COMMON CORE-ALIGNED TASK
WITH INSTRUCTIONAL SUPPORTS

Literacy

GRADE 8 LITERACY IN SCIENCE: STRAW ROCKETS

Unit Overview

Applying Newton's three laws of motion, students design an investigation involving straw rockets. The five tasks have students develop their writing skills by having them practice formulating a question, paraphrasing text, developing a hypothesis, constructing a procedure, and analyzing data to draw a conclusion. The final performance task requires them to aggregate these portions of a lab report as well as make real-world connections from what they learned. [See below for the NY State Intermediate Science content standards addressed.]

TASK DETAILS

Task Name: Controlled Experiment: Straw Rockets

Grade: 8

Subject: Physical science, Newton's laws of motion

Depth of Knowledge: 4 (Students apply Newton's laws of motion, create an experiment, analyze data to prove whether their hypothesis is supported or not, and apply their findings to real world situations.)

Task Description: The task requires students to write a lab report that demonstrates their knowledge of science content (laws of motion) as well as literacy skills, in which support their hypothesis, conclusion and application using evidence from informational texts. This content is usually taught towards the end of the year, so students should already have a basic understanding of the scientific method and lab procedures. This task can be used as a year-end exit project.

Standards Assessed:

WHST.6-8.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

a. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.

b. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.

c. Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.

d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

e. Establish and maintain a formal style and objective tone.

f. Provide a concluding statement or section that follows from and supports the information or explanation presented.

WHST.6-8.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.6-8.9. Draw evidence from informational texts to support analysis, reflection, and research.

RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

NYS Intermediate Science 5–8

Standard 1: Analysis, Inquiry, and Design: Scientific Inquiry

Key Idea 2: Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

Key Idea 3: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

Standard 4: The Physical Setting
Key Idea 5: Energy and matter interact through forces that result in changes in motion.
5.1 Describe different patterns of motion of objects.
5.2 Observe, describe, and compare effects of forces (gravity, electric current, and magnetism) on the motion of objects.

Materials Needed:

While this performance task and unit uses instructional material from Pitsco Education, it can easily be applied to anything that students can make fly: paper planes, balloon rockets, etc.

Pitsco Straw Rockets
http://www.pitsco.com/store/default.aspx?CategoryID=85&searchtype=0&c=2-1|17-2|85-3&t=&l=&loc=mm1

Texts:
Article: "What is a Rocket?"
http://www.nasa.gov/audience/foreducators/rocketry/home/what-is-a-rocket-k4.html (Lexile 980)

Article: "Special Delivery"
http://www.timeforkids.com/news/special-delivery/40616 (Lexile 970)

Website: "How Rocket Engines Work"
http://www.howstuffworks.com/rocket.htm (Lexile 1090)

Article: "NASA Launches New 'Black Hole Hunter'"
http://news.nationalgeographic.com/news/2012/06/120613-nasa-nustar-launches-x-rays-black-holes-supernovas-space-science/ (Lexile 1510)

Article: "Water Rocket Stability"
http://www.seeds2lrn.com/rocketSoftware.html (Lexile 1600)

Article: "Mechanics and Motion"
http://www.physics4kids.com/files/motion_intro.html (Lexile 940)

Article: "What a Drag: The Effect of Friction/Drag on Rocket Performance"
http://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_energy/cub_energy_lesson04.xml (Lexile 1000)

Article: "What is Drag? Factors That Affect Aerodynamics"
http://www.grc.nasa.gov/WWW/K-12/airplane/drag1.html (Lexile 1140)

Article: "Beginner's Guide to Propulsion: Balloon Rocket Car"
http://www.grc.nasa.gov/WWW/K-12/BGP/Ashlie/BalloonRocketCar_easy.html (Lexile 1260)

Article: "What is Aerodynamics?"
http://www.nasa.gov/audience/forstudents/5-8/features/what-is-aerodynamics-58.html (Lexile 690)
New York Science Grade 8. Chapter 16. New York, NY: Glencoe/McGraw-Hill, 2008. Print.

TABLE OF CONTENTS

The task and instructional supports in the following pages are designed to help educators understand and implement Common Core–aligned tasks that are embedded in a unit of instruction. We have learned through our pilot work that focusing instruction on units anchored in rigorous Common Core–aligned assessments drives significant shifts in curriculum and pedagogy. Callout boxes and Universal Design for Learning (UDL) support are included to provide ideas around how to include multiple entry points for diverse learners.

Acknowledgments: This bundle was developed by a team of teachers from PS 207 The Fillmore Academy that was led by Common Core Fellow, Dianne Kelly. Diane Kelly and Therese Reiser are participants in Urban Advantage Middle School Science Initiative (UA), which provided them with the UA tools used in this bundle, including the IDD, DSET and UA Rubric. Diane Kelly participated in straw rocket design investigations during UA professional development at the New York Hall of Science.

GRADE 8 LITERACY IN SCIENCE:

STRAW ROCKETS

PERFORMANCE TASK

Controlled Experiment: Building a Straw Rocket

Content: Newton's three laws of motion

Performance Task Description:

Develop your own controlled experiment to see how a variable (e.g., fin size, shape, cone size, etc.) affects the way a rocket flies (e.g., distance, speed, vertical height, etc.). Using Microsoft Word or PowerPoint to create a report or presentation, you will communicate your full investigation, maintaining a formal and appropriate style and tone for peers, teachers, and parents.

