
Physics of Sight



Fourth-Grade Teacher Resource Guide

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Physics of Sight Lesson Summary and Vocabulary

Lesson Summary: The YSI *Physics of Sight* program touches on topics in biology, neuroscience, and physics to offer a basic overview of vision and light. The class begins by helping to complete a layered poster of an eye, learning about how each of its structures functions in human sight. They next apply this newfound understanding to a series of optical illusions, learning about the blind spot in the human eye and the way the brain processes visual information. Finally, students explore the nature of the light spectrum through prism experiments and build a spectroscope they can take home.

Vocabulary: Below are words and concepts that relate to the *Physics of Sight* program.

Blood vessel: Any of the vessels (arteries, veins, or capillaries) through which blood circulates.

Cornea: The transparent part of the sclera covering the iris and the pupil

Fovea: A small pit or depression in a bone or other structure.

Iris: The ring of muscle forming the colored portion of the eye and containing a circular opening, the pupil, in its center.

Lens: A convex, transparent part of the eye behind the iris that focuses light on the retina.

Light: Electromagnetic radiation visible to the eye.

Optic nerve: Cranial nerves consisting of sensory fibers that conduct impulses from the retina to the brain.

Pupil: The expanding and contracting opening in the iris of the eye, through which light passes to the retina.

Refraction: The change of direction of a ray, such as light, in passing from one medium into another in which its velocity is different.

Reflection: The return of light, heat, sound, etc., after striking a surface.

Retina: The innermost layer of the back of the eyeball that receives the image produced by the lens.

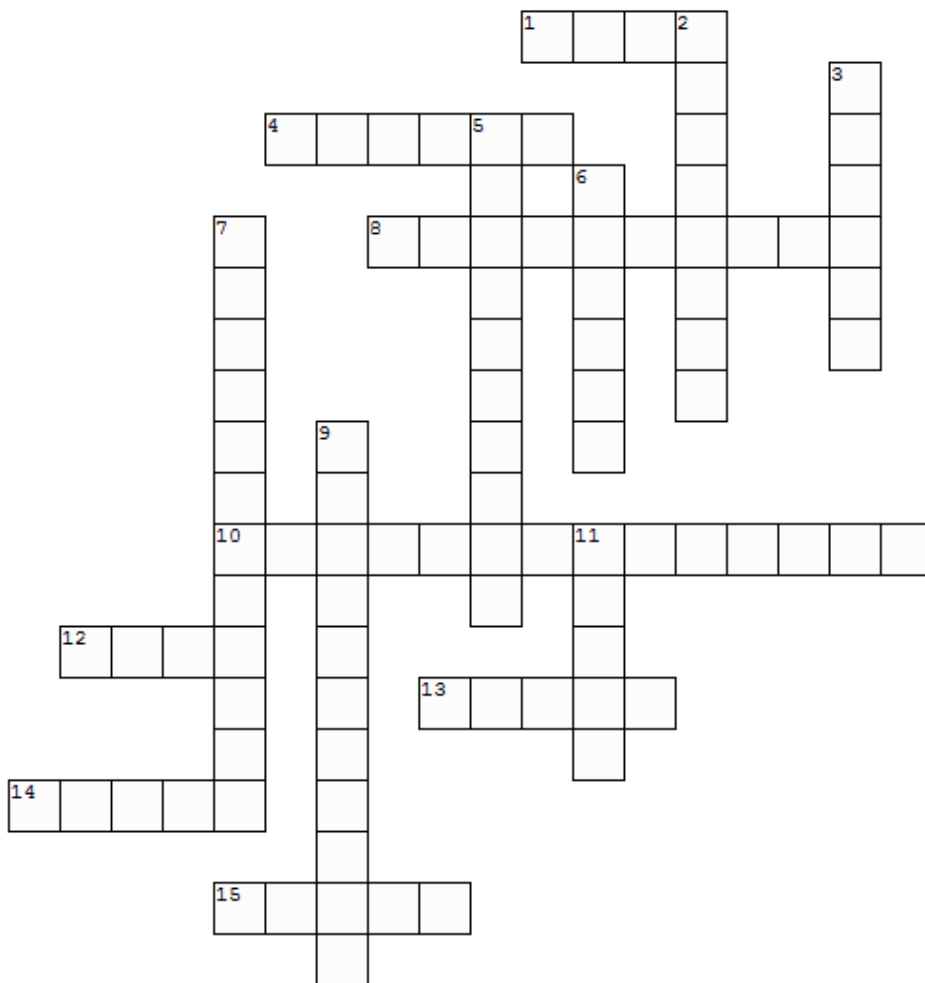
Sclera: A dense, white membrane that forms the external covering of the eyeball.

