Topic	Ramp Follower Robot- II	
Class Description	**Students will learn about differential drive wheel Robots. Students will design Motors and Hinges used to connect motors with the Robot body**	
Class	**PRO C281**	
Class time	**45 mins**	
Goal	• Introduction to Wheels • Introduction to Hinges • Rotational Motors	

Resources Required	• Teacher Resources:
	  ○ Laptop with internet connectivity
	  ○ Earphones with mic
	  ○ Notebook and pen
	  ○ Smartphone
	• Student Resources:
	  ○ Laptop with internet connectivity
	  ○ Earphones with mic
	  ○ Notebook and pen	

Class structure	**Warm-Up** **Student-Led Activity 1** **Student-Led Activity 2** **Wrap-Up**	**05 mins** **20 mins** **10 mins** **10 mins**
Credit & Permissions:	**This project uses Webots, an open-source mobile robot simulation software developed by Cyberbotics Ltd.** **License**	
WARM-UP SESSION - 05 mins		

Teacher Starts Slideshow 
Slide # to #
<**Note**: Only Applicable for Classes with VA>
Refer to speaker notes and follow the instructions on each slide.

Teacher Action	Student Action
Hey <student's name>. How are you? It's great to see you! Are you excited to learn something new today? **Following are the WARM-UP session deliverables:** • Greet the student. • Revision of previous class activities. • Quizzes.	**ESR**: Hi, thanks! Yes I am excited about it! Click on the slide show tab and present the slides

WARM-UP QUIZ
Click on In-Class Quiz

Activity Details

Following are the session deliverables:
- Appreciate the student.
- Narrate the story by using hand gestures and voice modulation methods to bring in more interest in students.

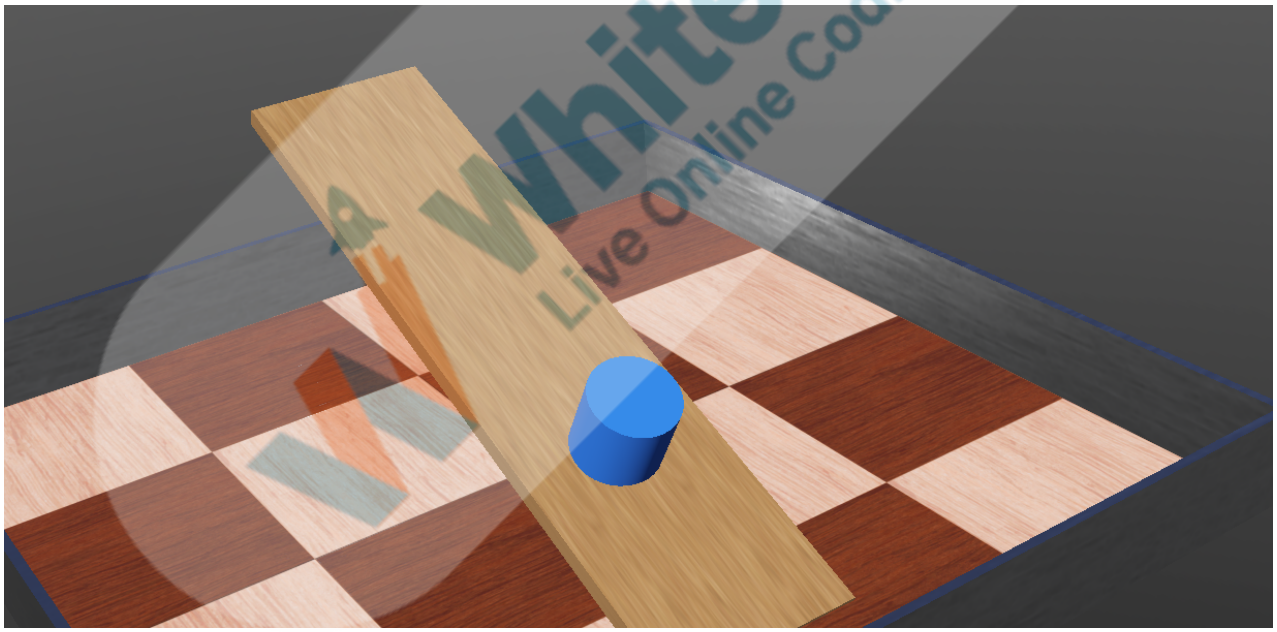
STUDENT-LED ACTIVITY-1 - 20 mins

Student Initiates Screen Share

- **Introduction to Wheel Design**
- **Installation of Rotational Motors**

Teacher Action	Student Action
Any doubts from the last class! *The teacher will clarify if there are any doubts!*	**ESR:** Varied!

