

THE STANDARD

Particles of Matter

Develop a model to describe that matter is made of particles too small to be seen.



PS1.A · Structure and Properties of Matter

"Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects."

Everything is made of tiny pieces too small to see. 5th graders won't see the particles, so they have to picture them. They draw little dots to stand in for those pieces, then use the dots to explain something real, like why a basketball gets firm when you pump in air. The drawing IS the science here. **It lets them describe what their eyes can't catch.**



Developing and Using Models

"Use models to describe phenomena."

A model is a stand-in for something you can't see directly. 5th graders make a drawing of tiny particles, then point to it to describe what happened in a real test. The skill is using that picture to explain, not just to decorate. **When the syringe gets hard to push, their dots show why: the air pieces got squeezed closer.**



Scale, Proportion, and Quantity

"Natural objects exist from the very small to the immensely large."

Some things are huge, like a planet, and some are so tiny you'll never see them, like the particles in air. This is the idea 5th graders carry out the door: just because something is too small to see doesn't mean it isn't there. **The air in a balloon is real matter, made of pieces far too small for your eyes.**

THE STANDARD

Conservation of Mass

Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

**PS1.A • Structure and Properties of Matter**

"The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish."

Here is the whole idea: when you heat, cool, or mix stuff, the weight never changes. Melt an ice cube in a sealed bag and the bag weighs the same. The matter is still all there, just in a new form. **5th graders prove this by weighing before and after.**

**Using Mathematics and Computational Thinking**

"Measure and graph quantities such as weight to address scientific and engineering questions and problems."

5th graders aren't told the answer. They put a container on a balance, read the weight, write it down, make a change, then weigh again. They graph the before and after as two bars. **When the bars are the same height, their own data answers the question for them.**

**Scale, Proportion, and Quantity**

"Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume."

Here is the idea 5th graders carry out the door: to prove weight stayed the same, you need a fair, standard unit like grams. "It feels about the same" is not evidence. "It weighed 52 grams before and 52 grams after" is. **Standard units let everyone compare the same way.**

THE STANDARD

Properties of Matter

Make observations and measurements to identify materials based on their properties.



PS1.A · Structure and Properties of Matter

"Measurements of a variety of properties can be used to identify materials."

Every material has its own set of properties, like its color, hardness, or whether a magnet grabs it. Think of those properties as a fingerprint no other material shares. **A 5th grader tests several properties, writes down what they find, and uses that list to figure out what the material is.**



Planning and Carrying Out Investigations

"Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon."

5th graders don't just eyeball the material and guess. They run real tests, measure where they can, and record the results so the data becomes evidence. Did the magnet pull it? How many drops until it dissolved? **The numbers and observations they collect are what back up their answer.**



Scale, Proportion, and Quantity

"Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume."

Here is the big idea: a real test gives a number with a unit, not just "a lot" or "kind of hard." Saying "it dissolved in 10 milliliters of water" lets another group repeat the test and check. **Standard units make results you can trust and compare.**

THE STANDARD

Formation of New Substances

Conduct an investigation to determine whether the mixing of two or more substances results in new substances.



PS1.B • Chemical Reactions

"When two or more different substances are mixed, a new substance with different properties may be formed."

Mix two things and sometimes you just get a blend, like sand in water. Other times something new shows up: bubbles fizz, the cup gets cold, or a solid forms out of two liquids. 5th graders test mixtures and watch the properties. **If the new stuff acts different from what they started with, a new substance formed.**



Planning and Carrying Out Investigations

"Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered."

5th graders don't just watch a demo. They run the test themselves, in a group, and keep it fair. Same amount each time, same cups, only one thing changed. They mix it more than once so a weird result doesn't fool them. **The data they record becomes the evidence.**



Cause and Effect

"Cause and effect relationships are routinely identified and used to explain change."

Here's the thinking 5th graders carry out the door: a change has a cause. The fizzing didn't just happen. It happened BECAUSE two certain substances mixed. **They point to the cause (mixing baking soda and vinegar) and connect it to the effect (bubbles and a new substance), then use that link to explain what they saw.**

THE STANDARD

Gravitational Force

Support an argument that the gravitational force exerted by Earth on objects is directed down.

