Spirit Lesson 3

Lesson Title: **Robot Wheelies**
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Algebra Topic: Formulas: Circumference, Distance
Grade Level: Upper Elementary, Middle School
Cartoon Idea: Robot doing a wheelie or an animated wheel

Lesson Outline:
Students will measure the diameters of wheels and calculate wheel circumferences for three or more sets of robot wheels. Circumference will be used to calculate the distance the robot will travel in 10 revolutions. Wheels are attached, the robot is driven 10 revolutions forward, and distance is measured. Repeat the activity for each set of wheels, Record and use circumference and distance data to summarize learning.

Content:
- Calculating circumference: C= D(pi)
- Measuring distance using meters and centimeters
- Using an algebraic equation to find distance: D = R • C (distance= no. of wheel revolutions times circumference)
- Making data tables and graphs
- Motion- Revolutions

Context:
Each group will:
- Measure the diameters of various sized robot wheels and find circumferences
- Calculate the distance the robot will move forward with each set of wheels
- Attach wheels and move the robot forward 10 revolutions; repeat for each set
- Measure the distance traveled
- Record circumference and distance data for each set
- Organize information into a data chart and graph
- Write summary paragraph

Activity Description:
Students find the circumference of different sizes of robot wheels by measuring the diameter and using the formula to find circumference. (C = D • pi). Circumference and wheel revolution data is used to calculate the distance the robot travels with each set of wheels. (Distance = No. of revolutions times circumference). Wheels are attached to the robot and it is driven forward ten revolutions. (mark a spot on the wheel that can be observed to count revolutions if the robot doesn't have a

counter). Distance is measured and recorded. Compare the measurements with the distance calculations made using the equation. The process is repeated for all wheel sizes. Circumference and distance information is organized into a data chart and graph that will be used to help formulate a paragraph summarizing what was learned.

Standards:

Math: A3, B1, B2, B3, D1, D2, E1, E3

Science: A1, B1

Technology: B4, D3

Material List:

- Robot(s)
- 3 or more different sizes of wheels that can be put on the classroom robot or 3 or more separate robots with various sizes of wheels
- Ruler or tape measure
- Pencil
- Paper for data collection, data chart and graph
- Tape

Asking Questions (Robot Wheelies)

Summary: Students are given different sizes of robot wheels to observe and asked questions about finding circumference, wheel revolutions, and distance traveled.

Outline:

- Show different sizes of robot wheels
- Ask questions that would lead up to the activity to compare wheel sizes and the distances they would travel in 10 revolutions.

Activity: Students are shown 3 or more different sizes of robot wheels. Discuss the difference each wheel would make in distance and how the robot travels. Discuss using circumference and wheel revolutions to determine distance and ways to show and compare the data.

Questions	Possible Answers
Would the size of a wheel affect how far a robot travels in ten wheel revolutions?	Yes, small wheels will travel a shorter distance than larger ones in 10 revolutions.
What information would be needed to compare the wheels and how far they would travel in 10 revolutions?	Circumference of each wheel Number of revolutions needs to be the same for each test.
How could the circumference of each wheel be measured? How could wheel revolution be measured?	Wrap a string around the wheel, then measure the string. Use the formula: C=D•pi Use a revolution counter on the robot Put a mark on the wheel and visually count the wheel revolutions
Is there any way to determine the distance traveled besides measuring? What data is needed to do the calculations?	Yes, use an equation: Distance = Circumference • No. of Revolutions You would need to know the circumference and the number of revolutions for each wheel.
What information should be recorded after each trial? How can the information be organized to compare the different wheel sizes and distances?	Circumference and wheel revolutions Make a table, graph

Image Idea: Picture of a variety of robot wheels, students measuring diameters

Exploring Concepts (Robot Wheelies)

Summary: Students investigate how wheel size affects the distance the robot can travel in 10 wheel revolutions.

Outline:
Each group will:

- Measure the diameter of each set of wheels and use that information to find the wheel circumference.
- Calculate the distance a robot will travel with each set of wheels by using the equation: Distance = Circumference • No. of Wheel Revolutions
- Use the robot's revolution counter or make a mark on a wheel to visually count wheel revolutions.
- Attach a set of wheels to the robot and drive it forward 10 revolutions.
- Measure the distance traveled and compare with initial calculations.
- Record distance and circumference data.
- Repeat activity for each set of wheels.

