The focus in IS4 on monitoring/minimizing human environmental impacts as well as on global climate change, complete the year's science education and reconnect with the systems thinking explored in IS1, especially the emphasis on properties of the whole **system [CCC-4]**. Earth's web of life is a property of the whole system that emerges from the interactions of organisms with each other and with the huge diversity of Earth environments. Similarly, the global climate is a whole-system property that emerges from the interactions of the Earth subsystems, with each other, and with the inflow of sunlight. Human actions can change the Earth system's components and interactions in ways that profoundly alter organisms and climate at local, regional, and global levels. The Integrated Grade Six course can help build a middle grades foundation of science and engineering understandings and practices related to citizenship and sustainability that can grow in depth in the succeeding middle and high school grades. (Two EEI Curriculum units, *Energy: It's Not All the Same to You* http://www.cde.ca.gov/ci/sc/cf/ch5.asp#link12 and *Responding to Environmental Change* http://www.cde.ca.gov/ci/sc/cf/ch5.asp#link13 provide a variety of resources that can support this instruction.)

Grade Seven Preferred Integrated Course Model

This section is meant as a guide for educators on how to approach the teaching of the California Next Generation Science Standards (CA NGSS) in grade seven according to the Integrated Model (see the introduction to this chapter for details regarding different models for grades six, seven, and eight). This section is not meant to be an exhaustive list of what can be taught or how it should be taught.

A primary goal of this section is to provide an example of how to bundle the performance expectations into integrated groups that can effectively guide instruction in four sequential instructional segments (IS). There is no prescription regarding the relative amount of time to be spent on each instructional segment. As shown in figure 5.25, the overarching guiding concept for the entire year is "Natural processes and human activities cause energy to flow and matter to cycle through Earth systems."

Figure 5.25. Grade Seven Integrated Storyline

Guiding Concept: Natural processes and human activities cause energy to flow and matter to cycle through Earth systems.

Instructional Segment	1 Living and nonliving things are made of atoms	2 Matter cycles and energy flows in systems of all scales within the Earth system.	3 Natural processes and human activities have shaped Earth's resources and ecosystems.	4 Human activities help sustain biodiversity and ecosystem services in a changing world.
Life Science (LS)	Organisms are made of molecules of mostly six different elements.	Organisms grow and get energy by rearranging atoms in food molecules.	Matter cycles and energy flows among living and nonliving parts of ecosystems. Resource availability affects organisms and ecosystem populations. Ecosystems have common patterns of organism interactions.	Biotic and abiotic changes affect ecosystem populations. Design solutions can help maintain biodiversity and ecosystem services.
Earth and Space Sciences (ESS)	Earth materials are mostly made of eight different elements. Earth has mineral, energy, and water resources.	Earth's cycles of matter are driven by solar energy, Earth's internal thermal energy, and gravity.	Fossils, rocks, continental shape, and seafloor structures provide evidence of plate motion. Geoscience processes unevenly distribute Earth's mineral, energy, and groundwater resources.	Geoscience processes change Earth's surface. Damage from natural hazards can be reduced.
Physical Science (PS)	The interaction and motions of atoms explain the properties of matter. Thermal energy affects particle motion and physical state.	Chemical reactions make new substances and can release or absorb thermal energy. Mass is conserved in physical changes and chemical reactions.	Chemical reactions make new substances. Mass is conserved in physical changes and chemical reactions.	Synthetic materials impact society.
Engineering, Technology, and Applications to Science (ETS)	N/A	Design criteria. Evaluate solutions. Analyze data. Iteratively test and modify.	N/A	Design criteria. Evaluate solutions. Analyze data.

Each of the four instructional segments integrates the different disciplines. Concepts across the domains integrate within each of the four instructional segments. Each instructional segment has a summary sentence; for IS1 it is "Living and nonliving things are made of atoms." Figure 5.25 also indicates a sequence of concepts within each discipline such as the progression in life science from the idea that organisms are made of molecules (IS1) to photosynthesis (IS2) to ecosystem cycles of matter (IS3) to biodiversity concepts (IS4).

Students begin their exploration by categorizing the kinds of living and nonliving matter in a natural environment. Guided research and hands-on investigations lead to discussions and understandings about atoms and molecules. By comparing various solids, liquids, and gases, students begin constructing an understanding that the interactions and movements of submicroscopic particles result in properties of matter that we observe at our macroscopic level of reality. Thoughtful applications of a crosscutting concept (CCC) can help with the learning of the specific topic and simultaneously deepen the understanding of the CCC. Instructional segment 2 expands the instructional focus by including a highly detailed vignette that describes instruction over a much longer time period.