Sight: Perception of objects by use of the eyes

Spectrum: The band of colors produced when sunlight is passed through a prism, comprising a rainbow

Vitreous humor: The transparent gelatinous substance filling the eyeball behind the lens.

**Physics of Sight
 Language Arts Crossword Puzzle**



- | | | | | | | | |
|--------------|------------|--------|--------|-------|----------|----------------|-------|
| BLOOD VESSEL | CORNEA | FOVEA | IRIS | LENS | LIGHT | OPTIC NERVE | PUPIL |
| REFRACTION | REFLECTION | RETINA | SCLERA | SIGHT | SPECTRUM | VITREOUS FLUID | |

Across

- A convex, transparent part of the eye behind the iris that focuses light on the retina.
- A dense, white membrane that forms the external covering of the eyeball.
- The return of light, heat, sound, etc., after striking a surface.
- The transparent gelatinous substance filling the eyeball behind the lens
- The ring of muscle forming the colored portion of the eye and containing a circular opening, the pupil, in its center..
- Electromagnetic radiation visible to the eye.
- The expanding and contracting opening in the iris of the eye, through which light passes to the retina
- A small pit or depression in a bone or other structure.

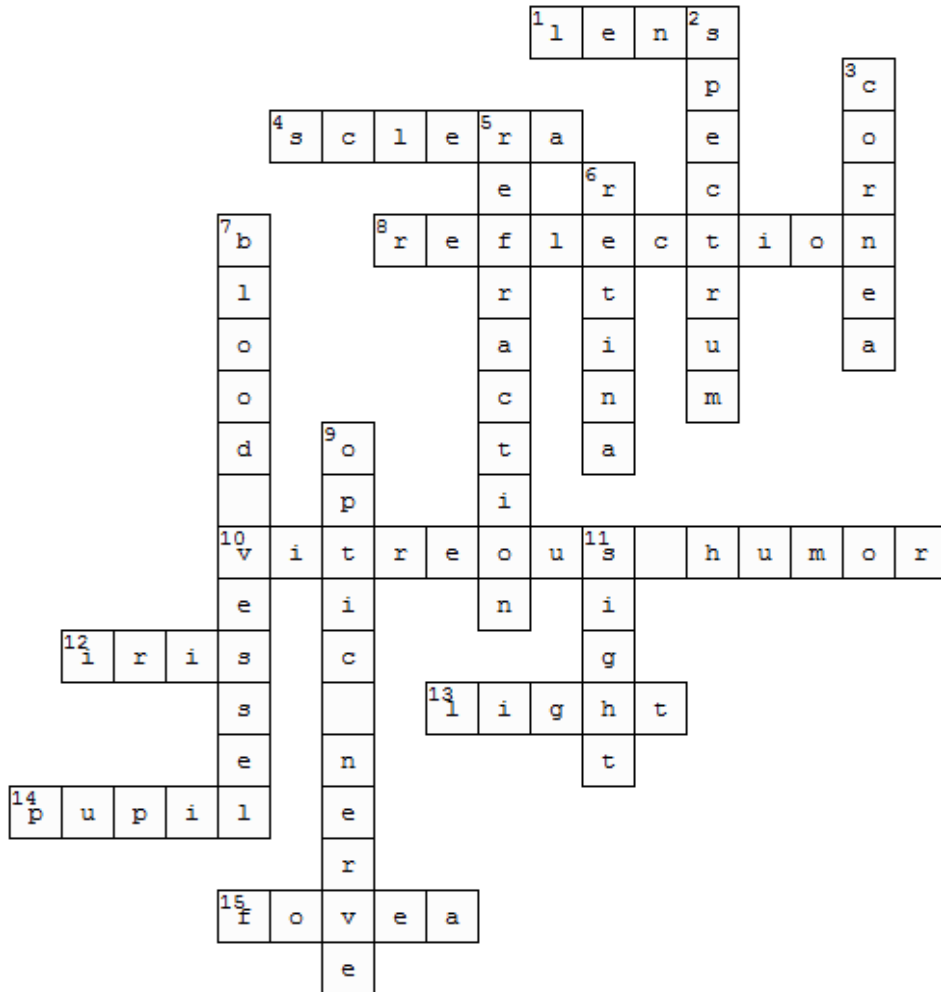
Down

- The band of colors produced when sunlight is passed through a prism, comprising a rainbow
- The transparent part of the sclera covering the iris and the pupil.
- The change of direction of a ray, such as light, in passing from one medium into another in which its velocity is different.
- The innermost layer of the back of the eyeball that receives the image produced by the lens.
- Any of the vessels (arteries, veins, or capillaries) through which blood circulates.
- Nerves consisting of sensory fibers that conduct impulses from the retina to the brain
- Perception of objects by use of the eyes

Answer Key

Physics of Sight

Language Arts Crossword Puzzle



Across

1. A convex, transparent part of the eye behind the iris that focuses light on the retina (**lens**).
