

Selecting Natural Phenomena to Drive Science Instruction and Assessment

1. What are Natural Phenomena and why do we need them?

Natural phenomena are observable events that can be explained and/or predicted using our knowledge of science. Natural phenomena can occur anywhere in the universe. Natural phenomena can be:

- observed first-hand in and around the classroom,
- introduced using pictures, videos, graphs, or tables,
- or introduced using a short story or demonstration.

After a natural phenomenon is introduced it should always be followed by a detailed description of the observable event so that it is clear what observable event we are trying to make sense of. For example:

- There is very little or no grass around the trees in the school yard.
- The sky is changing colors as the sun is setting.
- A marble released from a greater height causes a louder sound when it hits the floor.

Natural phenomena provide students with opportunities to **USE Core Ideas** and **Crosscutting Concepts** and engage in **Practices** to make sense of observable events in the world. Once students make sense of and construct an explanation for a phenomenon they can now also make sense of a host of **analogous phenomena**. If a student can explain why water condenses on the outside of a glass of ice water, they can now also explain why the mirror in the bathroom fogs up after a shower, or why they can see their breath on a cold day.

2. What makes a Good Natural Phenomenon?

Phenomena should be **SPECIFIC, OBSERVABLE, GRADE-APPROPRIATE, and RELEVANT (SOAR)**

a. Natural Phenomena should be **SPECIFIC**

Natural phenomenon should be as specific as possible so that students can collect data and obtain information about the phenomenon.

Non-specific natural phenomena	Specific natural phenomena
Hurricanes	Hurricane Michal increased in strength from a tropical storm to a category 4 hurricane in two days.
Bat populations in New Jersey are changing.	The Big Brown Bat population in New Jersey has increased since 2009, while the Little Brown Bat population has decreased dramatically.
Sweat sometimes smells.	The classroom smells bad after students come back from gym.

b. Natural Phenomena should be **Observable**

Observable through	Example natural phenomenon
Direct observations	Ice cubes float on top of water.
Observations using technological aids	Animal and plant cells look different.
Picture (or sets to show change)	The Dutch shore line has changed significantly over the past 500 years.
Video (including slow/fast motion)	When a golf ball is hit by a golf club its shape changes instantaneously.
Stories	Students are camping and in the middle of the night they feel water dripping inside their tent. They look outside and it is a clear night.
Data graph or table	The Yellowstone ecosystem changed after wolves were reintroduced.

c. Natural Phenomena should be **GRADE-APPROPRIATE**

Grade-appropriate natural phenomena can be explained at some level with the Core Ideas that the teacher introduced for the first time, were introduced earlier in the grade or in previous grades. These core ideas can be found in the Core Ideas Matrix or the NGSS Standard pages and are related to the topics listed on the next page:

REMEMBER: PHENOMENA DO NOT NEED TO BE PHENOMENAL!

Grades K-5	Grades 6-12
Grade K: Pushes & Pulls; Ecosystems; Weather & Climate Grade 1: Light & Sound; Structure and Function of Living Things; Patterns and Cycles of Sun, Moon, and Stars Grade 2: Structure and Properties of Matter: Heating & Cooling; Ecosystems; Processes that Shape the Earth Grade 3: Force & Motion; Ecosystems; Life Cycles; Weather & Climate Grade 4: Energy; Waves; Structure and Function of Living Things; Processes that Shape the Earth Grade 5: Structure and Properties of Matter: Mixtures & Solutions; Ecosystems; Earth Systems; Solar System	Physical Science: Structure of Matter; Chemical Reactions; Force & Motion; Energy; Waves Life Science: Structure and Processes in Living Things; Ecosystems; Heredity; Evolution Earth and Space Science: Earth Systems; Weather & Climate; Human Impacts; Earth, Sun, Moon System; Solar System; Galaxies and the Universe

d. Natural Phenomena should be RELEVANT

Selecting phenomena that students find interesting, relevant, and consequential helps support their engagement. A good phenomenon builds on every day or family experiences: who students are, what they do, where they came from. Such phenomena highlight how science ideas help us explain aspects of the world that matter to students, their communities, and society. Below are some example for students in urban or suburban/rural schools.

Urban schools	Suburban or rural schools
It is 20 degrees hotter on the subway platform than on the street.	I don't like going up to my attic in the summer because it is so hot up there.
They stopped construction next door and now the lot is overgrown with vegetation.	There have been an increased number of bear sightings in our town over the past two years.

3. Questions, concepts, processes, explanations, and activities are NOT natural phenomena!

NOT a natural phenomenon	Natural phenomena
Questions are <u>NOT</u> natural phenomena <ul style="list-style-type: none"> Why are deer coming into our neighborhood? Why are some apples crispier than others? 	Observable events lead to questions: <ul style="list-style-type: none"> Over the past three months, we have seen an increasing number of deer in our neighborhood. Some apples are crisp while others are soft.
Concepts, processes, or explanations are <u>NOT</u> natural phenomena: <ul style="list-style-type: none"> Forces change the motion of objects (concept) The water cycle (process) Photosynthesis (process) Oxidation reactions change the colors of apples (explanation) 	Understanding of concepts is used to construct explanations for natural phenomena; natural phenomena are examples of processes: <ul style="list-style-type: none"> I can use my feet/hands to change the speed and direction of a soccer ball. It rains more often in the mountains than in the valleys. I planted a small seed which has grown into a huge tree. My cut-up apple is turning brown after I leave it on the table for a few hours.
Activities/investigations are <u>NOT</u> natural phenomena: <ul style="list-style-type: none"> Using shadows to track the motion of the Sun. Using a stream table to investigate erosion. 	Natural phenomena will lead students to plan and carry out investigations: <ul style="list-style-type: none"> My shadow is changing during the day. The creek has gotten wider over the past two decades.

References and Resources

NGSS Phenomena (ngssphenomena.com)

STEM Teaching Tools 42 - Using Phenomena in NGSS-Designed Lessons and Units (STEMteachingtools.org/brief/42)

Teaching Science is Phenomenal: Using Phenomena to Engage Students in Three-dimensional Science Performances Consistent with the NRC Framework and the NGSS (teachingscienceisphenomenal.org)

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