In IS 2, students **investigate [SEP-3]** physical changes and chemical reactions in the contexts of organisms and rocks. With chemical reactions, atoms rearrange their connections and form new substances. Chemical reactions also often involve the absorption or release of energy. The formation by plants of food consumed by other organisms and the breaking down of this food sets the stage for one strand of understanding cycles of matter and flows of energy. The transformations of minerals and rocks provide a complementary strand of physical and chemical changes that also involve **cycles of matter and flows of energy [CCC-5]**. As they engage with these changes in very different contexts, students can attain a deeper appreciation that the amount of matter always remains the same. In physical changes and in chemical reactions, the numbers of each type of participating atom remains the same (MS-PS1-5).

As the year progresses, students begin exploring cycles of matter and flows of energy at larger **scales [CCC-3]**, such as in different kinds of natural environments and their ecosystems. Ecosystems by their very nature embody the integration of Earth science and life science. This integration is especially evident in the flows of matter and energy that connect organisms with each other and with their physical environments.

Students also investigate the geoscience processes that change Earth's surfaces at varying time and spatial **scales [CCC-3]**, and that results in the uneven distribution of Earth's mineral, energy, and groundwater resources. These physical environments play large roles in determining features of the organisms that live in the local ecosystems.

Students explore biotic and abiotic interactions within these ecosystems, and the resulting macroscopic cycles of matter, flows of energy, and changes in organism populations. These general **patterns [CCC-1]** apply across ecosystems that may otherwise appear to be very different from each other.

Toward the end of the year, students address challenges to sustainability by applying their understanding of the natural processes and human activities that shape Earth's resources and ecosystems. These environmental challenges can cover a wide variety of contexts such as adverse consequences of synthetic materials, natural hazards (e.g., earthquakes and hurricanes), climate change, and habitat destruction.

In IS4, students research issues related to sustaining biodiversity and ecosystem services. They then have the responsibility to design engineering solutions that rely on the basic science skills that they developed in earlier instructional segments. They apply their knowledge, such as a **systems-based [CCC-4]** understanding of how Earth's organisms, including humans, are intimately connected with each other and with Earth's **cycles of matter and flows of energy [CCC-5]**. In their design challenges, students define the problem, balance criteria and constraints, and evaluate their proposed solutions.

IS1 Integrated Grade Seven Instructional Segment 1: Organisms and Nonliving Things Are Made of Atoms

According to the developmental progressions in the CA NGSS (see appendix 1 of this framework), **patterns [CCC-1]** at the middle grades level include the concept that "[m]acroscopic patterns are related to the nature of microscopic atomic-level structure." Instructional segment 1 constantly moves back and forth between these two **scales [CCC-3]** as students confront phenomena and try to use models to explain them at the atomic level.

INTEGRATED GRADE SEVEN INSTRUCTIONAL SEGMENT 1: ORGANISMS AND NONLIVING THINGS ARE MADE OF ATOMS

Guiding Questions

- How does the matter in living and nonliving things differ?
- How does adding or removing thermal energy affect the physical states of matter?
- How do interactions at the atomic level help us understand the observable properties of organisms and nonliving matter?

Performance Expectations

Students who demonstrate understanding can do the following:

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).] (Introduced, but not assessed until IS3)

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [*Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.*] (Introduced, but not assessed until IS3)

MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [*Assessment Boundary: Assessment does not include valence electrons and bonding energy,*

INTEGRATED GRADE SEVEN INSTRUCTIONAL SEGMENT 1: ORGANISMS AND NONLIVING THINGS ARE MADE OF ATOMS

discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.]

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [*Assessment Boundary: Assessment is limited to qualitative information.*] (Introduced, but not assessed until IS4)

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

The bundle of performance expectations above focuses on the following elements from the NRC document *A Framework for K–12 Science Education*:

Highlighted Science and Engineering Practices	Highlighted Disciplinary Core Ideas	Highlighted Crosscutting Concepts
[SEP-2] Developing and Using Models [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering) [SEP-8] Obtaining, Evaluating, and Communicating Information	ESS3.A: Natural Resources PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS3.A: Definitions of Energy	[CCC-2] Cause and effect [CCC-3] Scale, Proportion, and Quantity [CCC-6] Structure and Function

Highlighted California Environmental Principles and Concepts:
Principle I The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services.

