

Lesson 1 - Outline

General Lesson Information

Title: Understanding Cybersecurity aspects of Autonomous Vehicle Navigation

Overview/Annotation: Autonomous systems are integral to sensitive and often critical missions, including general transportation, search and rescue, surveillance, reconnaissance, mapping, and firefighting. These systems rely heavily on Positioning, Navigation, and Timing (PNT) services, primarily supported by GNSS, such as GPS. However, GNSS faces vulnerabilities that challenge safe and reliable navigation, including spoofing, jamming, atmospheric interference, and signal multipath effects. Students will explore cybersecurity aspects of autonomous vehicle navigation through interactive activities, including completing surveys, watching short educational videos, and participating in a quiz and discussion questions. Students will engage with the material to enhance their understanding and apply their knowledge through thoughtful responses. The lesson concludes with a final survey to assess learning outcomes and gather feedback.

Setting or format (outdoors, in groups, lab, etc.): Individual or Group

Intended group size (if groups are used): No more than 2-3 (if needed)

Intended grade level(s): 6-12th

Approximate Time of Lesson: 50 Minutes

- Introduction & Pre-Survey (5 minutes)
- Video lesson (15 minutes)
- Kahoot quiz (10 minutes)
- Discussion and questions (10 minutes)
- Post-Survey and wrap-up (10 minutes)

Commented [HW1]: What is GNSS?

Researcher Biography

Name & Professional Title:

Research Assistants

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Advisors

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Brief Description of Research Interests: Our research focuses on positioning, navigation, and timing (PNT) technology, cybersecurity of next-generation cyber-physical systems, and the transportation digital twin/multiverse. In effect, our interests lie in using an interdisciplinary approach to solving mobility challenges to revitalize our transportation system. The potential benefits of such research transcend the boundaries of social, economic, and environmental domains, which include reduced traffic congestion, delays, crashes, fuel use, emissions, and lowered monetary costs for transportation infrastructure.

Associated Standards and Objectives

Content Standards: *List Alabama Course of Study Standards that connect to lesson*

CE350: Introduction to Transportation: The fundamentals of transportation, with a focus on roadway and traffic engineering. Key topics include transportation economics, planning, highway design, drainage, construction, traffic control devices, traffic operations, management, and highway capacity analysis.

Primary Learning Objectives:

Students will be able to

- explain key concepts from the lesson by watching educational videos and engaging in discussions.
- demonstrate their understanding of the topic by participating in a Kahoot quiz.

In summary, students will be able to reflect on their learning progress by completing pre- and post-surveys.

Additional Learning Objectives: *N/A*

Commented [HW2]: This section should list content standards from the Alabama Course of Study

Commented [HW3R2]: Standards can be found at this link:
https://alabamalearningexchange.org/courses/Science/High_School

Commented [HW4]: Objectives should be more specific

Preparation Information

Total Duration: 50 Minutes

- Introduction & Pre-Survey (5 minutes)
- Video lesson (15 minutes)
- Kahoot Quiz (10 minutes)
- Discussion Questions (10 minutes)

- Post-Survey & Wrap-up (10 minutes)

Materials and Resources

- Computer or laptop with internet access
- Projector or smartboard for video presentation
- Kahoot account and quiz setup
- Survey platform (Google Forms, Microsoft Forms, or paper-based alternative)
- Speakers for clear audio during the video lesson

Technology Resources Needed:

Teacher:

- Computer or laptop with internet access
- Projector or smartboard for video presentation
- Kahoot account and quiz setup
- Survey platform (Google Forms, Microsoft Forms, or paper-based alternative)
- Speakers for clear audio during the video lesson

Students:

- Individual or shared devices (laptops, tablets, or smartphones) for Kahoot quiz
- Internet access for participating in Kahoot and completing surveys
- Headphones (optional, if students watch videos individually)

Background and Preparation

Preparation (Throughout the Week):

- Students are tasked with using Google Maps using the tablets.
- Teacher periodically reminds students about the upcoming hands-on activity on Friday.

Procedures and Activities

Engagement

Introduce the topic in a way that connects students' everyday experiences.

- Ask a thought-provoking question:
 - Example: "Have you ever used GPS on your phone? What would happen if it suddenly gave you the wrong directions?"
 - Have students briefly discuss their thoughts in pairs or small groups.
- Show a short introduction video (Optional):
 - Play a 1–2-minute video that introduces the topic in a relatable way.

- Example: A video demonstrating a real-world example of a cybersecurity threat or technological failure.
- **Pre-survey (Google Forms or Printed Handout):**
 - Students answer a few multiple-choice or short-answer questions to assess their prior knowledge and opinions.
 - Example Questions:
 - "What do you already know about cybersecurity threats?"
 - "Have you ever played a Kahoot quiz before?"

Commented [HW5]: Have these resources been created?

Main activity

Engage students with educational videos, a Kahoot quiz, and a class discussion.

- Play a short educational video related to the lesson topic. (5-7 minutes)
- After the video, pause and ask reflection questions:
 - "What was the most surprising thing you learned from the video?"
 - "How does this concept relate to something you've seen in real life?"
- Play a second short video (if necessary) to reinforce concepts.

Wrap-up and Reflection

Summarize key points, assess student learning, and gather feedback.

Steps:

1. Post-Survey (Google Forms or Printed Handout):
 - Example Question: "What is one thing you learned today that you didn't know before?"
2. Class Wrap-Up Discussion:
 - Summarize the lesson's key takeaways.
 - Ask students: "What was the most interesting part of today's lesson?"
3. Exit Ticket (Optional):
 - Students write one question they still have about the topic.

Final Product/Summative Evaluation

- Option 1: Quiz – A short assessment based on lesson concepts.
- Option 2: Mini Presentation – Students present solutions for protecting GPS systems from cyberattacks.
- Option 3: Essay/Reflection – Students write a short essay explaining why cybersecurity in transportation is important.

Attachments:

Possible lesson videos and corresponding link

Commented [HW6]: Great Resources!

- What is Cybersecurity? Educational Video for Kids: <https://youtu.be/wpX2O2B2uGE>
- The Simple Solution to Traffic: <https://youtu.be/iHzzSao6ypE>
- How does GPS work? <https://youtu.be/RSA3feQ9gKk>
- What is a Satellite? <https://youtu.be/03pZdYVacaM>
- Cyber-attacks on the car? <https://youtu.be/IVZ2TjEL9LI>
- Fate of the Furious 8 (2017) All the cars in Newyork are hacked.
<https://youtu.be/19zeMqh-zqY>
- Fully autonomous driving technology: <https://youtu.be/aaOB-ErYq6Y>