So we designed our Slope and base of the Robot in the last class Can you tell me Ramp Follower Drive Robot? **Ramp Follower Drive Robot:** A differential wheeled robot is a mobile robot whose movement is based on two separately driven wheels placed on either side of the robot body. The robot moves on a slope or Ramp. Its Altimeter sensor is used to switch direction when the robot is close to the slope's/Ramp border. Ramp Follower Robot will focus on an altimeter which is used to control the robot's ascent and descent position on the ramp/Slope. *Note: This activity will be student driven.Teacher will guide the student to follow the same.But teacher should practice all the activity beforehand.*	**ESR:** Varied!
Teacher will click on Teacher Activity 1 Download the previous code file or the student can open his/her file too. If there is any error then use the last class as Boilerplate code.	Student will click on **Student Activity 1**
As we discussed in the last class 1. Ramp/Slope: For Ascent and Descent 2. Robot Design Body	

3. Two Wheel: To drive Robot 4. Distance Sensors to follow the ramp/Slope size 5. Altimeter: An altimeter or an altitude meter is **an instrument used to measure the altitude of an object above a fixed level.** *So let's start with the design part: Robot's design usually takes patience and time.Please follow instructions to get exact designs.*	
If you see a small rectangle arena, No need to increase the size for the rectangle arena, we will change the view option to make it large. 1. Go to **view** 2. Select **Orthographic Projection or press F10**	
Output will look like this:	
	
So today we will focus on Robot wheels and Motors. Do you think connecting a direct motor will make our Robot work?	**ESR: Varied!**

No, whenever we want to connect something we must need some supporting device.

Right!

Same is the case with our Robot.

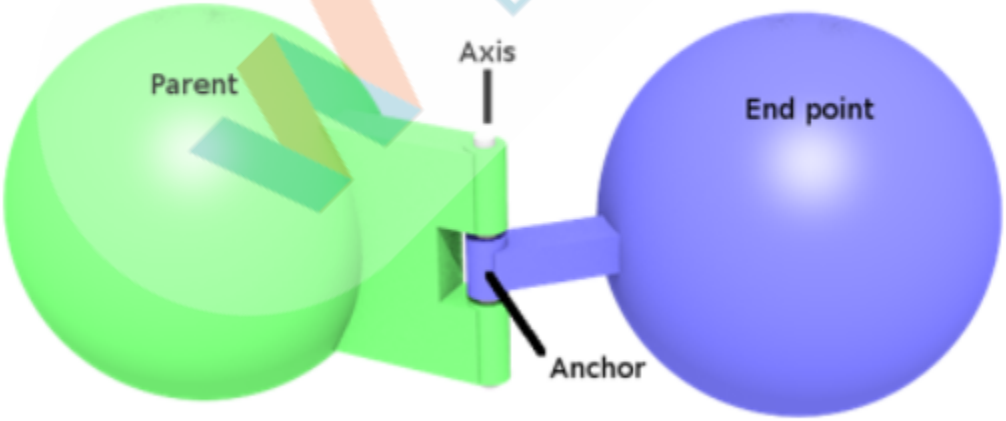
To connect Motors we must need some supporting device like hinges or some joints.

Even in real Robots, we need the same.

So Let's learn about Hinge Joints first!

HingeJoint:

The HingeJoint is a joint which allows a rotational motion around a given axis. It will use a device like Rotational Motor, a position sensor inside it. If no device then it will act as a simple joint.



Hinge joint

Let's design Hinge Joint for the same.

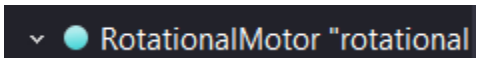
Procedure for Hinge Joint

1. Click on **transform**
2. Click on **+**
3. Select **Base nodes**
4. Click **Base nodes drop down** 
    a. Select **HingeJoint**
    b. Click **Add**
    c. Now Double click on Hinge joint Select **Select JointParametersNull**
    d. Double click on **JointParamtersNull and select Hinge Joint Parameters**
    e. Click **Add**
    f. click on drop down of **Hinge Joint Parameters**
        i. Select **position 0**
        ii. Select **axis 0, 1, 0**
        iii. Select **anchor 0, 0, 0.025**
    g. Double Click **on device**

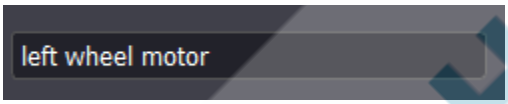
h. Select **Rotational Motor** under Base nodes

i. Click **Add**

j. **Click on drop down of**

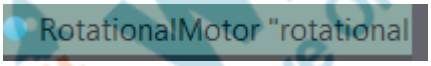


i. **Write name “left wheel motor”**



ii. **Set consumption factor 70**

Note : Repeat the device step again to set the position sensor .

k. Click on 

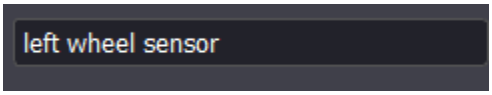
l. Click on **+**

m. Select **Position Sensor** under Base nodes

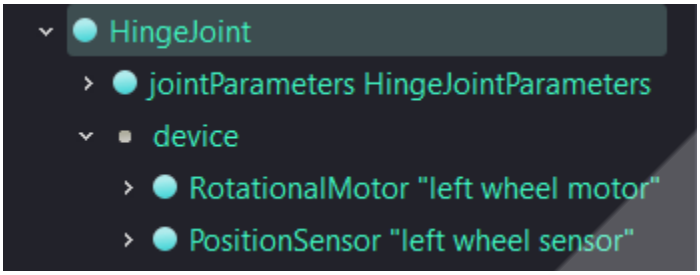
n. Click **Add**

o. Click on drop down of

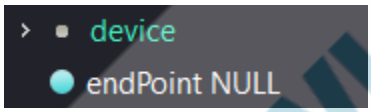
i. Click on name field and write name **“left wheel sensor”**



Scene Tree will look like this:



p. Now close the **Drop down of**

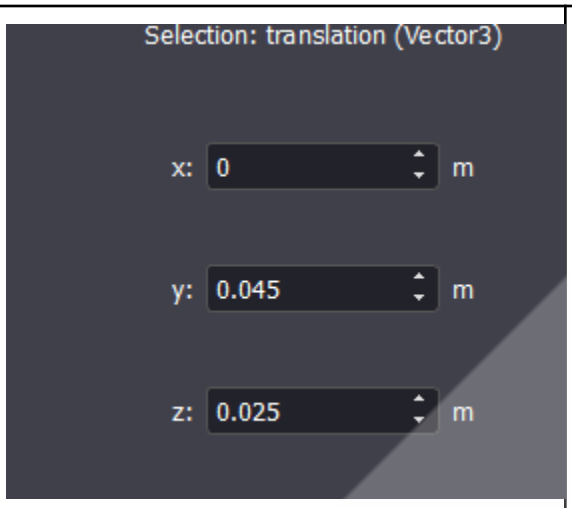


q. Double Click on **endPoint PointNull**

r. Select **solid** under Base nodes

s. Click on **Add**

i. Select **translation 0, 0.045, 0.025**



ii. Select **Rotation -0.6, 0.6, 0.53, 4.12**

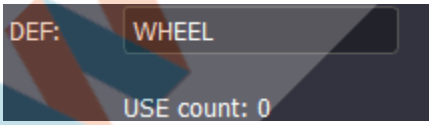
Write name **"left wheel"**

iii. Double Click **on children**

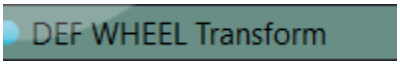
iv. Select **transform under Base nodes**