Principle II The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies.

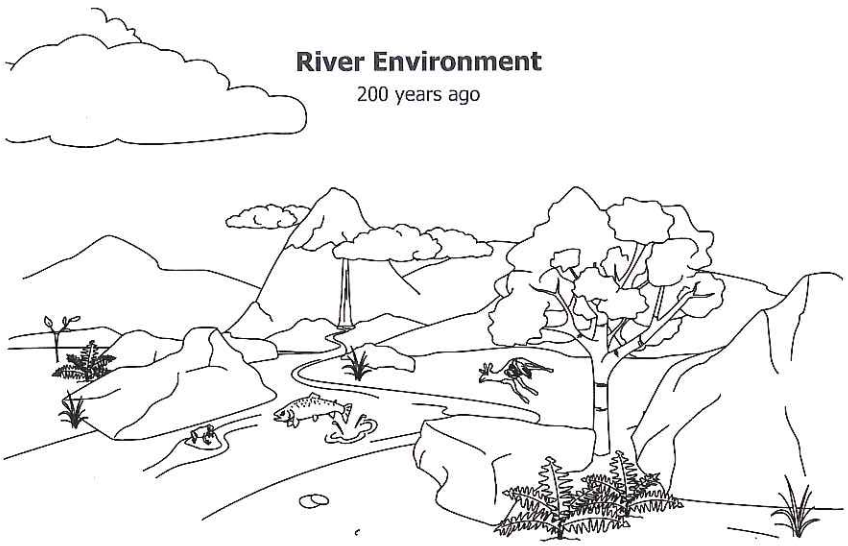
CA CCSS Math Connections: 6.EE.6, 6.RP.3, 6.NS.5, 7.EE.4, MP.2, MP.4

CA CCSS for ELA/Literacy Connections: RST.6–8.1, 7, WHST.6–8.2, 8

CA ELD Connections: ELD.PI.6.1, 5, 6a–b, 9, 10, 11a

For this instructional segment, the anchoring phenomenon is based on students looking at the world around them and considering, What are things in the world made out of? Students can go outside to the schoolyard or nearby natural setting and sit silently, recording in their notebook all the different materials they see nearby. Do they observe **patterns [CCC-1]** that allow them to group matter into different categories (like living, nonliving, or once living; solid, liquid, or gas)? Students can compare the local environment around them to a picture or diagram of an environment that includes a full range of materials that can motivate the rest of the unit (figure 5.26; see the Environment Diagrams produced by WestEd for this purpose, http://www.cde.ca.gov/ci/sc/cf/ch5.asp#link14). Environment diagrams should be selected so that they include living and nonliving parts of environments (to motivate MS-LS2-3 in IS3) and illustrate processes that may cause uneven distribution of resources in different environments (to motivate MS-ESS3-1 in IS3). A single-environment diagram ties together all of grade seven (e.g., rivers), though students can also periodically break out into small groups to apply their understanding to other environment diagrams.

Figure 5.26. A River Environment



A river environment with diverse forms of living and nonliving matter. *Source:* From Making Sense of SCIENCE: Earth Systems (WestEd.org/mss) by Daehler and Folsom. Copyright © 2013 WestEd. Reproduced with permission.

Particle Models of Materials in the Environment

A key feature of an environment diagram is the existence of water in all three states (solid, liquid, and gas). Water is something students directly observe in their everyday life (at least in two of its three states, as water vapor is hard to directly observe, even though they see its effects regularly), and they have explored the water cycle in grade six. As such, water is the perfect bridge between the concrete observations that characterized elementary school and observations in the middle grades where students use what they can see in everyday life to infer what occurs at **scales [CCC-3]** that they cannot directly experience. What is water made of, and what actually happens when it changes between solid, liquid, and gas?