Your report or presentation should include an organized development of all the steps of the scientific method:

- Question to investigate
- Hypothesis
- All variables and constants
- Procedure
- Data tables and graphs
- Discussion and conclusion

To demonstrate your understanding of Newton's laws and other physical science principles you have learned, it is vital that you incorporate appropriate content-specific vocabulary in your report. Your hypothesis must be an educated guess that answers your specific experiment question and must cite reliable resources to support relevant scientific reasoning for your prediction. Your conclusion must include evidence (data) you gathered during your investigation to support your claim as well as any possible sources of error that may have influenced your results. Your discussion should include an application of your findings to the real world, which must also cite reliable relevant resources. Use MLA formatting for all citations. When appropriate, use transitional words or phrases (e.g., *furthermore*, *at first*, *as a result*) to help create clarity and relationship among ideas presented in the report.

Additional Support Strategy:

While most students should be familiar with the scientific method at this point in the school year, some students who struggle with organization may benefit from the following handout. While this sheet gives descriptions of the different sections required in the report and can be used as a checklist, it does not significantly diminish the rigor of the assignment, as it does not tell students *how* to complete each section of the report.

Helpful Information for Completing Your Report

Question

The question describes the focus of the investigation. The question should ask how the independent variable will affect the dependent variable. The question should be written so that someone unfamiliar with your experiment can easily understand it.

Sample format: "How will (the independent variable) affect (the dependent variable)?"

Hypothesis

A hypothesis is an educated prediction. It should explain the effect that changing the independent variable will have on the dependent variable in the investigation. The hypothesis **should state why** you think this will happen ("because . . . "). **You must have a reference (evidence from an outside source) to support why you think something is going to happen.**

Sample format: **"**I think (independent variable) will cause (dependent variable to . . .), and I expect this to happen because (describe the scientific reasons of why you expect this relationship between the variables)." **Include cited scientific concepts that relate to this prediction**.

Investigation Design

Using the five components below, describe the design of the investigation:

1. **Independent variable**: the variable that is changed on purpose
2. **Dependent variable:** the variable that is measured as a result of changes purposely made in the independent variable
3. **Constant variables** (also called "constants"): the variable(s) in an investigation that are kept the same and not allowed to change or vary
4. **Number of repeated trials:** the number of times that a level of the independent variable is tested in an investigation, or the number of objects or organisms tested at each level of the independent variable

Procedure

List materials and provide a detailed and logical step-by-step description of procedures.

Data Results (Table and Graphs) and Data Analysis

The data reported in this section are the basis on which the student will claim that their hypothesis is or is not supported. The data should be shown in appropriate table and graph formats to be sure trends or patterns in the data are summarized.

Discussion/Conclusion

Conclusion: State whether the hypothesis was—or was not—supported by the data**, and be sure to refer to and explain the data you collected**. Also, you must use the scientific knowledge you learned in class to explain your interpretation of your results.

Discussion: Also important are reflections on possible sources of experimental error and suggestions for further investigations, as well as how your experiment and results relate to real-world applications. Here again you should be **citing information** to help explain results and real-world applications.

Works Cited

List the sources you used in your project. Sources should be varied (books, articles, websites, and so on), clearly related to the topic, reliable, and at the appropriate grade level. Citations should be written in MLA style.

GRADE 8 LITERACY IN SCIENCE:

STRAW ROCKETS

RUBRIC

This task was scored using a task-specific rubric that assesses the target Common Core standards.

RUBRIC

Question (WHST.6-8.2.a)	
4	The question asks how the independent variable affects the dependent variable and is testable.
3	The question is testable but does not ask how the independent variable affects the dependent variable.
2	The question is present but is not testable.
1	Not attempted
Hypothesis (WHST.6-8.2.b,d, WHST.6-8.9, RST.6-8.1)	
4	The hypothesis predicts the effect of changing the independent variable on the dependent variable and explains the reason for the prediction using scientific reasoning ("because . . . ") that is supported by many details and inferences **cited** from reliable and relevant research.
3	The hypothesis predicts the effect of changing the independent variable on the dependent variable and explains the reason for the prediction using scientific reasoning (" because . . . ") that is supported by some details and inferences **cited** from reliable and relevant research.
2	The hypothesis predicts the effect of changing the independent variable on the dependent variable but does not explain the reason for the prediction (no "because . . . " statement is present).
1	The prediction is present but does not show a relationship between the variables.
Experimental Design/Procedure (Counted Double) (WHST.6-8.2.a,b,c,d)	
4	All five components of experimental design are clearly stated. Variables are correctly identified, constants are detailed, multiple materials are listed, and a detailed and logical step-by-step procedure is described.
3	Three or four of the five components of experimental design are clearly stated and/or Materials are listed, and a logical step-by-step procedure is described, but some steps are missing or incomplete.
2	At least two of the five components of experimental design are clearly stated and/or A logical step-by-step procedure is listed, but many steps are missing or incomplete.
1	Not attempted or only one of the five components of experimental design is clearly stated or summarized.
Data Results (Tables and Graphs) and Data Analysis (WHST.6-8.2.a)	
4	Data table(s) and graph(s)—or other representations of the data—are accurate and appropriate, easily understood, and complete (include titles, labels, appropriate placement of variables, and correct units of measure). Trends or patterns in the data are identified and summarized.
3	Data table(s), graph(s), and other representations of data include most of the above components. Some trends or patterns in data are identified and summarized.
2	Data table(s), graph(s), and other representations of data include some of the above components. Trends in data not identified and summarized.
1	Not attempted
Conclusion (Counted Double) (WHST.6-8.2.d,f)	
4	Conclusion makes a claim (i.e., the hypothesis is or is not supported . . .), supports the claim with evidence (data), and uses reasoning in the form of connections to scientific concepts to relate claim and evidence. Sources of error that may have influenced the results are identified and well explained.
3	Most parts of conclusion are complete and accurate.
2	Some parts of conclusion are complete and accurate.
1	Not attempted
Discussion (Counted Double) (WHST.6-8.2.b,f, WHST.6-8.9, RST.6-8.1)	
4	Real-world application is clearly and logically applied to the experiment and is supported with many relevant details and inferences drawn from text. Relevant, reliable research is properly **cited.**
3	Real-world application is clearly and logically applied to the experiment and is supported with some relevant details and inferences drawn from text. Relevant, reliable research is properly **cited.**
2	Real-world application is attempted but not relevant to specific experiment, and/or relevant, reliable research is missing.
1	Not attempted
Literature Cited (WHST.6-8.9, RST 6-8.1)	