v. **Click Add**

vi. **Write the name of DEF function "WHEEL"**

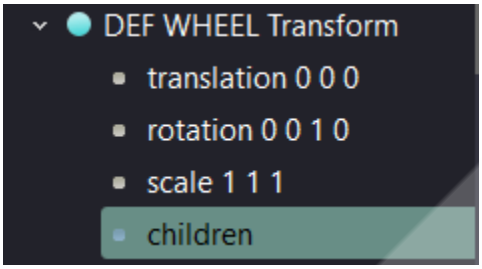


vii. Click on drop down of



viii. Set **Rotation 0.5778, 0.577 -0.577, -2.09**

ix. Click on **children under**



x. **Double Click on children**

xi. **Select** Shape **under Base nodes**

xii. Click **Add**

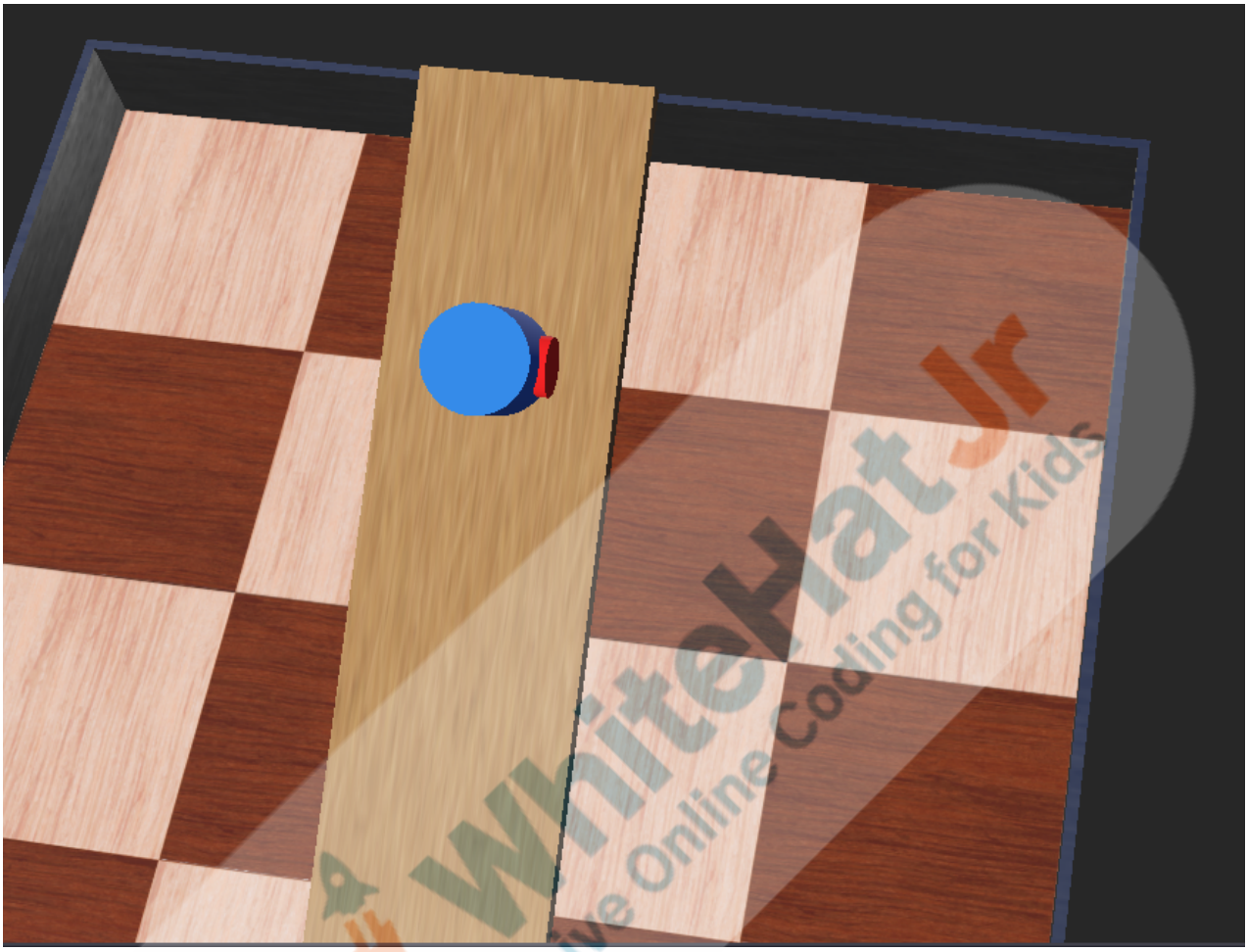
xiii. Double click on drop down of **Shape**

