WAMC Lab Template

Math Concept(s): Determining Velocity Vectors & Magnitude
Source / Text: Bright Ideas: Algebra 1
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Date: WAMC Summer Conference 2021

Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

Short Description (Be sure to include where in your instruction this lab takes place):

Students will construct a fidget spinner, spin it and calculate the angular velocity of the blades, determining the speed at which their spinner is spinning. Whomever can construct the fastest spinner wins a prize! This lesson is located at the beginning of a unit on vectors (after several introductory lessons on vectors and determining their magnitude).

Lab Plan

Lab Title: Fidget Spinner Challenge!

Prerequisite skills:

- Using scissors and sharp objects safely.
- Understanding of what a vector is.

Lab objective: Students will be able to determine the angular velocity of a fidget spinner.

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

- HSN.VM.A.1: Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes.
- HSN.VM.A.3: Solve problems involving velocity and other quantities that can be represented by vectors.

Standards for Mathematical Practice:

- MP1: Make sense of problems and persevere in solving them.
- MP2: Reason abstractly and quantitatively.
- MP4: Model with mathematics.
- MP5: Use appropriate tools strategically.
- MP6: Attend to precision.

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

- RST.9-10.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
- RST.9-10.4: Determine meaning of symbols, key terms, or other domain specific words and phrases as they are used in specific technical context.
- RST.9-10.7: Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed verbally or mathematically into words.

K-12 Science Standards

- HS-PS2-1: Analyze data to support the claim that Newton's Second Law of Motion describes the mathematical relationship among the net force on a macrsocpic object, its mass, and its acceleration.

Technology

- 1.2.1: Communicate and collaborate to learn with others.
- 1.3.2: Locate and organize information from a variety of sources and media.
- 2.2.1: Develop skills to use technology effectively.
- 2.4.1: Formulate and synthesize new knowledge.

Engineering

- HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☐ Think Creatively
☐ Work Creatively with Others
☒ Implement Innovations
Critical Thinking and Problem Solving
☒ Reason Effectively
☐ Use Systems Thinking
☒ Make Judgments and Decisions
☒ Solve Problems
Communication and Collaboration
☒ Communicate Clearly
☐ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☒ Access and Evaluate Information
☐ Use and manage Information
Media Literacy
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☐ Apply Technology Effectively

LIFE & CAREER SKILLS
Flexibility and Adaptability
☐ Adapt to Change
☒ Be Flexible
Initiative and Self-Direction
☒ Manage Goals and Time
☒ Work Independently
☐ Be Self-Directed Learners
Social and Cross-Cultural
☒ Interact Effectively with Others
☐ Work Effectively in Diverse Teams

Productivity and Accountability
☐ Manage Projects
☒ Produce Results
Leadership and Responsibility
☐ Guide and Lead Others
☐ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

Each student will need the following:

- Smartphone with the Spectroid App installed
- Cardboard or heavy cardstock (may need to use two layers to make spinner more durable)
- 1 toothpick
- 2-3 Quarters (depending on design) (can use washers or nuts depending on supply availability
- STRONG Glue (wood glue or rubber cement)
- 1 Pin or Needle
- 1 Scissors
- 1 Ruler with cm
- 1 Fidget Spinner Template
- 1 Fidget Spinner Challenge "Work" Sheet

Set-Up Required:

- Assemble all of the items above and place them in lab baskets to distribute to each lab group (have 1 set of all materials for each student in the lab basket).
- If possible, print the Fidget Spinner Template onto the heavy cardstock to save time in cutting.
- Have students install the Spectroid app on their smart phone prior to starting the activity.
    - If a student does not have a smart phone, or cannot download the app, have them paired with a student who can.

Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Each student should be working cooperatively with their group to create their own individual fidget spinner.
- Students must produce a fidget spinner in order to continue with the lab, so they must make something and work independently to do so.

Cooperative Learning:

- Making the fidget spinner may take some collaboration on how the parts go together, and what specific strategies are best to build the spinner itself.
- Students must work together to ensure that all lab partners have a completed product by the end of the lab.

