

Warm-Up

Practice graphing virtual energy values.

30-
45
min.



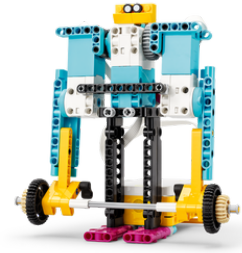
Advanced



Grades
6-8



Hybrid



Teacher Support

Key objectives

- Create a program to be introduced to the LEGO® Education SPIKE™ Prime line graphing tool
- Graph data coming from virtual energy values

Things you will need

Device with the LEGO Education SPIKE App installed
LEGO Education SPIKE Prime Set (Optional)

Additional resources

[Building instructions \(The Giant\)](#)

[Student Inventor Notebook](#)

Educational standards

NGSS

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.

MS-PS3-3

Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion).

Common Core

CCSS.MATH.CONTENT.7.RP.A.2

Recognize and represent proportional relationships between quantities.

CSTA

2-DA-08

Collect data using computational tools and transform the data to make it more useful and reliable.

ISTE

5b

Students collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.

Hybrid learning resources

[5 Ideas and examples for Blended Learning Using the 5E Model](#)

Prepare for Blended Learning

- This lesson is designed to be completed using primarily the SPIKE App. Your

students will create a simulation using the programming blocks without connecting to the SPIKE Prime Hub. If you prefer to facilitate this lesson using the SPIKE Prime Set, you can find building instructions in the *Additional Resources* section of this page.

- Make sure to watch the lesson video on this page.
 - Read through the student material for this lesson via the link on this page, or in the SPIKE App.
 - You might want to consider:
 - Choosing the right tool(s) and the right place. For example, watching videos, reading a textbook, or preparing for a hands-on experience can easily be done at home. Performing the experiment and collecting data "hands-on" is easier in a classroom setting.
 - Using a variety of tools and allowing for broad differentiation. This will increase your students' engagement and improve learning outcomes.
 - Providing various methods of virtual collaboration. Here are some examples:
 - Videoconferencing
 - Blogs, chats, or wall posts
 - Digital versions of student worksheets
 - Adapting the lesson flow to account for not being a classroom setting throughout the entire lesson. We've provided an example lesson flow below.
 - Here are other ways to adapt the lesson flow to your student needs:
 - Have your students watch the videos describing what they're about to do. You can point them to the SPIKE App or use the student worksheet URL.
 - Use any other material you may have already prepared on the topic.
 - Customize the Student Inventor Book to have your students prepare their learning experience and reflect on their findings. (see Additional Resources)
 - Use the Lesson Briefs (an easy-to-use lesson overview printable 1-pager) to inspire your students with an open ended challenge. (see Additional Resources)
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Engage

(Before Class, 20 Min.)

- The topic of this lesson is *metabolic energy*. Your students will graph the virtual values of calories burned during exercise. These values are approximated for the MET (i.e., metabolic equivalent of task), which will allow them to explore different types of energy. This will open a broader discussion of kinetic and potential energy in the unit's later lessons.
- Use various materials to engage your students on the topic of *metabolic energy*.

Ignite a Discussion

Start a discussion by asking questions related to the lesson. Here are a few suggestions:

- Can you name two smart tracking devices and describe what they can track?
- Which type of energy are you expending when you exercise?
- How can you measure that energy?
- Which unit would you use to measure that energy?

Have your students write down their thoughts and formulate a hypothesis.

Explore

(In Class, 30 Min.)

- Have your students explore the code that's already on the Programming Canvas.
 - Ask them to explain what they see on the line graph tool while the virtual calories burned are plotted.
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Explain

(In Class, 15 Min.)

- Ask your students to create a simulated workout. Explain that they should use a simulated robot on the screen to perform the exercises.
 - Have them graph the number of virtual calories the robot is burning while doing the exercises.
 - Have them follow the dataset that's been preloaded on the line graph.
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Elaborate

(After Class, 20 Min.)

- Assign your students a follow-up task to expand on their learning. Here are some suggestions:
 - Ask each student to record a video of themselves performing the same exercises as their simulated robot.
 - Have each student describe what a "MET" is and how it can help them keep track of their energy burn.

Evaluate

- Give feedback on each student's performance.
 - You can use the assessment rubrics provided to simplify the process.
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Assessment Opportunities

Teacher Observation Checklist

Establish a scale that meets your needs, for example:

- Partially accomplished
- Fully accomplished
- Overachieved

Use the following success criteria to evaluate your students' progress:

- The students can trace graphs using virtual calorie values.
- The students can export values for further use.
- The students can create virtual workouts, graphing virtual values, and use these graphs to explain what *metabolic energy* is.

Self-Assessment

Have each student choose the brick that they feel best represents their performance.

- Blue: I can create a short program that displays images of a robot.
- Yellow: I can create a program that generates a line graph.
- Violet: I can create a program that generates a complex line graph showing different types of slopes.

Peer-Assessment

Encourage your students to give feedback to others by:

- Having one student score the performance of another using the colored brick scale above.
- Asking them to present constructive feedback to each other so that they can improve their performance during the next lesson. This is a great opportunity to use videoconferencing tools or blog posting tools in a blended learning scenario.

Differentiation

Take this lesson to the next level by:

- Having your students build a physical model by following the building instructions for the The Giant model, then using their models to conduct the "simulated robot" experiment.
 - Making sure that your students adjust the suggested program in the SPIKE app to match their model configuration.
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Tips

Building Tips

Introducing a model for this lesson

You can use this model if you have access to a SPIKE Prime set.

Coding Tips

Using Streaming Mode

To play a program without being connected to a Hub, you need to use the Streaming Mode. In that mode, each programming blocks are executed from your device.

Main Program (without model)

Possible Program (using the suggested model)

Science Data Tips

Here is an example of the data students can expect from this experiment.

Extensions

Math Extension

Math Extension

To incorporate the development of math skills:

- Have your students explore further equations of the form $y = mx + b$ in this exercise, and describe some of the things they see.
- Ask them to answer these questions in writing:
 - Why does the graph they have plotted start at the origin (0,0)?
 - Why are some slopes steeper than others?
 - How could you generate negative slopes (i.e., those sloping downward)?
 - What would a downward slope indicate?

Note: This will require additional time.

Language Arts Extension

To incorporate the development of language arts skills:

- Have your students research and describe different types of energy (e.g., metabolic, potential, kinetic, electric), giving written or sketched examples. Make sure that they research on potential and kinetic energy because these concepts will be used throughout this unit.

Note: This will require additional time.

Career Links

Students who've enjoyed this lesson might be interested in exploring this career pathway:

- Health Science