



Experience overview

The WeDo 2.0 projects are developed with science and engineering practices from the NGSS in mind.

These practices represent NGSS's expectations for students to learn scientific knowledge as well as the practical skills. The practices are not to be seen as separate, rather as an interconnected set of expectations for students.

The crosscutting themes are also important, and teachers are encouraged to view NGSS documents for those themes as well as specific content area standards.

Both English Language Arts and Math Common Core State Standards (CCSS) are interwoven throughout the document and are used within the WeDo 2.0 curriculum.

The “habits of mind,” as outlined in *Engineering Habits of Mind* (EHoM) and defined by the National Academy of Engineering (NAE) and the National Research Council (NRC), are an important part of project-based learning.

The habits of mind are found throughout the practices and standards for all grade levels. The habits of mind are centered on the fact that science is about the attitudes, values, and skills that determine how people learn and acquire knowledge about the world.

According to both the NAE and NRC, there are six habits of mind that are essential for science and engineering growth:

1. Systems thinking
2. Creativity
3. Optimism
4. Collaboration
5. Communication
6. Ethical considerations

The WeDo 2.0 curriculum projects are built upon the habits of mind and interconnected throughout the practices and standards.



Develop science and engineering practices with WeDo 2.0

WeDo 2.0 projects will develop science practices. They provide opportunities for students to work with and develop ideas and knowledge as well as an understanding of the world around them.

The progression and difficulty level in the projects allow students to develop competency while exploring and learning about key science topics. The projects have been carefully chosen to cover a wide variety of topics and issues.

WeDo 2.0 projects develop eight science and engineering practices:

1. Ask questions and solve problems.
2. Use models.
3. Design prototypes.
4. Investigate.
5. Analyze and interpret data.
6. Use computational thinking.
7. Engage in argument from evidence.
8. Obtain, evaluate, and communicate information.

The guiding principle is that every student should engage in all of these practices across the projects in each grade.



Science practices and the engineering habits of mind

The science and engineering practices serve as the common thread throughout the curriculum, and all standards should, in essence, be taught through them. While the academic definition of each process is important, it is probably a good habit to verbalize the practices in a way that is understandable to students at that level.

The following identifies the basic principles of these practices and gives examples on how they are used in WeDo 2.0 projects.

1. Ask questions and define problems.

This practice focuses on simplistic problems and questions based upon observational skills.

2. Develop and use models.

This practice focuses upon students' prior experiences and the use of concrete events in modeling solutions to problems. It also includes improving models and new ideas about a real-world problem and solution.

3. Plan and carry out investigations.

This practice is about how students learn and follow directions for an investigation to formulate probable solution ideas.

4. Analyze and interpret data.

The focus of this practice is to learn ways to gather information from experiences, document discoveries, and share ideas from the learning process.



Science practices and the engineering habits of mind

5. Use mathematics and computational thinking.

The purpose of this practice is to realize the role of numbers in data-gathering processes. Students read and gather data about investigations, make charts, and draw diagrams resulting from the numerical data. They add simple data sets to come up with conclusions. They understand or create simple algorithms.

6. Construct explanations and design solutions.

This practice is about ways they might go about constructing an explanation or designing a solution for a problem.

7. Engage in argument from evidence.

Constructively share ideas based upon evidence that it is an important feature of science and engineering. This practice is about how students begin to share their ideas and demonstrate proof to others in a group.

8. Obtain, evaluate, and communicate information.

Teaching children what real scientists do is key to this practice. The way in which they set up and complete investigations to gather information, how they evaluate their findings, and how they document are all important elements. It is important that teachers explore a plethora of ways to have students gather, record, evaluate, and communicate their findings. Ideas include digital presentations, portfolios, drawings, discussion, video, and interactive notebooks.

▶ Important

The WeDo 2.0 projects will engage your students in all science and engineering practices. Refer to the practices grid of this chapter to get the overview.



Use the LEGO® bricks in a scientific context

LEGO® bricks have been used in three different ways in the WeDo 2.0 projects:

1. To model reality
2. To investigate
3. To design

These three ways will give you the opportunity to develop a different set of practices, as the outcome of the project is different in each case.

1. Use models

Students represent and describe their ideas using the bricks.

Students can build a model to gather evidence or provide a simulation. Although only representations of reality, models enhance understanding and explain natural phenomena.

When implementing a modeling project, encourage students to focus their creativity on representing the reality as accurately as possible. By doing that, they will need to identify and explain the limitations of their models.

Examples of modeling Guided Projects are:

- Frog's Metamorphosis
- Plants and Pollinators

2. Investigate

Planning and carrying out investigations is an ideal framework for a science project. Students' learning is enhanced by active engagement with the problem. Students are encouraged to make predictions, carry out tests, collect data and draw conclusions.