Expectations:

- Students will create a working fidget spinner. Students will then use calculations to determine the speed of their fidget spinner.

Timeline:

- This lab can be competed within a single 55-minute class period.

Post Lab Follow-Up/Conclusions:

Discuss real world application of learning from lab

- What are other things that spin and measure speed?
    - Examples:
        - Weathervanes
        - Windmills
        - Tires on a car
- Fidget Spinners are really gyroscopes. These are more common than you think:
    - Alzheimer's patients' utensils and office tools
    - BB8 in Star Wars
    - Bender in Futurama

Career Applications

- Windmills & Green Energy: The speed of the rotation of the vane and the relationship to the energy produced.
- Construction: To keep something constantly rotating & steady

Optional or Extension Activities

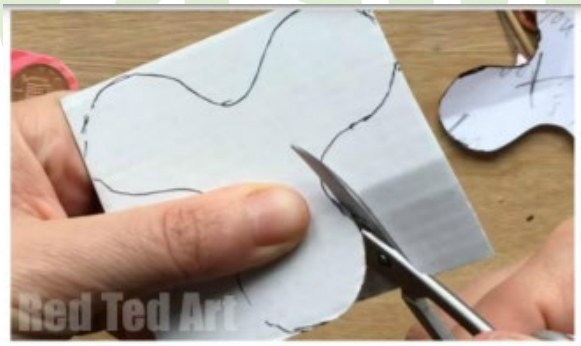
- How long does it take for the fidget spinner to stop? Graph the results and discuss the exponential decay graph.

Student Name: _____ Date: _____ Period: _____

FIDGET SPINNER CHALLENGE!

Construct your Fidget Spinner

Follow these instructions to create your own fidget spinner using the materials in front of you.



1. Choose which template you would like to make and cut it out!

2. Trace onto your cardboard – old cereal packets are idea, but you will need two layers glued together

3. Once you have your basic shape decorate it whatever way you want – doodle on it, paint on it, stick more colourful paper on it… your imagination is the limit

4. Take 2 or 3 1 penny coins (or coins of similar denomination from your country). You will need 2 for simple fidget spinner and 3 for all other shapes. If you wish, you can replace these coins with buttons (the heavier the better) or small bolts.

5. Glue your coins into place and let dry.

6. Use your template to help locate the centre of your fidget spinner and make a hole with a pin. Using smaller scissors, make the hole bigger – until your toothpick fits in comfortably and loosely. Test the spin. If it keeps getting stuck, make the hole a little bigger

Student Name: _____ Date: _____ Period: _____

7.Now cut out 2-4 cardboard discs (if using cereal box cardboard you will need 4 in total, glue two together).

8.Again take your pin and make a small hole. Use your toothpick to widen that hole, so the toothpick fits in tightly.

9.Glue the first disc to the end of your toothpick.

(a hot glue gun dries quickly and is great if making this in groups)

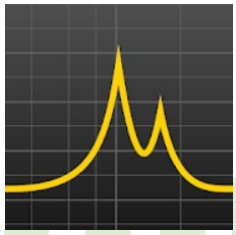
10. Insert the toothpick into your fidget spinner. Take your second disc and slide down the other side of the toothpick and glue in place.

11. Snip off any protruding toothpick.

Student Name: _____ Date: _____ Period: _____

Calculate Your Fidget Spinners' Speed

Now that you have a fidget spinner, let's see how fast it can go.



1. Get out your smart phone, and download the Spectroid App (picture on the right)
2. Once you have the app, spin your spinner as fast as you can, and place your smartphone's microphone as close to the spinner as possible. This is crucial, as your microphone is trying to measure the Hertz that your spinner is outputting.
3. Run the app and spinner for 5 seconds. Then pause the Spectroid app and spinner.
4. Choose the highest node that you can on the read out on the app. Record that amount here: _____ Hz
5. Take your value from step 4 and divide it by the number of nodes your spinner has. Record that amount here: $H =$_____ Hz
6. Measure the radius of your fidget spinner. *Remember, attend to precision!*

   Record that amount here: $r =$_____ cm
7. Solve the following equation for v using the calculations that you have completed above. Round to the nearest hundredth, and use the pi button on your calculator.

$$v = 2\pi rH$$

8. Convert your velocity (v) to kilometers per hour, rather than centimeters per second.

Student Name: _____ Date: _____ Period: _____

9. How fast was your fidget spinner spinning? _____ km/h

10. Write your answer on the whiteboard to compare with the rest of the class.

11. Draw a vector representation of the forces acting on your fidget spinner. Must include the velocity vector and friction vector.

