Investigating Water Transformations: Keeping Track of Matter

The Developing Model of Matter

1. WATER, A LIQUID	2. WATER TO VAPOR	3. WATER TO ICE	4. AIR, A GAS	5. TWO SCALES
1. Why are these ships in a field? Students weigh materials to build class-room-sized mini-lakes to investigate. The amount of matter is indicated by weight.	**6. What happens to the water?** As students watch with magnifiers, water droplets shrink and disappear. Does evaporation destroy water, or has it gone somewhere else? This question launches a search for the answer.	**10. How are ice and water the same and different?** Students launch this 3-session investigation by contrasting and comparing the properties of ice and water. They also revisit condensation in a different context.	**13. Is air matter?** An exploration with syringes provides evidence that air takes up space. A demonstration comparing air-filled and empty balloons establishes that air has weight. Air is determined to be *matter*.	**17. What's the story behind the graph?** Students annotate mini-lake graphs to tell the story of transformation of water on a macroscopic – visible – scale and on a particle scale.
2. How can we keep track of our mini-lake materials? Students are reintroduced to the concepts of volume and *heavy for size*, They learn that everything that has weight and takes up space is *matter*. They finish building their mini-lake and begin to track its matter by measuring and graphing weight.	**7. What happened to the water?** The class assembles a set of three closed 2-bottle systems in order to study evaporation. Can this small system help us investigate processes that happen in the larger world?	**11. What happens to weight and volume when water freezes?** Students discover that while the volume of a water sample changes as it is frozen, the weight remains the same. Has the material also changed?	**14. What are some properties of air? (1)** Further exploration reveals that air is compressible while water is not. Students develop an annotated drawing (an explanatory model) to explain this difference in properties. Reasoning suggests there is space between air particles.	**18. How have our understandings changed?** Students reflect on how the 2-bottle system and other investigation materials have helped them develop new understandings about real-world transformations of water.
3.How does water compare with sand? As they compare the weights and volumes of materials used in their mini-lakes, students discover the unit weight of water; each material has a constant heaviness for size.	**8. What is happening in the 2-bottle system?** Students learn about the elements of a system: the boundaries, components, and interactions. They record the transformations underway in the 2-bottle systems.	**12. What changes and what stays the same as ice melts?** Reasoning suggests that the material itself does not change as ice melts to water. A computer "particle magnifier" showing a particle model of water and ice reinforces the reasoning.	**15. What are some properties of air? (2)** A demonstration highlights the response of air to heating and cooling. Students develop an annotated drawing to explain this response. Can a particle model account for the changes?	
4. What does a drop of water weigh? In working with single drops of water, students see that very small things can take up space and have weight, even when that weight does not register on a classroom scale.	**9. Why do the water drops form?** Through a study of water drop patterns in the 2-bottle systems, students begin to understand the relationship between condensation and temperature. Reasoning suggests that evaporation does not destroy water; it continues to exist as water vapor and then condenses to reappear as liquid water.	Students continue to track matter in their mini-lake system by measuring and graphing weight.	**16. What are some properties of air? (3)** Students again use the "particle magnifier" to help them understand the relationship between temperature, particle motion, and the volume of gas.	
5.What changes and what stays the same when salt dissolves in water? Dissolving salt in a cup of water shows that even particles too small to see have weight and take up space.			Students continue to track matter in their mini-lake system by measuring and graphing weight.	