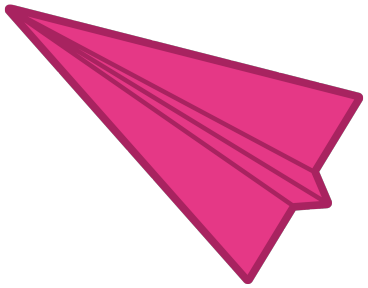
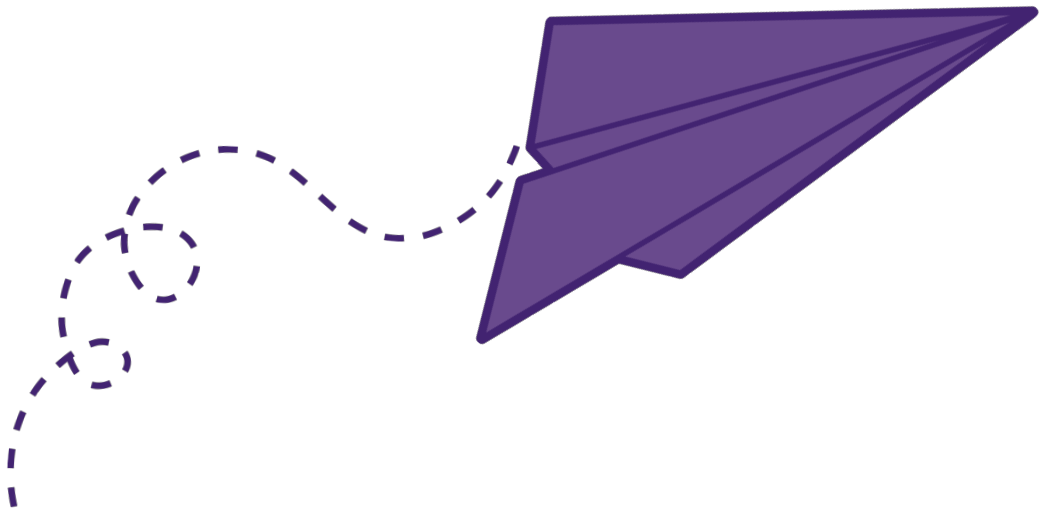
Scientific Method and Paper Airplanes

Contents



Materials Needed

- Paper (different types of paper might be used for the students independent investigation)
- Tape
- Paper clips
- Calculators
- Pencils
- Measuring tapes, yard sticks or meter sticks
- Copies of student sheets



Scheduling the Activities

This is just a sample schedule, and depending on the time you have available you might combine or leave out certain parts.

Day 1- Introduce the scientific method, go through vocabulary, complete Frayer Model sheets for selected vocabulary.

Day 2- Introduce the group experiment. Guide students through the question, research, hypothesis and summary of experiment.

Day 3- Guide students through writing up a materials list and written procedure

Day 4- Guide students through the actual experiment. Show them how to make records of their data.

Day 5- Analyze data- discuss qualitative/quantitative data, graph the data, and come to a conclusion about your hypothesis.

Day 6- review the scientific method
- do the written response activity

Day 7- Have students start on their own investigation using paper airplanes. (formulate a question, research, hypothesis, short experiment plan summary)

Day 8- Students complete their materials list and procedure write up.

Day 9- Students conduct their experiment, and collect /record data.

Day 10- Students complete their experiment (analyze data, draw conclusions). Introduce ways to present/communicate findings. Assign project.

***If you do the above activities on a Mon-Fri, the kids could have the weekend to put together their presentation. Or, you could give them class time to work on their presentation.

Day 11- work on presentations in class OR start giving presentations

Day 12- continue with presentations if needed

Instructions

Part One: Whole Group Activity

During part one of this activity you will be doing the steps of the experiment together. This is a chance to explain each step, answer questions, model quality work and scientific thinking.

1. Introduce the activity. Ask students if they know what the scientific method is. Let students respond.
2. Complete steps of the scientific method and vocabulary activities. There are two versions of the "Steps of the Scientific Method" worksheet. One includes a word bank.
3. Step 1 – question-. In this part of the activity the question is already stated. Everyone will be working on the same question. Ask students to notice how the question is written, what is included etc…
4. Step 2- research- it is helpful to gather as much information as possible about your topic before designing and carrying out an experiment. Brainstorm with students what information might be useful to learn. What do they already know about paper airplanes from prior experiences. Do some research together. Some things you might want to research are: How do airplanes fly? How do birds fly? What are some different ways of making a paper airplane?
5. Step 3- hypothesis- Tell students that a hypothesis is a prediction, an educated guess. It is not just a wild guess. Since everyone is doing the same experiment in part one, your hypothesis will be something like: If a paper airplane has wings _____then_____. Have students help formulate the hypothesis. Using the If…then…. format is helpful.
6. Step 4- Experiment- Ask students what we could do to test our hypothesis.
7. Help students decide on a list of materials needed. Emphasize how important it is to be SPECIFIC when listing details. What kind of paper will we use? How big will the paper be?
8. Next, guide students through writing a step by step procedure for the experiment. This is a part that many kids have a harder time with. Again, emphasize how important it is to describe every step, every detail, exactly how you plan to do it. Where are you doing the test flights? (hallway, classroom, outside?) In order for someone to replicate your experiment they need to know EXACTLY what you did.
9. Step 5 – Experiment- Conduct the experiment. I have included a data chart that students can use to record the distance each plane flies.
10. Step 6- Analysis- Show students how to analyze the data (qualitative and quantitative) and graph the data.
11. Step 7- Conclusion- Compare the hypothesis to the experiment results. Think about your hypothesis, does your data support it? Why/why not?
12. As a final step of part one, discuss the various ways scientists share their conclusions/findings when they do an experiment. Discuss why it is important to share your conclusions, and how sharing can help others.

Instructions

Part Two: Individual or Partner Activity

For part two you can have students work independently or with a partner. In this part of the activity, students will be going through the same steps, but they will choose what to test/how to test it.

This part of the activity allows students to apply what they learned in the group activity more independently. Students can use resources from the group activity to help them with their independent/partner investigation.

They will be choosing a variable to test, creating a question, doing research, writing a hypothesis, conducting an experiment (including a materials list and set of procedures), collecting and analyzing data, drawing conclusions and sharing results.

