PARACHUTE ENGINEERS!

Notes to the teacher

Thanks for downloading this lesson! It is my hope you will enjoy this lesson as much as I have.

Some useful information is below.

- It is better not to rush this lab - it isn't uncommon for this to take 3 or so periods. After the do now, it is helpful and informative to show this YouTube video on the origin of the parachute https://www.youtube.com/watch?v=PWD-KZ0urxU
- I have found the following materials to be helpful
    - Scissors
    - Saran wrap and waxed paper
    - Coffee filters make great parachute materials, straws help as well
    - Masking tape and thread
    - Plastic army figures (easily found on amazon or toy stores)
    - Sometimes students like to use fans in the class as wind tunnel-style testers while building their designs.
- If feasible, it is great to have students drop their chutes over the side of a balcony or other high point in your building. If not, they can use a meter stick, place it under the chute, hold up to a consistent height and then drop the stick and time the drop.
- NGSS lends itself to this lab – design, and process is throughout – you can apply it in various ways- the questions to fill out at the end are only an example of what you can do. SAMPLE ANSWERS BELOW.
- For resources and graphic organizers see https://thewonderofscience.com/documents
- SPECIFIC STANDARDS ADDRESSED CAN BE FOUND AT https://www.nextgenscience.org/pe/ms-ets1-2-engineering-designhttps://www.nextgenscience.org/pe/ms-ets1-4-engineering-design
- It is best to have students design and test a parachute (and collect data on the drop time) and then make a modification. I have tried several approaches, and this works well.

Sample NGSS answers to final questions

STRUCTURE AND FUNCTION - NEXT GENERATION SCIENCE

DESCRIBE the phenomenon that is being displayed by your parachute modification
Briefly note the phenomenon on your sketch
Greater control of air under the parachute, creating as much wind resistance as possible, etc., etc.

MODIFICATION DRAWING –
Refer to your sketch and label the critical structures you modified "before" and "after."

DESCRIBE THE FUNCTION of your modification within your parachute design
We cut a carefully placed hole in the center. It had to be large enough to funnel aI used straws as a modification to hold

Or
We placed straws in the formation of a "cage" to prevent our shoot from closing and to maximize wind resistance.

DESCRIBE how the structure of your modification determines the function **label the structure on your sketch**

The parachute is prone to wobble and fall faster when there was no hole because air was not being controlled.

Or

The arrangement of straws prevents closing that can happen while falling and provides greater control. This increases the time to fall.

DESCRIBE how the function depends on the structure of your modification. **Briefly note the function on your sketch**

The parachute must have air flow control that centers the funneling. This will keep the chute open and allow for a smooth drop. Therefore, the hole must be the proper placement and size to balance wind resistance and gravity.

Or

The straws needed to be arranged in a triangular cone shape in order to keep the widest base of the chute open. The more open the straws hold the chute the better the wind resistance is which results in a longer time to fall.

_____ _____

Name Date

Parachute Design Experiment – Scientific Method in Action

DO NOW

How do you think the first person was convinced to jump out of an airplane or high place with a parachute? Write your answer below.

_____

_____

In this activity, you will become "parachute engineers". You will investigate whether your original design or a change to your parachute design will help our "soldier" fall at a slower speed (take a longer time to fall)

PROBLEM: Which parachute modification will make a parachute fall **more slowly**?

HYPOTHESIS:
Write your **HYPOTHESIS** using the "If, then, because" format ("If we (describe your modification) ……. Then the parachute will take a longer time to fall, **Because……..)**

_____

_____

MATERIALS: You may select from the items provided, which may include saran wrap, waxed paper, string/thread, scissors, masking tape, ruler, meter stick, plastic army figure, paper clips

PROCEDURE:

<u>PART 1- Design and Experiment</u>

1. Select the materials that you will use to make a parachute. With your partner, sketch up a design for your parachute in the space provided, and sketch a change you wish to make to that design (**Hint: We will make and test our chute, get your first round of data, and then modify the chute before your second round of data collection.)**
2. Working with your partner, construct the parachute. (**Be creative**! You may make them with **any designs you choose**, but do not take too long).
3. After your parachute is built, hang the trooper your teacher gives on it. (**Hint- you must use the same trooper between the two parachutes – why?)**
4. Out in the hall you will be given directions for how to drop your parachute.
   - You will do five drops
   - modify your design
   - You will do five more drops
   - For each drop, time your results with a stopwatch to the **nearest tenth of a second.**

   Each member of your group must record their data in the data table provided.`

PART 2- Data and Design Analysis

1. Using your data, graph the Drop Trial Number vs. the Time to fall (seconds) for your original and modified design. **You will plot one line for original parachute and one line for the modified parachute version... this is a double line graph.**
2. **Make a key for your graph**

The title should be written as follows: ("the effect of _____ (modification)__ on ____(Y axis)___")
Remember to use a consistent scale on each axis. (They do not have to be the same)
CONCLUSION: - (To be completed on the "Data and Analysis" page)

