

Not Sure Where to Go From Here?

The challenges are grouped by grade level. Choose from the two options below.

[Click here for Elementary Challenges](#)

[Click here for Middle School Challenges](#)

AWIM Elementary Challenges By Grade Level Based on Standards Alignment

Kindergarten	1 st Grade	2 nd Grade	3 rd Grade	4 th Grade	5 th Grade
<ul style="list-style-type: none">• Rolling Things• Making Music	<ul style="list-style-type: none">• Rolling Things• Engineering Inspired By Nature• Making Music	<ul style="list-style-type: none">• Pinball Designer• Engineering Inspired By Nature• Straw Rockets• Making Music	<ul style="list-style-type: none">• Pinball Designer• Straw Rockets• Engineering Inspired By Nature• Skimmer	<ul style="list-style-type: none">• Skimmer• JetToy• Programming Each Other	<ul style="list-style-type: none">• JetToy• Gravity Cruiser• Programming Each Other

AWIM Middle School Challenges By Grade Level Based on Standards Alignment

6 th Grade	7 th Grade	8 th Grade
<ul style="list-style-type: none">• <u>Gravity Cruiser</u>• <u>Motorized Toy Car</u>• <u>Fuel Cell</u>• <u>Keeping Our Networks Secure</u>• <u>Programming Each Other</u>	<ul style="list-style-type: none">• <u>Gravity Cruiser</u>• <u>Motorized Toy Car</u>• <u>Fuel Cell</u>• <u>Glider</u>• <u>Keeping Our Networks Secure</u>	<ul style="list-style-type: none">• <u>Motorized Toy Car</u>• <u>Fuel Cell</u>• <u>Glider</u>• <u>Keeping Our Networks Secure</u>

Rolling Things

In this challenge, students are experimenting with how ramp height and car weight affect momentum. Ramp height affects the velocity of the car when it strikes the crash box—the greater the height of the ramp, the greater the velocity of the car when it reaches the bottom of the ramp. Because momentum is the product of velocity and mass, it is greater when velocity is greater. The same holds true for mass—the greater the mass, the greater the velocity.

NGSS

- [Kindergarten – Grade 1](#)
- Engineering Design
- Forces and Interactions: Pushes and Pulls

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
- [Kindergarten](#)
 - Measurement and Data
- [Grade 1](#)
 - Measurement and Data

Common Core ELA

- [Kindergarten](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening
- [Grade 1](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening

NGSS for Rolling Things

Physical Sciences Strand

K.Forces and Interactions: Pushes and Pulls

[K-PS2-1](#). Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

[K-PS2-2](#). Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull.

Engineering, Technology, and Applications of Science Strand

K-2.Engineering Design

[K-2-ETS1-1](#). Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

[K-2-ETS1-2](#). Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

[K-2-ETS1-3](#). Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Common Core Mathematics Standards for Rolling Things

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.

Kindergarten → Measurement and Data

Describe and compare measurable attributes.

- [CCSS.Math.Content.K.MD.A.1](#) Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
- [CCSS.Math.Content.K.MD.A.2](#) Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference. *For example, directly compare the heights of two children and describe one child as taller/shorter.*

Grade 1 → Measurement and Data

Measure lengths indirectly and by iterating length units

- [CCSS.Math.Content.1.MD.A.1](#) Order three objects by length; compare the lengths of two objects indirectly by using a third object.
- [CCSS.Math.Content.1.MD.A.2](#) Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.*

Common Core ELA/Literacy Standards for Rolling Things

Kindergarten → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.K.1](#) With prompting and support, ask and answer questions about key details in a text.
- [CCSS.ELA-Literacy.RI.K.3](#) With prompting and support, describe the connection between individuals, events, ideas, or pieces of information in a text.

Kindergarten → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.K.7](#) Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them).

Kindergarten → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.K.3](#) Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

Presentation of Knowledge and Ideas

- [CCSS.ELA-Literacy.SL.K.5](#) Add drawings or other visual displays to descriptions as desired to provide additional detail.

Common Core ELA/Literacy Standards for Rolling Things

Grade 1 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.1.1](#) Ask and answer questions about key details in a text.
- [CCSS.ELA-Literacy.RI.1.3](#) Describe the connection between individuals, events, ideas, or pieces of information in a text.

Grade 1 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.1.2](#) Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.

Grade 1 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.1.1](#) Participate in collaborative conversations with diverse partners about *grade 1 topics and texts* with peers and adults in small and larger groups.

Presentation of Knowledge and Ideas

- [CCSS.ELA-Literacy.SL.1.5](#) Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.

Making Music

In this challenge, students explore the how, what and why of sound and vibration through interactive lessons. Students learn how the human eardrum works and explore concepts such as pitch and longitudinal and transverse waves. Working in teams, they will collect information through hands-on investigation and observation to engineer a musical instrument according to specific criteria.

NGSS

Grade K-2

- **Engineering Design**
- **Structure and Properties of Matter**
- **Energy**

Grade 3-5

- **Engineering Design**
- **Motion and Stability: Forces and Interactions**
- **Conservation of Energy and Energy Transfer**
- **Energy**
- **Waves**

Common Core ELA

Grade 2

- **Reading Informational Text**
- **Writing**
- **Speaking and Listening**

Grade 3

- **Reading Informational Text**
- **Writing**
- **Speaking and Listening**

NGSS for Making Music

Engineering, Technology, and Applications of Science Strand

K-2. Engineering Design

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2 Develop a simple model based on evidence to represent a proposed object or tool.

