Aim High: Building Mathematical Thinking Through Coding and Robotics

Curriculum Idea Packet

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Table of Contents

1. Project Overview
2. Goals and Objectives
3. Florida Standards
4. Lesson Plan
5. Student worksheet
6. Resource List

Project Overview

Aim High is a cross-curricular robotics program designed for fifth-grade students that integrates mathematics, computer science, and engineering through the use of the VEX AIM robot. Students develop computational thinking while strengthening mathematical reasoning through engaging, hands-on coding challenges. Using both block-based coding and introductory Python programming, students solve authentic problems involving measurement, distance, angles, patterns, and logical reasoning.

The curriculum encourages collaboration, creativity, and perseverance while introducing students to careers in science, technology, engineering, and mathematics. The visual and interactive nature of robotics provides meaningful learning opportunities for all students, particularly English Language Learners and students who benefit from experiential instruction.

Goal

Increase students' mathematical reasoning, coding proficiency, and computational thinking through robotics-based problem solving.

Objectives

Students will:

- Develop foundational programming skills using VEXcode.
- Apply mathematics to solve robotics challenges involving measurement, distance, angles, and estimation.
- Demonstrate computational thinking by sequencing, debugging, decomposing problems, and creating algorithms.
- Collaborate effectively during engineering design challenges.
- Build confidence and positive attitudes toward mathematics and computer science.

Florida Standards

This project aligns with Florida's B.E.S.T. Mathematics Standards for Grade 6, Florida Computer Science Standards, CSTA computer science standards.

Mathematics

MA.6.NSO.4.1

Apply and extend previous understandings of operations with whole numbers to add and subtract integers with procedural fluency.

MA.6.AR.3.2

Given a real-world context, determine a rate for a ratio of quantities with different units. Calculate and interpret the corresponding unit rate.

MA.6.GR.1.3

Solve mathematical and real-world problems by plotting points on a coordinate plane, including finding the perimeter or area of a rectangle.

Computer Science

SC.6.PE.1.1

Identify the types of operations that can be performed on different data types.

SC.6.PE.1.3

Develop a program using a numeric data type.

SC.6.PE.1.7

Write code segments that use standard mathematical operators.

Aim High: Investigating Rate with VEX AIM

MA.6.AR.3.2: Given a real-world context, determine a rate for a ratio of quantities with different units. Calculate and interpret the corresponding unit rate.

Grade Level: 6 Time: 60–75 minutes

Lesson Title: **How Fast Does AIM Move?**

Essential Question: How do changes in velocity and distance affect the rate at which a robot travels?

Learning Objectives

Students will:

- Set and change the velocity of the VEX AIM robot.
- Measure the time needed for the robot to travel a given distance.
- Calculate a rate in centimeters per second.
- Compare rates when distance remains constant and velocity changes.
- Compare rates when velocity remains constant and distance changes.
- Interpret the meaning of a unit rate in a real-world robotics context.

Students can:

- Accurately record distance, velocity, and time.
- Calculate centimeters traveled per second.
- Explain how changing velocity affects the robot's rate.
- Explain what happens to the rate when velocity remains constant but distance changes.

Materials

- VEX AIM robot
- CodeAim.vex.com
- Chromebook or tablet
- Measuring tape or meter stick
- Stopwatch
- Masking tape
- Student worksheet
- Calculator

Vocabulary

Distance, Time, Velocity, Rate, Unit rate, Centimeters per second, Constant, Variable, Trial

Teacher Preparation

Create a straight testing path with masking tape.
Mark a starting line and distances of 100, 150, and 200 centimeters.
Make sure each robot is charged and connected to VEXcode.
Review how students set the robot's drive velocity.
Organize students into groups of three or four.

Suggested group roles:

- Programmer
- Timer
- Measurer
- Recorder

Students should rotate roles during the investigation.

Opening Activity

Ask students: If two robots travel the same distance, but one is programmed at a higher velocity, which robot should arrive first?

Allow students to make predictions.

Explain that students will test this idea by changing one variable at a time. In the first investigation, the distance will remain constant while velocity changes. In the second investigation, velocity will remain constant while distance changes.

Mini-Lesson: Calculating Rate

Explain that a rate compares two quantities with different units.

For this investigation: **Rate = Distance ÷ Time**

Example:

A robot travels 120 centimeters in 6 seconds. 120 ÷ 6 = 20

The robot's rate is **20 centimeters per second**.

Emphasize that the unit rate tells how many centimeters the robot travels in one second.

Introduction to Setting Velocity

Demonstrate how to set the robot's drive velocity in VEXcode.

Example sequence:

1. Set drive velocity to 25%.
2. Drive forward for the selected distance.

3. Stop the robot.

Explain that the velocity percentage is the programmed setting. Students will measure the robot's actual travel time and calculate its rate in centimeters per second.

Investigation 1: Constant Distance, Changing Velocity

Question

How does changing the programmed velocity affect the robot's rate when the distance remains constant?

Procedure

1. Set the testing distance at **150 centimeters**.
2. Program the robot to move at **25% velocity**.
3. Place the robot at the starting line.
4. Start the timer when the robot begins moving.
5. Stop the timer when the robot reaches 150 centimeters.
6. Record the time.
7. Calculate the rate using:

   Rate = 150 centimeters ÷ time in seconds
8. Repeat the investigation at **50% velocity**.
9. Repeat the investigation at **75% velocity**.
10. Compare the three rates.

Teacher Discussion Questions

- Which velocity produced the greatest rate?
- Which velocity produced the shortest travel time?
- What pattern do you notice as velocity increases?
- Was doubling the velocity percentage the same as doubling the calculated rate?
- Why might the actual results differ from the programmed settings?