4. A dense, white membrane that forms the external covering of the eyeball (**sclera**).
8. The return of light, heat, sound, etc., after striking a surface (**reflection**).
10. The transparent gelatinous substance filling the eyeball behind the lens (**vitreous humor**).
12. The ring of muscle forming the colored portion of the eye and containing a circular opening, the pupil, in its center (**iris**).
13. Electromagnetic radiation visible to the eye (**light**).
14. The expanding and contracting opening in the iris of the eye, through which light passes to the retina (**pupil**).
15. A small pit or depression in a bone or other structure (**fovea**).

Down

2. The band of colors produced when sunlight is passed through a prism, comprising a rainbow (**spectrum**).
3. The transparent part of the sclera covering the iris and the pupil (**cornea**).
5. The change of direction of a ray, such as light, in passing from one medium into another in which its velocity is different. (**refraction**).
6. The innermost layer of the back of the eyeball that receives the image produced by the lens (**retina**).
7. Any of the vessels (arteries, veins, or capillaries) through which blood circulates (**blood vessel**).
9. Nerves consisting of sensory fibers that conduct impulses from the retina to the brain (**optic nerve**).
11. Perception of objects by use of the eyes (**sight**).

Physics of Sight Language Arts Word Search

Circle the vocabulary in the word search below. Can you find all the earth-related words?

O	P	T	I	C	N	E	R	V	E	A	D	Z	B	T	I
P	H	I	R	D	T	Y	S	R	F	G	S	K	O	O	A
R	M	L	E	D	I	I	E	C	O	R	N	E	A	P	L
E	X	F	F	K	R	N	S	P	E	C	T	R	U	M	K
E	G	O	R	I	W	L	T	U	D	J	F	O	I	U	S
G	B	V	A	T	F	J	U	W	J	K	E	Z	F	W	L
C	T	E	C	A	R	E	L	C	S	A	R	D	H	S	E
Z	S	A	T	F	Y	I	A	N	I	T	E	R	F	M	S
B	Z	V	I	T	R	E	O	U	S	H	U	M	O	R	S
E	W	Q	O	T	M	I	Z	L	D	S	I	G	H	T	E
N	L	C	N	G	J	W	B	Y	I	K	N	W	T	C	V
P	O	R	W	E	Y	H	Y	S	S	P	F	E	J	Z	D
D	R	E	F	L	E	C	T	I	O	N	U	J	L	F	O
A	O	V	L	Z	W	U	Y	I	W	Y	Q	P	N	J	O
O	C	K	Z	J	W	Z	K	H	M	G	R	X	E	P	L
A	Z	V	K	Y	Q	M	Y	S	L	I	G	H	T	X	B