Since you went through an almost identical investigation together, they can use their materials/student sheets from part one to refer to as they write up their own experiment.

Have students check in with you as they progress through each step of the scientific process and check to be sure they are doing things correctly before they move on to the next step.

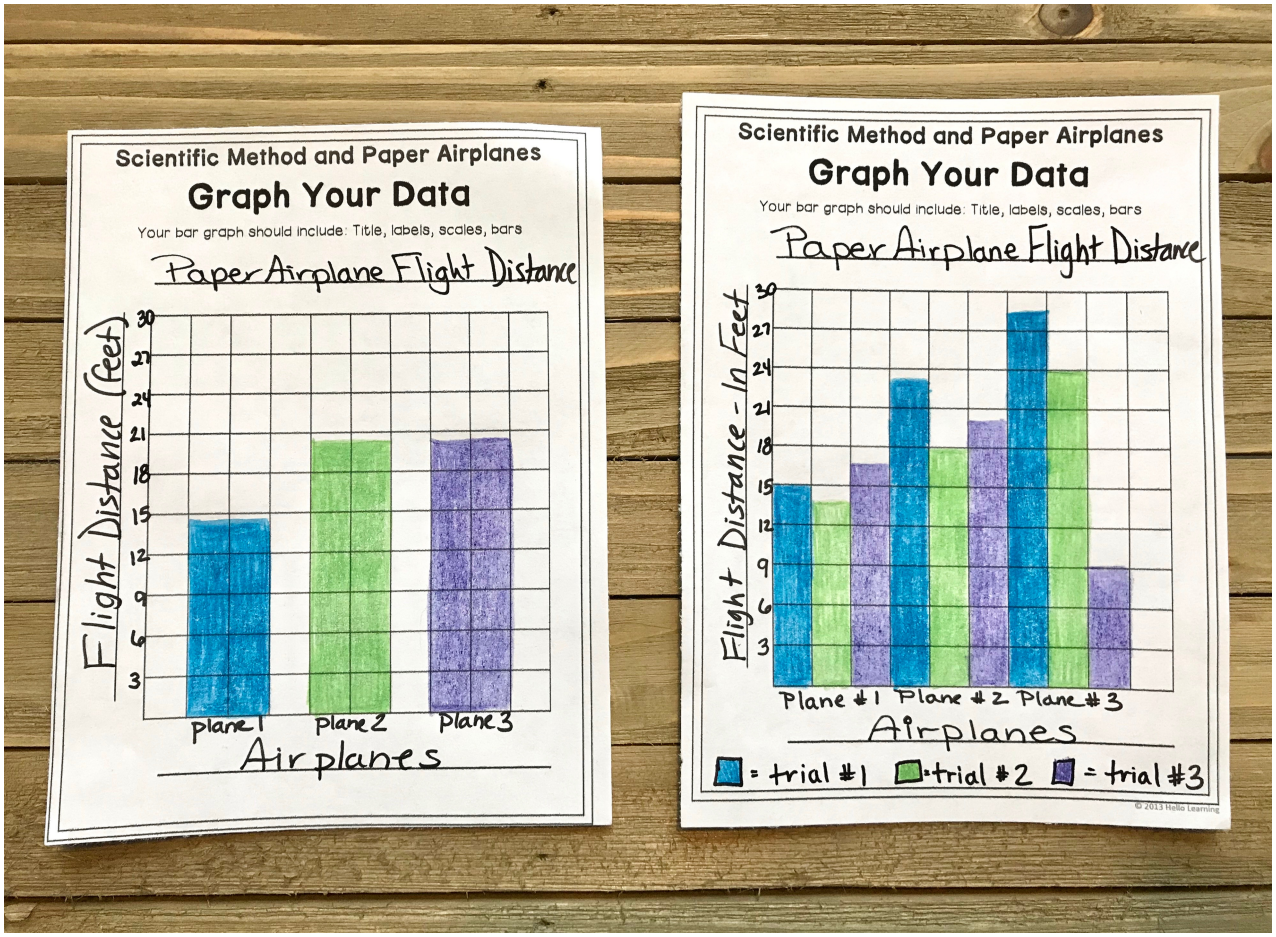
This time, students will have many different findings since they are designing their own experiments. This is a great opportunity to have them present their findings to their classmates. I have included a sheet with possible project/sharing results choices that you can use, or you can tell students what their options are.

Some ideas for student investigations:

- Weight- put paper clips on different parts of the plane, or a different amount on each plane
- Paper used- make the same plane out of different types of paper
- Location- outside (does wind affect distance?)
- Size of plane (vary the sizes of paper used)

Suggestions for Graphing

When you have your students graph their data, you can choose to have them graph each trial (making a triple bar graph) or graph the average. You might even have them graph their data both ways as I did in the photo below.



Sometimes data can be misleading, depending on the graph. Looking at the graph on the left, one would think that plane #2 and plan #3 did equally as well. However, if you look at the graph on the right, you can see plane #3 did better, but had one bad trial.

This could lead to interesting discussions about how to choose what data to use, why plane #3 might have had a much shorter flight on the third trial, and how to analyze graphs.

Steps of the Scientific Method

1. Question
2. Research
3. Hypothesis
4. Experiment
5. Collect Data
6. Analysis
7. Conclusions

Hypothesis

Predict the outcome

Question

Ask a question that you want to have answered

Experiment

Develop a procedure to test the hypothesis

Research

Learn more about the topic

Conclusions

Compare the hypothesis to the experiment results

Collect Data

Record the results of the experiment

Steps of the Scientific Method

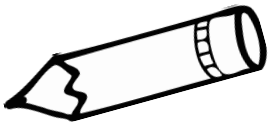
Analysis

Examine the data

Name:_____

Steps of the Scientific Method

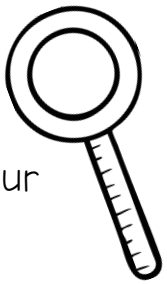
Directions: fill in the blanks to complete the steps of the scientific method.



1. Ask a _____ that needs to be answered.

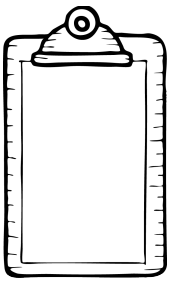
2. Do some _____ to find out more about your topic.