**PS2.B • Types of Interactions**

"The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center."

Gravity is the invisible pull Earth has on everything near it. Drop a pencil and it falls. Toss a ball and it comes back down. Every time, Earth pulls the object toward its center. **For a 5th grader standing on the ground, that pull feels like "down," and it never changes.**

**Engaging in Argument from Evidence**

"Support an argument with evidence, data, or a model."

5th graders don't just say "gravity pulls down" because the teacher said so. They make an argument and back it with evidence: every object they dropped fell straight down, never sideways, never up. **The skill is using what they actually saw to defend the claim.**

**Cause and Effect**

"Cause and effect relationships are routinely identified and used to explain change."

Here's the idea 5th graders carry out the door: things don't fall by accident. There's a cause. Earth's gravity is the cause, and the object moving down is the effect. **Name the cause, name the effect, and you can explain why anything you let go of drops.**

THE STANDARD

The Sun's Energy

Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun.



PS3.D • Energy in Chemical Processes and Everyday Life

"The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water)."

This standard is really one connection traced backward. A 5th grader follows the energy in a meal all the way to its source. The energy your body uses to run, grow, heal a scrape, and stay warm came from the food you ate. That food came from a plant, or from an animal that ate plants. And the plant captured that energy from sunlight. So a kid building a flow chart from 'sun' to 'plant' to 'animal' to 'me' is doing all three dimensions at once. **They show the core idea (food energy traces back to the sun), use the practice (building a model to describe it), and apply the crosscutting lens (energy transferring from one thing to the next).**



Developing and Using Models

"Use models to describe phenomena."

5th graders aren't writing an essay here. They're building a model, a flow chart or labeled diagram, that shows the path energy takes. The model has to actually describe what's happening: sun feeds plant, plant feeds animal, food fuels the body. A good model isn't decoration. **Someone should be able to read it and follow the energy.**



Energy and Matter

"Energy can be transferred in various ways and between objects."

Here's the big idea a 5th grader walks out with: the energy never gets made and never disappears, it just keeps getting handed off. Sunlight is captured by a plant. A rabbit eats the plant and takes the energy. A hawk eats the rabbit. At every step, the same energy transfers to the next living thing. **Your lunch is just the last handoff in a long chain.**

THE STANDARD

Plant Growth

Support an argument that plants get the materials they need for growth chiefly from air and water.



LS1.C • Organization for Matter and Energy Flow in Organisms

"Plants acquire their material for growth chiefly from air and water."

Here is the surprising part for 5th graders. A giant tree did not eat the soil to get that big. Most of what a plant is made of comes from air and water. **The plant pulls in carbon dioxide from the air and takes up water through its roots, and it builds new plant material out of those.**



Engaging in Argument from Evidence

"Support an argument with evidence, data, or a model."

5th graders are not told the answer and asked to repeat it. They make a claim, like "the plant's mass came from air and water," and then back it up with real data, like the before-and-after soil weights or a graph of how the plant grew. **The skill is connecting the claim to the numbers and observations that prove it.**



Energy and Matter

"Matter is transported into, out of, and within systems."

Here is the idea 5th graders carry out the door: matter moves. A plant is a system, and stuff is constantly moving into it. Carbon dioxide moves in from the air through the leaves. Water moves in through the roots. The plant uses that incoming matter to build new leaves, stems, and roots. The new mass did not come from nowhere. **It was transported in.**

THE STANDARD

Cycling of Matter

Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.



LS2.A · Interdependent Relationships in Ecosystems

"The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as 'decomposers.' Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem."

This standard is about following matter as it moves in a loop. A plant pulls in air, water, and soil material and turns it into food. An animal eats the plant. When things die, decomposers send the matter back to the soil and air. **5th graders model that whole loop.**



Developing and Using Models

"Develop a model to describe phenomena."

