



TEACHING CHALLENGE-BASED ROBOTICS

MOUNTAIN CLIMB CHALLENGE

Colorado State University Extension with RoboRAVE International

OVERVIEW

In the Mountain Climb Challenge, inspired by RoboRAVE International's Alpinebot contest, youth build robots that can summit slopes of various degrees of steepness.

Approximate Challenge Time: 3 hours (2 ½ hours build/program, 30 minutes competition)

SUPPLIES

- LEGO Mindstorms EV3 robotics kits (1 per team)
- LEGO Mindstorms EV3 expansion kits (optional)
- Stop watch or timer
- Smart phone or protractor for slope measurement
- Mountain slopes (from 1 to 4)

Mountain Slope Supplies

- At least 1 piece of board, 48" long and a minimum of 9" wide.
- Painter's tape
- Books
- Items of various heights (chair, table, boxes, etc.)

Creating the Mountain Slopes

1. Lay 1 piece of board from the floor up to the level of a chair. Place a few books or other heavy objects at the base of the board on the floor to prevent the board from sliding.
2. Place some books at the top of the board to level off the board top with the chair. Tape the edge between the books and the board to provide a smooth transition to the summit.
3. Use a smart phone app or a protractor to determine the angle of the slope and note it on your score sheet.
4. Create another slope up to the level of a table, repeating steps 1-3 to create a climb with a steeper angle. Repeat this process until you have a variety of slopes available to practice on, ranging from about 20 degrees to 60 degrees. You can stack objects like boxes on top of other items, like the table, to create steeper slopes.

If you only have one board available for your groups to climb, start it at chair level and give teams time to work towards achieving that height. Then increase the steepness of the angle for all groups. You may want to provide additional materials for teams to use to increase traction for their robot, including rubber bands, tape, or other materials. Alternately, you can choose to use board materials that provide various levels of friction, such as carpet, whiteboard, and plywood.

CHALLENGE INSTRUCTIONS

Build

Allow teams approximately 2 ½ hours to build and program a robot that can start on the bottom of each ramp, climb up the ramp, and clear the summit (pass completely from the angled board onto the flat summit area). Show teams the various summits and let them know the angle of each one. Encourage teams to attempt the easiest summit first, then move on and make changes to their robot to summit steeper slopes.

Teams will likely need to use gearing to help them get the torque to make the summit. However, time is also factored into the contest, so they should try to balance torque and speed. For this challenge, teams are allowed to use any parts in their EV3 kit. If you have it available, also provide the EV3 Expansion kit, so teams will have access to additional sets of wheels. You may choose to provide some additional materials to help teams with traction. This might include rubber bands, tape and other materials. Make sure if teams use supplemental materials, they do so in a way that doesn't damage the slopes or EV3 parts.

Competition

1. Have each team individually line up their robot at the bottom of the least steep mountain track.
2. Have the team start their program, and at the same time start a timer.
3. If the team manages to reach the top of the incline and clear the summit, stop the timer and record the time on the scoresheet.
4. Once all teams have scored on the easiest track, repeat this procedure on the next steepest track.
5. Continue scoring on all tracks that at least one team can clear. If a team can't clear any given track, by successfully making it up the ramp and over the summit, give them an incomplete or zero for that track.
6. Recognize teams with the fastest scores on each track, or the fastest scores on the steepest track.

You can choose to score this challenge in a number of ways. You can give awards for the fastest times on each individual track, or you can give an award to the robot that can summit the steepest track in the fastest time.

Looking to up the difficulty? Try out RoboRAVE's Alpinebot Challenge, which includes a very steep slope and requires teams to plant a flag on top of the summit. Download instructions at www.roboquerque.org.