K-2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

3-5. Engineering Design

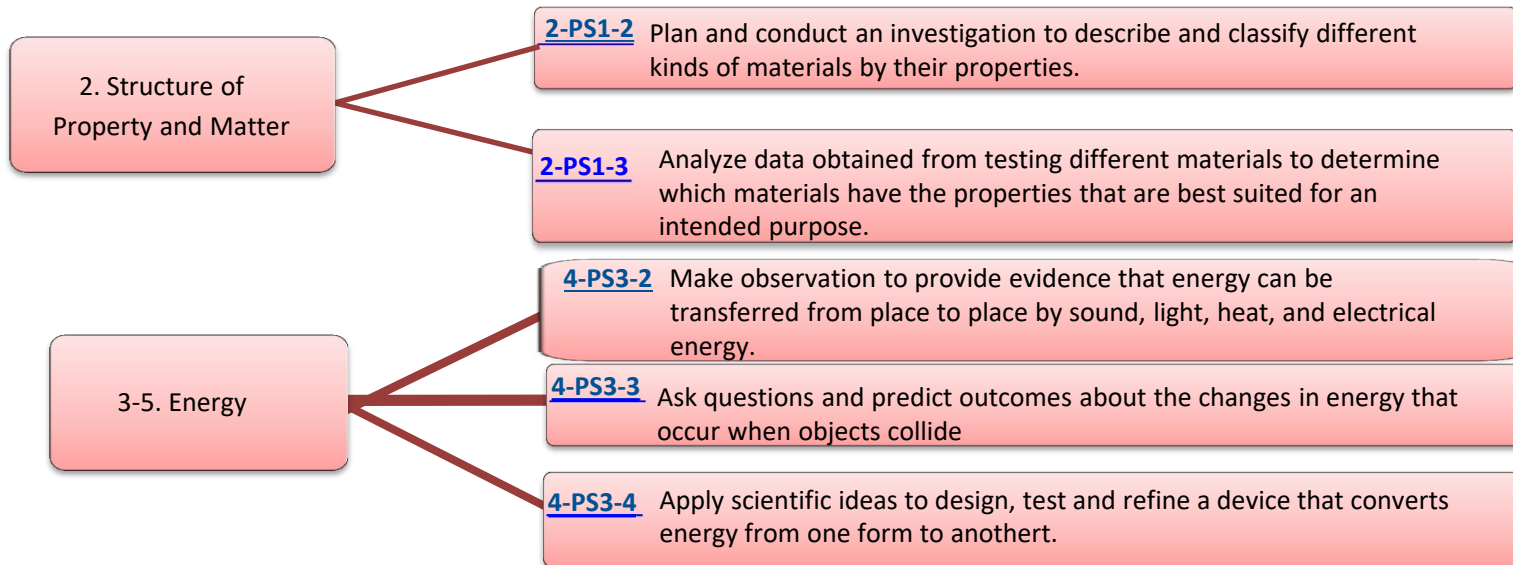
3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for constraints on materials, time or cost

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is related to the constraints of the problem.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered in a model or prototype to be improved.

NGSS for Making Music

Physical Sciences Strand



NGSS for Making Music

Physical Sciences Strand

3-5. Motion and Stability: Forces and Interactions

[3-PS2-2](#) Make observations and /or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

K-2. Waves: Light and Sound

[1-PS4-1](#) Plan and conduct an investigation to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.

[1-PS4-4](#) Use tools and materials to design and build a device that uses light or sound to solve problems of communicating over a distance.

3-5. Waves: Light and Sound

[4-PS4-1](#) Develop a model of waves to observe patterns in terms of amplitude and wavelength and that waves cause objects to move.

Common Core ELA/Literacy Standards for Making Music

Grade 2 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.2.1](#) Ask and answer such questions as who, what, where, when, why and how to demonstrate understanding of key details in a text.
- [CCSS.ELA-Literacy.RI.2.2](#) Identify the main topic of a multi-paragraph text as well as the focus of specific paragraphs within the text.
- [CCSS.ELA-Literacy.RI.2.3](#) Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.

Grade 2 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.2.1](#) Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g. because, and, also) to connect opinion and reasons, and provide a concluding statement or section.
- [CCSS.ELA-Literacy.W.2.2](#) Write informative/explanatory texts which they introduce a topic, use facts and definitions to develop points and provide a concluding statement or section.
- [CCSS.ELA-Literacy.W.2.7](#) Participate in shared research and writing project to produce a report; record science observations.
- [CCSS.ELA-Literacy.W.2.8](#) Recall information from experiences or gather information from provided sources to answer a question.

Grade 2 → Speaking and Listening

Comprehension and Collaboration

- [CCSA.ELA-Literacy.SL.2.1](#) Participate in collaborative conversations with diverse partners about gradeopics and texts with peers and adults in small and larger groups.
- [CCSA.ELA-Literacy.SL.2.1A](#) Follow agreed upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion.)
- [CCSA.ELA-Literacy.SL.2.1B](#) Build on others' talk in conversations by linking their comments to the remarks of others.
- [CCSA.ELA-Literacy.SL.2.1C](#) Ask for clarification and further explanation as needed about the topics and texts under discussion.
- [CCSA.ELA-Literacy.SL.2.2](#) Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
- [CCSA.ELA-Literacy.SL.2.3](#) Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.

Presentation of Knowledge and Ideas

- [CCSA.ELA-Literacy.SL.2.4](#) Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.
- [CCSA.ELA-Literacy.SL.2.5](#) Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experience when appropriate to clarify ideas, thoughts and feelings.

Grade 3 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.3.1](#) Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for answers.
- [CCSS.ELA-Literacy.RI.3.2](#) Determine the main ideas of a text; recount the key details and explain how they support the main idea.
- [CCSS.ELA.Literacy.RI.3.4](#) Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area
- [CCSS.ELA.Literacy.RI.3.6](#) Distinguish their own point of view from that of the author of a text.
- [CCSS.ELA.Literacy.RI.3.7](#) Use informed gained from illustrations and the words in a text to demonstrate understanding of the text (e.g. where, when, why, and how key events occur.)
- [CCSS.ELA.Literacy.RI.3.8](#) Describe the logical connection between particular sentence and paragraphs in a text (e.g., comparison, cause/effect, first/second/third/sequence.)

Grade 3 → Writing

- [CCSSELA-Literacy.W3.1](#) Write opinion pieces on topics or texts, supporting a point of view with reasons.
- [CCSSELA-Literacy.W3.1B](#) Provide reasons that support the opinion.
- [CCSSELA-Literacy.W3.1C](#) Use linking words and phrases (e.g., because, therefore, since, for example) to connect opinion and reasons.
- [CCSSELA-Literacy.W3.2](#) Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
- [CCSSELA-Literacy.W3.2B](#) Develop the topic with facts, definitions, and details.

Grade 3 → Speaking and Listening

CCSS.ELA-Literacy.SL.3.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.

CCSS.ELA-Literacy.SL.3.1A 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.

CCSS.ELA-Literacy.SL.3.1B Follow agreed upon rules for discussion (e.g. gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion.)

CCSS.ELA-Literacy.SL.3.1C Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others.

CCSS.ELA-Literacy.SL.3.1D Explain their own ideas and understanding in light of the discussion.

CCSS.ELA-Literacy.SL.3.2 Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and or orally.

CCSS.ELA-Literacy.SL.3.3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.

CCSS.ELA-Literacy.SL.3.6 Speak in complete sentences when appropriate to the task and situation in order to provide requested detail or clarification.

Pinball Designer

Students are using scientific inquiry-based approaches to experiment with homemade pinball machines. The challenge emphasizes the practices of testing and optimization, asking students to test and refine various aspects of their pinball game in order to meet certain design specifications. From a science perspective, they will be able to explore potential energy, kinetic energy, inclined planes, and gravity by changing the height on the launch ramp from which they launch the pinball.

NGSS

- [Grade 2](#)
 - Engineering Design
 - Structures and Properties of Matter
- [Grade 3](#)
 - Forces and Interactions

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
 - Model with mathematics
 - Use appropriate tools strategically

Common Core ELA

- [Grade 2](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening
- [Grade 3](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening

NGSS for Pinball Designer

Physical Sciences Strand

2. Structure and Properties of Matter

[2-PS1-2](#). Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

3. Forces and Interactions

[3-PS2-1](#). Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

[3-PS2-2](#). Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Engineering, Technology, and Applications of Science Strand

K-2. Engineering Design

[K-2-ETS1-1](#). Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

[K-2-ETS1-2](#). Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

[K-2-ETS1-3](#). Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Common Core Mathematics Standards for Pinball Designer

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.
- [CCSS.Math.Practice.MP5](#) Use appropriate tools strategically.