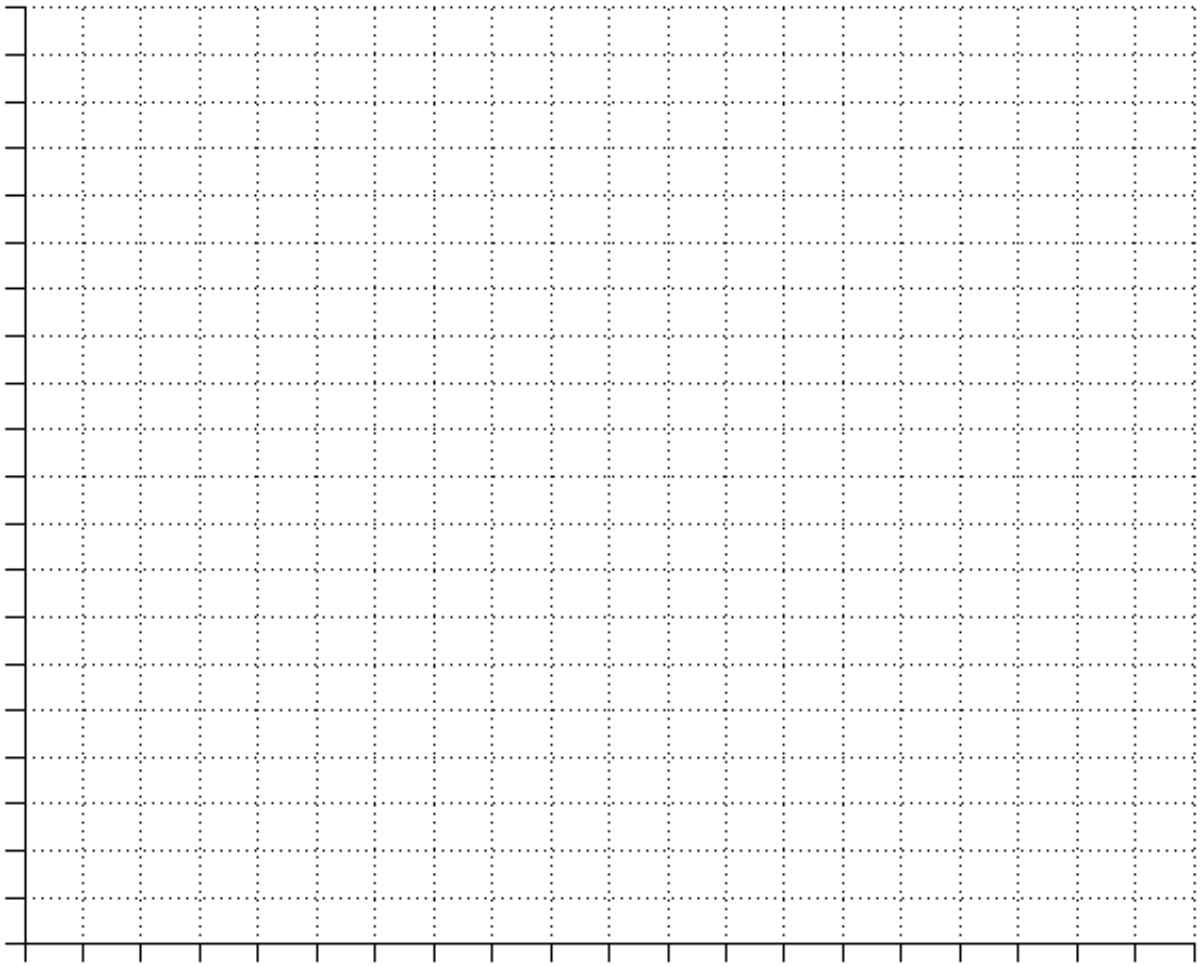
PLANNING AND DESIGN

Make a sketch of potential designs and write descriptions of how structures you draw will function (example -"These straws will hold the chute open.")

DATA

Trial number	**Time for Parachute #1 to fall (nearest .1 sec)**	**Time for Parachute # 2 to fall (nearest .1 sec)**
1		
2		
3		
4		
5		

Graph **Title: _____**



Analysis – Use space provided

1. **Describe** 3 possible sources of experimental error and explain how your drop time would have been affected by it. (What could or did cause your results to be inaccurate?)
2. **Recommend** 3 ways to improve the experiment**-** How will those suggestions **make our data more accurate**? Be specific.
3. Write a conclusion in a few sentences stating **how the results related to your hypothesis.** Support your conclusion using the numbers from your data table. (example: "Based on ____ data my hypothesis was/was not supported because……)

1.

SOURCE OF ERROR	**HOW THE ERROR AFFECTED THE DROP TIME**
1.	**1a.**
2.	**2a.**
3.	**3a.**

2.

HOW TO IMPROVE THE EXPERIMENT (HINT – HOW TO FIX THE SOURCES OF ERROR)	**HOW THIS SUGGESTION WILL IMPROVE THE ACCURACY OF DATA COLLECTION**
1.	**1b.**
2.	**2b.**
3.	**3b.**

3. CONCLUSION SECTION

4. STRUCTURE AND FUNCTION

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DESCRIBE THE FUNCTION of your modification within your parachute design on your sketch

DESCRIBE how the structure of your modification determines the function **label the structure on your sketch**

DESCRIBE how the function depends on the structure of your modification. **Briefly note the function on your sketch**