3. Make a _____, which is an educated guess about the outcome of your experiment.



4. Complete an _____ to test your _____.

5. Collect _____ about the results of your experiment.



6. _____ the data from your experiment.

7. Draw _____. Compare the _____ to the _____ results.

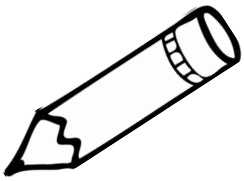
Name:_____

Steps of the Scientific Method

Directions: fill in the blanks to complete the steps of the scientific method.

Word Bank

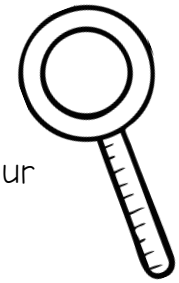
research	data	hypothesis	conclusions	experiment
question	hypothesis	experiment	analyze	hypothesis



1. Ask a _____ that needs to be answered.

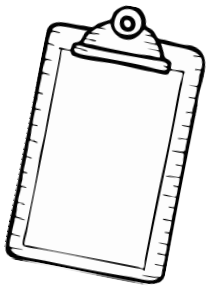
2. Do some _____ to find out more about your topic.

3. Make a _____, which is an educated guess about the outcome of your experiment.



4. Complete an _____ to test your _____.

5. Collect _____ about the results of your experiment.



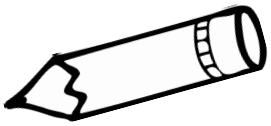
6. _____ the data from your experiment.

7. Draw _____. Compare the _____ to the _____ results.

Name:_____

Steps of the Scientific Method

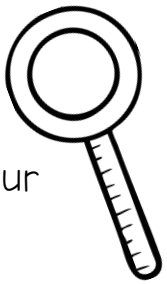
Directions: fill in the blanks to complete the steps of the scientific method.



1. Ask a question that needs to be answered.

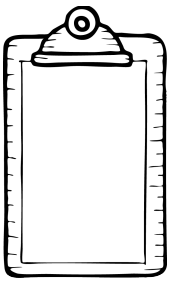
2. Do some research to find out more about your topic.

3. Make a hypothesis, which is an educated guess about the outcome of your experiment.



4. Complete an experiment to test your hypothesis.

5. Collect data about the results of your experiment.



6. Analyze the data from your experiment.

7. Draw conclusions. Compare the hypothesis to the experiment results.

Vocabulary

Aerodynamics- the study of the ways gasses (air) flows over moving objects

Air Pressure- the force exerted by air

Air Resistance- see drag

Bernoulli's Principle – helps explain how an airplane can achieve lift because of the shape of its wings. Air flows faster over the top and slower underneath. Fast air = low pressure, slow air = high pressure. The high pressure underneath lifts the plane up.

Drag- the force of friction that slows down objects moving in air

Flight- the action or process of moving through air

Gravity- the force that attracts objects together

Launch- to start or set in motion

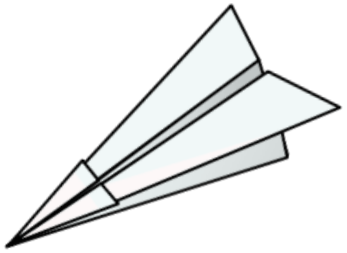
Lift- the upward force created by the shape of an aircrafts wings moving through air

Thrust- the force that moves an airplane forward

Weight- the measure of the strength of the pull of gravity on an object

Scientific Method and Paper Airplanes

Vocabulary



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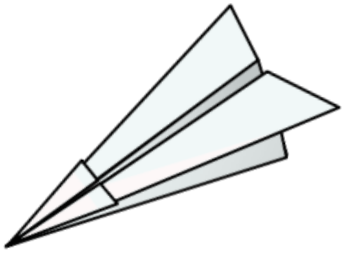
Scientific Method and Paper Airplanes