Adapted from the Urban Advantage Science Exit Project Evaluation Rubric:http://www.urbanadvantagenyc.org/www/urbanadvantage/site/hosting/UA_exit_project_rubric.pdf

RUBRIC

4	A variety of sources are cited, that are clearly related to the topic, and analysis of text helps support hypothesis, conclusion, and real-world application. All sources are reliable and at the appropriate grade level, and citations follow MLA format.
3	Limited variety of sources cited, most are clearly related to the topic, and analysis of text helps support hypothesis, conclusion, and real-world application. Most sources are reliable and are at the appropriate level and citations follow MLA format.
2	Mostly one type of source cited, relation to the topic is unclear, level may not be appropriate or resources unreliable.
1	Not attempted
Quality of Writing (WHST.6-8.2.c,d,e, WHST.6-8.4)	
4	Writing is always coherent regarding the following: development, organization, and style are appropriate to task, purpose, and audience and maintains a formal style. Excellent use of precise language and domain-specific vocabulary to inform about or explain the topic. Uses sophisticated and varied transitions that create cohesion and clarity of the relationships among ideas and concepts throughout the entire report.
3	Writing is most of the time coherent regarding the following: development, organization, and style are appropriate to task, purpose, and audience and maintains a formal style. Good use of precise language and domain-specific vocabulary to inform about or explain the topic. Uses varied transitions that create cohesion and clarity of the relationships among ideas and concepts throughout the entire report.
2	Writing is sometimes coherent regarding the following: development, organization, and style are appropriate to task, purpose, and audience and maintains a formal style. Language and domain-specific vocabulary used to inform about or explain the topic is below grade level. Uses some transitions that attempt to create cohesion and clarity of the relationships among ideas and concepts throughout some parts of the report.
1	Writing is rarely coherent regarding development and organization. Style is not appropriate to task, purpose, and audience. Language and domain-specific vocabulary used to inform about or explain the topic is below grade level. Transitions are not used or do not provide cohesion and clarity of the relationships among ideas and concepts throughout the report.

Adapted from the Urban Advantage Science Exit Project Evaluation
Rubric:http://www.urbanadvantagenyc.org/www/urbanadvantage/site/hosting/UA_exit_project_rubric.pdf

GRADE 8 LITERACY IN SCIENCE:

STRAW ROCKETS

ANNOTATED STUDENT WORK

This section contains annotated student work at a range of score points and suggested next steps for students. The student work shows examples of student understandings and misunderstandings of the task.

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Student Work Level 3

Question: How does the shape of the fins affect the speed of the rocket?

Hypothesis: I think that the shape of the fin will affect the speed of the rockets. I have three different types of fins, I have curved, triangle, rectangle. I think that the fin that will fly the fastest is the triangle shaped fin. The reason I think this, is because the more air hits the surface, the more drag the air will give you. Drag is a force that opposes motion, like friction. So the triangle shaped fin will have less surface area hitting the air, less drag and fly at the fastest speed. My hypothesis is based off of Aerodynamics, "What is drag".

Comment [k1]: Although the citation is not in MLA format, student still stated prediction and supports it with sound science concepts and informational text, using paraphrasing and not direct quotation. (WHST 6-8.2.b,d. 6-8.9 RST 6-8.1)

Variables

Independent Variable : shape of the fins

Dependent Variable: speed of the rocket

Constants:

length of the rocket, mass of the rocket, mass of the cone, size of the cone, degree of the launch angle, air pressure (force put on rocket), length of the straw, shape of the cone, and the amount of tape, fine size, fin material

Comment [k2]: Correctly identifies variable and a multitude of constants. (WHST 6-8.2.a, d)

Materials

3 straws, tape, triple beam balance scale, ruler, clay, index cards, rocket launcher, meter sticks, stop watch

Procedure

1. Tape the openings of the straw shut (both sides of each straw)
2. Measured out a piece of clay 45grams
3. Form a triangular shaped cone out of clay (height 1.5cm)
4. Cut different shaped fins out of index cards. Three fins each; triangle, curved, rectangle. All with a height of 3cm and width 1.5cm
5. Tape 3 fins of same shape on the bottom of each straw
6. Measure the mass of the rocket after everything was put together, make sure they are all equal
7. Launch rocked at a 45degree angle and 2meters of pressure
8. Record time and distance the rocket travels
9. Repeat launch at same angle and pressure three times each for the three different fin types.

