Main Activity: Ferris Wheel

Teacher’s Notes

Description:
Students will build and program a mechanical ferris wheel that rotates using gears and a motor and axle mechanism. Triggered by a motion sensor, the model rotates and stops for passengers.

Before starting, we recommend students have experience with:
• Goal Kicker, Play Soccer
• Airplane Rescue, Adventure Stories
• Hungry Alligator, Wild Animals

Science
Conduct an investigation using the appropriate tools.
Construct and program a technology-enhanced model.
Modify an existing model or program to solve a problem.
Observe and measure to answer questions.

Mathematics
Add and subtract within 1000.
Identify shapes and their attributes.
Measure length with a ruler.
Perform multi-digit arithmetic.
Solve word problems using the four operations.

Language
Communicate using grade and activity-appropriate vocabulary.
Describe a process using language of sequence, cause, and effect.
Recall information from previous experience or print resources.
Use information gained from illustrations.

Introduce and define key vocabulary before beginning the lesson:
A-frame, assembly, passenger car, and rotate.
You will need:
• Building Instruction: Ferris Wheel
• Element Overview: Ferris Wheel
• Ruler

Our model:
Uses the motor to rotate a spur gear...
The gear rotates a larger spur gear...
The larger spur gear rotates an axle...
The axle rotates the Ferris Wheel!

Build a Ferris wheel that rotates and stops for passengers.

Tip:
Use the element overview as a checklist when taking out and putting away the elements.
Max and Mia are visiting an amusement park. They want to see a view of the whole park. A ferris wheel is a ride with a large wheel attached to a tall support structure.

Have you ever seen a ferris wheel at an amusement park?

Can you help Max and Mia build a ferris wheel?

Two important parts of a ferris wheel are:

1. The Passenger car
2. The A-frame

Can you identify these parts on this picture?
Here are other ways of connecting:
Look at the Connect image and think about different ways in which structures like the ferris wheel have been used throughout history and how they are used today.

Similar structures have been used historically as watermills or turbines to drive machines in grain production.

What safety precautions should be taken when the ferris wheel is moving?
People should stand at a safe distance behind a designated line while waiting for their turn. The speed of the ferris wheel should be regulated to suit the size of the wheel. All passengers should remain seated while the ride is moving and wear seat belts or lower the safety bars into the “locked” position.
Construct

1. **Build the A-frame.**
   Follow Building Instruction, steps 1 to 24.

2. **Make observations.**
   a. Look carefully at the model. What shapes can you see in the structure of the model?

<table>
<thead>
<tr>
<th>Properties of Shapes</th>
<th>Find it on the Model</th>
<th>Draw and name it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrilateral</td>
<td>Shape of space between the white plates on either side of the A-frame</td>
<td>Rectangle</td>
</tr>
<tr>
<td></td>
<td>Shape of space on arms</td>
<td></td>
</tr>
<tr>
<td>Three-sided</td>
<td>Side of A-frame</td>
<td>Isosceles Triangle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadrilateral</td>
<td>Base plate</td>
<td>Square</td>
</tr>
<tr>
<td></td>
<td>All of the corners are right angles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All of the sides are of equal length</td>
<td></td>
</tr>
<tr>
<td>Curved line</td>
<td>Gears</td>
<td>Circle</td>
</tr>
<tr>
<td></td>
<td>There are no corners</td>
<td></td>
</tr>
</tbody>
</table>
b. Use a ruler to measure the height of the A-frame. Measure from the top of the base plate to the black axle.
21 cm (≈ 8.25 in)

c. Use a ruler to measure the width of the A-frame. Measure the inside width of the red beams between the white plates.
6.25 cm (≈ 2.5 in)

3. **Build the passenger car assemblies.**
   Follow Building Instruction, steps 25 to 37.

4. **Take measurements.**
   a. Use a ruler to measure the length and width of one passenger car assembly. Measure the length from the top of the gray peg to the bottom of the passenger seat. Measure the width from the outside of the two red angular blocks.
   *Approximately 17 cm (≈ 7.5 in) long
   *Approximately 4.5 cm (≈ 1.75 in) wide
   b. Think about the measurements from Question #2b and Question #4a. Why is it important for the passenger car assembly to be shorter and narrower than the opening on the A-frame?
   *Space is needed to allow the passenger car assembly to pass through the A-frame.*
5. **Investigate the cost of building.**

Look at the list of prices below and investigate the passenger car assembly to complete these questions.

