ***Assessments: aligned with state stds; measurement criteria; measure student performance in more than 2 ways (project, experiment, presentation, essay, short answer, multiple choice test) (NOTE: Clearly identify where you will use each of these in your lesson; do not just check the box!)***  **\_\_x\_ Teacher made test:** A future test may include items like the following:  Shuri blew up a balloon little bit, tied the balloon, and placed it in a beaker of hot water. She watched as the balloon grew larger. When she removed the balloon from the beaker the balloon slowly shrank back to its original size.  1) Construct a model to explain what Shuri observed.  2) Predict what would happen when the room temperature balloon is placed in ice water.  3) How does your model in (1) align with your prediction for the balloon in ice water?  4) State a claim (draw a conclusion) that relates the motion of particles to thermal energy using evidence from Shuri’s observations.  *\****Students should achieve \_\_\_\_\_% mastery of this objective: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | |
| **CLOSURE** | **Reflection/Wrap Up.** Summarizing, reminding, reflecting, restarting, connecting. |
| * ***Review/Summary: wrap up what has been learned and accomplished in the lesson (even if they are in the middle of an exercise, it is still important to summarize to the point where they are now). Ideally involve students in this synthesis.*** * ***Preview for next lesson:*** * ***Upcoming assignments: remind them of any upcoming assignments.***   ***Today we…. Turn to your partner and…. Let’s review our I Can statements……***  **Follow-up Activities/Extension *These may be designed to create a longer or more intense lesson. For example, if the class is able to cover the material in a lesson much faster than expected, extensions may prove helpful. Extensions may also be useful in various parts of a lesson where the teacher (and class) decides they should spend more time on a skill or topic.***  ***Reflection: You must reflect on every lesson you teach.*** | |

**NOTES:**

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