Just as organisms are made of building blocks (cells) that are too small to see with the naked eye (grade six MS-LS1-1), all matter is made of building blocks (particles) that are orders of magnitude smaller, and that cannot be seen even with the most powerful light microscopes. In grade five, students developed a model of matter made up of particles too small to see. In the CA NGSS, students will progressively refine this model throughout the middle grades and high school. In grade seven, students will include the following features:

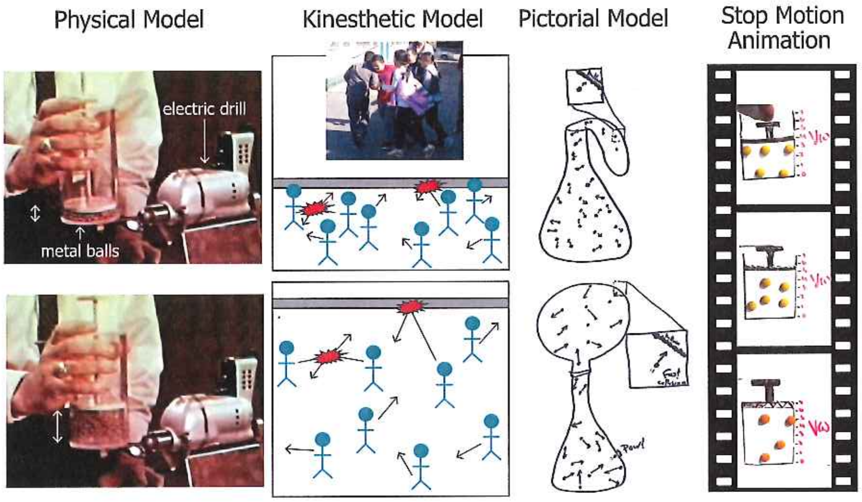
- Particles are always moving.
- Particles can interact (including collide, attract, and repel one another).
- Particles can be complex structures called molecules that are made up of smaller particles called atoms. Or, particles can be individual atoms.

It is not until high school that students add the additional refinement that atoms have an internal structure and are made up of parts that have positive and negative electrical charges.

The **structure [CCC-6]** of atoms, the periodic table, and the details of chemical bonding are all addressed in detail when it is developmentally appropriate during high school (HS-PS1-1 through HS-PS1-8). This focus contrasts with the 1998 CA Science Content Standards, where the periodic table was introduced in grade five and the interior **structure [CCC-6]** of atoms was introduced in grade eight. Part of the motivation is that these features are best understood in light of a more complete understanding of electromagnetic interactions, which are complex enough that they are introduced in high school. Teachers are expected to use the names of elements and compounds essential for life and use language that describes the atoms bonding together, but the features that make the elements different and the details of chemical bonds are not required at the level of understanding expected for the middle grades. Taking the time to develop a robust, particulate model of matter is a significant undertaking and lays key foundations for success in high school physical science. To emphasize this slow developmental progression, teachers should maintain the grade five terminology of matter made as particles in the first part of the instructional segment and then formally introduce the distinction between atoms and molecules near the end.

In Integrated Grade Six, students investigated objects heating up as energy transferred to them. These investigations introduced the DCI that thermal energy is really just the energy of motion of individual particles (PS3.A). When studying the water cycle in grade six, students also recognized changes in the state of matter (MS-ESS2-4). In grade seven, they will **develop models [SEP-2]** that explain the relationships between thermal energy, changes of state, and the motion of particles at scales too small to see (MS-PS1-4). Because the focus is on developing a conceptual model, students spend most of their time in this instructional segment observing simple phenomena involving heat transfer and trying to develop a model at the level of particles for each situation. The evidence statement for MS-PS1-4 outlines a range of "Connections" where students can *connect* their model to the real world (in other words, students should be able explain or predict phenomena using their model). In many cases, computer simulations or animations can quickly illustrate key concepts, but these models should not be introduced to students until they have time to grapple with the observations and develop their own models. The specific representation they use to depict their conceptual models can be physical, kinesthetic (using their bodies), pictorial (a diagram), stop-motion animation, or anything else the students can dream up (figure 5.27). As students create and manipulate their models, they are forced to decide how to represent things; they must figure out where to move their bodies in a kinesthetic model, what to draw in a diagram, etc. Each of these decisions requires them to think about what actually happens in the physical system. This process takes considerable time, and a simple two-minute demonstration can sometimes spur model development and revision that takes several class periods. For example, fill a cup with water and push a cork down to the bottom of the cup and release it. It quickly rises to the surface. Do the same thing with a penny and it stays at the bottom. In both cases, the water seems to be "pushing down" on the objects, so how do individual collisions between particles cause the cork to rise up? If collisions are pushing the cork upwards, why doesn't it just keep going up and launch out of the water? And if we figure all those things out, where in the **system [CCC-4]** does the **energy [CCC-5]** come from to push the cork up? This particular example is too complex for grade seven and not part of the evidence statement of MS-PS1-4, but we include it in this framework as an illustration to help teachers recognize that students will confront simple phenomena and have to think about them very abstractly. Students should confront phenomena in a sequence of increasing complexity, where each example requires them to build on the model they refined in the previous example.