Common Core ELA/Literacy Standards for Pinball Designer

Grade 2 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.2.1](#) Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RI.2.7](#) Explain how specific images (e.g., a diagram showing how a machine works) contribute to and clarify a text.

Grade 2 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.2.7](#) Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

Grade 2 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.2.1](#) Participate in collaborative conversations with diverse partners about *grade 2 topics and texts* with peers and adults in small and larger groups.

Presentation of Knowledge and Ideas

- [CCSS.ELA-Literacy.SL.2.5](#) Create audio recordings or poems; add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.

Common Core ELA/Literacy Standards for Pinball Designer

Grade 3 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.3.1](#) Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- [CCSS.ELA-Literacy.RI.3.3](#) Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Grade 3 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.3.7](#) Conduct short research projects that build knowledge about a topic.
- [CCSS.ELA-Literacy.W.3.8](#) Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.

Grade 3 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.3.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 3 topics and texts*, building on others' ideas and expressing their own clearly.

Engineering Inspired By Nature

Students explore two methods of seed dispersal that will inspire them to build flying toys. They first investigate the idea of seed dispersal and why plants might “need” to have their seeds travel away from them. They then focus on two methods of dispersal: helicopter seeds (such as maples) and parachute seeds (such as dandelions). They create approximations of those seeds with common materials and test how variables such as rotor size (in helicopters) and canopy size (in parachutes) affect the time it takes for the object to fall.

NGSS

- [Grade 1](#)
 - Structure, Function, and Information Processing
 - Engineering Design
- [Grade 2](#)
 - Interdependent Relationships in Ecosystems
 - Earth’s Systems: Processes that Shape the Earth
 - Engineering Design
- [Grade 3](#)
 - Inheritance and Variation of Traits
 - Interdependent Relationships in Ecosystems

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
 - Model with mathematics
 - Use appropriate tools strategically
- [Grade 1](#)
 - Measurement and Data
- [Grade 2](#)
 - Measurement and Data
 - Numbers & Operations in Base Ten
- [Grade 3](#)
 - Measurement and Data

Common Core ELA

- [Grade 1](#)
 - Reading: Informational Text
 - Writing
- [Grade 2](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening
- [Grade 3](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening

NGSS for Engineering Inspired By Nature (Page 1 of 2)

Life Sciences Strand

1. Structure, Function, and Information Processing

[1-LS1-1](#). Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.

[1-LS3-1](#). Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.

2. Interdependent Relationships in Ecosystems

[2-LS2-2](#). Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

[2-LS4-1](#). Make observations of plants and animals to compare the diversity of life in different habitats.

Engineering, Technology, and Applications of Science Strand

K-2. Engineering Design

[K-2-ETS1-1](#). Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

[K-2-ETS1-2](#). Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

[K-2-ETS1-3](#). Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

NGSS for Engineering Inspired By Nature (Page 2 of 2)

Life Sciences Strand

3. Interdependent Relationships in Ecosystems: Environmental Impacts on Organisms

[3-LS4-3](#). Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

[3-LS4-4](#). Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

3. Inheritance and Variation of Traits: Life Cycles and Traits

[3-LS3-1](#). Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

[3-LS3-2](#). Use evidence to support the explanation that traits can be influenced by the environment.

[3-LS4-2](#). Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Earth and Space Sciences Strand

2. Earth's Systems: Processes that Shape the Earth

[2-ESS1-1](#). Make observations from media to construct an evidence-based account that Earth events can occur quickly or slowly.

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Common Core Mathematics Standards for Engineering Inspired By Nature

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.
- [CCSS.Math.Practice.MP5](#) Use appropriate tools strategically.

Grade 1 → Measurement and Data

Measure lengths indirectly and by iterating length units.

- [CCSS.Math.Content.1.MD.A.1](#) Order three objects by length; compare the lengths of two objects indirectly by using a third object.

Represent and interpret data.

- [CCSS.Math.Content.1.MD.C.4](#) Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

Common Core Mathematics Standards for Engineering Inspired By Nature

Grade 2 → Measurement and Data

Relate addition and subtraction to length.

- [CCSS.Math.Content.2.MD.B.5](#) Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.

Represent and interpret data.

- [CCSS.Math.Content.2.MD.D.10](#) Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems¹ using information presented in a bar graph.

Grade 2 → Numbers & Operations in Base Ten

Understand place value.

- [CCSS.Math.Content.2.NBT.A.1](#) Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones.

Common Core Mathematics Standards for Engineering Inspired By Nature

Grade 3 → Measurement and Data

Represent and interpret data.

- [CCSS.Math.Content.3.MD.B.3](#) Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.*
- [CCSS.Math.Content.3.MD.B.4](#) Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

Common Core ELA/Literacy Standards for Engineering Inspired By Nature

Grade 1 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.1.1](#) Ask and answer questions about key details in a text.
- [CCSS.ELA-Literacy.RI.1.2](#) Identify the main topic and retell key details of a text.

Grade 1 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.1.7](#) Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions).
- [CCSS.ELA-Literacy.W.1.8](#) With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Common Core ELA/Literacy Standards for Engineering Inspired By Nature

Grade 2 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.2.1](#) Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text.
- [CCSS.ELA-Literacy.RI.2.3](#) Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.

Craft and Structure

- [CCSS.ELA-Literacy.RI.2.6](#) Identify the main purpose of a text, including what the author wants to answer, explain, or describe.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RI.2.8](#) Describe how reasons support specific points the author makes in a text.

Grade 2 → Writing

Production and Distribution of Writing

- [CCSS.ELA-Literacy.W.2.6](#) With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.2.7](#) Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).
- [CCSS.ELA-Literacy.W.2.8](#) Recall information from experiences or gather information from provided sources to answer a question.

Common Core ELA/Literacy Standards for Engineering Inspired By Nature

Grade 2 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.2.1](#) Participate in collaborative conversations with diverse partners about *grade 2 topics and texts* with peers and adults in small and larger groups.
- [CCSS.ELA-Literacy.SL.2.2](#) Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.

Presentation of Knowledge and Ideas

- [CCSS.ELA-Literacy.SL.2.5](#) Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings.

Common Core ELA/Literacy Standards for Engineering Inspired By Nature

Grade 3 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.3.1](#) Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- [CCSS.ELA-Literacy.RI.3.2](#) Determine the main idea of a text; recount the key details and explain how they support the main idea.
- [CCSS.ELA-Literacy.RI.3.3](#) Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Grade 3 → Writing

Text Types and Purposes

- [CCSS.ELA-Literacy.W.3.1](#) Write opinion pieces on topics or texts, supporting a point of view with reasons.
- [CCSS.ELA-Literacy.W.3.2](#) Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Grade 3 → Speaking and Listening

Presentation and Knowledge of Ideas

- [CCSS.ELA-Literacy.SL.3.4](#) Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

Straw Rockets

Students explore air pressure as a means of thrust to launch their rockets, demonstrating Newton's First Law. They then explore how the length of a rocket changes its flight distance - a longer straw is filled with more air, which pushes on the straw for a longer time, causing it to speed up and fly farther. They also examine how fins and nose weight affect a rocket's stability (or its ability to fly in a smooth and uniform direction).