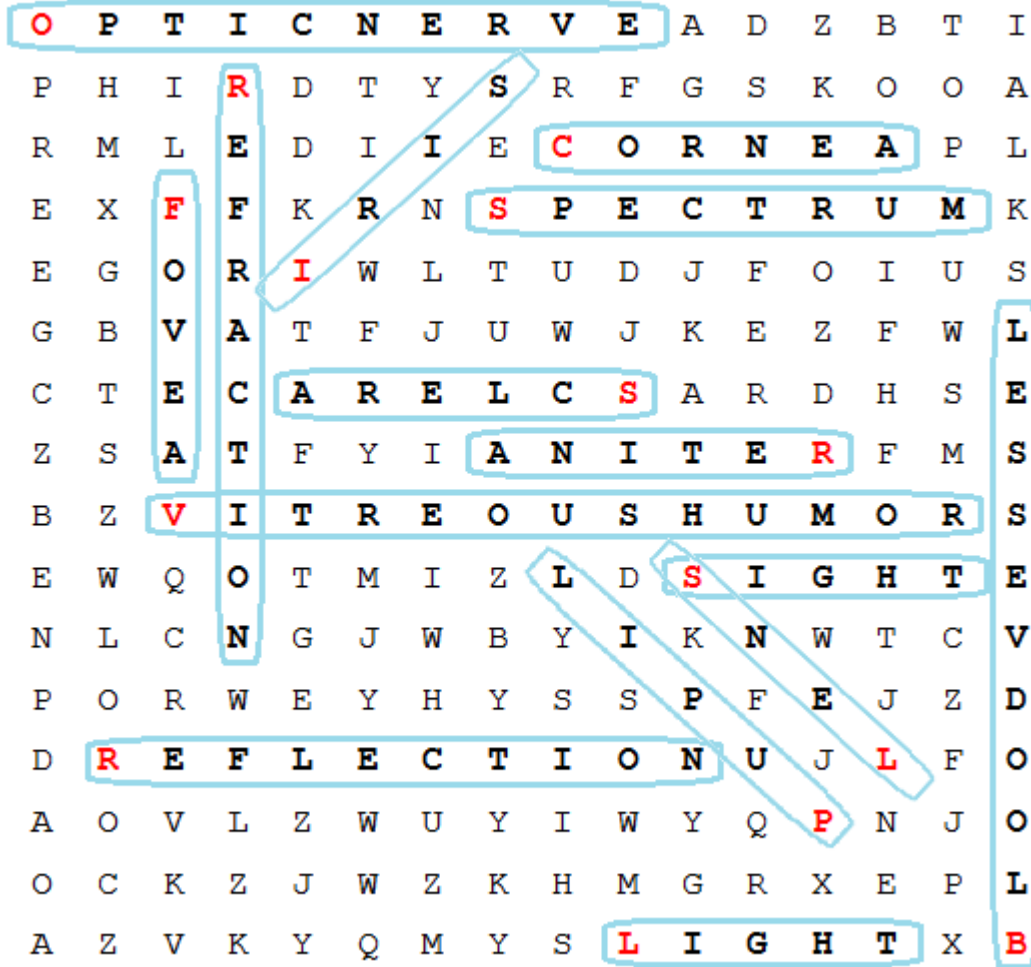
Word Bank

BLOOD VESSEL
CORNEA
FOVEA
IRIS
LENS

LIGHT
OPTIC NERVE
PUPIL
REFRACTION
REFLECTION

RETINA
SCLERA
SIGHT
SPECTRUM
VITREOUS HUMOR

Answer Key
Physics of Sight
Language Arts Word Search



Word Bank

BLOOD VESSEL
CORNEA
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Physics of Sight Extension Activities

The extension activities listed below are from RAFT (Resource Area For Teaching). RAFT educational content is available online (www.raftbayarea.org) at no cost and is aligned to California Science Standards and Next Generation Science Standards. Below is a selection of post-visit activities from RAFT to build on student learning about physics and sight.

[RAFT Idea: Café Wall Illusion - Resource Area For Teaching - RAFT Bay Area](#)

Grades Covered: 4 through 12

Subjects Covered: Physical Science, Life Science

Curriculum topics: Vision, Function of the Eye, Illusion

Description: Students learn about how their eyes function with this fun illusion

<http://www.raftbayarea.org/ideas/Cafe%20Wall%20Illusion.pdf>

[RAFT Idea: Animated Flip Books - Resource Area For Teaching - RAFT Bay Area](#)

Grades Covered: 2 through 8

Subjects Covered: Physical Science, Life Science, Art

Curriculum topics: Eye, Persistence of Vision, Animation

Description: This fun activity will give students the opportunity to create basic animations that can help them understand how motion pictures and the human eye work.

<http://www.raftbayarea.org/ideas/Animated%20Flip%20Books.pdf>

[RAFT Idea: Eye See It - Resource Area For Teaching - RAFT Bay Area](#)

Grades Covered: 3 through 12

Subjects Covered: Physical Science, Life Science

Curriculum topics: Optics, Anatomy, Vision, Structure, Function of the Eye

Description: Use a bulk CD container to model parts of the eye and their functions.

