

## THE STANDARD

# Speed & Energy

Use evidence to construct an explanation relating the speed of an object to the energy of that object.



## PS3.A • Definitions of Energy

*The faster a given object is moving, the more energy it possesses.*

Energy of motion is simple. The faster something moves, the more energy it has. A marble barely rolling has a little. The same marble flying down a ramp has a lot. No formula needed. **Students just connect "it moved faster" to "it had more energy."**



## Constructing Explanations and Designing Solutions

*Use evidence (e.g., measurements, observations, patterns) to construct an explanation.*

4th graders aren't told the answer and asked to repeat it. They gather evidence, like how far a cup slid or how many blocks fell, and use it to build an explanation. **The skill is pointing to what they actually saw and saying what it proves.**



## Energy and Matter

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

Here's the idea students carry out the door: energy doesn't disappear, it moves. When the fast marble hits the cup, its energy of motion transfers to the cup and the cup slides. **More speed means more energy to hand off.**

## THE STANDARD

# Evidence of Energy Transfer

*"Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents."*



## PS3.A • Definitions of Energy

"Energy can be moved from place to place by moving objects or through sound, light, or electric currents."

This standard is all about energy on the move. A 4th grader watches energy travel four ways: sound, light, heat, and electricity. A buzzing phone, a warm sunbeam, a hot spoon, and a lamp turning on are all energy going somewhere. **Catch it traveling and point to proof.**



## Planning and Carrying Out Investigations

"Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution."

4th graders do not just get told that energy travels. They set something up, watch closely, and collect what they notice. The skill is turning careful watching into evidence. **When the metal spoon warms up but the plastic one stays cool, that is proof heat energy moved through the metal.**



## Energy and Matter

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

Here is the big idea 4th graders carry out the door: energy does not stay put. It can ride a moving object, travel as sound or light, move as heat through a material, or run through a wire as electricity. **Different paths, same idea: energy moved.**

## THE STANDARD

# Energy & Collisions

*"Ask questions and predict outcomes about the changes in energy that occur when objects collide."*



## PS3.A • Definitions of Energy

*"Energy can be moved from place to place by moving objects or through sound, light, or electric currents."*

This standard lives in the moment two things crash. Before the crash, a moving object carries energy. During the crash, that energy moves into whatever it hits. **After the crash, 4th graders see the change: one object slows, the other speeds up, you hear a sound, and the air warms a tiny bit.**



## Asking Questions and Defining Problems

*"Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships."*

4th graders aren't handed the question. **They watch a crash, notice it changes something, and ask a question they could actually test, like "What happens to the still marble if I roll a faster one into it?" Then they predict the outcome using a pattern they've seen: faster crash, bigger change.**



## Energy and Matter

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

Here's the idea 4th graders carry out the door: in a crash, energy doesn't disappear, it moves. When the rolling marble hits the still one, its energy of motion transfers over and the still marble takes off. Some energy also leaks into a sound and warms the air. **It's all still there.**

## THE STANDARD

# Changes in Forms of Energy

*"Apply scientific ideas to design, test, and refine a device that converts energy from one form to another."*

## DCI

DISCIPLINARY  
CORE IDEA

### PS3.B · Conservation of Energy and Energy Transfer

"Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy."

This is the build standard. 4th graders don't just talk about energy, they make a device that changes one kind into another. A battery's stored energy becomes motion in a fan, or light in a bulb, or sound in a buzzer. **The big science idea is that energy doesn't get created, it gets converted from one form to another.**

## SEP

SCIENCE &  
ENGINEERING  
PRACTICE

### Constructing Explanations and Designing Solutions

"Apply scientific ideas to solve design problems."

4th graders take a real science idea, that energy changes form, and use it to solve a building problem. When their circuit doesn't light up, they don't guess randomly. **They use what they know about energy and circuits to make a fix on purpose.**

## CCC

CROSSCUTTING  
CONCEPT

### Energy and Matter

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

Here's the idea students walk out with: energy can travel and change form. In a circuit, the battery's stored energy moves through the wires as electric current, then becomes light in the bulb or motion in the motor. **Same energy, just moved and changed into something new.**

## THE STANDARD

# Modeling Waves

*"Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move."*



## PS4.A • Wave Properties

"Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the wave meets a beach."

A wave is a pattern of motion that repeats. Make a wave on a rope or in water and you see the same shape over and over. Amplitude is how tall the wave is. Wavelength is how far apart the bumps are. **4th graders draw that pattern and label both parts.**



## Developing and Using Models

"Develop a model using an analogy, example, or abstract representation to describe a scientific principle."