NGSS

- [Grade 2](#)
 - Engineering Design
- [Grade 3](#)
 - Forces and Interactions

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
 - Model with mathematics
 - Use appropriate tools strategically
- [Grade 2](#)
 - Measurement and Data
- [Grade 3](#)
 - Measurement and Data

Common Core ELA

- [Grade 2](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening
- [Grade 3](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening

NGSS for Straw Rockets

Physical Sciences Strand

3.Forces and Interactions

[3-PS2-1](#). Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

[3-PS2-2](#). Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Engineering, Technology, and Applications of Science Strand

K-2.Engineering Design

[K-2-ETS1-1](#). Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

[K-2-ETS1-2](#). Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

[K-2-ETS1-3](#). Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Common Core Mathematics Standards for Straw Rockets

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.
- [CCSS.Math.Practice.MP5](#) Use appropriate tools strategically.

Grade 2 → Measurement and Data

Represent and interpret data.

- [CCSS.Math.Content.2.MD.D.10](#) Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems¹ using information presented in a bar graph.

Grade 3 → Measurement and Data

Represent and interpret data.

- [CCSS.Math.Content.3.MD.B.4](#) Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

Common Core ELA/Literacy Standards for Straw Rockets

Grade 2 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.2.1](#) Ask and answer such questions as *who, what, where, when, why, and how* to demonstrate understanding of key details in a text.
- [CCSS.ELA-Literacy.RI.2.3](#) Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text.

Grade 2 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.2.7](#) Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).
- [CCSS.ELA-Literacy.W.2.8](#) Recall information from experiences or gather information from provided sources to answer a question.

Grade 2 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.2.1](#) Participate in collaborative conversations with diverse partners about *grade 2 topics and texts* with peers and adults in small and larger groups.

Common Core ELA/Literacy Standards for Straw Rockets

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.3.1](#) Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- [CCSS.ELA-Literacy.RI.3.3](#) Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RI.3.8](#) Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence).

Grade 3 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.3.7](#) Conduct short research projects that build knowledge about a topic.
- [CCSS.ELA-Literacy.W.3.8](#) Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.

Grade 3 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.3.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 3 topics and texts*, building on others' ideas and expressing their own clearly.

Skimmer

Students make paper sailboats that are propelled by fans across the floor. They test the effect of different sail shapes, sizes, and construction methods on the performance of their skimmers. The goal of this challenge is to design a set of skimmers that reliably meet specific performance criteria. Friction, forces, and the effect of surface area are some of the physical phenomena students encounter in this challenge.

NGSS

- [Grade 3](#)
 - Forces and Interactions
 - Engineering Design
- [Grade 4](#)
 - Energy

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
 - Model with mathematics
 - Use appropriate tools strategically
- [Grade 3](#)
 - Measurement and Data
 - Geometry
- [Grade 4](#)
 - Operations and Algebraic Thinking
 - Geometry

Common Core ELA

- [Grade 3](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening
- [Grade 4](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening

NGSS for Skimmer

Physical Sciences Strand

3.Forces and Interactions

[3-PS2-1](#). Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

[3-PS2-2](#). Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

4.Energy

[4-PS3-1](#). Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Engineering, Technology, and Applications of Science Strand

3-5.Engineering Design

[3-5-ETS1-1](#). Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

[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.

[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.

Common Core Mathematics Standards for Skimmer

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.
- [CCSS.Math.Practice.MP5](#) Use appropriate tools strategically.

Grade 3 → Measurement and Data

Geometric measurement: understand concepts of area and relate area to multiplication and to addition.

- [CCSS.Math.Content.3.MD.C.5](#) Recognize area as an attribute of plane figures and understand concepts of area measurement.
- [CCSS.Math.Content.3.MD.C.6](#) Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).
- [CCSS.Math.Content.3.MD.C.7](#) Relate area to the operations of multiplication and addition.

Grade 3 → Geometry

Reason with shapes and their attributes.

- [CCSS.Math.Content.3.G.A.1](#) Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories.

Common Core Mathematics Standards for Skimmer

Grade 4 → Operations and Algebraic Thinking

Use the four operations with whole numbers to solve problems.

- [CCSS.Math.Content.4.OA.A.1](#) Interpret a multiplication equation as a comparison, e.g., interpret $35 = 5 \times 7$ as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.
- [CCSS.Math.Content.4.OA.A.2](#) Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.¹

Grade 4 → Geometry

Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

- [CCSS.Math.Content.4.G.A.2](#) Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles.
- [CCSS.Math.Content.4.G.A.3](#) Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

Common Core ELA/Literacy Standards for Skimmer

Grade 3 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.3.1](#) Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- [CCSS.ELA-Literacy.RI.3.3](#) Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RI.3.8](#) Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence).

Grade 3 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.3.7](#) Conduct short research projects that build knowledge about a topic.
- [CCSS.ELA-Literacy.W.3.8](#) Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.

Grade 3 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.3.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 3 topics and texts*, building on others' ideas and expressing their own clearly.

Common Core ELA/Literacy Standards for Skimmer

Grade 4 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.4.1](#) Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- [CCSS.ELA-Literacy.RI.4.3](#) Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RI.4.9](#) Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.

Grade 4 → Writing

Text Type and Purpose

- [CCSS.ELA-Literacy.W.4.2](#) Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.4.7](#) Conduct short research projects that build knowledge through investigation of different aspects of a topic.
- [CCSS.ELA-Literacy.W.4.8](#) Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Grade 4 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.4.1](#) 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.

JetToy

Students make balloon-powered toy cars. Their challenge is to design an appealing toy that performs in a specific way, such as travels far, carries weight, or goes fast. Students experiment with different chassis designs and nozzle sizes to determine their effect on the JetToy's performance. Jet propulsion, friction, and air resistance are the core scientific concepts students explore in this challenge.

NGSS

- [Grade 4](#)
 - Energy
 - Engineering Design
- [Grade 5](#)
 - Engineering Design

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
 - Model with mathematics
 - Use appropriate tools strategically
- [Grade 4](#)
 - Measurement and Data
- [Grade 5](#)
 - Operations and Algebraic Thinking

Common Core ELA

- [Grade 4](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening
- [Grade 5](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening

NGSS for JetToy

Physical Sciences Strand

4.Energy

[4-PS3-1](#). Use evidence to construct an explanation relating the speed of an object to the energy of that object.

Engineering, Technology, and Applications of Science Strand

3-5.Engineering Design

[3-5-ETS1-1](#). Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

[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.

[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.