Vocabulary



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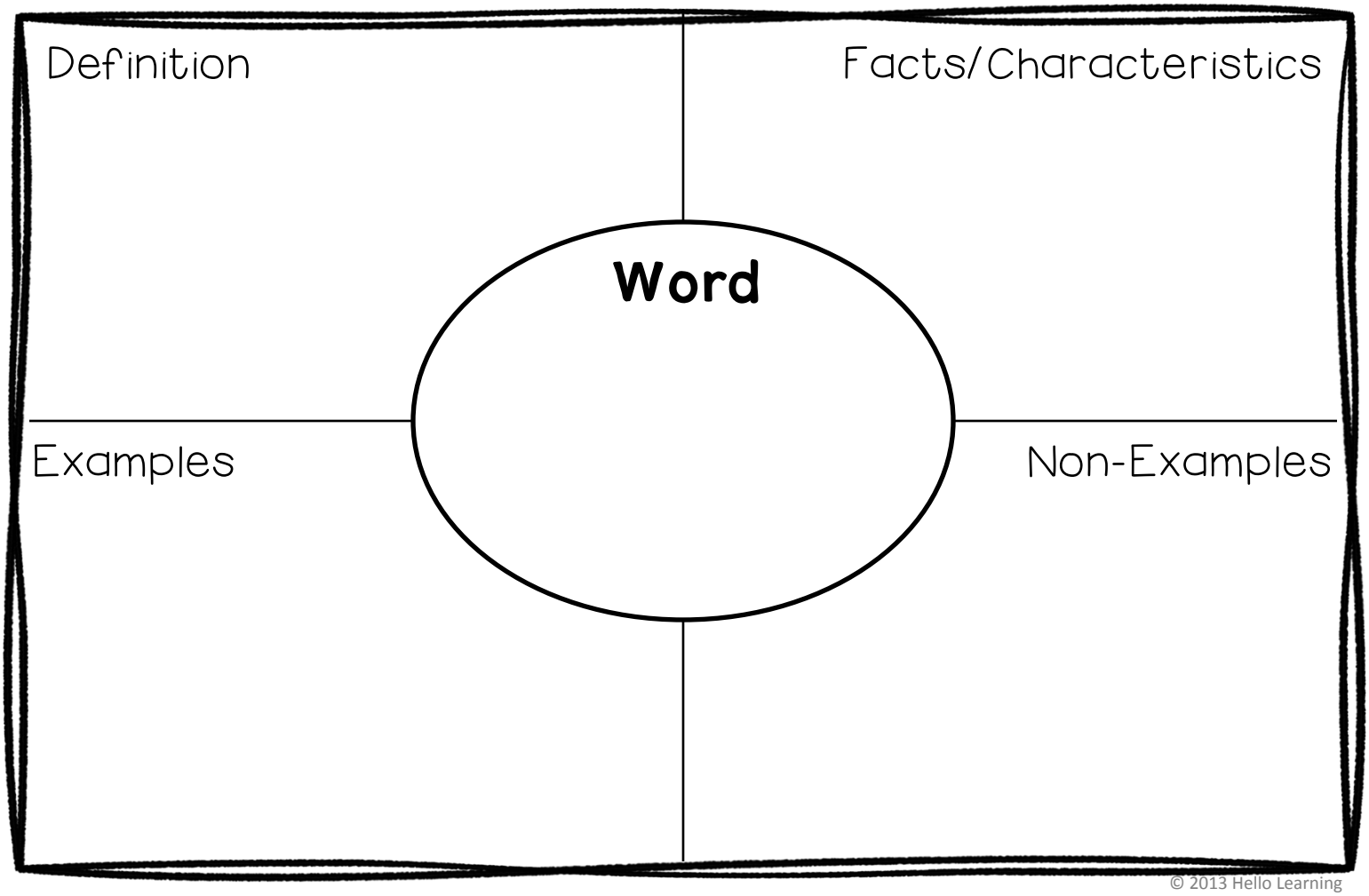
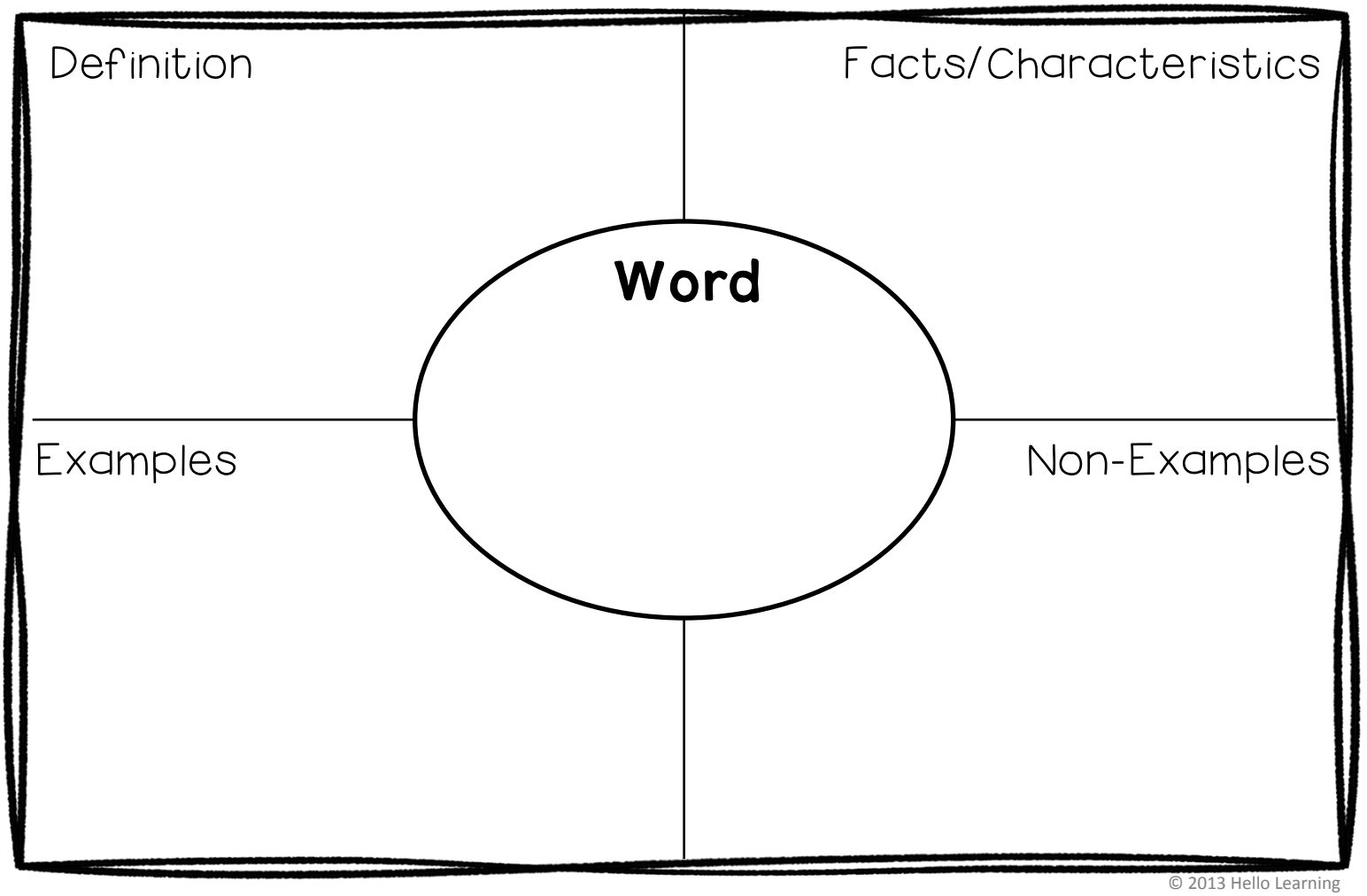




thrust

drag

air

pressure

lift

air

resistance

weight

gravity

aerodynamics

launch

Bernoulli's Principle

Possible Discussion Questions

Below is a list of questions that connect the concepts of flight to paper airplanes. You can use these as oral discussion questions to ask as a whole class, or you can use the following printable pages to have students independently reflect on the questions.

What is force?

What are some forces that might make a paper airplane go further? Explain.

What is drag?

Is drag a pull or a push?

Does drag help a paper airplane go further? Explain.

What is lift?

Is lift a pull or a push?

What might affect the lift of a paper airplane?

What is gravity?

Is gravity a pull or a push?

How does gravity affect paper airplanes?