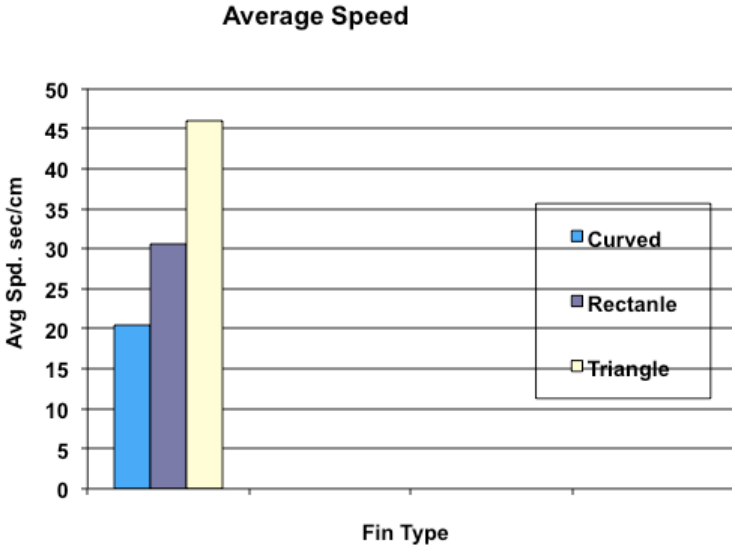
Comment [k3]: Procedure is clear, well sequenced and detailed. (WHST 6-8.2.b, d)

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Data Table: Speed of Different Shaped Fins on a Rocket

Comment [k4]: Well constructed data table, student could have included a row to show computations and averages. (WHST 6-8.2.a)

FIN(ID)	TRIAL 1	TRIAL 2	TRIAL 3
Curved	644 cm 1.29 sec	625 cm 1.26 sec	628 cm 1.79 sec
Rectangle	460 cm 1.81 sec	326 cm 1.81 sec	502 cm 1.28 sec
Triangle	386 cm 1.15 sec	506 cm 1.26 sec	207 cm 1.18 cm



Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Conclusion and Application

I can conclude that the shape of the rocket's fin does affect the speed the rocket travels. My hypothesis that the rocket with the triangle fin will fly the fastest is supported by the data, it flew on an average of 45 cm per second, the rectangle flew on an average of 30 cm per second, and curved flew on an average of 20cm per second. This is because the triangular shaped fin has less surface area creating less drag on the rocket so it will fly the fastest. (NASA "What is drag?")

Some rockets that NASA uses today do have very small and triangular shaped fins that are active! This means they move. According to Newton's 3rd Law every action has an equal and opposite reaction. Having fins can both help a rocket, when it is flying straight it stays straight, but when it "fishtails" or wobbles then the fins can make is worse. Rockets that have fins that can move can help the rockets straighten out. (NASA: Rockets Applying Newton's Laws)

Today rockets are used for many purposes. They are used to carry payloads for commercials or scientific purposes into space. One of the most important commercial payloads are satellites, which we use in our daily communication. (Rockets.com)

Comment [k5]: Student supports conclusion with data and scientific reasoning. They apply the experiment to uses in the real world. Information is cited, although conventional MLA style is not used. (WHST 6-8.2.b,f, 6-8.9 RST 6-8.1)

Comment [k6]: Interesting real-world information but not directly related to student's question about fin shape. (WHST 6-8.2.b)

Comment [k7]: Student did not list as resource in bibliography. This idea needs to be developed with more details. (WHST 6-8.9 RST 6-8.1)

Bibliogrpahy

1.Chapter 16 New York Science Grade 8, New York, NY: Glencoe/McGraw-Hill 2008 Print

2. NASA. (2009, August 23). Applying Newton's Laws. Retrieved from http://www.nasa.gov/pdf/153419main_Rockets_Applying Newtons_Law.pdf

3. NASA. (2009, October 6). What is Aerodynamics?. Retrieved fromhttp://www.nasa.gov/audience/forstudents/5-8/features/what-is-aerodynamics-58.ht

4. Rockets.com

Comment [k8]: Student needs to work on citing resources with proper web address that can be accessed. (WHST 6-8.9 RST 6-8.1)