Common Core Mathematics Standards for JetToy

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.
- [CCSS.Math.Practice.MP5](#) Use appropriate tools strategically.

Grade 4 → Measurement and Data

Represent and interpret data.

- [CCSS.Math.Content.4.MD.B.4](#) Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.*

Grade 5 → Operations and Algebraic Thinking

Write and interpret numerical expressions.

- [CCSS.Math.Content.5.OA.A.1](#) Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
- [CCSS.Math.Content.5.OA.A.2](#) Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation “add 8 and 7, then multiply by 2” as $2 \times (8 + 7)$. Recognize that $3 \times (18932 + 921)$ is three times as large as $18932 + 921$, without having to calculate the indicated sum or product.*

Common Core ELA/Literacy Standards for JetToy

Grade 4 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.4.1](#) Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- [CCSS.ELA-Literacy.RI.4.3](#) Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

Grade 4 → Writing

Text Type and Purpose

- [CCSS.ELA-Literacy.W.4.2](#) Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Production and Distribution of Writing

- [CCSS.ELA-Literacy.W.4.4](#) Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.4.8](#) Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Grade 4 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.4.1](#) 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.

Common Core ELA/Literacy Standards for JetToy

Grade 5 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.5.3](#) Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
- [CCSS.ELA-Literacy.RI.5.9](#) Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

Grade 5 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.5.7](#) Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
- [CCSS.ELA-Literacy.W.5.8](#) Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
- [CCSS.ELA-Literacy.W.5.9](#) Draw evidence from literary or informational texts to support analysis, reflection, and research.

Grade 5 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.5.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.

Programming Each Other

Students learn about thought processes involved in converting problems into subproblems and logical steps. Teams investigate the characteristics and write examples of flawed instructions as well as effective programs, using technical terminology to explain their revisions. Core concepts include computational thinking, conditional statements, error handling, and variables.

NGSS

- [Grades 3-5](#)
- Engineering Design

K-12 Computer Science Standards

- [Grades 4-6](#)
- Algorithms
- Variables
- Control
- Modularity
- Program Development

Common Core ELA

- [Grades 4-6](#)
- Language
- Writing
- Speaking and Listening

NGSS for Programming Each Other

Engineering, Technology, and Applications of Science Strand

3-5 Engineering Design

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graph LR; A[3-5 Engineering Design] --- B[3-5-ETS1-1 Define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost.]; A --- C[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.]; A --- D[3-5-ETS1-2 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.];
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[3-5-ETS1-1](#) Define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost.

[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.

[3-5-ETS1-2](#) 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.

K-12 Computer Science Standards for Programming Each Other

Algorithms

- [1A-AP-08](#) Model daily processes by creating and following algorithms (sets of step-by-step instructions) to complete tasks.
- [1B-AP-08](#) Compare and refine multiple algorithms for the same task and determine which is the most appropriate.

Variables

- [1A-AP-09](#) Model the way programs store and manipulate data by using numbers or other symbols to represent information.
- [1B-AP-09](#) Model how computer hardware and software work together as a system to accomplish tasks.

Control

- [1A-AP-10](#) Develop programs with sequences and simple loops to express ideas or address a problem.
- [1B-AP-10](#) Create programs that include sequences, events, loops, and conditionals.

Modularity

- [1A-AP-11](#) Decompose (break down) the steps needed to solve a problem into a precise sequence of instructions.
- [1B-AP-11](#) Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process.
- [1B-AP-12](#) Modify, remix, or incorporate portions of an existing program into one's own work, to develop something new or add more advanced features.

K-12 Computer Science Standards for Programming Each Other

Program Development

- [1A-AP-12](#) Develop plans that describe a program's sequence of events, goals, and expected outcomes.
- [1B-AP-13](#) Use an iterative process to plan the development of a program by including others' perspectives and considering user preferences.
- [1A-AP-14](#) Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops.
- [1B-AP-15](#) Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.
- [1B-AP-16](#) Take on varying roles, with teacher guidance, when collaborating with peers during the design, implementation, and review stages of program development
- [1A-AP-15](#) Using correct terminology, describe steps taken and choices made during the iterative process of program development.
- [1A-AP-17](#) Describe choices made during program development using code comments, presentations, and demonstrations.

Common Core ELA/Literacy Standards for Programming Each Other

Grade 4 → Language

Knowledge of Language

- [CCSS.ELA-LITERACY.L.4.3](#) Use knowledge of language and its conventions when writing, speaking, reading, or listening

Grade 4 → Writing

Text Types and Purposes

- [CCSS.ELA-Literacy.W.4.2](#) Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

Production and Distribution of Writing

- [CCSS.ELA-LITERACY.W.4.4](#) Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience
- [CCSS.ELA-LITERACY.W.4.5](#) With guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, and editing.

Grade 4 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-LITERACY.SL.4.1](#) Engage effectively in a range of collaborative discussions with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.

Presentation of Knowledge and Ideas

- [CCSS.ELA-LITERACY.SL.4.4](#)
Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.
- [CCSS.ELA-LITERACY.SL.4.5](#)
Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.
- [CCSS.ELA-LITERACY.SL.4.6](#)
Differentiate between contexts that call for formal English and situations where informal discourse is appropriate; use formal English when appropriate to task and situation

Gravity Cruiser

A gravity cruiser is a toy vehicle that can be easily constructed from common materials. It is powered by a lever and fulcrum mounted on the cruiser's body. At one end of the lever is a weight; the other end is connected to one of the cruiser's axles by string. As the weight rotates the lever, the string rotates the axle, propelling the gravity cruiser forward.

NGSS

- [Grade 5](#)
 - Engineering Design
- [Grades 6 – 7](#)
 - Forces and Interactions
 - Engineering Design

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
 - Model with mathematics
 - Use appropriate tools strategically
- [Grade 5](#)
 - Operations and Algebraic Thinking
- [Grade 6](#)
 - Expressions and Equations
- [Grade 7](#)
 - Expressions and Equations

Common Core ELA

- [Grade 5](#)
 - Reading: Informational Text
 - Writing
 - Speaking and Listening
- [Grades 6 – 7](#)
 - Science and Technical Subjects
 - Writing
 - Speaking and Listening

[Back to Elementary Challenges](#)

NGSS for Gravity Cruiser (Page 1 of 2)

Engineering, Technology, and Applications of Science Strand

3-5.Engineering Design

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graph LR; A[3-5.Engineering Design] --- B[3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.]; A --- C[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.]; A --- D[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.];
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[3-5-ETS1-1.](#) Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

[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.

[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.

[Continue to NGSS Standards page 2](#)

NGSS for Gravity Cruiser (Page 2 of 2)

Physical Sciences Strand

MS.Forces and Interactions

[MS-PS2-2](#). Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

Engineering, Technology, and Applications of Science Strand

MS.Engineering Design

[MS-ETS1-1](#). Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

[MS-ETS1-2](#). Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

[MS-ETS1-3](#). Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

[MS-ETS1-4](#). Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Common Core Mathematics Standards for Gravity Cruiser

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.
- [CCSS.Math.Practice.MP5](#) Use appropriate tools strategically.

