7th Grade Science

Unit 1: Cells and Cell Systems (“How do cells heal?”)

This unit launches with students hearing about an injury that happened to a middle school student that caused him to need stitches, pins, and a cast. They analyze doctor reports and develop an initial model for what is going on in our body when it heals. Students investigate what the different parts of our body are made of, from the macro scale to the micro scale. They figure out parts of our body are made of cells and that these cells work together for our body to function.

Once students have figured out what their bodies are made of and how the parts of their body work together to be able to move, they wonder how the parts of our body heal. They start by watching a timelapse of a knee scrape and notice that over time the part that was scraped is filled in with new skin cells. Students investigate what happens when cells make more cells, what cells need to make more cells, and how cells get what they need to make more cells. Students return to the healing timeline they made at the start of the unit and apply what they have figured out about the interactions between the different systems in the body to explain the various events of healing that took place for the injury at the start of the unit. Finally, they apply their model for healing to explain growth at growth plates in children's bodies as they become adults.

Unit 2: Genetics (“Why are living things different from one another?”)

This unit on genetics starts out with students noticing and wondering about photos of two cattle, one of whom has significantly more muscle than the other. The students then observe photos of other animals with similar differences in musculature: dogs, fish, rabbits, and mice. After developing initial models for the possible causes of these differences in musculature, students explore a collection of photos showing a range of visible differences.

In the first lesson set, students use videos, photos, data sets, and readings to investigate what causes an animal to get extra-big muscles. Students figure out how muscles typically develop as a result of environmental factors such as exercise and diet. Then, students work with cattle pedigrees, including data about chromosomes and proteins, to figure out genetic factors that influence the heavily muscled phenotype and explore selective breeding in cattle. In the second lesson set, students use what they’ve learned from explaining cattle musculature to help them explain other trait variations they’ve seen. They investigate plant reproduction, including selective breeding and asexual reproduction (in plants and other organisms) and other examples of traits that are influenced by genetic and environmental factors. Students figure out that environmental and genetic factors together play a role in the differences we see among living things.

Unit 3: Metabolic Reactions (“How do things inside our bodies work together to make us feel the way we do?”)

This unit on metabolic reactions in the human body starts out with students exploring a real case study of a middle-school girl, who reported some alarming symptoms to her doctor. Her symptoms included an inability to concentrate, headaches, stomach issues when she eats, and a lack of energy for everyday activities and sports that she used to play regularly. She also reported noticeable weight loss over the past few months, in spite of consuming what appeared to be a healthy diet. Her case sparks questions and ideas for investigations around trying to figure out which pathways and processes in her body might be functioning differently than a healthy system and why.

Students investigate data specific to this girl’s case in the form of doctor’s notes, endoscopy images and reports, growth charts, and micrographs. They also draw from their results from laboratory

experiments on the chemical changes involving the processing of food and from digital interactives to explore how food is transported, transformed, stored, and used across different body systems in all people. Through this work of figuring out what is causing her symptoms, the class discovers what happens to the food we eat after it enters our bodies and how her different symptoms are connected.

Unit 4: Matter Cycling & Photosynthesis (“Where does food come from and where does it go?”)

This unit on the cycling of matter and photosynthesis begins with 7th grade students reflecting on what they ate for breakfast. Students are prompted to consider where their food comes from and consider which breakfast items might be from plants. Then students taste a common breakfast food, maple syrup, and see that according to the label, it is 100% from a tree.

Based on the preceding unit, students argue that they know what happens to the sugar in syrup when they consume it. It is absorbed into the circulatory system and transported to cells in their body to be used for fuel. Students explore what else is in food and discover that food from plants, like bananas, peanut butter, beans, avocado, and almonds, not only have sugars but proteins and fats as well. This discovery leads them to wonder how plants are getting these food molecules and where a plant’s food comes from.

Students figure out that they can trace all food back to plants, including processed and synthetic food. They obtain and communicate information to explain how matter gets from living things that have died back into the system through processes done by decomposers. Students finally explain that the pieces of their food are constantly recycled between living and nonliving parts of a system.

Unit 5: Ecosystem Dynamics (How does changing an ecosystem affect what lives there?”)

This unit on ecosystem dynamics and biodiversity begins with students reading headlines that claim that the future of orangutans is in peril and that the purchasing of chocolate may be the cause. Students then examine the ingredients in popular chocolate candies and learn that one of these ingredients--palm oil--is grown on farms near the rainforest where orangutans live. This prompts students to develop initial models to explain how buying candy could impact orangutans.