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Level 3

Evidence for Meeting the Standard	Evidence for Not Meeting the Standard
Question (WHST 6-8.2.a)	Score: 4
Question is testable and asks how the independent variable would affect the dependent variable.	None
Hypothesis (WHST 6-8.2.b,d. 6-8.9 RST 6-8.1)	Score: 3
Hypothesis is stated and is supported by some details given in the text.	The concept of drag is defined but more details, are needed to clearly support the prediction.
Experimental Design/Procedure (Counted Double) (WHST 6-8.2.a,c)	Score: 3
The concept of drag is defined but more details, are needed to clearly support the prediction.	Construction of the rockets is missing
Data Results (Tables and Graphs) and Data Analysis (WHST 6-8.2.a)	Score: 3
Data table and graph are accurate and appropriate, easily understood and complete; includes title, labels, appropriate placement of variables, and correct units of measure .	Although data is discussed in the conclusion, trends are not identified and summarized directly below the graph. Also data table should have average of the three trials for each fin type.
Conclusion (Counted Double) (WHST 6-8.2.d,f)	Score: 3
The conclusion makes a claim (shape of the rocket affects the speed), supports the claim with data gathered from the experiment as well as uses principle from Newton's 3rd law to explain results.	Sources of error that may have influenced the results is missing.
Discussion (Counted Double) (WHST 6-8.2.b,f, 6-8.9 RST 6-8.8)	Score: 2
A real world situation is explained and supported with relevant details and inferences drawn about the importance of fins on a rocket flight path. The importance and use of rocket are also given and supported by research.	The relationship of the real world application and this experiment is unclear. The experiment is regarding fin shape, but the real-world application is regarding weather fins move or not.
Literature Cited (WHST 6-8.9 RST 6-8.8)	Score: 3
A variety of sources are cited, they are clearly related to the topic, analysis of text helps support hypothesis, conclusion and real-world application. Most sources are reliable and at the appropriate grade level.	"Rockets.com" needs more information to access for grade level and relevancy.
Quality of Writing (WHST 6- 8.2.c,d,e 6- 8.4)	Score: 3
Writing is well organized and style is appropriate to task, purpose. Uses domain-specific vocabulary (drag, friction surface area, motion, speed, Newton's 3rd Law) to develop the topic.	Sentence structure is simple, one thought sentences. Details and examples can be given for deeper understanding.

Next Steps: Student's sentence structure is simple. Each sentence contains one idea with no connecting clause. This makes the text appear "choppy" and unsophisticated. One next step could to underline each claim in the student paper and have the student add at least one more detail and example for each claim. Then have the student build on sentence complexity by stringing sentences that support/connect with each other together. See http://mrsdell.org/combiningsentences/ for further instruction.

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Student Work Level 2

How will the placement of the rocket affect where the rocket lands?

Hypothesis: I think the placement of the fin will not affect the distance. I think it will not affect the distance due to Newton's second law of motion which states F=MA. This means force is equal to the mass of the object and its acceleration. In other words if you move the same object with the same force the acceleration will stay the same. In the experiment we will not change the net force so the rocket should remain at a constant speed.

Resource Glencoe 8th grade science text book pg 470

Independent Variable: Placement of the fin

Dependent: Distance rocket flies

Materials: Fins made out of index cards, Straw also known as rocket, Clay also known as cone, Launcher

Procedure

1.Gather materials

2.Record what angle you launch at

3.Place rocket on its launch pad

4. Launch rocket

5. Record where your rocket land

6. Repeat these steps 3 different times for each rocket In total you should have 9 measurement

7. Conclude your data

Comment [k1]: "Where the rocket lands" is vague, student should use academic vocabulary of dependent variable, "distance". (WHST 6-8.2.d)

Comment [k2]: While this explanation is true and is a good application of Newton's 2nd Law, the hypothesis should focus on the independent variable, placement of fin and its effect on the dependent distance. Paraphrasing of Newton's 2nd Law is lacking key details. (WHST 6-8.2.b,d. 6-8.9 RST 6-8.1)

Comment [k3]: Need to state all things held constant. (WHST. 6-8.2.a)

Comment [k4]: Does not seem like a complete set of materials (i.e. did the student use tape?) Procedure needs greater details like how much force was applied, how did the student measure distance etc. (WHST 6-8.2.a,b,d)

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Data Table: Average Distance for each Fin Placement

Placement of the fin 1 bottom: weight 5.8 grams distance from cone 14 cm	Trial 1 1,020 cm	Trial 2 1,002 cm	Trial 3 645 cm	Avg. 919 cm
Placement of the fin 2 weight: 5.8 middle distance from cone 8.5 cm	928 cm	1,097cm	846 cm	957 cm
Placement of the 3 fin top: weight 5.8 grams distance from cone 0 cm	664 cm	597 cm	640 cm	634 cm

Conclusion

My hypothesis was incorrect because looking back at the data we found out the placing the fin in different positions does change the distance. The average distance rocket placement 1 was 919 cm, rocket placement 2 average distance was 957cm and rocket placement 3 average distance was 634 cm. So the rocket placement 2 which had the fins in the middle went the longest average distance and the rocket placement 3 which had the fins at the top of the rocket went the shortest average distance. The rocket with the fins at the bottom went the 2nd longest distance. The difference average distance between the rocket with the fins in the middle and at the bottom is not a big amount (36cm). In conclusion I can say there was an effect of distance due to the placements of fin. This is why most rockets you see have the fins at the bottom of the rocket. (Glencoe 8th grade science text book pg 468)

Comment [k5]: Table is clear and gives specific information like where the fins were placed. Also includes the averages for each type of rocket. Missing graph and summary. (WHST 6-8.2.a)