When implementing an investigation project, you should encourage students to pay special attention to ensure fair testing. Ask them to search for cause and effect in their tests, ensuring they change only one variable at a time.

Examples of investigating Guided Projects are:

- Pulling
- Speed
- Robust Structures



Use the LEGO® bricks in an engineering context

3. Design

Students design solutions for a problem for which there is no single answer.

The problem may require students to design a combination of plans, models, simulations, programs, and presentations. Going through the design process will require students to constantly adjust and modify their solutions to meet criteria.

While designing a solution, it will be important to recognize that the idea of “failure” in engineering is a sign of growth in the cognitive process. Therefore, students may not get a viable solution on the first try or within the provided time constraints. In that case, have them reflect on their process to identify what they have learned.

When you implement a design project, encourage students to focus their creativity on designing multiple solutions. Ask them to select the prototype they think is the best according to the criteria you have set.

Examples of designing Guided Projects are:

- Prevent Flooding
- Drop and Rescue
- Sort to Recycle

Important

Documents produced by students following the completion of these three types of projects may contain different types of information.



Use LEGO® bricks in a computational thinking context

Computational thinking is a set of problem-solving skills that are applied to working with computers and other digital devices. In WeDo 2.0, computational thinking is handled in a developmentally appropriate manner through the use of icons and programming blocks.

Computational thinking characteristics include:

- Logical reasoning
- Looking for patterns
- Organizing and analyzing data
- Modeling and simulations
- Using computers to assist in testing models and ideas
- Using algorithms to sequence actions

Its application in science and engineering projects enables students to use powerful digital tools to carry out investigations and build and program models, which might otherwise be tricky to do. Students use programs to activate motors, lights, sounds, or displays, or to react to sounds, tilt, or movement to implement functionalities to their models or prototypes.





Visual overview of Guided Projects

1. Pulling

Investigate the effects of balanced and unbalanced forces on the movement of an object.

2. Speed

Investigate what factors can make a car go faster to help predict future motion.

3. Robust Structures

Investigate what characteristics of a building would help make it resistant to an earthquake using an earthquake simulator constructed from LEGO® bricks.

4. Frog's Metamorphosis

Model a frog's metamorphosis using a LEGO representation, and identify the characteristics of the organism at each stage.

5. Plants and Pollinators

Model a LEGO representation of the relationship between a pollinator and flower during the reproduction phase.

6. Prevent Flooding

Design an automatic LEGO floodgate to control water according to various precipitation patterns.

7. Drop and Rescue

Design a device to reduce the impacts on humans, animals, and the environment after an area has been damaged by a weather-related hazard.

8. Sort to Recycle

Design a device to use physical properties of objects, including their shape and size, to sort them.





Visual overview of Open Projects

9. Predator and Prey

Model a LEGO® representation of the behaviors of several predators and their prey.

10. Animal Expression

Model a LEGO representation of various communication methods in the animal kingdom.

11. Extreme Habitats

Model a LEGO representation of the influence of the habitat on the survival of some species.

12. Space Exploration

Design a LEGO prototype of a rover that would be ideal for exploring distant planets.

13. Hazard Alarm

Design a LEGO prototype of a weather alarm device to reduce the impact of severe storms.

14. Cleaning the Ocean

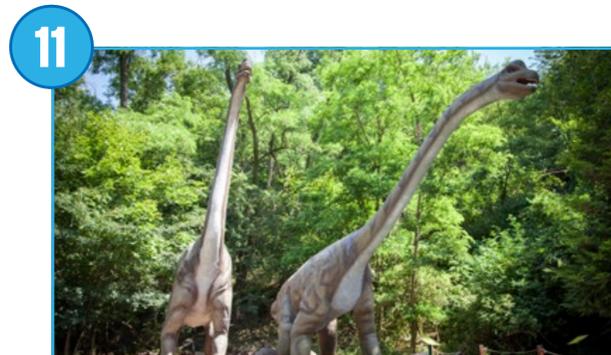
Design a LEGO prototype to help people remove plastic waste from the ocean.

15. Wildlife Crossing

Design a LEGO prototype to allow an endangered species to safely cross a road or other hazardous area.

16. Moving Materials

Design a LEGO prototype of a device that can move specific objects in a safe and efficient way.