4th graders do not just watch a wave. They build a stand-in for it. A drawing, a shaken rope, a bent wire, all stand for the real wave so they can show its parts. **The model just needs to show amplitude and wavelength clearly enough to read.**



## Patterns

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

Waves repeat, and that repeating shape is the pattern. Once 4th graders see the pattern, they can compare waves: this one is taller, that one has bumps closer together. **Spotting how two waves are alike and different is exactly the thinking the standard wants.**

## THE STANDARD

# Reflecting Light & Vision

*"Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen."*



## PS4.B • Electromagnetic Radiation

*"An object can be seen when light reflected from its surface enters the eyes."*

Seeing is a chain. Light starts at a source like the Sun or a lamp. It travels to an object, bounces off, and only then reaches your eyes. 4th graders connect those three parts: a light source, the object, and the eye. **Take away any one part and the object disappears.**



## Developing and Using Models

*"Develop a model to describe phenomena."*

4th graders don't just answer in words. They draw or build a model with arrows showing light traveling: source to object to eye. The model has to describe what is really happening, not just look nice. **A good arrow tells the whole story.**



## Cause and Effect

*"Cause and effect relationships are routinely identified."*

There is a clear cause and a clear effect here. The cause is light bouncing off an object and reaching your eye. The effect is that you see the object. No light reaching your eye means no seeing. **4th graders name which is the cause and which is the effect.**

## THE STANDARD

# Transferring Information

*"Generate and compare multiple solutions that use patterns to transfer information."*



## PS4.C · Information Technologies and Instrumentation

"Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information (convert it from digitized form to voice) and vice versa."

This standard is really about codes. **A code is a pattern that stands for something else, like two drum beats meaning "come home" or a black square meaning "on."** 4th graders design more than one way to send a message using a pattern, try each one, and decide which works best.



## 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 solution."

The key word is multiple. 4th graders don't build one code and stop. They build more than one, then line them up against the same goals: Did the message get through? Was it fast? Could a partner read it? **Comparing two real solutions, with reasons, is the actual skill here.**



## Patterns

"Similarities and differences in patterns can be used to sort and classify designed products."

Every code in this lesson is a pattern. The reason a code works is that the pattern stays the same every time, so a partner can tell beats apart and figure out the message. **4th graders compare patterns from different codes and sort which ones are easy to read and which get mixed up.**

## THE STANDARD

# Internal & External Structures

"Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction."



## LS1.A • Structure and Function

"Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction."

Every body part has a job. A structure is a part. A function is what that part does. Roots hold a plant in place and soak up water. A heart pumps blood. Thorns keep a hungry animal from taking a bite. **4th graders connect a part to its job, and to how that job helps the living thing stay alive.**



## Engaging in Argument from Evidence

"Construct an argument with evidence, data, and/or a model."

4th graders don't just say a part has a job. They back it up. They make a claim like "roots help the plant get water," then point to evidence: the plant with cut roots wilted, the one with roots stayed strong. **The argument is the claim plus the proof, in their own words.**



## Systems and System Models

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

A plant or animal is a system, and the parts are its components. Here's the idea 4th graders carry out the door: the parts work together. Roots grab water, the stem carries it up, the leaves use it. No single part does it alone. **They see a living thing as a team of parts, each helping the whole survive.**



## THE STANDARD

# Animal Senses

*"Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways."*



## LS1.D • Information Processing

*"Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions."*

This isn't five senses memorized off a poster. It's one chain of events: a sense picks up information, the brain figures out what it means, and the body does something about it. **The senses, the brain, and the response all work together as one system.**



## Developing and Using Models

*"Use a model to test interactions concerning the functioning of a natural system."*

4th graders build a model, like a flowchart or a labeled drawing with arrows, that shows information moving from a sense to the brain to an action. The model isn't decoration. **They use it to test their thinking: does my arrow chain actually explain why the animal reacted?**



## Systems and System Models

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

An animal sensing its world is a system: parts that work together. The parts are the senses, the brain, and the body that acts. The interaction is the information passing between them. **Break any link and the whole thing stops working.**

## THE STANDARD

# Landscape Changes

*"Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time."*



## ESS1.C • The History of Planet Earth

"Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed."

Rock layers are like a stack of pages, and the bottom one was laid down first. The fossils trapped inside each layer are clues about what lived there back then. **When 4th graders see shell fossils in a layer above plant fossils, the rock is telling them this place used to be dry land and later became covered by water.**



## Constructing Explanations and Designing Solutions

"Identify the evidence that supports particular points in an explanation."