Students spend the first lesson set better understanding the complexity of the problem, which cannot be solved with simple solutions. They will figure out that palm oil is derived from the oil palm trees that grow near the equator, and that these trees are both land-efficient and provide stable income for farmers, factors that make finding a solution to the palm oil problem more challenging. Students will establish the need for a better design for oil palm farms, which will support both orangutans and farmers. The final set of lessons engage students in investigations of alternative approaches to growing food compared to large-scale monocrop farms. Students work to design an oil palm farm that simultaneously supports orangutan populations and the income of farmers and community members.

8th Grade Science

Unit 1: Thermal Energy (How can containers keep stuff from warming up or cooling down?”)
What keeps different cups or containers from warming up or cooling down? Students begin this unit by experimenting with whether a new plastic cup sold by a store keeps a drink colder for longer than the regular plastic cup that comes free with the drink. Students find that the drink in the regular cup warms up more than the drink in the special cup. This prompts students to identify features of the cups that are different, such as the lid, walls, and hole for the straw, that might explain why one drink warms up more than the other.

Students then investigate the different cup features they conjecture to explain the phenomenon, starting with the lid. They model how matter can enter or exit the cup via evaporation. However, they find that in a completely closed system, the liquid inside the cup still changes temperature. This motivates the need to trace the transfer of energy into the drink as it warms up. Through a series of lab investigations and simulations, students find two ways to transfer energy into the drink: (1) the absorption of light and (2) thermal energy from the warmer air around the drink. They are then challenged to design their own drink container that can perform as well as the store-bought container, following a set of design criteria and constraints.

Unit 2: Contact Forces (“Why do things sometimes get damaged when they hit each other?”)

Oh, no! I’ve dropped my phone! Most of us have experienced the panic of watching our phones slip out of our hands and fall to the floor. We’ve experienced the relief of picking up an undamaged phone and the frustration of the shattered screen. This common experience anchors learning in the Contact Forces unit as students explore a variety of phenomena to figure out, “Why do things sometimes get damaged when they hit each other?”

Student questions about the factors that result in a shattered cell phone screen lead them to investigate what is really happening to any object during a collision. They make their thinking visible with free-body diagrams, mathematical models, and system models to explain the effects of relative forces, mass, speed, and energy in collisions. Students then use what they have learned about collisions to engineer something that will protect a fragile object from damage in a collision. They investigate which materials to use, gather design input from stakeholders to refine the criteria and constraints, develop micro and macro models of how their solution is working, and optimize their solution based on data from investigations. Finally, students apply what they have learned from the investigation and design to a related design problem.

Unit 3: Sound Waves (“How can sound make something move?”)

In this unit, students develop ideas related to how sounds are produced, how they travel through media, and how they affect objects at a distance. Their investigations are motivated by trying to account for a perplexing anchoring phenomenon — a truck is playing loud music in a parking lot and the windows of a building across the parking lot visibly shake in response to the music.

They make observations of sound sources to revisit the K–5 idea that objects vibrate when they make sounds. They figure out that patterns of differences in those vibrations are tied to differences in characteristics of the sounds being made. They gather data on how objects vibrate when making different sounds to characterize how a vibrating object’s motion is tied to the loudness and pitch of the sounds they make. Students also conduct experiments to support the idea that sound needs matter to travel through, and they will use models and simulations to explain how sound travels through matter at the particle level.

Unit 4: Forces at a Distance (“How can a magnet move another object without touching it?”)

This unit launches with a slow-motion video of a speaker as it plays music. In the previous unit, students developed a model of sound. This unit allows students to investigate the cause of a speaker’s vibration in addition to the effect.

Students dissect speakers to explore the inner workings, and engineer homemade cup speakers to manipulate the parts of the speaker. They identify that most speakers have the same parts–a magnet, a coil of wire, and a membrane. Students investigate each of these parts to figure out how they work together in the speaker system. Along the way, students manipulate the components (e.g. changing the strength of the magnet, number of coils, direction of current) to see how this technology can be modified and applied to a variety of contexts, like MagLev trains, junkyard magnets, and electric motors.

Unit 5: Chemical Reactions & Matter (“How can we make something new that was not there before?”)

Eighth grade chemistry students' conceptual understanding of chemical reactions for middle school science is foundational to much science learning. Understanding atomic level reactions is crucial for learning physical, life, earth, and space science. Even more importantly, they open up new windows of curiosity for students to see the world around them. By eighth grade, students are ready to take on the abstract nature of the interactions of atoms and molecules far too small to see.

To pique students’ curiosity and anchor the learning for the unit in the visible and concrete, they are presented with a number of phenomena that demonstrate observable characteristics of chemical reactions. Their observations and questions about what is going on drive learning that digs into a series of related phenomena as students iterate and improve their models depicting what happens during chemical reactions. By the end of the unit, students have a firm grasp on how to model simple molecules, know what to look for to determine if chemical reactions have occurred, and apply their knowledge to chemical reactions to show how mass is conserved when atoms are rearranged.