What would happen if you threw a paper airplane and there was no gravity?

What is thrust?

Is thrust a pull or a push?

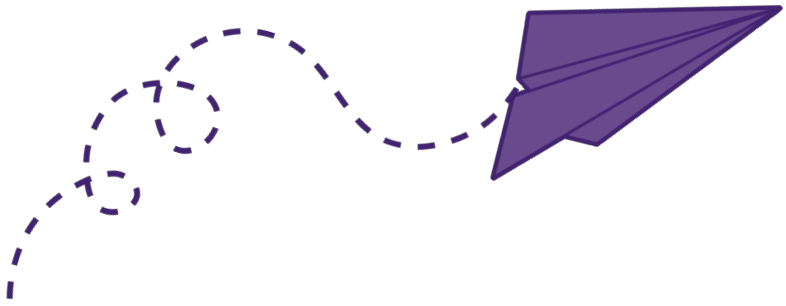
Can the amount of thrust change how far a paper airplane will travel? Explain.

Do aerodynamics impact the performance of a paper airplane? How?

What materials might affect how aerodynamic a paper airplane is?

What types of materials do you think would make the best paper airplanes? Explain.

What types of materials do you think would have a negative impact on how far a paper airplane can travel? Explain.



Name:_____

Think About It!

Connect what you have learned about the principles of flight to working with paper airplanes. Respond to each question below using complete sentences.

1. What is force?

_____

_____

2. What are some forces that might make a paper airplane go further

Explain.

_____

_____

3. What is drag?

_____

_____

4. Is drag a pull or a push? _____

5. Does drag help a paper airplane go further? Explain.

_____

_____

6. What is lift?

_____

_____

7. Is lift a pull or a push? _____

8. What might affect the lift of a paper airplane? Explain.

_____

_____

Name:_____

Think About It!

Connect what you have learned about the principles of flight to working with paper airplanes. Respond to each question below using complete sentences.

9. What is gravity?

_____

_____

10. Is gravity a pull or a push? _____

11. How does gravity affect paper airplanes?

_____

_____

12. What would happen if you threw a paper airplane and there was no gravity?

_____

_____

13. What is thrust?

_____

_____

14. Is thrust a pull or a push? _____

15. Can the amount of thrust change how far a paper airplane will travel? Explain.

_____

_____

16. Do aerodynamics impact the performance of a paper airplane? How?

_____

_____

Name:_____

Think About It!

Connect what you have learned about the principles of flight to working with paper airplanes. Respond to each question below using complete sentences.

17.. What materials might affect how aerodynamic a paper airplane is??

_____

_____

18. What types of materials do you think would make the best paper airplanes? Explain.

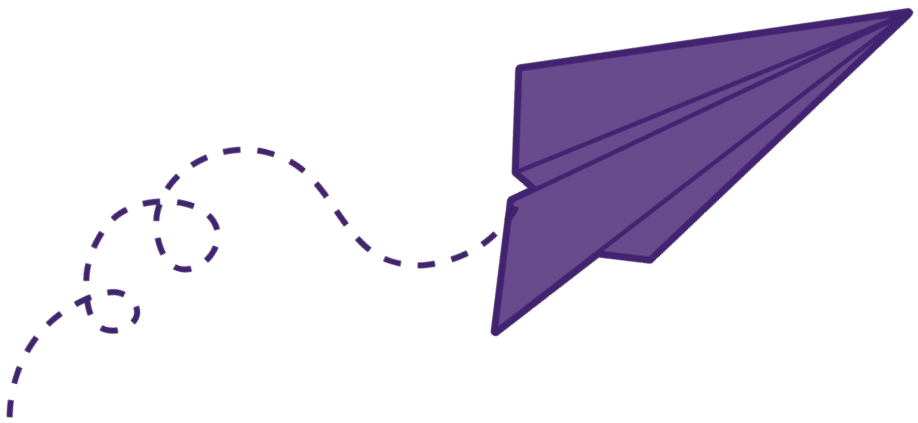
_____

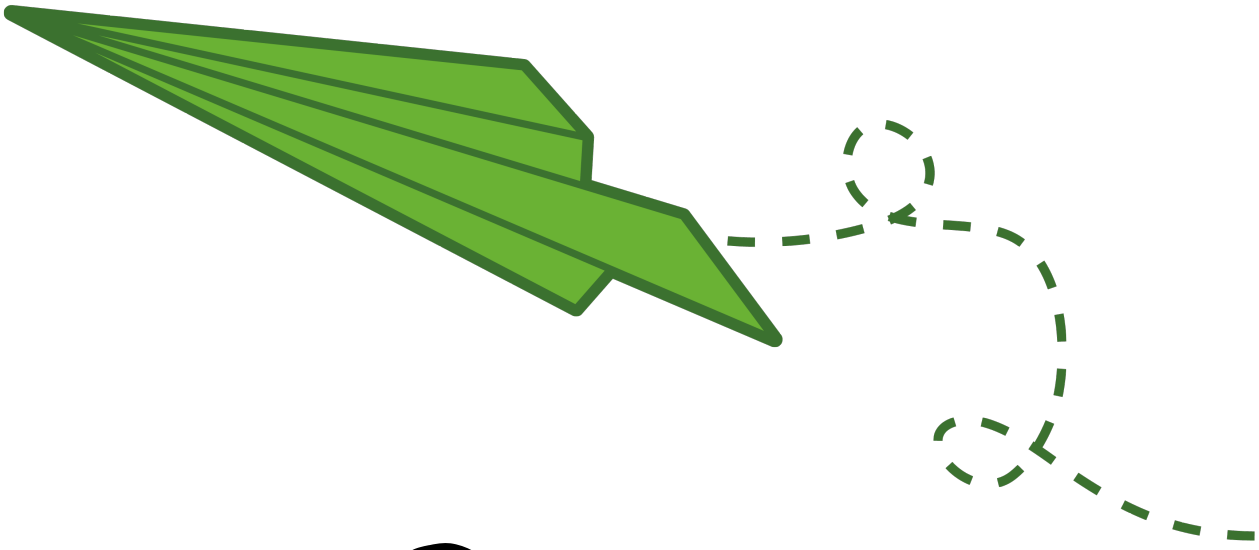
_____

19. . What types of materials do you think would have a negative impact on how far a paper airplane can travel? Explain.

