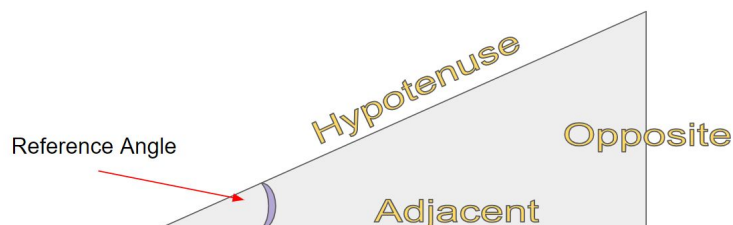


## Sphero RVR: Angle of Incline

Students studying trigonometry will apply their knowledge of solving a triangle to answer this question: What is the steepest angle of incline that the RVR can travel upwards? Students will work in pairs using a ramp and measuring tape to draw a diagram and calculate the angle, test driving the RVR in several trials.



## Materials

- Sphero RVR robot
- Ramp material ... plywood (?)
- Measuring Tape
- Floor Space, stairs, boxes

## Student Objectives

- After a class discussion, students will conduct a series of experiments in groups to determine the steepest angle of incline that the RVR can travel.
- They will run three trials each on ramps that they set up for their RVRs, recording the speed settings and success of each one on a student worksheet.
- Using trigonometric functions (tangent), students will solve for the angle of incline of each ramp.
- During this process, students will think like programmers and engineers, designing the best process to collect data and analyze their results while reflecting on their process.



## Teacher Technology Skills Needed

- Understanding of the Sphero RVR movement blocks and speed settings

## Standards

NYSED Standards

- **GEO.G.SRT.8** Use sine, cosine, tangent, the Pythagorean Theorem and properties of special right triangles to solve right triangles in applied problems.

## Activity Procedure

1. The teacher will review the use of trigonometric functions to solve for a missing angle in a right triangle.
2. Demonstrating with an RVR robot, discuss the idea of a ramp for the RVR. Emphasize the careful measurement of the ramp length, floor (horizontal) distance and ramp height, and how these numbers relate to the right triangle model.
3. Distribute the student worksheet and discuss the following:
  - a. Length of a proper ramp (unanimous agreement with the class)
  - b. Definition of a proper ramp
  - c. Agreement of a range of RVR speed numbers to be considered a successful trial (How do we overcome gravity but not spin our tread to affect the outcome?)
4. Using <http://edu.sphero.com> or the EDU mobile app, students create a program to send the RVR up the ramp.
5. Students conduct ramp trials and record results on the worksheet.
6. At the end of the worksheet, students will write their reflections of the process:
  - a. As a group, how confident that their calculations were accurate?
  - b. Did they self-assign roles in the task and was that effective?
  - c. What was their thought process in determining their best answer for the steepest angle of incline?



## Extension Activities

This basic programming challenge can be enhanced by having students add the following ideas to their program (assuming it works and follows the teacher's criteria):

- ✓ On the student worksheet, can the students confirm their angle of incline calculations using the sine or cosine function, instead of tangent?
- ✓ Generate a discussion about how the surface of the ramp material might matter. What are the best materials to have your RVR run on up the ramp and why?
- ✓ Have students experiment with having their RVR go backwards up the ramp at different angles of incline. Is there any difference, and why or why not?