1. Double Click on **Appearance**
2. **Select PBR Appearance**
3. **Click Add**
4. **Set base color 1 , 0, 0**

Note : Color can be selected from ColourBox too as per student wish.If not then use default one

5. **Set Roughness 1**
6. **Set metalness 0**
7. Under **Appearance** there is **Geometry Null.** Double Click

on **geometry Null** 8. Select **Cylinder under Base nodes** 9. Click **Add** a. Set **Height 0.01** b. Set **Radius 0.025** **xv. Set translation Step 0.01** **Rotation Step 0.262** Save the simulation.  You will see a tire on the left side. This tyre includes a hinge joint along with Rotational Motor and position sensor.	



So our one wheel is set. Next task is to set the another wheel i.e. Right Wheel.

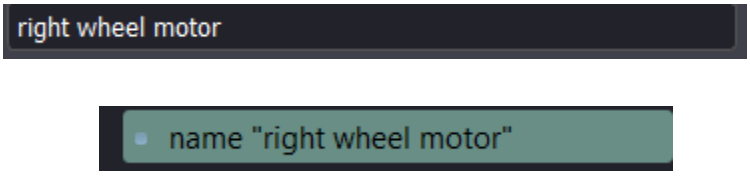
So are you enjoying it?

STUDENT-LED ACTIVITY -2 20 mins

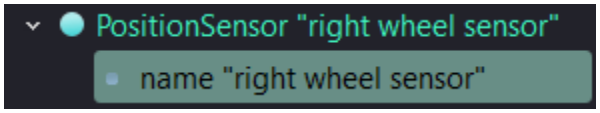
- **Ask the student to press the ESC key to come back to the panel.**
- **Guide the student to start Screen Share.**
- **The teacher gets into Full Screen.**

Student Initiates Screen Share

ACTIVITY • **Design wheels and hinge joints**	
Teacher Action	**Student Action**
Till now we have made one wheel. It's time to make another wheel i.e. Right Wheel. Procedure will remain the same. But little translation and alignment settings need to be changed as this will be the right wheel. In your webots Scene Tree go to your webots. Click on **HingeJoint** and copy the **HingeJoint** Then paste HingeJoint So no need to write/do the entire code but settings still need to be changed.	
Let's change some translational and Rotational settings to set the wheel. 1. Go to the devices 2. Click on Drop Down Rotational Devices *Note: You will see left wheel motor, bus as this is right wheel we need to change the name.* 3. Go to the name option and write "right wheel motor"	

