Name _____

Puff Mobile Derby Student Guide

Objectives:

1. Students will identify ways that wind energy can be used to perform work.
2. Students will understand that the position of an object can be changed through pushing or pulling. The amount of change is dependent on the mass of the object and the strength of the force acting upon it.
3. Students will recognize that engineers use creativity and problem solving when designing solutions to a problem.
4. Students will calculate average speed using time and distance measurements.

Challenge: You will have the opportunity to build and race your own car in a Puff Mobile Derby. A Puff Mobile is a vehicle made from common household items that is propelled using the force of wind created as you blow on the car. Your challenge is to create a vehicle that will move as quickly as possible in a linear direction on a five-meter course. In this activity, you are going to become an engineer as you design, construct, test, and modify your Puff Mobile.

Getting Started: Watch the video clip**, Puff Mobile - Zoom Sci - Zoom Into Engineering**. Discuss the following questions:

- What problems did students in the video encounter?
- Why did they struggle to get their car to move?
- Can you think of ways to improve their design?

Making a Puff Mobile

1. You are required to work in groups of two to four to create a Puff Mobile.
2. The Puff Mobile needs to be made from common household items. Please do not go out and buy any materials. Suggestions include:
    - Rubber bands
    - Straws
    - Skewers
    - Craft sticks
    - Thread spools
    - Empty water bottles
    - Buttons
    - Plastic cups

    You are welcome to use your creativity. The items listed above are suggestions, but you can certainly bring in other materials that you think would be helpful in creating a vehicle.

3. The vehicle can have a maximum mass of 50 grams.
4. You will have two class periods to work on the design and construction of your Puff Mobile.

Exploring Engineering: In order to get ready for this challenge, we are going to discuss the following:

- What is an engineer?
- Do you know any engineers?
- What kinds of engineers are you familiar with?
- What is the engineering problem that you need to solve?
- What materials could you use to design your Puff Mobile given the guidelines above?
- How can you design your car to optimize the use of the force of wind?
- How will you get your car to move five meters faster than any other group's car?

Time to Design: In the space below, draw a sketch of your Puff Mobile. Indicate what materials you will use to make each part of your vehicle.

Safety First

1. You must wear protective goggles while you are constructing your Puff Mobile, as well as when you are testing it.
2. You need to store your Puff Mobile and construction materials (tape, scissors, glue gun) in the closet, bin, or area your teacher designates.

Preparing to Race: Now that you have built your Puff Mobile, your team needs to consider what strategies you are going to use to get your car across the finish line first. Discuss the following with your group members:

- How can you use the force of the wind to move your Puff Mobile?
- Will you take turns puffing or will all team members puff at the same time?
- How does the wind energy of one person blowing to move the Puff Mobile compare to the wind energy generated by all team members to move the Puff Mobile?
- What unit of measurement makes the most sense for measuring distance?

Race Procedure:

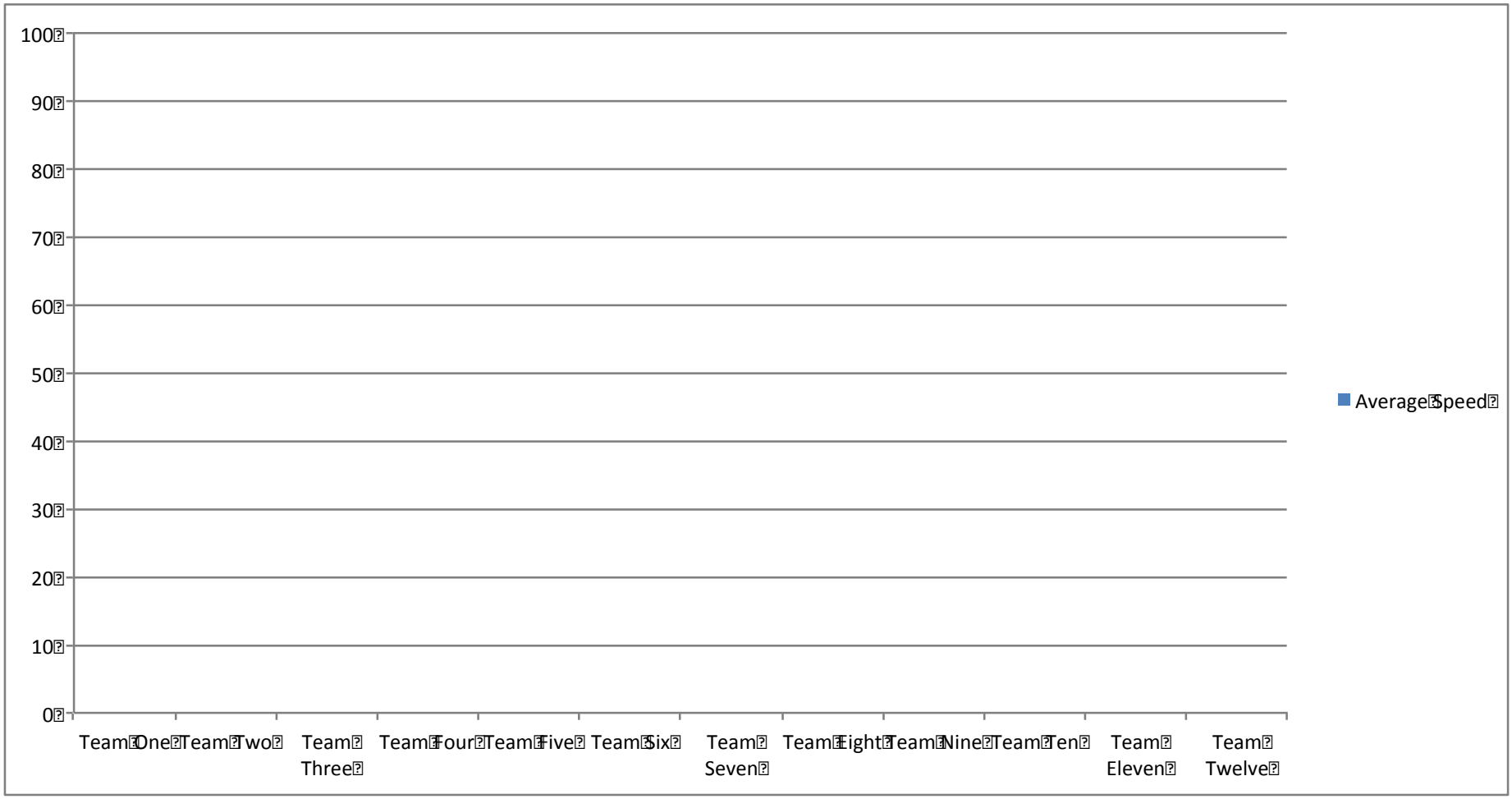
1. Place the front of your car behind the starting line.
2. Using the force of your team blowing on the car, move your car five meters.
3. Record the amount of time in seconds that it takes to move your car five meters.
4. Calculate your speed in centimeters per second for Trial 1.
5. Repeat steps #1–4 for a total of **five trials**.
6. Calculate the **total distance** and **total time** to determine **total average speed.**

   NOTE: If your car is unable to move, you can modify the design before the next trial.

Trial number	Distance	Time	Speed (cm/s_ Speed = distance ÷ time
Trial 1	5 m = 500 cm		
Trial 2	5 m = 500 cm		
Trial 3	5 m = 500 cm		
Trial 4	5 m = 500 cm		
Trial 5	5 m = 500 cm		
TOTAL			

Graph Your Results

1. On the back of this paper, graph the class results for average rate of speed.
2. Don't forget to give your graph a title and label the *y* axis.



Analyze Your Results

1. What is the median speed? _____cm/s
2. What is the mean speed? _____cm/s
3. What is the range of speeds? _____cm/s
4. What is the mode? _____cm/s

5. What was your fastest speed? _____
6. What was your slowest speed? _____
7. What factors affected the speed? _____
8. Which team had the fastest speed?

   _____

9. What did you notice about the design of that group's vehicle that affected the speed?

   _____

10. What did you do to maximize the impact of the force of your breath on the car?

    _____

Drawing Conclusions

- What patterns do you see in the data?
- What can you infer about the wind force exerted on the car and its movement?
- What will happen if you change the size of the car?

Time to Reflect and Write

1. What worked well in the design of your car?

   _____

   _____

2. What challenges did your car face?

   _____

   _____

3. What additional materials would you use to improve your design if you were to do this activity again?

_____

_____

4. What would you do differently to help your car travel more quickly?

_____

_____

5. DRAW A PICTURE OF YOUR IDEA FOR A NEW and IMPROVED PUFF MOBILE: