

Lesson 3.5 - Mars Rover

Overview

During this lesson, students will gain understanding of how more than one solution exists for many technological problems. Students will integrate and exhibit learning by creating a SAM Space Car which uses two different methods for forward movement, steering and reversing.

Key Information

Level 3: (Ages 10-11) US Grades 4 or 5

Time: 45/90 minutes

Warm-Up	5 minutes
Mini-lesson	10 minutes
Worked Example	7 minutes
Challenge 1	7 minutes
Challenge 1 - Debug	5 minutes
Challenge 2	7 minutes
Tidy Up / Exit Ticket	4 minutes

Lesson Topics

- **Computing**
 - Inputs, outputs, debugging, trial and error, calibration, workarounds
- **Engineering Design**
 - Working within constraints
- **Design and Technology**
 - Generate, develop, model and communicate ideas through talking, drawing and mock-ups
- **English Language Arts**
 - Use information gained from illustrations and text to demonstrate understanding

Learning Objectives

- ***As a result of this lesson, students will be able to***
 - See how more than one solution is available for any given problem
 - Contrast two solutions
 - Design a SAM car which can move, forward, steer and reverse using two different mechanisms

Materials

- SAM Labs Kit
- SAM Labs Student Workbook

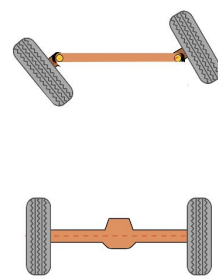
Warm Up

5 minutes

How do vehicles turn?

Objective: Conduct scientific inquiry about how vehicles turn with a view to investigating alternative mechanisms.

Procedures: Students identify that bikes, scooter and cars all use the same system to turn. *What are all these vehicles doing? Why does the front wheel or wheels move?*



Sample photo ideas: A bike, a scoot, a car wheel, rover wheels

Link forward: The teacher identifies how many common vehicles turn ... by making the front wheel or wheels change direction

Mini-lesson

10 minutes

How do other vehicles turn?

Objective: Students learn that some specialised vehicles use a different system.

Procedures: The teacher explains that many specialized vehicles, especially those that use tracks, cannot turn like a bike a scooter or car, since the have no wheels. These vehicles cannot use normal wheels as they have to travel over snow or very uneven ground. And they have to get there! Often these vehicle are used in extreme condition where people's' lives or survival depend on them, so their steering mechanism must be robust.



So how do they turn? These vehicles have two tracks, one on each side. There are motors attached to each track. If we make one track go faster than the other, then the vehicle will turn

Lesson 3.5 - Mars Rover

At the end of the mini-lesson, students match or define keywords in their workbooks (2 minutes).

Keywords

- Turn
- Track
- Steer
- Motor
- Different

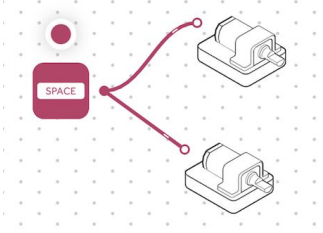
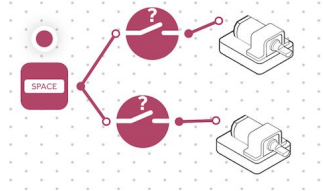
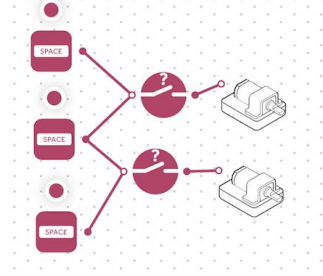
Let's Discuss: How do tracked vehicles turn? In your workbooks or with a partner, record, discuss, or share how different vehicles steer.

Link forward: The teacher prepares students to designing a car using SAM blocks which replicates the turning mechanism of these unusual vehicles.


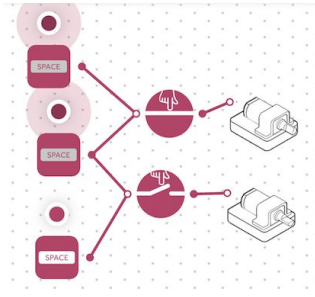
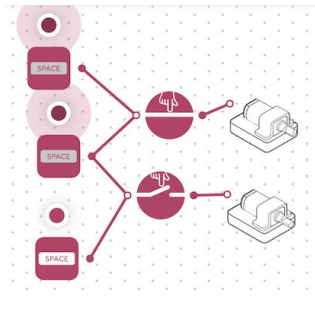
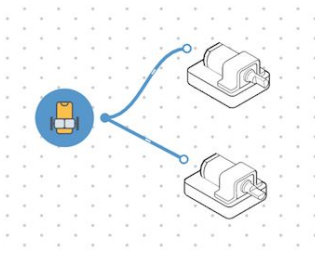
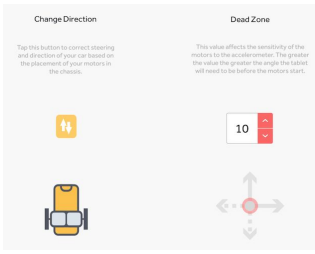
Worked Example

7 minutes

Investigate different methods of controlling motors

Instructions	Workspace	Notes for Teachers
<p>Step 1. Turn on and pair 2 DC Motor blocks. Drag and connect a Key Press block or a Light Sensor block (as a Button) to 2 motors on the Workspace.</p>		<p>Teacher says, 'This will make both motors turn' We'll call this 'Key Press 1'</p>
<p>Step 2. Add 2 Switches onto the Workspace between the Key Press and the DC Motors.</p>		<p>Teacher says, "Watch how both motors turn</p>
<p>Step 3. Connect 2 more Key Press blocks to each Switch.</p>		<p>Teacher says, 'These Switches are to disable one or other of the two motors. We'll call these 'Key Presses 2 & 3'.</p>

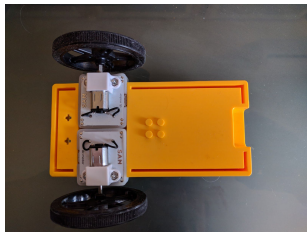
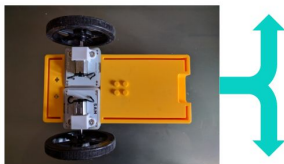
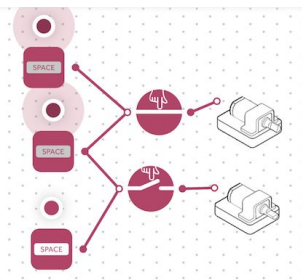
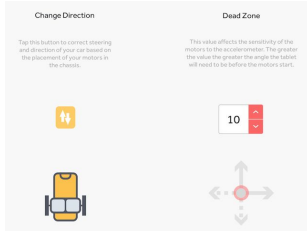
Lesson 3.5 - Mars Rover

<p>Step 4. Open the Switch settings and choose one of the new Key Press blocks as the input.</p>		<p><i>Teacher says, 'Make sure you choose a different Key Press for each DC Motor'.</i></p>
<p>Step 5. Press only one of the new Key Press Buttons and the original one.</p>		<p><i>Teacher says, 'Because only one switch is 'on' only one motor will rotate'.</i></p>
<p>Step 6. Press all 3 Key Press buttons and your car will move in a straight line!</p>		<p><i>Teacher says, 'Now the both Motor blocks will rotate.'</i></p>
<p>Step 7. Remove everything except the two Motors and add a Car Controller block and connect it to the Motors.</p>		<p><i>Teacher says, 'The Car Controller is a special block to control Cars on devices that can sense Tilting. We are going to see if your devices can do this'.</i></p>
<p>Step 8. Open the Settings and tilt your device. Watch how, depending on how you tilt, the little dot on the Controller Settings moves forward, left and right.</p>		<p><i>Not all devices support the Car Controller. Desktop computers can obviously not be lifted and tilted and only some laptops are able to sense tilting, If this is the case, then your students will have to use the Switch method of making the Car steer.</i></p>

Challenge 1

7 minutes

Make a SAM Can which steers using two options.