5th graders aren't just labeling a diagram from a textbook. They build their own model, usually a drawing with arrows, to show how matter actually moves. The model has to describe something real they observed, like a rotting apple feeding the soil. **The model is the thinking, not decoration.**



Systems and System Models

"A system can be described in terms of its components and their interactions."

An ecosystem is a system, which just means a group of parts that work together. The parts here are plants, animals, decomposers, and the environment (air, water, soil). 5th graders describe how those parts interact: who feeds whom, what gets returned, where the matter goes. **The model shows the whole system at once.**

THE STANDARD

Brightness of the Sun and Stars

Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.



ESS1.A • The Universe and its Stars

"The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth."

The sun is a star, just like the ones you see at night. It looks gigantic and blinding only because it is the closest star to us. The other stars are unbelievably far away, so they shrink to tiny dots. **A 5th grader explains the sun's brightness by saying it is the nearest star, then backs that claim with evidence.**



Engaging in Argument from Evidence

"Support an argument with evidence, data, or a model."

5th graders don't just state that the sun is close. They build an argument and back it with proof. A flashlight that dims as you walk it across the room, a data table of distances, a labeled model. **The skill is making a claim and pointing to the evidence that supports it.**



Scale, Proportion, and Quantity

"Natural objects exist from the very small to the immensely large."

Here's the idea 5th graders carry out the door: space is bigger than they can picture. The sun is enormous, but it looks small enough to block with a thumb because it is so far away. Other stars are even farther, so they shrink to specks. **Real size and apparent size are not the same thing, and distance is why.**

THE STANDARD

Observable Patterns of the Sky

Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.



ESS1.B • Earth and the Solar System

"The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year."

This whole standard lives in one move: 5th graders take real sky data and turn it into a graph that makes a pattern jump out. They measure how a shadow shrinks and stretches through a day. They chart how many hours of daylight a date gets. They list which stars show up in which months. Once it is graphed, the pattern is impossible to miss. The sky is not random. **It repeats.**



Analyzing and Interpreting Data

"Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships."

5th graders are ready to graph, and this standard expects it. They are not just told a pattern exists. They build the bar graph or pictograph themselves, then read it to spot the repeat. **The skill is turning a messy list of measurements into a picture that shows the trend at a glance.**



Patterns

"Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena."

This is the big idea 5th graders carry out the door: the sky changes on a schedule. Shadows change length all day, the same way, every day. Daylight stretches and shrinks across the year, the same way, every year. **Once you see the repeat, you can predict what comes next.**

THE STANDARD

Earth's Spheres

Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.



ESS2.A • Earth Materials and Systems

"Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather."

Earth has four big systems: the geosphere (rock, soil, land), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (everything alive). None of them works alone. They constantly push and pull on each other. **A 5th grader builds a model of ONE real example, like the ocean shaping a beach, and shows two systems touching and changing each other.**



Developing and Using Models

"Develop a model using an example to describe a scientific principle."

A 5th grader isn't just told that Earth's systems interact. They build a model to show it. The model can be a labeled diagram, a flowchart with arrows, or a hands-on setup. **The point is the model has to do a job: make the interaction between two systems easy to see and explain.**



Systems and System Models

"A system can be described in terms of its components and their interactions."

Here's the big idea 5th graders carry out the door: a system is a set of parts that work together, and you understand it by looking at how the parts affect each other. Earth's four spheres are systems and also parts of one bigger Earth system. **The interactions are where the action is.**

THE STANDARD

Distribution of Water on Earth

Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.



ESS2.C • The Roles of Water in Earth's Surface Processes

"Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere."

Picture all the water on Earth as 100 cups. About 97 of those cups are salty ocean water. Only 3 are fresh. And most of those 3 are frozen in glaciers or hidden underground. That leaves barely a splash in the lakes and rivers we can actually use. **5th graders take that fact and turn it into a graph that shows the sizes side by side.**



Using Mathematics and Computational Thinking

"Describe and graph quantities such as area and volume to address scientific questions."

5th graders aren't just told "most water is salty." They take real amounts and build a graph that proves it. **The skill is turning numbers into a picture, then reading that picture to answer a question about where Earth's water actually is.**



Scale, Proportion, and Quantity

"Standard units are used to measure and describe physical quantities such as weight and volume."