*Note:* Each element has a different price, depending on its color.

a. Count the different colored elements used in this assembly and find the total cost for each color using the chart below. *Count and use tally marks or numbers to record the number of elements. This can be done as you build the passenger car assembly, or you can use the element boxes (in the upper left corner) on the Building Instruction to track and count the elements in the assembly.*

<table>
<thead>
<tr>
<th>Element Colour</th>
<th>Number of Elements Used</th>
<th>Price of Single Element = 1 LEGO® coin</th>
<th>Calculations</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>8</td>
<td>🟥</td>
<td>8 x 4</td>
<td>32</td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>🟌</td>
<td>4 x 3</td>
<td>12</td>
</tr>
<tr>
<td>Green</td>
<td>0</td>
<td>🟡</td>
<td>0 x 2</td>
<td>0</td>
</tr>
<tr>
<td>Black</td>
<td>8</td>
<td>🟠</td>
<td>8 x 2</td>
<td>16</td>
</tr>
<tr>
<td>White</td>
<td>1</td>
<td>🟤</td>
<td>1 x 1</td>
<td>1</td>
</tr>
<tr>
<td>Gray</td>
<td>4</td>
<td>🟦</td>
<td>4 x 1</td>
<td>4</td>
</tr>
<tr>
<td>Beige</td>
<td>2</td>
<td>🟧</td>
<td>2 x 1</td>
<td>2</td>
</tr>
</tbody>
</table>

**Tip:**
If time allows, discuss alternative criteria for pricing the elements or have students assign their own values to the elements based on area or weight. Encourage students to think of an original mathematical question for other students to answer.

b. How much does it cost to build one passenger car assembly?  
67 coins

c. What is the total cost of building all four of the passenger car assemblies?  
268 coins

**Tip:**
To add an additional challenge to this activity, assign a value of 10 units or a real monetary value to each LEGO® coin (Coins) when calculating cost.
6. **Complete and connect the Ferris Wheel.**
   Follow Building Instruction, steps 38 to 53.

   **Note:** Before you run a program, make sure that you have the motion sensor correctly positioned as shown in the Building Instruction.

7. **Prepare to create your program.**
   a. Look at the position of the motion sensor. What do you think the motion sensor is for? Why do you think the motion sensor is mounted on the two yellow bricks? *The motion sensor is used to detect the movement of the passenger cars as they pass by. This information can be used to tell the program when to stop, so that passengers can get on or off the ride. The yellow bricks are used to raise the position of the motion sensor so it is high enough to detect the movement of the passenger cars.*
Contemplate

8. **Program the Ferris Wheel to rotate and stop for passengers, like a real ferris wheel.**

   The program should:
   1. Use the motion sensor.
   2. Rotate the Ferris Wheel in one direction.
   3. Stop to allow passengers to get on or off the ride.

   Try our program or create your own.

9. **How can you change the speed of the Ferris Wheel's rotation?**

   Change the speed of the Ferris Wheel's rotation by increasing or decreasing the value in the Motor Power Block's input, or by exchanging the Number Input with a Random Input.

10. **Test your program.**
    
    Add passengers to the Ferris Wheel.
    
    Start the program to rotate the Ferris Wheel and stop for passengers.

11. **Identify key programming blocks and use complete sentences to explain your program. Use language related to time, sequence, cause, and effect.**

    First, this program begins with a Start Block. Next, the Motor That Way Block rotates the motor while the Motor Power Block controls the speed of rotation. Then, the Wait For Block makes the program wait for half a second before the Motor On For Block detects a signal from the Motion Sensor Input. When the motion sensor detects an object, the motor will stop.

Need Help?
Refer to the LEGO® Education WeDo Teacher's Guide:
• 11. Motion Sensor, Getting Started

Tip:
For example, use words such as first, then, next, and because.
Continue

12. Think about the total cost of all the passenger car assemblies from Question #5.
   The Ferris Wheel is very popular. Can you redesign the passenger car assemblies to seat more people without increasing the building cost?
   *Students may consider using different elements of similar colors, reconfiguring the existing assemblies, or removing two of the passenger car assemblies and redesigning the remaining assemblies to hold more people.*

   **Note:** Use the list of prices from Question #5 to determine the cost of the new elements used in this task. Each element has a different price, depending on its color.

**Extensions:**
- With a partner, discuss what you would see or hear at an amusement park or carnival. Add sound effects and images to the program to demonstrate what passengers would experience while riding a ferris wheel.
- Use a Repeat Block to make the Ferris Wheel rotate three times before stopping.
- Investigate and describe how this Ferris Wheel is similar to or different from a real Ferris wheel.

**Tip:**
Discuss several strategies as a class and then give students time to build and experiment with their designs.