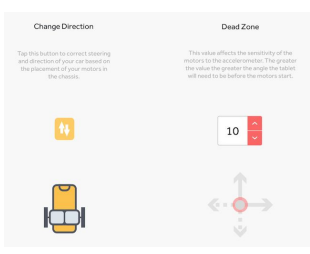

Instructions	Workspace	Notes for Teachers
<p>Step 1. Make a car by putting your DC Motors (with wheels attached) into the yellow car chassis, and make sure the rollerball is also attached.</p>		<p>Teacher says, 'Remember this car. We used a chassis, a rollerball and two Motors attached to two wheels. We made sure that one wheel was set to turn clockwise and the other, anticlockwise... If we didn't do this the car would go round and round in circles'.</p>
<p>Step 2. Make your car steer by tilting your tablet.</p>		<p>Students will need some practice in getting to feel how the Car Controller works on their device.</p>
<p>Step 3. Now disconnect the Car Controller and go back to our original system using 3 Key Press Blocks and 2 Switches between the Key Press and the Motors.</p>		<p>Although the Car Controller is a dedicated block it is important best scientific practice for students to learn how to work under constraints for occasions when convenient solutions are not available. We'll call this 'Key Press 1'</p>
<p>Step 4. Have a go using the new controls. It's tricky, but lots more fun!</p>		<p>Teacher says, 'It might take you a while to get used to these controls, so keep practicing'.</p>

Checks for understanding: You have two solutions to make a car turn. The Car Controller uses the tilt of your device to make the motors slow down, speed up and reverse. The Switch mechanism has different controls for each motor.

Challenge 1 - Debug it

5 minutes

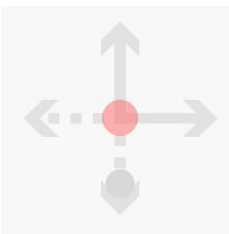
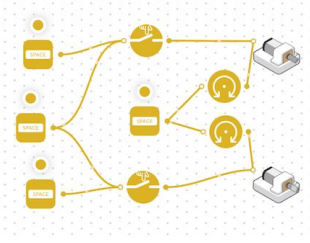
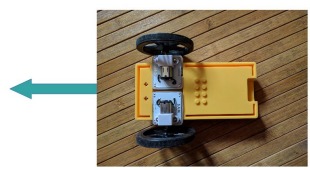
Is the Car easy to control?

Instructions	Workspace	Notes for Teachers
<p>Step 1. Open the Settings of the Car Controller and set the value to one that is comfortable to use.</p>		<p>Teacher says, "The higher the number the more you will have to tilt your device to operate the car."</p>
<p>Step 2. If you are using the Switch method to control you Car, open the Motor settings and modify the speed of the Motors so that the Car doesn't move too quickly.</p>		<p>Teacher says, "The Car will go very fast by default. Try and get as slow a speed as possible without the car stopping. You will have to use trial and error for this."</p>

Challenge 2

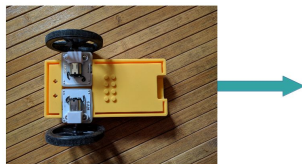
7 minutes

Make a SAM Car which turns and reverses using two different mechanisms

Instructions	Workspace	Notes for Teachers
<p>Step 1. If you are using the car Controller, this is very simple, just tilt your device backwards.</p>		<p>Teacher says "Try using the Car Controller with Small movements first and then, as you get more confident, increase the speed of the Car".</p>
<p>Step 2. If you are using the Switch mechanism, add another Key Press with 2 Switch Direction blocks connect to your Motor blocks.</p>		<p>Teacher says, "This adds another system which reverses the direction of the motors and therefore the Car.. If you want to change the direction of the the car, operate the latest key Press again Key Press 1 operates the motors Key Presses 2 & 3 operate the switches Key Pres 4 operates the Switch Direction block."</p>
<p>Step 3. Operate this Key Press and the first one.</p>		<p>Teacher says, "You will first have to set the direction of the motors with the Key Press and then operate the car with your original Key Press. The newest Key Press block and the Switch Direction block operate together to reverse the direction of the motors"</p>

Lesson 3.5 - Mars Rover

Step 4. Operate the new Key Press again and watch how the Car moves in the opposite direction.



Teacher says, 'Every time you press this Key Press, the motors will change direction'.

Extension Ideas:

- Make a track for your car, try one by one to drive round.
- Time each group to see who is the winner.
- See which group stay on the track longest (irrespective of the time it takes).

Checks for understanding: of the two mechanisms: *Which one is the best? Which one is more precise? Which one is more convenient? Will both work on your equipment?*

Tidy Up / Exit Ticket

4 minutes

Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an exit ticket.