Comment [k6]: Student supports conclusion with the data but does not give any scientific reasoning as to why they got these results. Need more information about real world rockets. (WHST 6-8.2.d,f 6-8.9, RST 6-8.1)

Sources of Error:

The cones may have been damaged during the trials of the rocket launches. For instance, after the first launch when it hit the ground it got smashed. The fins were not stable in one of our rockets. The fin may have been damaged after each trial, like the cone. The rocket may not have been at the same launching angle each trial. The amount of force applied may have not been same

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Level 2

Evidence for Meeting Standard	Evidence for Standard Not Met
Question (WHST 6-8.2.a)	**Score: 3**
The question asks how the independent variable (placement of fin) affects the "where the rocket lands"	"Where the rocket lands" is vague, should use specific quantity being measures; distance.
Hypothesis (WHST 6-8.2.b,d. 6-8.9 RST 6-8.1)	**Score: 2**
The hypothesis predicts that "the placement of the fin will not affect the distance." Explanation of Newton's 2nd law is paraphrased. (developing level) from cited text.	The explanation given does not directly relate to prediction, rather it refers to force of rocket and does not address the placement of the fin.
Experimental Design/Procedure (Counted Double) (WHST 6-8.2.a,c)	**Score: 2**
Independent and dependent variables are identified. Most materials are listed and procedure is vaguely described.	Constants not identified (i.e. force, mass of rocket, fin size…) Construction of rocket not stated.
Data Results (Tables and Graphs) and Data Analysis (WHST 6-8.2.a)	**Score 2:**
Data table neat organized and properly labeled.	Graph is not included.
Conclusion (Counted Double) (WHST 6-8.2.d,f)	**Score: 2**
.Hypothesis is evaluated and is supported by data, from the experiment	Scientific reasoning is not used to support findings.
Discussion (Counted Double) (WHST 6-8.2.b,f, 6-8.9 RST 6-8.8)	**Score: 2**
Includes reflection of experiment by including sources of error.	Relationship of this particular experiment (placement of fins) is not directly made to real-world rockets or missiles.
Literature Cited (WHST 6-8.9 RST 6-8.8)	**Score: 1**
Glencoe Text is cited.	Only one resource is cited.
Literature Cited (WHST 6-8.9 RST 6-8.8)	**Score: 2**
Writing is clear and logical.	Lacks details, examples and direct relationships to scientific reasoning and real world applications

Next Steps: This student is struggling to make clear direct relationships between their experiment and scientific concepts as well as between their results and real world applications. It might be helpful for student to perform simple activities that apply Newton's laws and have student practice writing what happened and how these laws of motion explain the outcomes. Once they have mastered using scientific concepts to explain the outcomes in the activity, have them write a scenario for how they can be applied to real life situations. For example: Have student put a coin on a toy car and push the car towards a wood block. Have them repeat this but now tape the coin to the car. Student should write explaining how Newton's 1st law explains the motion of the coin in both scenarios and then the teacher could prompt them to make the real life application to using a seat belt in a car.

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Student Work Level 1

How will the density of the cone affect the distance the rocket travels?

Comment [k1]: Good clear, testable question. (WHST 6-8.2.a)

If the density decreases the rocket will travel at a longer distance because the weight on the rocket is less.

Comment [k2]: This attempts to answer the question, but lacks scientific reasoning for the prediction. (WHST 6-8.2.b,d. 6-8.9 RST 6-8.1)

Independent Variable: The density of the cone

Dependent Variable: The distance the rocket travels.

Constants: The length of the rocket, the size of the fins, the mass of the fins, the placement of the fins, the volume of the cone, the shape of the cone, the position of the cone, the position of the rocket launcher, the angle of the rocket launcher, location, force used to launch the rocket, meter stick used to measure distance

Materials
Straw
Tape
2 Index cards
Ruler
Rocket launcher
Clay
Tin foil
Scissors
Triple beam balance