Grade 5 → Operations and Algebraic Thinking

Write and interpret numerical expressions.

- [CCSS.Math.Content.5.OA.A.1](#) Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.
- [CCSS.Math.Content.5.OA.A.2](#) Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation “add 8 and 7, then multiply by 2” as $2 \times (8 + 7)$. Recognize that $3 \times (18932 + 921)$ is three times as large as $18932 + 921$, without having to calculate the indicated sum or product.*

Grade 6 → Expressions and Equations

Apply and extend previous understandings of arithmetic to algebraic expressions.

- [CCSS.Math.Content.6.EE.A.2](#) Write, read, and evaluate expressions in which letters stand for numbers.

Represent and analyze quantitative relationships between dependent and independent variables.

- [CCSS.Math.Content.6.EE.C.9](#) Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.

Common Core Mathematics Standards for Gravity Cruiser

Grade 7 → Expressions and Equations

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

- [CCSS.Math.Content.7.EE.B.3](#) Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional $\frac{1}{10}$ of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar $9\frac{3}{4}$ inches long in the center of a door that is $27\frac{1}{2}$ inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.*
- [CCSS.Math.Content.7.EE.B.4](#) Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Common Core ELA/Literacy Standards for Gravity Cruiser

Grade 5 → Reading: Informational Text

Key Ideas and Details

- [CCSS.ELA-Literacy.RI.5.3](#) Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
- [CCSS.ELA-Literacy.RI.5.9](#) Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

Grade 5 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.W.5.7](#) Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
- [CCSS.ELA-Literacy.W.5.8](#) Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
- [CCSS.ELA-Literacy.W.5.9](#) Draw evidence from literary or informational texts to support analysis, reflection, and research.

Grade 5 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.5.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.

Common Core ELA/Literacy Standards for Gravity Cruiser

Grades 6 – 8 → Science and Technical Subjects

Key Ideas and Details

- [CCSS.ELA-Literacy.RST.6-8.1](#) Cite specific textual evidence to support analysis of science and technical texts.
- [CCSS.ELA-Literacy.RST.6-8.3](#) Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RST.6-8.7](#) Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- [CCSS.ELA-Literacy.RST.6-8.9](#) Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Grades 6 – 8 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.WHST.6-8.7](#) Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- [CCSS.ELA-Literacy.WHST.6-8.8](#) Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
- [CCSS.ELA-Literacy.WHST.6-8.9](#) Draw evidence from informational texts to support analysis, reflection, and research.

Grade 7 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.7.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Fuel Cell

Students receive a letter from a fictitious toy company, Green Design Toys (GDT). Green Design Toys is interested in receiving new designs for toys that are environmentally friendly and are powered with alternative power sources and fuels. This letter asks students to work in teams to design a vehicle that can meet specific performance goals. Students are asked to keep a design log in which they record the results of experiments, design sketches of their vehicles, and performance data. The program culminates in student presentations of their working models and a discussion of the design teams' efforts to address the challenge.

NGSS

- [Grade 6 – 8](#)
 - Chemical Reactions
 - Structure and Properties of Matter
 - Forces and Interactions
 - Energy
 - Engineering Design

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
 - Model with mathematics
- [Grade 6](#)
 - Ratios and Proportional Relationships
 - The Number System
 - Statistics and Probability
- [Grade 7](#)
 - Expressions and Equations
- [Grade 8](#)
 - The Number System

Common Core ELA

- [Grades 6 – 8](#)
 - Science and Technical Subjects
 - Writing
 - Speaking and Listening

NGSS for Fuel Cell (Page 1 of 2)

Physical Sciences Strand

MS.Chemical Reactions

[MS-PS1-2.](#) Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS.Structure and Properties of Matter

[MS-PS1-1.](#) Develop models to describe the atomic composition of simple molecules and extended structures.

[MS-PS1-4.](#) Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance.

MS.Forces and Interactions

[MS-PS2-2.](#) Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

[MS-PS3-1.](#) Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS.Energy

[MS-PS3-5.](#) Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

[Continue to NGSS page 2](#)

NGSS for Fuel Cell (Page 2 of 2)

Engineering, Technology, and Applications of Science Strand

MS.Engineering Design

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graph LR; A[MS.Engineering Design] --- B[MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.]; A --- C[MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.]; A --- D[MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.]; A --- E[MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.];
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MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Common Core Mathematics Standards for Fuel Cell

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.

Grade 6 → Ratios and Proportional Relationships

Understand Ratio Concepts and use Ratio Reasoning to Solve Problems

- [CCSS.Math.Content.6.RP.A.3](#) Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

Grade 6 → Statistics and Probability

Summarize and Describe Distributions

- [CCSS.Math.Content.6.SP.B.4](#) Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
- [CCSS.Math.Content.6.SP.B.5](#) Summarize numerical data sets in relation to their context.

Grade 6 → The Number System

Apply and Extend Previous Understandings of Numbers to the System of Rational Numbers

- [CCSS.Math.Content.6.NS.C.5](#) Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.

Common Core Mathematics Standards for Fuel Cell

Grade 7 → Expressions and Equations

Use properties of operations to generate equivalent expressions.

- [CCSS.Math.Content.7.EE.A.2](#) Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, $a + 0.05a = 1.05a$ means that “increase by 5%” is the same as “multiply by 1.05.”*

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

- [CCSS.Math.Content.7.EE.B.3](#) Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making \$25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or \$2.50, for a new salary of \$27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.*

Grade 8 → The Number System

Know that there are numbers that are not rational, and approximate them by rational numbers.

- [CCSS.Math.Content.8.NS.A.1](#) Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

Common Core ELA/Literacy Standards for Fuel Cell

Grades 6 – 8 → Science and Technical Subjects

Key Ideas and Details

- [CCSS.ELA-Literacy.RST.6-8.1](#) Cite specific textual evidence to support analysis of science and technical texts.
- [CCSS.ELA-Literacy.RST.6-8.3](#) Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RST.6-8.7](#) Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- [CCSS.ELA-Literacy.RST.6-8.9](#) Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Grades 6 – 8 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.WHST.6-8.7](#) Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- [CCSS.ELA-Literacy.WHST.6-8.8](#) Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
- [CCSS.ELA-Literacy.WHST.6-8.9](#) Draw evidence from informational texts to support analysis, reflection, and research.

Grade 7 and Grade 8 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.7.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. (Grade 8 standard: [CCSS.ELA-Literacy.SL.8.1](#))

Motorized Toy Car

This challenge is posed in a letter from a fictitious toy company, Mobility Toys, Inc., which is interested in receiving new designs for moving toys. The toy company sends a letter to the class requesting written proposals, sketches, and working models of designs that meet a specific set of requirements. Over the course of the curriculum, a variety of activities will prepare the students to develop a proposal and a prototype for a toy of their own design. The students must work in teams and as a team to complete the requirements stated in the letter. The program culminates in student presentations of their working models and a discussion of the design teams' efforts to address the challenge.