Curriculum overview of Guided Projects organized by NGSS disciplinary core ideas

	1 Pulling	2 Speed	3 Robust Structures	4 Frog's Metamorphosis	5 Plants and Pollinators	6 Prevent Flooding	7 Drop and Rescue	8 Sort to Recycle
Life Sciences				3-LS1-1 3-LS3-1 3-LS3-2	2-LS2-2 4-LS1-1			
Earth and Space Sciences			4-ESS3-2			2-ESS2-1 3-ESS3-1 3-ESS2-1 4-ESS2-2	3-ESS3-1	2-PS1-1
Physical Sciences	3-PS2-1	3-PS2-2 4-PS3-1						
Engineering, Technology, and Applications of Science	3-5-ETS-1-2		3-5-ETS-4-3			3-5-ETS-1-2	3-5-ETS-1-2	K-2-ETS-1-2



Curriculum overview of Open Projects organized by NGSS disciplinary core ideas

	9 Predator and Prey	10 Animal Expression	11 Extreme Habitats	12 Space Exploration	13 Hazard Alarm	14 Cleaning the Ocean	15 Wildlife Crossing	16 Moving Materials
Life Sciences	3-LS4-3	3-LS4-2 4-PS4-3 4-LS1-2	2-LS4-1 3-LS3-2 3-LS4-1				2-LS4-1 3-LS4-4	
Earth and Space Sciences					3-ESS3-1			
Physical Sciences								2-PS1-3
Engineering, Technology, and Applications of Science				3-5-ETS1-2 3-5-ETS1-3	3-5-ETS1-2	3-5-ETS1-1 3-5-ETS1-2	K-2-ETS1-1 K-2-ETS1-3	K-2-ETS1-2



NGSS performance expectations: Grade 2

Life science

2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.

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.

Physical science

2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

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.

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a wholly new object.

2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Earth and space science

2-ESS1-1. Use information from several sources to provide evidence that earth events can occur quickly or slowly.

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the physical shape of the land.

2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.

2-ESS2-3. Obtain information to identify where water is found on earth and understand that it can be solid or liquid.

Engineering

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change in order 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 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 performance expectations: Grade 3

Physical science

- 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.
- 3-PS2-3.** Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
- 3-PS2-4.** Define a simple design problem that can be solved by applying scientific ideas about magnets.

Earth and space science

- 3-ESS2-1.** Represent data in tables and graphic displays to describe typical weather conditions expected during a particular season.
- 3-ESS2-2.** Obtain and combine information to describe climates in different regions of the world.
- 3-ESS3-1.** Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

Engineering

- 3-5-ETS1-1.** Define a simple design problem reflecting a need 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 meets 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.

Life science

- 3-LS2-1.** Construct an argument that some animals from groups that help members survive.
- 3-LS4-1.** Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
- 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 that is caused when the environment changes and the types of plants and animals that live there may also change.
- 3-LS1-1.** Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
- 3-LS3-1.** Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variations of these traits exist 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.



NGSS performance expectations: Grade 4

Energy

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

4-ESS3-1. Obtain and combine information to describe the fact that energy and fuels are derived from natural resources and that their use will affect the environment.

Structure, function, and information processing

4-PS4-2. Develop a model to describe how light reflecting from objects and entering the eye of a sighted person allows objects to be seen.

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support their survival, growth, behavior, and reproduction.

4-LS1-2. Use a model to describe how animals receive different types of information through their senses, then process the information in their brain, and respond to the information in a range of different ways.

Waves: Waves and information

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

4-PS4-3. Generate and compare multiple solutions that use patterns for the transfer of information.

Earth's systems: Processes that shape the earth

4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

4-ESS2-2. Analyze and interpret data from maps to describe patterns of earth's features.

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural earth processes on humans.

Engineering

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

3-5-ETS1-2. Generate and compare 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.



Curriculum overview of Guided Projects organized by NGSS practices

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Practice 1: Ask questions and define problems	●	●	●	●	●	●	●	●
Practice 2: Develop and use models				●	●			
Practice 3: Plan and carry out investigations	●	●	●					
Practice 4: Analyze and interpret data	●	●	●					
Practice 5: Use mathematics and computational thinking	●	●	●	●	●	●	●	●
Practice 6: Construct explanations and design solutions						●	●	●
Practice 7: Engage in argument from evidence	●	●	●	●	●	●	●	●
Practice 8: Obtain, evaluate, and communicate information	●	●	●	●	●	●	●	●



Curriculum overview of Open Projects organized by NGSS practices

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Practice 1: Ask questions and define problems	●	●	●	●	●	●	●	●
Practice 2: Develop and use models	●	●			●			
Practice 3: Plan and carry out investigations								●
Practice 4: Analyze and interpret data								
Practice 5: Use mathematics and computational thinking	●	●	●	●	●	●	●	●
Practice 6: Construct explanations and design solutions			●	●		●	●	●
Practice 7: Engage in argument from evidence	●	●	●	●	●	●	●	●
Practice 8: Obtain, evaluate, and communicate information	●	●	●	●	●	●	●	●