Figure 5.27. Different Models of Gases



Source: Diagram by M. d'Alessio with image adapted from Exploratorium Teacher Institute 2016.

First, students must refine their understanding that the temperature of a material depends on the average speed of the particles that make it up. When students drop food coloring into hot water, they observe that it spreads out more quickly than in cold water. Students represent the water as closely spaced particles and the dye as different particles and, through drawings, stop-motion animation, or other modeling techniques, illustrate how collisions between particles spread the dye at a rate that depends on the temperature.

Students can consider the everyday phenomenon of measuring the air pressure in bicycle tires on a cold morning and again later in the day after riding on hot pavement. To make sense of the changes they see on the tire gauge, they should consider the question, What is air pressure? To bring the phenomena into the classroom for investigation [SEP-3], students can heat a flask topped by a balloon and watch as the air inflates the balloon and then deflates as it cools. Repeating the process over and over again helps convince students that the air is not escaping the system [CCC-4] as it "deflates," but there is some change of the air inside the system. Students must then use their model of matter as particles separated by empty space to explain how the density of the air changes and how the particles push each other apart as they collide.

Changes in particle kinetic energy can have other dramatic effects at the macroscopic level, notably changes in physical state. Students can describe the differences they observe at the macroscopic level between solids, liquids, and gases. Then, they must relate these changes to interactions between particles at the particle level (table 5.7). Thinking about water specifically can help this process because students share the familiar experience of water changing from one state to another. This change requires only a change in temperature (and therefore kinetic energy of particles). The phenomenon that "you cannot pull many solids apart" is a good clue that there must be some force that holds particles together in addition to the collisions that push them apart.

Table 5.7. Comparing Solids, Liquids and Gases

PHYSICAL STATE	PARTICLE PERSPECTIVE	MACROSCOPIC PROPERTIES
Solid State associated with lowest temperatures and/or highest pressures.	Particles have the least freedom of motion. Forces of attraction between particles lock them in their local neighborhood where they vibrate in place.	Solids maintain their volume and keep their shape independent of their container.
Liquid State associated with "moderate" temperatures and/or "moderate" pressures.	Particles have some freedom of motion. Forces of attraction keep each particle associated with nearby particles. Particles have too much kinetic energy for the attraction to lock them in place, so the particles slide past each other and change their neighborhoods.	Liquids flow as a unit and maintain their volume. Liquids adapt their shape to the shape of their container. If the container has more volume than the liquid, then the liquid does not fill the container.
Gas State associated with high temperatures and/or "low" pressures.	Particles have so much kinetic energy that they break completely free of the attractive force that would keep them in the liquid state. Particles are far enough apart that they do not interact except when they collide with other particles.	Gases have no fixed volume and will spread out within any size container.

Given the example of solids and liquids, students can fill out the bottom row of this table (from right to left) using their model of gases. Table developed by Dr. Art Sussman, courtesy of WestEd.

Students have already investigated the gas state in grade five and Integrated Grade Six, so they should have the knowledge to make the claim that the empty space in the unfilled glass actually has matter in the gas state (air consisting mostly of nitrogen gas and oxygen gas). Students can explore interactive computer simulations that help them visualize the accepted scientific model of molecular motion and extend their own model so that they can **explain [SEP-6]** phase changes between solids, liquids, and gases, and the transfer of **energy [CCC-5]** in terms of colliding molecules.

Many students hold the preconception that water is one of the only materials that can exist in all three states of matter. This false idea arises because it is one of few materials that changes state over the range of temperatures in common, everyday experience. Students can apply what they have learned about states of water to predict the behavior of different substances. For example, copper is a solid at room temperature. What does this tell us about the attraction between particles of copper compared to particles of water? Particles of helium have very weak attraction with themselves or other particles. Students can **use their model [SEP-2]** of phase changes to predict something about the relative freezing temperature of helium compared to other gases like nitrogen, the biggest component of air (table 5.8).

Table 5.8. Physical States at Normal Atmospheric Pressure

ELEMENT	GAS STATE	LIQUID STATE	SOLID STATE
Water	Above 100°C	From 0°C to 100°C	Below 0°C
Copper	Above 2,560°C	From 1,084°C to 2,560°C	Below 1,084°C
Helium	Above -270°C	Below -270°C	Never
Nitrogen	Above -196°C	From -196°C to -210°C	Below -210°C

Table developed by Dr. Art Sussman, courtesy of WestEd.