NGSS

- [Grades 6 – 8](#)
 - Forces and Interactions
 - Energy
 - Engineering Design

Common Core Mathematics

- [Mathematical Practices](#)
 - Reason abstractly and quantitatively
 - Model with mathematics
- [Grade 6](#)
 - Expressions and Equations
 - Ratios and Proportional Relationships
- [Grade 7](#)
 - Expressions and Equations
 - Ratios and Proportional Relationships
- [Grade 8](#)
 - Expressions and Equations
 - Functions

Common Core ELA

- [Grades 6 – 8](#)
 - Science and Technical Subjects
 - Writing
 - Speaking and Listening

NGSS for Motorized Toy Car

Physical Sciences Strand

MS.Forces and Interactions

[MS-PS2-2](#). Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS.Energy

[MS-PS3-1](#). Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

[MS-PS3-5](#). Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Engineering, Technology, and Applications of Science Strand

MS.Engineering Design

[MS-ETS1-1](#). Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

[MS-ETS1-2](#). Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

[MS-ETS1-3](#). Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

[MS-ETS1-4](#). Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Common Core Mathematics Standards for Motorized Toy Car

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.

Grade 6 → Ratios and Proportional Relationships

Understand ratio concepts and use ratio reasoning to solve problems.

- [CCSS.Math.Content.6.RP.A.1](#) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”*
- [CCSS.Math.Content.6.RP.A.2](#) Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. *For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $3/4$ cup of flour for each cup of sugar.” “We paid \$75 for 15 hamburgers, which is a rate of \$5 per hamburger.”¹*

Grade 6 → Expressions and Equations

Apply and extend previous understandings of arithmetic to algebraic expressions.

- [CCSS.Math.Content.6.EE.A.2](#) Write, read, and evaluate expressions in which letters stand for numbers.

Common Core Mathematics Standards for Motorized Toy Car

Grade 7 → Ratios and Proportional Relationships

Analyze proportional relationships and use them to solve real-world and mathematical problems.

- [CCSS.Math.Content.7.RP.A.2](#) Recognize and represent proportional relationships between quantities.

Grade 7 → Expressions and Equations

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

- [CCSS.Math.Content.7.EE.B.3](#) Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
- [CCSS.Math.Content.7.EE.B.4](#) Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Grade 8 → Expressions and Equations

Expressions and Equations Work with radicals and integer exponents.

- [CCSS.Math.Content.8.EE.A.1](#) Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.
- [CCSS.Math.Content.8.EE.A.2](#) Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

Grade 8 → Functions

Define, evaluate, and compare functions.

- [CCSS.Math.Content.8.F.A.3](#) Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

Common Core ELA/Literacy Standards for Motorized Toy Car

Grades 6 – 8 → Science and Technical Subjects

Key Ideas and Details

- [CCSS.ELA-Literacy.RST.6-8.1](#) Cite specific textual evidence to support analysis of science and technical texts.
- [CCSS.ELA-Literacy.RST.6-8.3](#) Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RST.6-8.7](#) Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- [CCSS.ELA-Literacy.RST.6-8.9](#) Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Grades 6 – 8 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.WHST.6-8.7](#) Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- [CCSS.ELA-Literacy.WHST.6-8.8](#) Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
- [CCSS.ELA-Literacy.WHST.6-8.9](#) Draw evidence from informational texts to support analysis reflection, and research.

Grade 6, Grade 7, and Grade 8 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.6.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (Grade 7 standard: [CCSS.ELA-Literacy.SL.7.1](#) Grade 8 standard: [CCSS.ELA-Literacy.SL.8.1](#))

Glider

This challenge is posed in a letter from a fictitious publishing company, Mobility Press, which explains that it wants to publish a book of designs for gliding toys that children of ages 8–12 can build with assistance from an adult. The company invites the class to submit a manuscript that includes drawings and plans for building the gliders, as well as instructions for how to fly them and a description of how they work. Student design teams design two products: a gliding toy and a set of book pages that describe how to build and fly the toy. Over the course of the eight weeks, a variety of activities prepare the students to develop a prototype gliding toy and a book manuscript. The challenge culminates in a book-signing event, in which the class presents its book and student design teams present their gliding-toy prototypes.

NGSS

- [Grades 6 – 8](#)
- Forces and Interactions
- Energy
- Engineering Design

Common Core Mathematics

- [Mathematical Practices](#)
- Reason abstractly and quantitatively
- Model with mathematics
- [Grade 6](#)
- Expressions and Equations
- Ratios and Proportional Relationships
- [Grade 7](#)
- Expressions and Equations
- Ratios and Proportional Relationships
- [Grade 8](#)
- Expressions and Equations
- Functions

Common Core ELA

- [Grades 6 – 8](#)
- Science and Technical Subjects
- Writing
- Speaking and Listening

NGSS for Glider

Physical Sciences Strand

MS.Forces and Interactions

MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS.Energy

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Engineering, Technology, and Applications of Science Strand

MS.Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Common Core Mathematics Standards for Glider

Mathematical Practices

- [CCSS.Math.Practice.MP2](#) Reason abstractly and quantitatively.
- [CCSS.Math.Practice.MP4](#) Model with mathematics.

Grade 6 → Ratios and Proportional Relationships

Understand Ratio Concepts and use Ratio Reasoning to Solve Problems

- [CCSS.Math.Content.6.RP.A.1](#) Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”*
- [CCSS.Math.Content.6.RP.A.2](#) Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. *For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $3/4$ cup of flour for each cup of sugar.” “We paid \$75 for 15 hamburgers, which is a rate of \$5 per hamburger.”¹*

Grade 6 → Expressions and Equations

Apply and extend previous understandings of arithmetic to algebraic expressions.

- [CCSS.Math.Content.6.EE.A.2](#) Write, read, and evaluate expressions in which letters stand for numbers.

Common Core Mathematics Standards for Glider

Grade 7 → Ratios and Proportional Relationships

Analyze proportional relationships and use them to solve real-world and mathematical problems.

- [CCSS.Math.Content.7.RP.A.2](#) Recognize and represent proportional relationships between quantities.

Grade 7 → Expressions and Equations

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

- [CCSS.Math.Content.7.EE.B.3](#) Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
- [CCSS.Math.Content.7.EE.B.4](#) Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Grade 8 → Expressions and Equations

Expressions and Equations Work with radicals and integer exponents.

- [CCSS.Math.Content.8.EE.A.1](#) Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.
- [CCSS.Math.Content.8.EE.A.2](#) Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.

Grade 8 → Functions

Define, evaluate, and compare functions.