Procedure

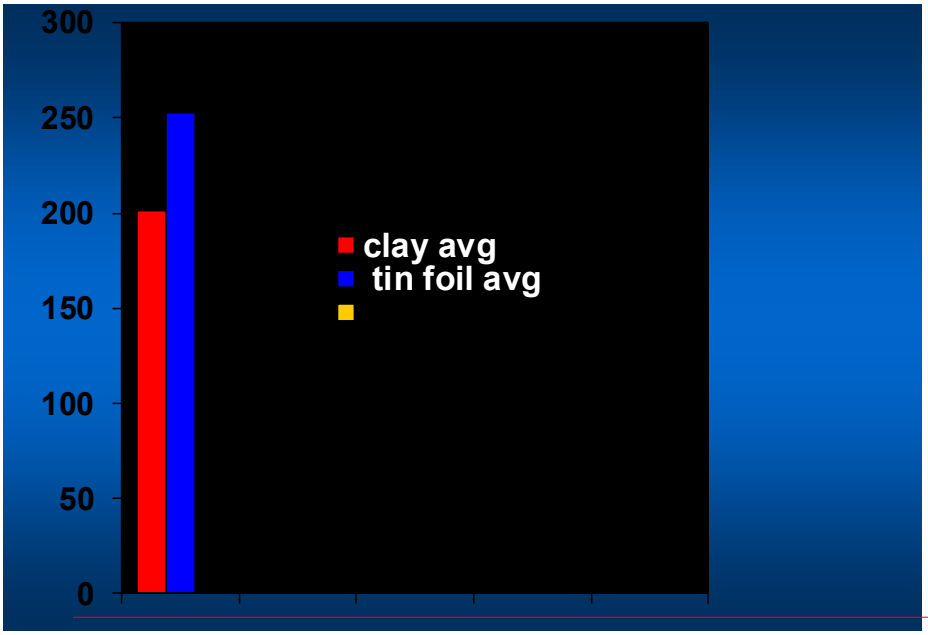
1. Measure the straw and record length
2. Make fins out of index cards, by measuring the size to keep them constant.
3. Attach the fins to both straws (rockets) in the same spot with tape.
4. Form cones out of both tin foil and clay.
5. Measure the volume and mass of each cone.
6. Attach the cones to each rocket.
7. Measure the mass of each rocket.
8. We did a practice run to see if the rockets would launch.
9. Create data table
10. Place rocket on rocket launcher at a 45 degree angle.
11. Launch rocket with clay cone with a force of 30m, repeat for three trials, measure and record data
12. Repeat steps 10 and 11 with rocket with foil cone.

Comment [k3]: While it is good that the student measured the item, in a procedure they should also state state what the measurements should be. (WHST 6-8.2.a,d)

Comment [k4]: Student needs to give more precise details for the "form" of the cone, dimensions, etc. (WHST 6-8.2.a,d)

Comment [k5]: This should be done prior. (WHST 6-8.2.a)

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work



Conclusion
The foil has less density then the clay so the clay didn't go that far. If the rocket average of the tin foil had a better average distance because it was lengthier then the clay. The rocket with the clay went 200.7 and the tin foil went 253 so it went further.

Application
Our experiment can be applied to a real rocket or airplane. A rocket or plane built out of less dense material will travel further with the same amount of force than the rocket made from a more dense material.
Citation: Chapter 16 New York, NY: Glencoe/ McGraw Hill 2008

Comment [k6]: Key elements for graph are missing, such as title, label for X and Y axis and summary of trends. Also, data table needs to be present to accurately assess if graph is correct. (WHST 6-8.2.a)

Comment [k7]: Student attempts to address the experimental question but key elements are missing such as what the density of the foil and clay cones are, distance units, and scientific reasoning as to why these results were obtained. (WHST 6-8.2.d,f, 6-8.9)

Comment [k8]: Although student attempts to apply their finding to the real world, it lacks specific details as to what materials are used and their density. It's not clear how the text cited supports the information given. (WHST 6-8.2.b,f, 6-8.9 RST 6-8.1)

Grade 8 Literacy in Science: Straw Rockets
Annotated Student Work

Level 1

Evidence for Meeting the Standard	Evidence for Not Meeting the Standard
Question (WHST 6-8.2.a)	Score: 4
The question asks how the independent variable affects the dependent variable and is testable.	
Hypothesis (WHST 6-8.2.b,d. 6-8.9 RST 6-8.1)	Score: 1
The hypothesis predicts the effect of changing the independent variable (density) on the dependent variable (distance).	A hypothesis does not explain the reason for the prediction using scientific reasoning ("because…") that is supported by relevant research
Experimental Design/Procedure (Counted Double) (WHST 6-8.2.a,c)	Score: 2
Variable and constants are identified. Materials are listed and procedure is listed in numbered order.	While the procedure attempts to include details, it lacks pertinent information such as how density was determined, specific rocket part measurements and how distance was measured.
Data Results (Tables and Graphs) and Data Analysis (WHST 6-8.2.a)	Score: 1
Graph is included with legend,	Graph needs to have a title, X and Y axis needs to be labeled as well as summary of trends the graph shows needs to be included. Need to include data table so graph can be accurately assessed.
Conclusion (Counted Double) (WHST 6-8.2.d,f)	Score: 1
Conclusion answers the experimental question with limited data to support it.	The conclusion needs to reflect as to whether the hypothesis is supported or not and needs to include data with measured units to support it. Also, there is scientific reasoning to explain results.
Discussion (Counted Double) (WHST 6-8.2.b,f, 6-8.9 RST 6-8.8)	Score: 1
Limited real-world application is given with a reliable .	Discussion is not directly relevant to the experiment.
Literature Cited (WHST 6-8.9 RST 6-8.8)	Score: 1
Only one source is cited.	More research and scientific reasoning is needed to be cited to support you hypothesis, conclusion and real-world applications.
Quality of Writing (WHST 6- 8.2.c,d,e 6- 8.4)	Score 2
A formal lab report format is used and is presented in a logical order.	Domain specific vocabulary, like Newton's Laws, gravity, aerodynamics etc. should be used to explain hypothesis, conclusion and real world application

Next Steps: While the student seems to understand most of the steps to scientific method, it is unclear they grasp the physical science content of the unit, or whether they are struggling with the writing process. Consider conferencing with the student verbally and discuss each section separately. Have student take notes on "post-its" to add content they are able to express verbally or questions that need to be clarified with more research.