Preparation: Set up an area big enough for the class to work in small groups of four or less. Each group will need: 3 or more different sizes of robot wheels (one set of wheels can be divided among 4 groups), a tape measure or ruler, paper and pencil. Name or label each wheel to identify. Classroom robot(s) and tape will be needed for Activity 3.

Activity 1: Each small group measures the diameter of the different sizes of wheels available. Using the formula: 'C=D•pi', the groups will find the circumference of each wheel. Record the circumferences of each size of wheel.

Activity 2: Each group will use the circumference of each size of wheel to calculate the distance the robot will travel after moving forward 10 wheel revolutions. Use the formula: 'Distance= Circumference • Number of Wheel Revolutions' to calculate the distance. Record the distance the robot will travel with each set of wheels.

Activity 3: Mount a set of wheels on the robot. If the robot doesn't have a revolution counter, attach a thumbtack or piece of tape to one of the wheels and practice counting revolutions.

Mark a starting point on the floor with tape and drive the robot forward 10 revolutions. Mark the stopping point. Use the tape measure or ruler to measure the distance traveled. Repeat this activity for each size of wheels available. Record the distances on the same sheet used for Activity 1 & 2.

Video Idea: Clip of students' measuring the diameters of wheels.

Organizing Learning (Robot Wheelies)

Summary: – Students organize the distance and circumference information in a data chart that can be used to contrast and compare results.

Outline:

- Groups use the circumference and distance information collected on the activities to make a data chart
- Organize the information by wheel size (small to large)

Activity:

Each group will organize the information recorded on circumference (Activity 1), calculated distance (Activity 2), and measured distance (Activity 3) in a data chart (see Sample Chart). Organize the information by increasing wheel size starting with the smallest and ending with the largest wheel.

Sample Data Chart:

Wheel Measured	Wheel Circumference C= D • pi	Calculated Distance D = C • R	Measured Distance

Understanding Learning (Robot Wheelies)

Summary: Groups and individuals compare and contrast information organized on the Data Sheet to summarize learning, identify patterns, and make predictions about wheel circumference and distance traveled.

Outline:

Group:

- Each group analyzes the data sheet to discuss results, find patterns, and make predictions for changes in wheel size and the number of revolutions.
- Groups will use the Learning Worksheet to guide the discussion and record what was learned.
- Observe each group as they complete the activities to access participation.
- Groups prepare and give a presentation of their learning to the class.

Individual:

- Each student completes an Individual Worksheet that will be used to assess each student's understanding of:
  - Using diameter to find circumference
  - Using an equation to calculate distance
  - Organizing information in a data table
  - Using a data table to answer questions

Activity:

Each group will use the completed Data Sheet to compare and contrast the results of the activities. Groups will use the Learning Worksheet to write notes about the results, patterns observed, what was learned, and predictions for other wheel sizes and number of revolutions. Each group will prepare and give a presentation to the class which summarizes their learning.

Each student will complete the Individual Assessment sheet that will be used to assess his/her understanding of finding circumference, using an equation to find distance, making and using a data table.

Robot Wheelies
Learning Worksheet

Directions: Use the wheel size and distance Data Chart to discuss and answer the following questions. Write your answers on another sheet of paper.

1. What is the relationship between wheel size and the distance a wheel can travel in 10 revolutions?

2. Was the data for 'Calculated' and 'Measured' distance the same or very close? Why or why not?

3. Did you find any patterns on the Data Chart? If so, what were they?

4. How did you calculate the circumference of each wheel?

5. How did you calculate the distance each wheel would travel?

6. How would the distances change if the robot traveled 20 revolutions?

7. If you put on a wheel larger than any of the ones on your chart, would the distance traveled in 10 revolutions increase or decrease?

Robot Wheelies Name_____
Individual Assessment

Directions:

1. Use the information below to calculate the circumferences of each wheel.
2. Use the wheel circumference information to calculate the distance each wheel would travel in 15 wheel revolutions.
3. Organize the information on the data chart from smallest to largest wheel.
4. Write a summary paragraph of what you have learned on the back of this sheet.

Monster Wheel- Diameter = 9 centimeters.
Wimpie Wheel- Diameter = 3 centimeters
Middle of the Road Wheel = 6 centimeters

Show Calculations:

Data Table

Name of Wheel	Wheel Circumference C= D • pi	Calculated Distance D = C • R	Measured Distance