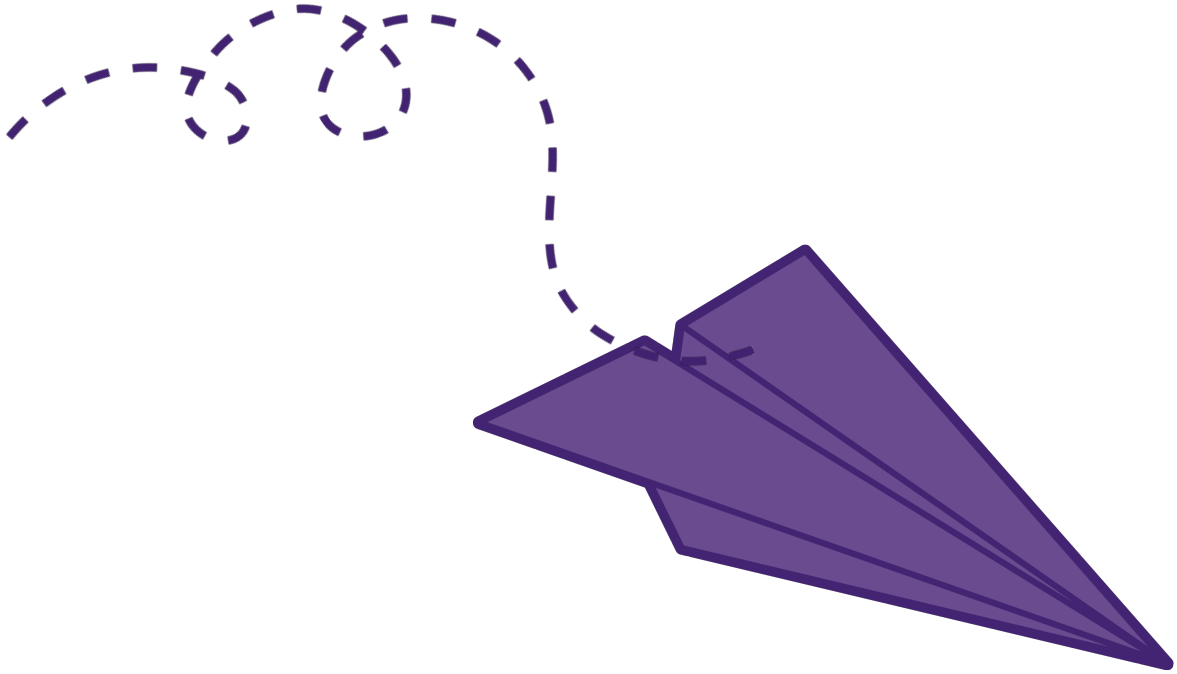
_____

_____

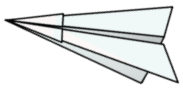




Group Investigation



Scientific Method and Paper Airplanes



Question

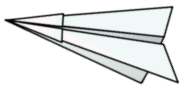
The question is the reason you are doing the investigation/experiment. What are you wondering? What do you want to learn? What would you like to try and find out?

How will different styles of wings affect how far a paper airplane will fly?

Research

Before you set up your experiment, do some research to find any possible background information that might be helpful on your topic.

Scientific Method and Paper Airplanes



Hypothesis

Here is where you will make a prediction (an educated guess) about what will happen in response to your question.

You can write this as an "If_____, then_____." statement.

If_____

_____

then_____

_____

_____

_____

_____.

Experiment

What will you do to test your question and hypothesis? Give a brief summary. You will write up a step by step plan next.

_____

_____

_____

_____

_____

_____

_____

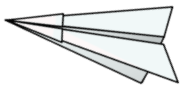
_____

_____

_____

Scientific Method and Paper Airplanes

Experiment



Variables:

Independent Variable: (what causes the change)

_____

_____

_____

_____

_____

Dependent Variable: (changes in the independent variable cause changes in the dependent variable)

_____

_____

_____

_____

_____

_____

Constant(s): (always remain the same)

_____

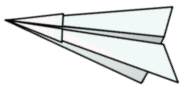
_____

_____

_____

_____

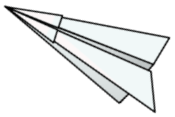
Scientific Method and Paper Airplanes



Materials Needed

Here is where you will write down EXACTLY what you need to conduct your experiment. Be specific, others may want to replicate your experiment in the future and it is important they use the same materials. Be very thorough and list each and every item and quantity needed.

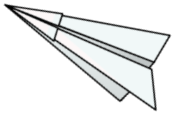
Scientific Method and Paper Airplanes



Procedure

Scientists write very detailed procedures so that if someone tries to repeat the experiment they do it exactly the same. Be specific with measurements, times, types of materials, brands, and tools.