4th graders aren't just told that a place changed. They point to the exact clue that proves it. **When they say "this used to be underwater," they have to back it up with "because there are shell fossils in this layer."** The skill is matching each part of their story to a real piece of evidence.



## Patterns

"Patterns can be used as evidence to support an explanation."

Here's the idea 4th graders carry out the door: rock layers follow a pattern, and patterns are clues you can trust. In an undisturbed stack, older layers sit on the bottom and newer ones on top. **Because the pattern is so reliable, students can read it like evidence and say what the landscape used to look like.**

## THE STANDARD

# Weathering & Rate of Erosion

*"Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation."*



## ESS2.A • Earth Materials and Systems

*"Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around."*

This standard is about how the land slowly changes. Water, ice, wind, and even plants break rocks into smaller pieces and carry them away. 4th graders don't memorize a list. **They run a test, like pouring water down a sand hill, and watch the land change in front of them.**



## Planning and Carrying Out Investigations

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

4th graders aren't told how fast erosion happens and asked to repeat it. They build a little hill, pour the water, and measure how much sand washed to the bottom. That number is their data. **The skill is collecting it carefully so it can back up what they say later.**



## Cause and Effect

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

Here's the big idea 4th graders carry out the door: the land didn't just change on its own. Something caused it. More water means more erosion. Plant roots holding the soil means less. **4th graders test the cause and watch the effect change.**

## THE STANDARD

# Earth's Features

*"Analyze and interpret data from maps to describe patterns of Earth's features."*



## ESS2.B • Plate Tectonics and Large-Scale System Interactions

"The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth."

This isn't about memorizing where one mountain sits. **It's about noticing that Earth's biggest features line up in patterns.**



## Analyzing and Interpreting Data

"Analyze and interpret data to make sense of phenomena using logical reasoning."

A map IS data. 4th graders aren't told the answer, they dig it out of the map themselves. **They look at where the symbols sit, notice what repeats, and reason their way to "these aren't random." The skill is turning a busy map into one clear sentence about a pattern.**



## Patterns

"Patterns can be used as evidence to support an explanation."

Here's the big idea 4th graders walk away with: a pattern is proof. When the volcanoes and earthquakes keep landing in the same bands, that repeating shape becomes evidence. **It tells us something real is happening underground in those exact places, even before we know what.**

## THE STANDARD

# Energy & Fossil Fuels

*"Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment."*



## ESS3.A • Natural Resources

*"Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not."*

Every bit of energy we use starts somewhere on Earth. The gas in a car comes from oil. The power in an outlet might come from coal, wind, sun, or water behind a dam. **Here is what 4th graders connect: getting and using that energy changes the land, air, and animals.**



## Obtaining, Evaluating, and Communicating Information

*"Obtain and combine information from books and other reliable media to explain phenomena."*

4th graders aren't expected to already know this. They go find it. They pull facts from a book, a kid-friendly article, or a short video, then put pieces from different sources together into one clear description. **The skill is choosing trustworthy sources and combining what they say, not just copying one page.**



## Cause and Effect

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

This is the thread that holds the whole standard together. Using an energy resource is the cause. A change to the environment is the effect. Burning coal causes dirtier air. Building a dam causes a flooded valley and lost animal homes. **4th graders practice spotting that cause-to-effect link every time.**

## THE STANDARD

# Solutions to Natural Hazards

*"Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans."*



## ESS3.B • Natural Hazards

"A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts."

4th graders learn one honest truth: nobody can stop an earthquake, a flood, a tsunami, or a volcano. Those are natural Earth processes and they're going to happen. But people are not helpless. We can build smarter, warn earlier, and plan ahead so fewer people get hurt. The job isn't to stop the hazard. **It's to shrink the damage it causes.**



## 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 solution."

This standard is engineering, so 4th graders don't just have one idea. They come up with several solutions, then hold them up against each other. Which one protects the most people? Which one fits the rules, like only using the materials we have? Comparing is the real skill. One idea is a guess. **Three ideas you can test and rank is engineering.**



## Cause and Effect

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

Every hazard is a cause that leads to an effect. A flood (cause) washes out a road (effect). 4th graders trace that chain, then design something that breaks it or softens it. A levee blocks the rising water, so the road stays dry. **When they test a solution, they're checking whether their fix really changes the effect, not just hoping it does.**

## 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.**