Opportunities for ELA/ELD Connections

As a concluding activity, students create a set of true/false text cards with statements that summarize particle interactions that happen under different conditions and the resulting macroscopic properties of solids, liquids, and gases. Working in groups, students exchange the cards with other students so they can use what they have learned about states of water (see table 5.7 Comparing Solids, Liquids, and Gases) to discuss the statements on the cards. They then use the true cards as reasoning to help explain the behavior of different substances (such as helium, nitrogen, and copper as shown in table 5.8).

CA CCSS for ELA/Literacy Standards: RST.6–8.2; SL.6–8.1

CA ELD Standards: ELD.PI.6–8.3

For the next "everyday phenomenon," students return to the environment diagram (figure 5.26), which shows a snow-capped mountain. In grade six, students observed patterns that led them to the Earth and space science DCI that water condenses into rain drops as air masses rise and therefore precipitation is more likely at high altitude. Why? And why is it colder at high altitudes? Students must use their model of particles and physical science DCIs to develop the definition of air pressure in terms of particles. How does a change in pressure cause a change in temperature? Students can investigate air pressure in the classroom by exploring the phenomena of inflating a tire with a bicycle pump (which warms up), and then rapidly deflating the tire and feeling the valve cool down.

Looking further at the environment diagram, what other effects can students explain? Why are rocks hard and resistant to erosion? (They must be made from materials where the attraction between them is strong). What happens when water flows over a rock and weathers it into pieces? (The collision of water particles with the rock particles must be strong enough to break the attraction between rock particles). How does a stream move sediment grains? (Collisions between water particles and rock particles push the rock downstream).

Particles Can Be Simple Atoms or Complex Molecules

As students explore matter as particles, they notice that not all particles behave the same. We breathe in oxygen but breathe out something called carbon dioxide. We drink water and eat sugar. Each of these names is just a label to describe a material with distinct properties. Some of these materials are made of simple particles that we call *atoms*, but often two or more simple particles can combine to make much more complicated particles called *molecules*. Teachers can introduce this terminology of atom and molecule by providing physical models of these combinations (MS-PS1-1) using interconnecting plastic toy bricks, sticky notes, or digital representations. Not only do these models depict atoms that are chemically bonded together, but they also introduce students to the concept of molecular shape. Molecular **structure [CCC-6]** is crucial in determining the behavior and function of these molecules in living **systems [CCC-4]**, but also in determining the properties of water and other inorganic compounds. It should be emphasized that explaining these applications is outside the scope of the middle grades (for example, water's polarity cannot be explained without a detailed understanding of the internal **structure [CCC-6]** of the atom and chemical bonding), but this performance expectation lays the foundation for more advanced study. Students will build on this terminology in IS2.

Today, mass spectrometers, x-ray diffractometers, and other devices allow scientists to take materials, crush them into a powder, and determine their composition (atoms and molecules). If students could take objects from the environment diagram and place them in these devices, they would find that the majority of living things are made of just a few types of atoms. These same types of atoms are common in the nonliving parts of the environment and in synthetic materials as well (MS-PS1-3, assessed in IS3). Teachers can simulate this process using an interactive Web page where students click on objects or use flashcards with object pictures on one side and a simplified molecular and atomic composition of the object on the other side. Exploring this data set, students can identify **patterns [CCC-1]** in the common types of atoms in the natural environment and begin to develop models of how **matter cycles [CCC-5]** in the environment. They will examine these cycles in more detail in IS2.

IS2

Integrated Grade Seven Instructional Segment 2: Matter Cycles and Energy Flows through Organisms and Rocks

Students apply their understanding of materials to the **cycling of matter [CCC-5]** in two different **systems [CCC-4]**, the cycle of rock material in the geosphere and the cycling of biomass between organisms. In each case, the **flow of energy [CCC-5]** within the system is intimately tied to the flow of matter.

INTEGRATED GRADE SEVEN INSTRUCTIONAL SEGMENT 2: MATTER CYCLES AND ENERGY FLOWS THROUGH ORGANISMS AND ROCKS

Guiding Questions

- How do rocks and minerals record the flow of energy and cycling of matter in the Earth?
- How do we get energy from our food?
- How are hot objects different than cold objects? What changes when they heat up or cool down?

Performance Expectations

Students who demonstrate understanding can do the following:

MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [*Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.*]

MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [*Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.*]