<http://www.raftbayarea.org/ideas/Eye%20See%20It.pdf>

[RAFT Idea: Image Viewer - Resource Area For Teaching - RAFT Bay Area](#)

Grades Covered: 3 through 12

Subjects Covered: Physical Science, Life Science

Curriculum topics: Light, Optics, Refraction

Description: Explore images formed by a pinhole and a lens. See what the eye really "sees" - an inverted image!

<http://www.raftbayarea.org/ideas/Image%20Viewer.pdf>

Physics of Sight Education Standards

This page references California Science Content Standards, Common Core, and Next Generation Science Standards, which students will be exposed to during the program.

California Science Content Standards Fourth Grade:

Physical Sciences: 1. Electricity and magnetism are related effects that have many useful applications in everyday life. As a basis for understanding this concept:

- g.** Students know electrical energy can be converted to heat, light, and motion.

Investigation and Experimentation: 5. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

- a.** Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- b.** Measure and estimate the weight, length, or volume of objects.
- c.** Formulate and justify predictions based on cause-and-effect relationships.
- d.** Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- f.** Follow a set of written instructions for a scientific investigation.

Excerpted from CA State Standards: <http://www.cde.ca.gov/>

Common Core Fourth Grade:

Speaking and Listening Standards: Students will...

- 1.** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.
 - a.** Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.
 - b.** Follow agreed-upon rules for discussions and carry out assigned roles.
 - c.** Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.
 - d.** Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
- 2.** Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- 3.** Identify the reasons and evidence a speaker or media source provides to support particular points

Excerpted from Common Core Standards: <http://www.corestandards.org/>

Next Generation Science Standards Fourth Grade: Energy

- **4-PS3-2:** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
 - **Science and Engineering Practices:**
 - **Planning and Carrying Out Investigations:** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
 - Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)
 - **Disciplinary core ideas:**
 - **PS3.A: Definitions of Energy:** Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2)
 - **PS3.B: Conservation of Energy and Energy Transfer** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2)
 - Light also transfers energy from place to place. (4-PS3-2)
 - 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. (4-PS3-2)
 - **Crosscutting Concepts:**
 - **Energy and Matter:** Energy can be transferred in various ways and between objects. (4-PS3-2)

Structure, function and information processing

- **4-PS4-2.** Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
 - **Science and Engineering Practices:**
 - **Developing and Using Models:** Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
 - Develop a model to describe phenomena. (4-PS4-2)
 - **Disciplinary core ideas:**
 - **PS4.B: Electromagnetic Radiation:** An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)
 - **Crosscutting Concepts:**
 - **Cause and Effect:** Cause and effect relationships are routinely identified. (4-PS4-2)
- **4-LS1-1:** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
 - **Science and Engineering Practices**
 - **Engaging in Argument from Evidence:** builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed worlds
 - Construct an argument with evidence, data, and/or a model. (4-LS1-1)
 - **Disciplinary Core Ideas**

Physics of Sight Education Standards

- **LS1.A: Structure and Function:** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)
 - **Crosscutting Concepts**
 - **Systems and System Models:** A system can be described in terms of its components and their interactions. (4-LS1-1)
- **4-LS1-2:** 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.
 - **Science and Engineering Practices**
 - **Developing and Using Models:** builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2).
 - **Disciplinary Core Ideas**
 - **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. (4-LS1-2)
 - **Crosscutting Concepts**
 - **Systems and System Models:** A system can be described in terms of its components and their interactions. (4-LS1-2)

Engineering Design

- **3-5-ETS1-2.** 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.
 - **Science and Engineering Practices:**
 - **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
 - Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)
 - **Disciplinary core ideas:**
 - **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. (3-5-ETS1-2)
 - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
 - **Crosscutting Concepts**
 - **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. (3-5-ETS-2)
- **3-5-ETS1-3:** 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.

Physics of Sight Education Standards

- **Science and Engineering Practices:**
 - **Planning and Carrying Out Investigations:** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
 - 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. (3-5-ETS1-3)
- **Disciplinary core ideas:**
 - **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. (3-5-ETS1-3)
 - **ETS1.C: Optimizing the Design Solution:** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Excerpted from NGSS: <http://www.nextgenscience.org/>