

Exploring GPS

Companion Lesson to X-STEM All Access Episode “[The Military Technology We All Use](#)”

Grade/ Grade Band: High School		Topic: Engineering
Brief Lesson Description: Students will compare measurement using GPS versus traditional methods, learn how GPS works, and research applications of GPS and how they solve human problems.		
Performance Expectation(s): NGSS-HS-ETS1-3 : Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.		
Specific Learning Outcomes: Students will be able to: -Use technology to determine the distance between two given points. -Explain how GPS works using academic vocabulary. -Research how GPS is used to solve a complex real-world problem. -Compare how the GPS solution addresses human problems with traditional methods.		
Narrative / Background Information		
Prior Student Knowledge: -Students should have a basic understanding of the concept of distance and how it is measured using traditional tools. -Students should be able to use text based evidence to answer research questions. -Students should be familiar with using the Google Maps App on a cell phone. -Students should know the definitions of precise and accurate in terms of measurement.		
Science & Engineering Practices: Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-ETS1-3)	Disciplinary Core Ideas: ETS1.B: Developing Possible Solutions When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (HS-ETS1-3)	Crosscutting Concepts: Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-3)
Possible Preconceptions/Misconceptions: 1. GPS technology is complex and difficult to use. You must be an expert to benefit from GPS technology. 2. GPS tracking is expensive to utilize. 3. There are few benefits in using GPS systems.		

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:

Begin class by having students answer these three questions as a warm up:

- What does the acronym GPS stand for?***
- How do you use GPS in your daily life?***
- How do you think GPS works?***

After writing their own answers, have students share with a partner and then have them share their thinking with the larger class. Then explain that in this lesson we will be learning about GPS technology and how it solves many problems for our society.

To introduce this technology, show the X-STEM video: "[The Military Technology We All Use with Captain Colton Mott.](#)" As students watch the video, you may have them add additional information to the initial questions from the warm up.

Following the video, have students respond to the following prompts:

- What surprised you in this video?***
- Why did the military release GPS technology to the public? Do you think this was a good decision? Why or why not?***

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

Explain to students that today we will be using GPS technology to complete a simple task – measuring a distance on our school campus. We will compare this process to the more traditional methods used to measure distances.

Prior to class, teachers should clearly mark two spots at least 100 meters apart on the school campus. Possible methods include using sidewalk chalk to mark on pavement, using flags to mark grass, etc.

Hand out the [student lab sheet](#). Students will follow the procedures outlined on the lab sheet to collect data. Following data collection, students should share the following information to a class data table:

Distance Measured Traditionally (meters)	Distance Measured with GPS Coordinates (meters)

As a class, discuss the results in the data table. Then have students complete the **analysis questions** on the lab sheet.

EXPLAIN:

Show students the Video "[How does GPS Work?](#)". As they watch the video, you can have them take notes on the process that is used to calculate the position of an object by GPS. Alternative: You can use this [Edpuzzle](#) for students to view the video independently and answer questions about the video as they watch.

Following the video, have students discuss **how GPS works**. Discuss **how students use GPS in their own lives** as well as the examples provided in the video.

ELABORATE: Applications and Extensions:

Explain that now we will look at how GPS is solving problems for people in our society.

Divide students into the following groups:

- Agriculture
- Aviation
- Environment
- Marine
- Public Safety and Disaster Relief
- Rail
- Recreation
- Roads and Highway
- Space
- Surveying and Mapping

-Timing

Once students are divided into groups, explain that their job is to research these applications of GPS and create a presentation for the class that includes the following information:

- Explain what this application is.
- What human problems does this application solve?
- How did humans traditionally solve this problem before GPS?
- What benefits does GPS provide for solving these problems?
- Do you think that GPS has had a significant impact on this application? Why or why not?

Students should start their research at <https://www.gps.gov/applications/>

EVALUATE:

Formative Assessment: Formative assessment problems throughout the lesson are ***bold and italicized***. Use student responses to these questions to help teach/reteach ideas as the lesson progresses. You may also use the Edpuzzle quiz from the Explain section as a formative assessment.

Summative Assessment:

Have students present their presentations to the class. You may grade their presentations using the following Rubric:

https://www.readwritethink.org/sites/default/files/30700_rubric.pdf

Elaborate Further / Reflect: Enrichment:

Have students use GPS technology to create/participate in Geocaching. See the following resources to develop an activity for your students:

[Hide and Seek with Geocaching](#)

[Geocaching and Orienteering](#)

[Geocaching in STEM Classrooms](#)

SOCIAL EMOTIONAL LEARNING ACTIVITY

CASEL Competency: Relationship Skills

In the video, Captain Mott discussed the importance of those who helped him through college when times were challenging. Today we are going to consider how others help us to be successful in our own learning.

Start the lesson by having students discuss the following prompt with a partner or small group:

“Who has helped you in school this week? How have they helped you?”

[Next, show the video “The Power of Relationships in Schools”](#)

After the video, have students discuss the following prompts:

1. What are your thoughts related to this video?
2. Which parts can you relate to?
3. Who has been your favorite or most impactful teacher or school staff? Why?

Next, hand out blank cards and have students write a thank you card to a favorite teacher or school staff member. Have them deliver this thank you to that person!

You may use these [printable thank you cards](#) for this activity.

INTERDISCIPLINARY CONNECTIONS/IDEAS

Social Studies: Use the resources from the Smithsonian's Virtual Exhibit [“Time and Navigation: The untold story of getting from here to there.”](#) to explore how navigation has developed over time—including the use of GPS. Lesson plans and primary sources are provided.

Art: Use the lesson [“GPS Artists” from Sciencspot.net](#) to help your students create GPS inspired art in their community.

CTE: Explore how GPS is used in Agriculture using [this lesson](#) from National Agriculture in the Classroom.



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