

### Abstract:

In this lesson, we will discuss how robots use the metric system as their system of measurement and explore how they measure distances, angles, and time. We will walk through how to calculate the distance to objects if we know the time it took for light to leave the robot, bounce off the object and return to the robot. Finally, we will see how trigonometry can be used to determine how long a robot arm must be, or how high a table can be reached by a robot with a simple arm.

### Objective:

By the end of this lesson, students will be able to:

- Describe how robots measure distances, angles, and time
- Solve for the distance of objects to robots via light waves
- Formulate the length of a robot arm
- Recite the idea of abstraction in robot design

### Standards:

Computer Science Teachers Association (CSTA):

- 2-AP-11 Create clearly named variables that represent different data types and perform operations on their values.
- 3A-AP-22 Design and develop computational artifacts working in team roles using collaborative tools.

### Resources / Materials:

Playlist Overview: [The Robot Doctor Series](#)

Lesson Video: [Lesson 103 - Robot Measurements](#)

Student Handout: [103 Student Handout](#)

Student Handout: [103 Student Handout - Modified](#)

Teacher Handout: [103 Teacher Handout](#)

Student Survey: <https://forms.gle/vNKUqjGNyuC2X8zNA>

(Have students complete this at the end of the lesson)

### Procedures:

1. Opening Questions: **How do robots measure? What do robots measure?**
2. Review Opening Question: Explain that robots measure using trigonometry and the use of sensors that capture information. Make sure to support/compliment student ideas about the opening question.
3. Explain that the video was created by **WQED** (Television Company) and **RobotWits** (Artificial Intelligence Company) who partnered to create the Robot Doctor educational video series.
4. Read the Abstract to the students or explain in your own words what the video will be about.
5. Prepare the room for the video by asking students to eliminate distractions (close laptops, lower blinds, put away folders, set down pencils, ect.).
6. **Show the video** to the students.
7. After the video, ask the students to share **what they liked** and **what they learned** from the video with someone beside them. Facilitate discussion, then ask for volunteers to share with the rest of the class.
8. Pass out the **Student Handout** to each student.

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9. Discuss the elements of calculating the distance to objects by using light and review the first page of the student handout.
10. Have the students work on the Challenge questions. They may work individually or in small groups.
11. Provide light guidance to each student on their progress with the challenge questions, if needed. Students may also use the **Modified Student Handout** to help structure their work (the questions on this worksheet are different, but the 'fill in the blank' setup and the formulas are the same).
12. After the majority of the students have finished the student handout (or a majority are stuck), prepare to review the challenge questions one at a time.
13. Use the **Teacher Handout** to help students walk through each part of the Student Handout.
14. Review with the students the concept of measuring the speed of light and distances to objects from a robot.
15. Have the students go to this link: <https://forms.gle/vNkUqjGNyuC2X8zNA> and fill out the survey.

#### Modification:

Students will have their lesson modified according to their IEPs and individual capabilities. The modified Student Handout does not have an accompanying Teacher Handout because the problems follow the video. Use the video as a reference when working through the problem with students. The first activity explanation is at **8:29** and the second activity explanation is at **9:59** in the video.

#### Enrichment:

Students who are advanced will finish early and have extra time. They may watch other episodes of the Robot Doctor or they may assist students who are struggling with the assignment.

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