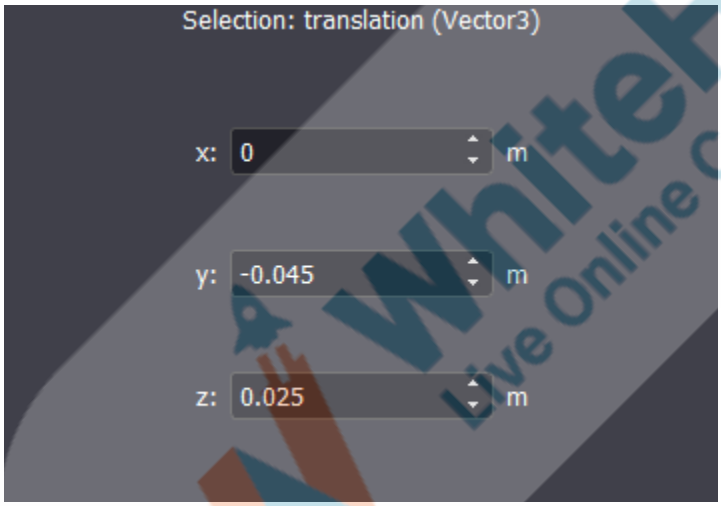


4. Do the same settings for **PositionSensor**

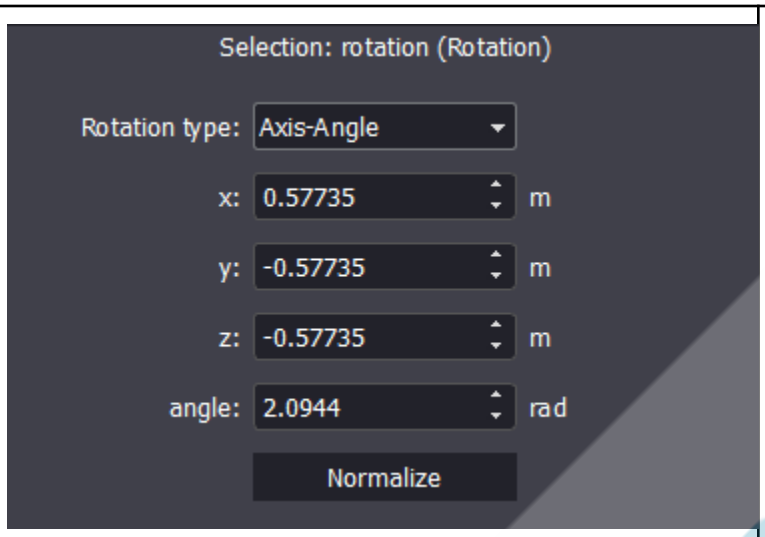


5. Write the “right wheel sensor”

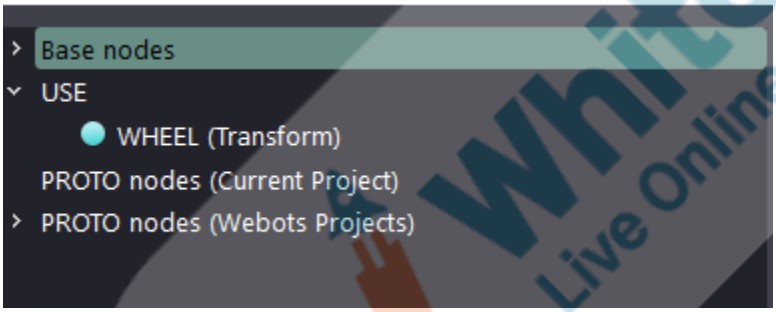
6. Change translation settings:



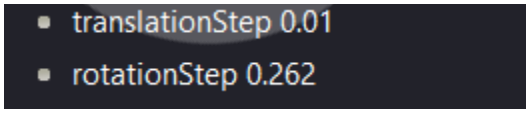
7. Set Rotation

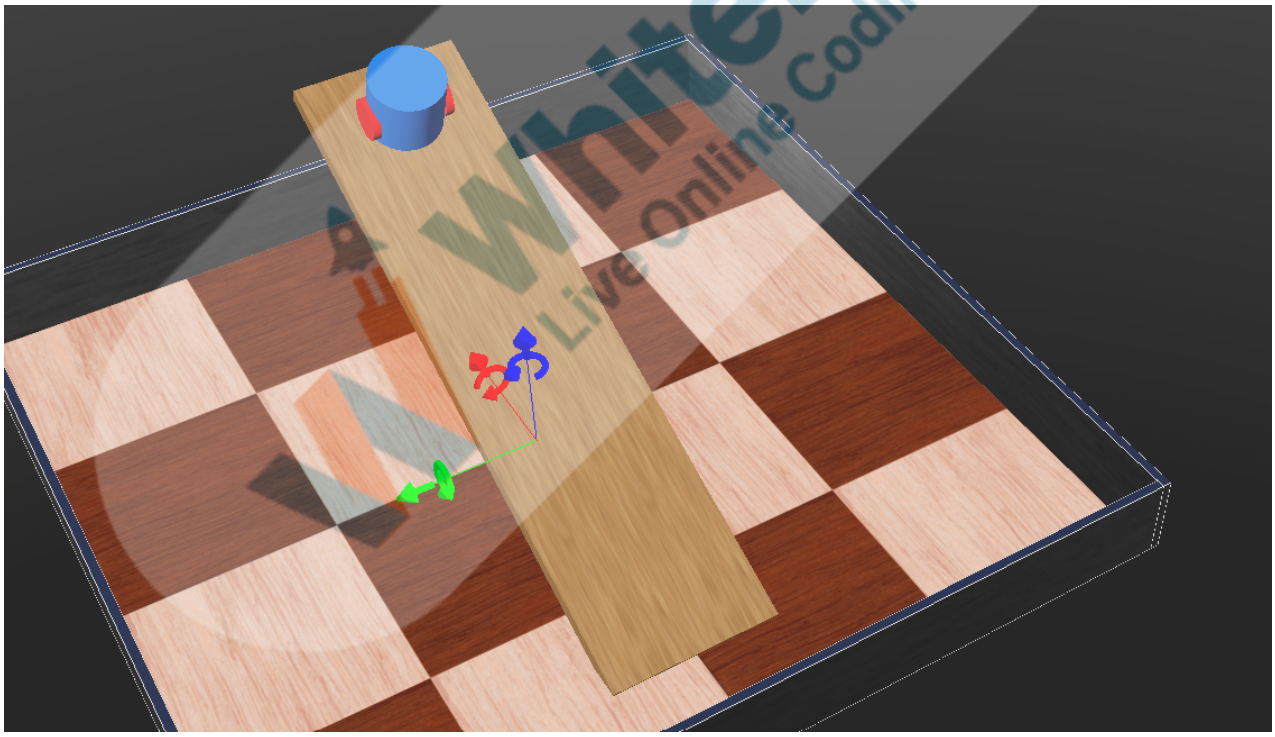


8. Double click on **children** under **endpoint Solid**
9. Click on **Use and** Select **WHEEL (Transform)**



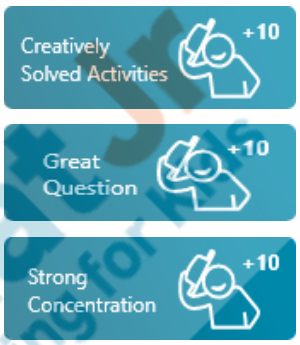
10. Click on **Add**
11. Translational and Rotational Step setting will remain same



Save the simulation. 	
If there are any design errors, Save the file first and then open the file with Notepad++. Open the Teacher reference file code with Notepad, Check if something is missing Actual Output will look like this:	
	
Now the next task is to set the Distance sensor and Face.	

We will do it in the next class.	
Teacher Guides Student to Stop Screen Share	
WRAP-UP SESSION - 05 mins	
Teacher Starts Slideshow  **Slide # to #** <**Note**: Only Applicable for Classes with VA>	
Activity details **Following are the WRAP-UP session deliverables:** ● Appreciate the student. ● Revise the current class activities. ● Discuss the quizzes.	
WRAP-UP QUIZ Click on In-Class Quiz	
Continue WRAP-UP Session  **Slide # to #** <**Note**: Only Applicable for Classes with VA>	
Activity Details **Following are the session deliverables:** ● Explain the facts and trivia ● Next class challenge ● Project for the day ● Additional Activity (Optional)	
FEEDBACK ● **Appreciate and compliment the student for trying to learn a difficult concept.** ● **Get to know how they are feeling after the session.**	

- **Review and check their understanding.**

Teacher Action	Student Action
You get “hats-off” for your excellent work! In the next class, we will learn about Distance sensors and how to design Face.	*Make sure you have given at least 2 hats-off during the class for:* 
PROJECT OVERVIEW DISCUSSION Refer the document below in Activity Links Sections	
Teacher Clicks 	

ACTIVITY LINKS		
Activity Name	**Description**	**Links**
Teacher Activity 1	Boilerplate Code	https://github.com/procodingclass/PRO-C280-REFERENCE-CODE
Teacher Activity 2	Reference Code	https://github.com/procodingclass/Pro-C281_Reference-Code
Teacher Reference 1	Project	https://s3-whjr-curriculum-uploads.whjr.online/aadda5aa-5e31-4f37-9bcb-0cf101a53356.pdf

Teacher Reference 2	Project Solution	https://github.com/procodingclass/PRO-C281-Project-Solution
Teacher Reference 4	In-Class Quiz	https://s3-whjr-curriculum-uploads.whjr.online/cfa243a1-4768-44d0-b37e-d96f263c9549.pdf
Student Activity 1	Boilerplate Code	https://github.com/procodingclass/PRO-C280-REFERENCE-CODE