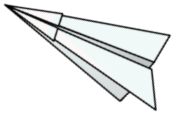
Scientific Method and Paper Airplanes



Procedure Continued…

Scientific Method and Paper Airplanes

Collect Data



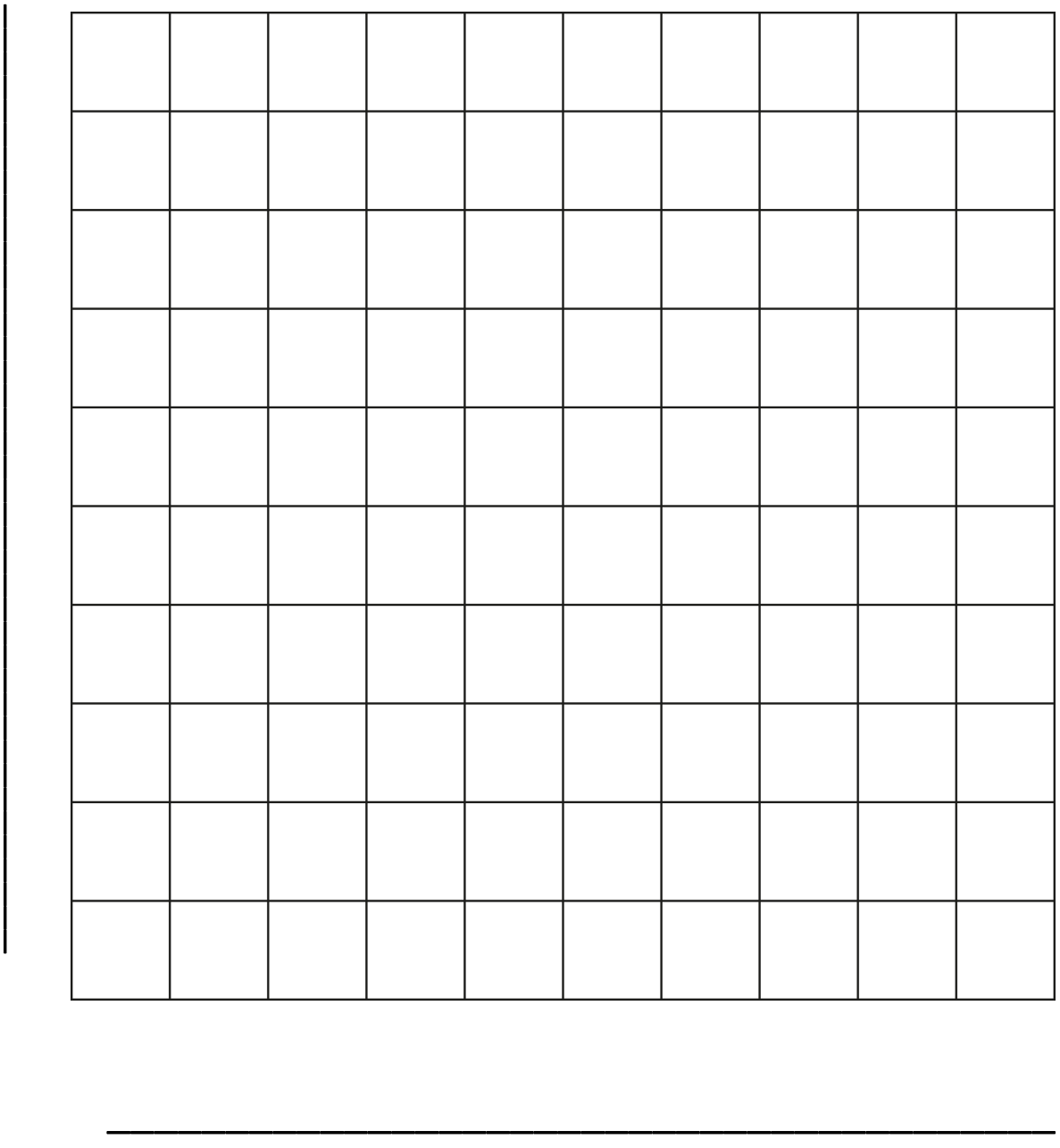
	Wing Style #1	Wing Style #2	Wing Style #3
Trial #1			
Trial #2			
Trial #3			
AVERAGE			

Sketch of Plane #1 Sketch of Plane #2 Sketch of Plane #3

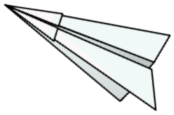
Scientific Method and Paper Airplanes

Graph Your Data

Your bar graph should include: Title, labels, scales, bars



Scientific Method and Paper Airplanes



Analysis

When your experiment is complete you will want to analyze your data to see if your hypothesis has been accepted/supported or rejected.

Qualitative Data- what information did you collect using observations and your senses.

Quantitative Data- what information did you collect using numbers, measurements, charts and graphs

Conclusion

Here is where you summarize what your hypothesis was, how you tested it, and whether the data from your experiment supports or does not support your hypothesis.

The purpose of this experiment was to

_____

_____

_____

The data I collected in my experiment showed

_____

_____

_____

_____

My hypothesis that

_____

_____

was _____

(supported, not supported, partially supported) by the data I collected.