- [CCSS.Math.Content.8.F.A.3](#) Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

Common Core ELA/Literacy Standards for Glider

Grades 6 – 8 → Science and Technical Subjects

Key Ideas and Details

- [CCSS.ELA-Literacy.RST.6-8.1](#) Cite specific textual evidence to support analysis of science and technical texts.
- [CCSS.ELA-Literacy.RST.6-8.3](#) Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Integration of Knowledge and Ideas

- [CCSS.ELA-Literacy.RST.6-8.7](#) Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- [CCSS.ELA-Literacy.RST.6-8.9](#) Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Grades 6 – 8 → Writing

Research to Build and Present Knowledge

- [CCSS.ELA-Literacy.WHST.6-8.7](#) Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- [CCSS.ELA-Literacy.WHST.6-8.8](#) Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
- [CCSS.ELA-Literacy.WHST.6-8.9](#) Draw evidence from informational texts to support analysis reflection, and research.

Grade 6, Grade 7, and Grade 8 → Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.6.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (Grade 7 standard: [CCSS.ELA-Literacy.SL.7.1](#) Grade 8 standard: [CCSS.ELA-Literacy.SL.8.1](#))

Keeping Our Networks Secure

In this challenge, students investigate the architecture of the internet and how it was designed to withstand both physical and electronic attacks. Through modeling, students experience how information moves and its inherent potential to be exposed. Students explore a number of physical models that simulate the movement of information through the internet; they identify problems with each model and test different enhancements to help make the network operate better and faster. They investigate the two basic components of securing data and systems: encryption (changing information from one form to another, especially to hide its meaning), and authentication (proof that something is real, true, or genuine).

NGSS

- [Grades 6 – 8](#)
- Engineering Design

K-12 Computer Science Standards

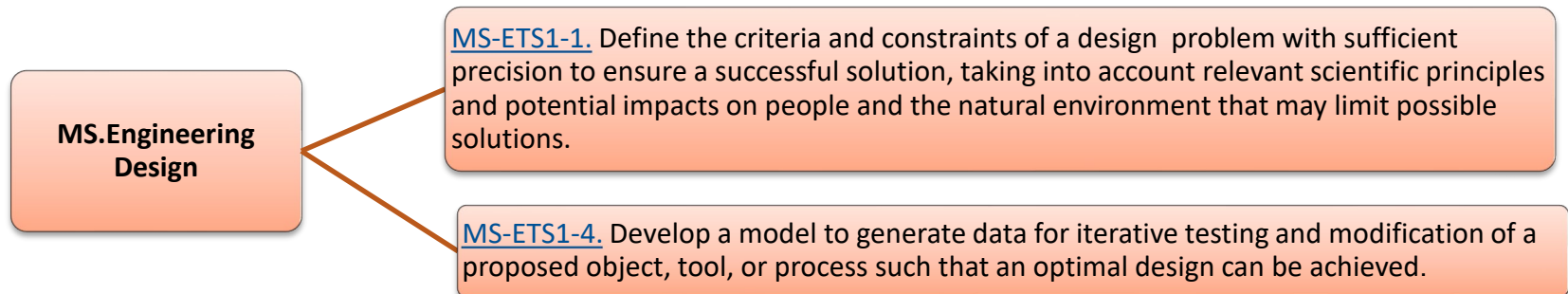
- Ages 5-7
 - Networks and the Internet
- Ages 8-11
 - Computing Systems
 - Networks and the Internet
 - Impacts of Computing
- Ages 11-14
 - Computing Systems
 - Networks and the Internet
 - Impacts of Computing
- Ages 14-16
 - Networks and the Internet

Common Core ELA

- [Grades 6 – 8](#)
- Writing
- Speaking and Listening
- Science and Technical Subjects

NGSS for Keeping Our Networks Secure

Engineering, Technology, and Applications of Science Strand



K-12 Computer Science Standards for Keeping Our Networks Secure

Ages 5-7 Networks & the Internet

- [1A-NI-04](#) Explain what passwords are and why we use them, and use strong passwords to protect devices and information from unauthorized access.

Ages 8-11 Computing Systems

- [1B-CS-01](#) Describe how internal and external parts of computing devices function to form a system.
- [1B-CS-02](#) Model how computer hardware and software work together as a system to accomplish tasks.
- [1B-CS-03](#) Determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies.

Ages 8-11 Networks & the Internet

- [1B-NI-04](#) Model how information is broken down into smaller pieces, transmitted as packets through multiple devices over networks and the internet, and reassembled at the destination.
- [1B-NI-05](#) Discuss real-world cybersecurity problems and how personal information can be protected

Ages 8-11 Impacts of Computing

- [1B-IC-18](#) Discuss computing technologies that have changed the world, and express how those technologies influence, and are influenced by, cultural practices.

K-12 Computer Science Standards for Keeping Our Networks Secure

Ages 11-14 Computing Systems

- [2-CS-01](#) Recommend improvements to the design of computing devices, based on an analysis of how users interact with the devices.

Ages 11-14 Networks & the Internet

- [2-NI-04](#) Model the role of protocols in transmitting data across networks and the internet.
- [2-NI-05](#) Explain how physical and digital security measures protect electronic information.
- [2-NI-06](#) Apply multiple methods of encryption to model the secure transmission of information.

Ages 11-14 Impacts of Computing

- [2-IC-20](#) Compare tradeoffs associated with computing technologies that affect people's everyday activities and career options.

Ages 14-16 Networks & the Internet

- [3A-NI-04](#) Evaluate the scalability and reliability of networks by describing the relationship between routers, switches, servers, topology, and addressing.
- [3A-NI-05](#) Give examples to illustrate how sensitive data can be affected by malware and other attacks.

Common Core ELA/Literacy Standards for Keeping Our Networks Secure

Grades 6 – 8 → Science and Technical Subjects

Key Ideas and Details

- [CCSS.ELA-Literacy.RST.6-8.3](#) Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Grades 6 Writing

Text Types and Purposes

- [CCSS.ELA-LITERACY.W.6.1](#) Introduce claim(s) and organize the reasons and evidence clearly.
 - [CCSS.ELA-LITERACY.W.6.1.B](#) Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.
 - [CCSS.ELA-LITERACY.W.6.2](#)
Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
 - [CCSS.ELA-LITERACY.W.6.2.D](#)
Use precise language and domain-specific vocabulary to inform about or explain the topic.
- #### Production and Distribution of Writing
- [CCSS.ELA-LITERACY.W.6.4](#)
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1-3 above.)
 - [CCSS.ELA-LITERACY.W.6.5](#)
With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. (Editing for conventions should demonstrate command of Language standards 1-3 up to and including grade 6 [here](#).)

Common Core ELA/Literacy Standards for Keeping Our Networks Secure

Grade 6 Speaking and Listening

Comprehension and Collaboration

- [CCSS.ELA-Literacy.SL.6.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- [CCSS.ELA-LITERACY.SL.6.1.B](#)
Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.
- [CCSS.ELA-LITERACY.SL.6.1.C](#)
Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.

Presentation of Knowledge and Ideas

- [CCSS.ELA-LITERACY.SL.6.4](#)
Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
- [CCSS.ELA-LITERACY.SL.6.5](#)
Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.
- [CCSS.ELA-LITERACY.SL.6.6](#)
Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 6 Language standards 1 and 3 for specific expectations.)