Extension

12. Is there something you could do to make your spinner faster? What is it?

13. Will your spinner keep spinning forever once you start it? Why or why not?

Student Name: _____ Date: _____ Period: _____

Lesson 1: Vector or Scalar?

Learning Target: _____

_____

Entry Task

1. Watch the Despicable Me Video with the class.
2. Write your own definition of a vector: A vector is _____
   _____

Term	Definition	Example
Vector		
Scalar		
Magnitude		
Direction		

Examples

1. _____ is distance in a given direction.
   a. Choose one to fill in the blank: Scalar Vector

2. A scalar quantity only has magnitude, not _____.
   a. Choose one to fill in the blank: An arrow Direction

3. Time is a _____ quantity because it does not have direction.
   a. Choose one to fill in the blank: Scalar Vector

4. Any vector quantity can be shown by drawing it as _____.
   a. Choose one to fill in the blank: An arrow A line segment

QQT Class Activity

Be sure you listen to the directions!

Exit Ticket

Don't forget to turn this in by end of the period!

Student Name: _____ Date: _____ Period: _____

Distance	**Displacement**
Speed	**Velocity**
Mass	**Weight**
Energy	**Acceleration**
Density	**Force**
Power	**Impulse**

Student Name: _____ Date: _____ Period: _____

Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**

Student Name: _____ Date: _____ Period: _____

Length	**Pressure**
Area	**Momentum**
Volume	**Gravity**
Time	**Drag**
Temperature	**Lift**
Work	**Thrust**

Student Name: _____ Date: _____ Period: _____

Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**

Student Name: _____ Date: _____ Period: _____

Entropy	**Electric Field**
Charge	**Magnetic Field**
Resistance	**Torque**
Mechanical Advantage	**Temperature Gradient**
Electric Potential	**Impulse**
Angle	**Dipole Moment**

Student Name: _____ Date: _____ Period: _____

Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**
Vector	**Scalar**

Student Name: _____ Date: _____ Period: _____

Lesson 1: Exit Ticket

Circle the Vectors and Cross Out the Scalars

Distance Displacement Density Acceleration
Pressure Force Velocity Impulse
Time Speed Mass

Student Name: _____ Date: _____ Period: _____

Lesson 1: Exit Ticket

Circle the Vectors and Cross Out the Scalars

Distance Displacement Density Acceleration
Pressure Force Velocity Impulse
Time Speed Mass

Student Name: _____ Date: _____ Period: _____

Lesson 1: Exit Ticket

Circle the Vectors and Cross Out the Scalars

Distance Displacement Density Acceleration
Pressure Force Velocity Impulse
Time Speed Mass

Student Name: _____ Date: _____ Period: _____

Lesson 1: Exit Ticket

Circle the Vectors and Cross Out the Scalars

Distance Displacement Density Acceleration
Pressure Force Velocity Impulse
Time Speed Mass

Student Name: _____ Date: _____ Period: _____

Vector vs. Scalar Quiz

Answer each of the questions below to the best of your ability.

1. Define the term Vector using words, symbols, and/or pictures:

2. Define the term Scalar using words, symbols, and/or pictures:

3. Sort the following terms into the table on the right based on if they are a Scalar Quantity or a Vector Quantity.

    a. Distance
    b. Density
    c. Acceleration
    d. Displacement
    e. Time
    f. Velocity
    g. Weight
    h. Temperature
    i. Power
    j. Gravity

Scalar	Vector