Investigation 2: Constant Velocity, Changing Distance

Question

What happens to the calculated rate when velocity remains constant but distance changes?

Procedure

1. Set the robot's velocity to **50%**.
2. Program the robot to travel **100 centimeters**.
3. Measure and record the travel time.
4. Calculate the rate.
5. Repeat the procedure for **150 centimeters**.
6. Repeat the procedure for **200 centimeters**.
7. Compare the three calculated rates.

Teacher Discussion Questions

- Were the calculated rates approximately the same?
- Which trial took the greatest amount of time?
- Why did the time increase when the distance increased?
- If velocity remained constant, why should the unit rates be similar?
- What factors may have caused small differences between trials?

Closure

Bring the class together to summarize the two investigations.

Students should recognize:

- When distance stays constant, increasing velocity generally increases the rate and decreases travel time.
- When velocity stays constant, increasing distance increases travel time.
- If the robot moves consistently, the calculated unit rate should remain approximately the same when velocity is held constant.
- Experimental measurements may differ slightly because of timing, surface conditions, battery level, and measurement error.

Assessment

Students will be assessed using:

- Completed data tables
- Accurate unit-rate calculations
- Written analysis questions
- Participation in the investigation

- Exit ticket

Exit Ticket

A VEX AIM robot travels 180 centimeters in 6 seconds.

1. Calculate its unit rate.
2. Explain what the unit rate means.
3. Predict whether the travel time would increase or decrease if the distance remained 180 centimeters and the velocity were increased.

Differentiation- Support for English Language Learners

Provide sentence frames:

- “The robot traveled _____ centimeters in _____ seconds.”
- “The unit rate was _____ centimeters per second.”
- “When velocity increased, the travel time _____.”
- “When distance increased and velocity stayed constant, the time _____.”

Use visual cards for distance, time, velocity, and rate.

Support for Students Needing Additional Assistance

- Provide calculators.
- Use whole-number or easy decimal times.
- Complete the first rate calculation as a class.
- Assign clear group roles.
- Allow students to use a rate formula card.

How Fast Does AIM Move?

Name: _____ Date: _____

Group Members: _____ _____ _____

Learning Goal: I can collect data from a VEX AIM robot, calculate a unit rate, and explain how velocity and distance affect the robot's movement.

Rate = Distance ÷ Time

The unit for this investigation is:

centimeters per second, or cm/sec

Part 1: Constant Distance, Changing Velocity

Investigation Question

How does changing velocity affect the robot's rate when the distance remains constant?

Prediction

The distance will remain **150 centimeters**.

What do you predict will happen to the robot's travel time as velocity increases?

_____

_____

Data Table 1

Trial	Distance	Velocity Setting	Time in Seconds	Calculation	Rate in cm/sec
1	150 cm	25%		150 ÷ _____	
2	150 cm	50%		150 ÷ _____	
3	150 cm	75%		150 ÷ _____	

Analyze Your Results

1. Which velocity setting produced the greatest unit rate?
   _____

2. Which velocity setting produced the shortest travel time?
   _____

3. What happened to the travel time as velocity increased?
   _____

4. What happened to the calculated rate as velocity increased?
   _____

5. Did doubling the velocity setting exactly double the calculated rate? Use evidence from your table.
   _____
   _____

6. Identify one possible source of measurement error.
   _____

   _____
   _____

Part 2: Constant Velocity, Changing Distance

Investigation Question

What happens to the calculated rate when velocity remains constant but distance changes?

Prediction

The robot's velocity will remain at **50%**.

What do you predict will happen to the travel time as distance increases?

What do you predict will happen to the calculated unit rate?

Data Table 2

Trial	Distance	Velocity Setting	Time in Seconds	Calculation	Rate in cm/sec
1	100 cm	50%		100 ÷ _____	
2	150 cm	50%		150 ÷ _____	

3	200 cm	50%		200 ÷ _____	

Analyze Your Results

Which distance required the greatest travel time?

What happened to the travel time as distance increased?

Were the three calculated rates approximately equal?

Explain why the rates should be similar when velocity remains constant.

What may have caused differences among the calculated rates?

Compare the Two Investigations

In Part 1, which variable remained constant?

In Part 1, which variable was changed?

In Part 2, which variable remained constant?

In Part 2, which variable was changed?

Complete the statements.

When velocity increased and distance remained constant, the robot's travel time generally _____.

When distance increased and velocity remained constant, the robot's travel time generally _____.

When velocity remained constant, the calculated unit rates were approximately _____.

Explain the Unit Rate

Choose one trial from either table.

The robot traveled _____ centimeters in _____ seconds.

Calculation:

The unit rate was _____ centimeters per second.

This means the robot traveled approximately _____ centimeters during each second.

Reflection

What did this investigation teach you about rate?

How did changing the robot's velocity affect its movement?

What would you change to make the experiment more accurate?

Exit Ticket

Students can complete this on an index card.

A robot travels **180 centimeters in 6 seconds**.

Calculate the unit rate.
What does the answer mean?
The robot is programmed to travel the same distance at a higher velocity. Predict what will happen to its travel time.

Resource List

Vex Robotics Home
https://www.vexrobotics.com/?srsltid=AfmBOoqiN6br2QYzmGGWEljqDs4fWpsavt6qSgE1rJil0FbxCeRRoBFW

VEX STEM lab

https://education.vex.com/stemlabs/aim

https://education.vex.com/stemlabs/aim/activities