Here's the idea 5th graders walk out with: amounts only make sense when you compare them. One liter of ocean water doesn't mean much until you line it up next to a spoonful of river water. The graph shows the proportion. **A tiny bar next to a giant bar tells the whole story.**

THE STANDARD

Protect Earth's Resources

Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.



ESS3.C • Human Impacts on Earth Systems

"Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments."

This standard is about real people solving real problems. Humans change the land, water, and air. But communities also fix things. 5th graders gather information about an actual solution and explain how it protects a resource. **The science idea and the human action travel together in one explanation.**



Obtaining, Evaluating, and Communicating Information

"Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem."

5th graders don't make this up from memory. They go get information from real sources, a book, a kid-friendly article, a short video, and pull the useful parts together. Combining is the skill. One source might explain the problem and another explains the fix. **They merge both into one clear explanation.**



Systems and System Models

"A system can be described in terms of its components and their interactions."

A community is a system. The parts are the people, the houses, the factories, the rivers, the trash, the trees. Those parts interact. When 5th graders study a solution, they see how changing one part changes another. Plant trees along a stream, and the soil stays put, so the water runs cleaner. **Parts affecting parts.**

THE STANDARD

Defining Design Problems

"Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost."



ETS1.A • Defining and Delimiting Engineering Problems

"Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account."

This standard is not about building yet. It is about getting the problem clear before anyone touches a glue stick. Elementary students take a fuzzy need, like "my backpack is too heavy," and turn it into a sharp problem with rules. Criteria are what success looks like (it has to hold all my books and feel lighter). Constraints are the limits you have to live with (only these materials, only this much time). **The whole task is naming both before you design.**



Asking Questions and Defining Problems

"Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost."

In this standard, defining the problem IS the science work. Elementary students do not get handed a tidy task. They look at a messy need, ask sharp questions about it, and pin it down into a problem someone could actually solve. **The skill is turning "this is annoying" into "here is exactly what has to happen and exactly what I have to work with."**



Influence of Science, Engineering, and Technology on Society and the Natural World

"People's needs and wants change over time, as do their demands for new and improved technologies."

Here is the big idea students carry out the door: engineering starts with people. Every gadget, tool, and design exists because somebody had a need or a want. As life changes, the needs change, so the designs change too. **When a 3rd to 5th grader defines a problem, they are doing the very first thing real engineers do: listening to what people actually need.**

THE STANDARD

Comparing Solutions

"Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem."



ETS1.B • Developing Possible Solutions

"Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions."

This standard lives inside one job: a kid has two real designs for the same problem, and they have to pick the better one without just going with their favorite. They name what the design needs to do (the criteria), name what they're stuck with (the constraints), test both, and compare. **That single task is the science practice, the core idea, and the crosscutting concept all at once.**



Constructing Explanations and Designing Solutions

"Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem."

Elementary students aren't handed one right answer to build. They generate more than one possible solution, then compare them head to head. **The skill is using the same yardstick (the criteria and constraints) on both designs so the comparison is fair instead of a popularity contest.**



Influence of Science, Engineering, and Technology on Society and the Natural World

"Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands."

Here's the idea 3rd to 5th graders carry out the door: engineering exists to solve real problems people actually have. A backpack that won't stay zipped, a boot scraper that's always muddy, a phone that slides off the couch. **Comparing solutions is how engineers make the chosen design better for the people who need it.**

THE STANDARD

Improving Designs

"Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved."



ETS1.B • Developing Possible Solutions

"Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved."

This standard is the "make it better" step of engineering. Elementary students already built something. Now they test it on purpose to find the weak spot, then change one part to fix it. A test isn't pass or fail. **It's how you find what to improve next.**



Planning and Carrying Out Investigations

"Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered."

A fair test is the heart of this standard. If 3rd to 5th graders change the design AND change how hard they test it at the same time, they can't tell what made the difference. **They keep everything the same except the one thing they want to compare, and they test more than once.**