This experiment could possibly be improved by

_____

_____

_____

_____

_____

An additional experiment I could do in relation to this is

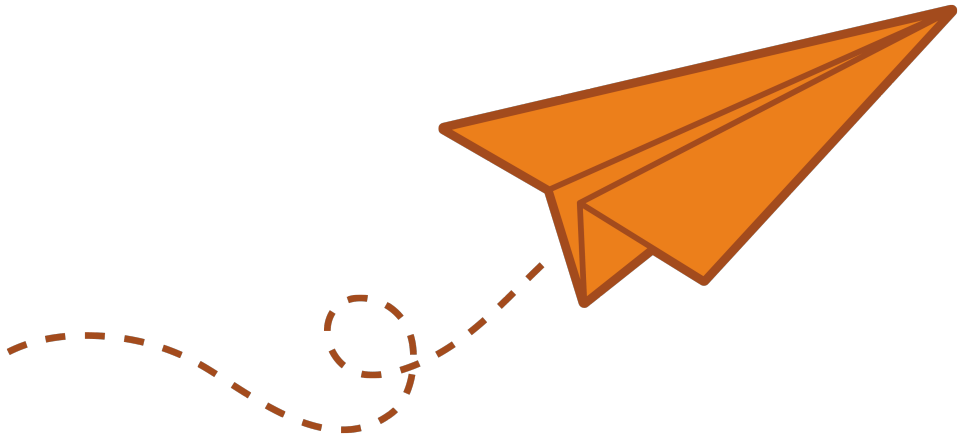
_____

_____

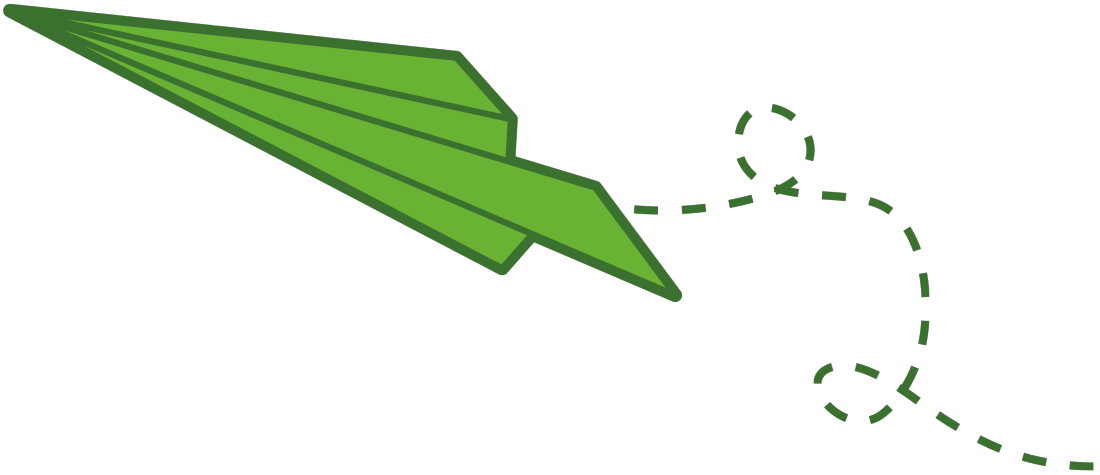
_____

_____

_____



Design Your Own Paper Airplane Investigation



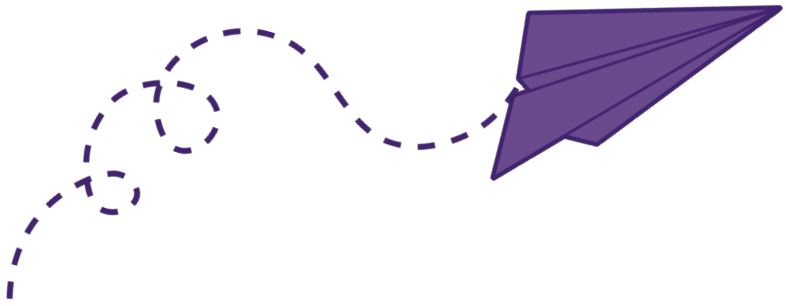
Information for Independent Investigation

- The only two sheets that are different from the original group experiment are the QUESTION page and the DATA page. Students need to fill in their own question and their own categories that they will collect data on.

- The rest of the experiment pages that follow the scientific method are the same as the group experiment, so you can copy the same ones from the first part.

- Some students might find it helpful to have their completed pages from the group experiment on hand to use as a reference for how to complete each step

- The next page has some possible ideas for variables students can change. You can make copies for students if you think it will be beneficial for them.



Possible Variables to Manipulate

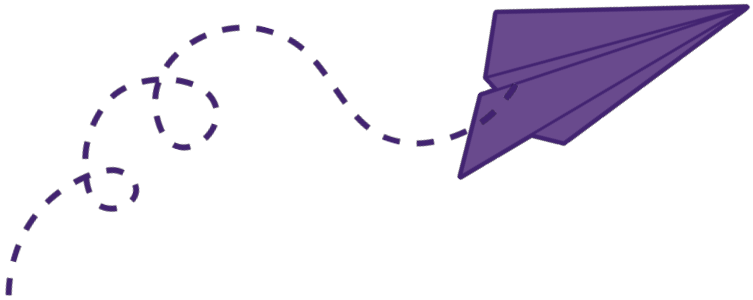
Remember: You should only change one variable at a time!

Weight

- Add 1 paperclip to each wing
- Add 1 paperclip to only one of the wings
- Add 1 paper clip to a different part of the plane (nose, tail, underneath)

Paper Used

- Construct planes from different types of paper (newspaper, magazine pages, copy paper, cardstock, construction paper etc...)



Location

- Inside classroom
- In the gym
- Outside

Size of Paper Airplane

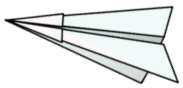
- Use different sizes of the same type of paper

Drag

- Attach something to hang off the wings (paper strips, string)

This is just a list of possibilities! Can you think of any other variables you could manipulate?

Scientific Method and Paper Airplanes



Question

The question is the reason you are doing the investigation/experiment. What are you wondering? What do you want to learn? What would you like to try and find out?

_____

_____

Research

Before you set up your experiment, do some research to find any possible background information that might be helpful on your topic.

_____

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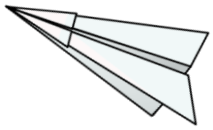
Scientific Method and Paper Airplanes

Collect Data



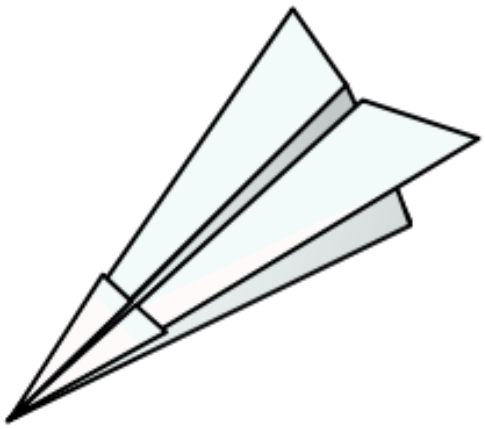
Trial #1					
Trial #2					
Trial #3					
AVERAGE					

Sketches of paper airplanes used

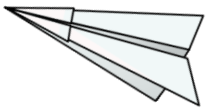
Ways to Present Your Findings

Scientists use many different methods to share what they learn from their experiments. Some ideas that your students could choose include:

- Poster
- Demonstration
- Smart Board slides
- Power Point
- Written paper/summary
- Diagrams with labels
- Prezi
- Movie/commercial
- Create a picture book
- Share with a younger grade
- Create a class book with all the students conclusions



Name:_____



Written Response

Zachary wanted to see which style of paper airplane would fly the farthest. He decided to test three different styles of planes. He folded a piece of paper into his first design, threw it and recorded the distance. He then unfolded the original plane and refolded it to make paper airplane design number two. He threw the second plane and recorded the distance it flew. He then unfolded the second plane and refolded it to make his third paper airplane, threw it and recorded the distance it flew.

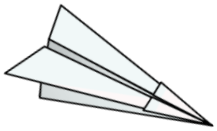
Below is a table of his data:

	Airplane #1	Airplane #2	Airplane #3
Trial #1	44"	38"	30"
Trial #2	40"	40"	26"
Trial #3	41.5"	36"	25"

Zachary looked at the data he collected and concluded that the style o his first paper airplane was the style that allowed the paper airplane to fly the farthest.

Do you agree with Zachary's conclusion? Why or why not. Describe what you agree with or disagree with and what you would do the same or change if you did the same experiment.

Name:_____



Written Response

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