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| **Lesson Name and appx. time** | **Driving Question** | **What Students Do, and Lesson Highlights** | **What Students Figure Out** |
| **1 - *Introduce the Lava Lamp Phenomenon and Start a Model***  One class period | What can we observe about the Lava Lamp and how do we think it works? | Students observea working Lava Lamp, generate questions, and develop an initial model.   * Observe lava lamp * Record student observations and questions * Share ideas in a gallery walk | Different science concepts need to be explored to understand how the Lava Lamp works.   * A detailed model aids in understanding * Heat is an important first step. |
| **2 – *Modeling Matter on the Molecular Level***  One class period | What kind of matter are the blobs in the Lava Lamp? | * Students investigate water and explain their observations on the molecular level. * Students view molecular animations of the particles in solids, liquids, and gases. | * All matter is made of atoms and molecules. * The attraction and motion of atoms and molecules determines whether a substance is a solid, liquid, or gas. |
| **3 – *Connecting Matter to Measuring and Modeling Mass***  One to two class periods | Does the mass of the blobs affect how they move in the Lava Lamp? | Teacher demonstrates measuring the mass of a gas.  Students measurethe massof solids and liquids.   * Measure the mass of different size rods of the same material. * Measure mass of different volumes of water. * Model matter as dots or circles. | * The mass of an object is the result of the atoms and molecules it is made up of. * The mass of a substance can be modeled by using dots or circles. * The spacing and size of the dots or circles should be the same for different masses of the same material. |
| **4 – *Measuring Volume***  One to two class periods | Does the volume of the blobs affect how they move in the Lava Lamp? | Students measurethe *volume* of liquids and solids.   * Precisely measure volumes of colored water from one test tube to another * Measure volume of solids by water displacement and with a metric ruler. | * A substance or object has a certain volume defined by how much space it takes up. * Volume of a solid can be measured using displacement or the mathematical formula: L x W x H. * Volume is often measured in cubic centimeters (cm3) |
| **5 – *Density is a Relationship Between Mass and Volume***  One to two class periods | What is the relationship between the mass and volume of the blobs? Density | Students explore the volume and mass of objects of *different* materials:   * Same volume and different mass, * Same mass and different volumes   Students also explore objects of the *same* materials:   * Different mass and volume * Students graph relationship between mass and volume as a straight line | * The density of a substance is determined by the size, mass, and arrangements of its atoms and molecules. * Density is the relationship between mass and volume and is constant for a particular type of matter. * Density is a characteristic property of matter, and can be used to identify a substance. * Density is usually measured in g/cm3. |
| **6 – *Density of Liquids and Why they Float or Sink***  One class period | Does the floating and sinking of the blobs have something to do with their density? | Students measure mass and volume of different liquids, calculate their density, and explore their sinking and floating in water.   * Calculate the density of water, vegetable oil, and alcohol * Predict the floating and sinking of water, oil, and alcohol based on their densities * Graph the density of different volumes of water | * The density of a substance is the same regardless of the size of the sample. * The mass and size of the molecules in a liquid and how closely they are packed together determine the density of the liquid. * Liquids can float and sink in other liquids depending on their densities. |
| **7 – *Relating Density to Floating and Sinking of Solids***  One class period | Can floating a sinking of an object change depending on the liquid it is placed in? | Students observe three demonstrations and conduct an activity to further explain density’s relationship to sinking and floating.   * A light grain of sand sinks and a heavier candle floats * Candle sinks in alcohol but floats in water * Carrot slice sinks in fresh water and floats in salt water | * An object that is less dense than water, floats in water. * An object that is more dense than water, sinks in water. * The density of water can be increased by dissolving salt into it. |
| **8 – *Exploring Kinetic Energy***  One class period | How does heating the blobs affect the motion of the molecules that make up the blobs? | Students explore how heating and cooling affect the motion of atoms and molecules in hot and cold water.   * Add blue and yellow food coloring to hot and cold water and observe speed of mixing. * Model the motion of atoms and molecules through music and movement. | * Adding energy (heating) increases molecular motion. * Removing energy (cooling) decreases molecular motion. * Faster moving molecules move a little further apart. * Slower moving molecules move a little closer together. |
| **9 – *Understanding Heat Transfer***  One class period | How does heat from the bulb at the bottom of the Lava Lamp get to the blob material? | Students observeheat transfer between water and metal washers.   * Hot metal washers placed in room temperature water. * Room temperature metal washers placed in hot water. * Observe change in temperature of washers and water. | * Heat can be transferred from one substance to another through conduction. * In conduction, faster-moving molecules contact slower-moving molecules and transfer energy to them. * During conduction the slower-moving molecules speed up, and the faster-moving molecules slow down. * Temperature is a measure of the average kinetic energy of the atoms or molecules of a substance. * Heat is the transfer of energy from a substance at a higher temperature to a substance at a lower temperature. |
| **10 – *Expansion and Contraction in Liquids, Solids, and Gases***  Two class periods | How does the heat affect the blobs in the Lava Lamp? | Students observethe expansion and contraction of matter when heated and cooled.  Heat and cool:   * Air in a bottle with detergent film on top * Brass ball that fits through a ring at room temperature * Alcohol in a thermometer | * Heating causes molecules to move faster and a little further apart. * Cooling causes molecules to move more slowly and get a little closer together. * Heating causes substances to expand, and cooling causes substances to contract whether or not a change in state occurs. |
| **11 – *Connecting Changes in Temperature and Density to Sinking and Floating***  One class period | Does heating and cooling affect the sinking and floating of the blobs? | Students observethe effects of temperature on whether samples of water sink or float.   * Heat and cool colored water and place in room temperature water to see if heating and cooling affects whether the water sinks or floats. | * Faster-moving molecules move further apart, volume increases, density of the substance decreases causing the substance to float. * Slower-moving molecules move closer together, volume decreases, density of the substance increases causing the substance to sink. |
| **12 – *Final Modeling of the Lava Lamp Phenomenon***  Two class periods | How can we take everything we now know and make a model to explain how the Lava Lamp works? | Students use their observations and understandings from all the lessons to explain and communicate how the Lava Lamp works with an annotated model.   * Start with a new model and clearly show heat transfer, molecular motion and spacing, state change, changing density, rising, and falling. * Include detailed captions to annotate the drawing to make it as clear as possible. | Answering the question, “How does a Lava Lamp work?”, is complex endeavor tying together concepts of energy, structure and function of a system, molecular motion, changes in density, and cause and effect. |