GRADE 8 LITERACY IN SCIENCE:

STRAW ROCKETS

INSTRUCTIONAL SUPPORTS

The instructional supports on the following pages include a unit outline with formative assessments and suggested learning activities. Teachers may use this unit outline as it is described, integrate parts of it into a currently existing curriculum unit, or use it as a model or checklist for a currently existing unit on a different topic.

Unit Outline

INTRODUCTION: This unit outline provides an example of how to integrate performance tasks into a unit. *Teachers may (a) use this unit outline as it is described below; (b) integrate parts of it into a currently existing curriculum unit; or (c) use it as a model or checklist for a currently existing unit on a different topic. The length of the unit includes suggested time spent on the classroom instruction of lessons and administration of assessments. Please note that this framework does not include individual lessons.*

Grade 8 Literacy in Science: Straw Rockets

UNIT TOPIC AND LENGTH: CONTROLLED EXPERIMENT 5–6 WEEKS

- About 1–2 weeks should be spent covering Newton's three laws of motion. Students then spend approximately 3–4 weeks designing and implementing a controlled experiment testing a variable on a straw rocket. The final assessment requires students to write a lab report describing their experiment, draw a conclusion based on the data and relate their findings to real world applications. Please note that this framework does not include individual lessons.

COMMON CORE LEARNING STANDARDS:

WHST.6-8

- 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- 9. Draw evidence from informational texts to support analysis, reflection, and research.

RST.6-8

- 1. Cite specific textual evidence to support analysis of science and technical texts.

BIG IDEAS/ENDURING UNDERSTANDINGS:

- To develop a scientific hypothesis one must use prior knowledge and background research.
- A series of calculated steps, the scientific method, must be used to test a specific variable's effect on the motion of a rocket.
- A scientific conclusion must be supported by evidence (data) and explained using established scientific reasoning.
- Valid controlled experiments can be applied to different scaled real-world applications.

ESSENTIAL QUESTIONS:

- How can one predict, test, and explain the interactions between a rocket's motion and the forces acted upon it?
- How do scientists develop experiments that produce reliable results that can be applied to the real world?

➢ Newton's laws of motion can be used to explain the motion or stability of an object.	
CONTENT: ➢ Newton's three laws of motion ➢ Forces: unbalanced, gravity, friction ➢ All steps to a valid controlled experiment	**SKILLS:** ➢ Develop a scientific hypothesis ➢ Design a controlled experiment ➢ Identify cause-and-effect relationships ➢ Analyze data ➢ Reason to support a conclusion
VOCABULARY/KEY TERMS: Newton's three laws of motion Drag Aerodynamics Friction Force Gravity Inertia Speed Independent and dependent variables Constants Hypothesis Conclusion	
ASSESSMENT EVIDENCE AND ACTIVITIES: **INITIAL ASSESSMENT :** Using the four-question strategy, elicit student's prior knowledge about rockets and their design. This will also help students identify independent and dependent variables as well as constants, which will enable them to formulate an investigable question.	
FORMATIVE ASSESSMENT: ➢ Investigative Design Diagram (IDD): Use this graphic organizer to assess students' ability to formulate their question, develop their hypothesis, and identify their variables and constants. ➢ Procedural Outline: Students should write an initial procedure, be given an opportunity to do a "trial run," and then revise their procedure. ➢ Developing Scientific Explanation Tool (DSET): Use this organizer to assess students' ability to develop a scientific conclusion.	
FINAL PERFORMANCE TASK: ➢ Lab Report: Students write a clear coherent report that includes all steps of the scientific method and includes works cited in their hypothesis, conclusion, and discussion.	

LEARNING PLAN & ACTIVITIES:

- The focus of this task is for students to design an investigation that demonstrates Newton's laws of motion. Pitsco straw rocket are used as an example, but can be substituted by balloon/straw rockets, models cars, etc.

- Prior to starting this task, be sure students have a good understanding of Newton's laws through reading and activities. (Glencoe Grade 8 Science Chapter 16)

- Formative Assessments: Students should be given feedback once each task is completed so they can make revisions. Posting their work, revisions, and progress on classroom bulletin boards with constructive comments is one way you might consider guiding students.

- Focus on writing strong scientific hypotheses; conclusions and discussions should be stressed. These portions of the report are where students should cite research about scientific principles that help explain their hypothesis and results as well real-world application.

- The five tasks that are outlined give specific lesson plans to accomplish each formative assessment.

Additional Support Strategies: Since this topic is content-heavy with lots of new vocabulary, additional support and assistance should be provided for English Language Learners and students with disabilities through the use of ESL and Special Education methodologies, such as explicit vocabulary instruction and reinforcement of high-frequency academic words and content-specific terminology. Students should be provided with examples of the target words within the context of the lesson; they should review the connection with cognates; and also have access to bilingual glossaries for native-language support. Teachers should model the correct use of words and provide lists with sentence starters to use during discussion of the unit material. The use of visuals (video, photos, and diagrams) can also help students to understand the content.

In this bundle the following are addressed:

Students are encouraged to actively engage in hands-on activities to promote scientific thinking and writing.

Students create their own investigation based on ability and interest.

Technology is infused throughout, with the use of videos, internet, and publishing programs to engage all learning styles.

Graphic organizers, checklists, and other techniques are used to help students keep clear records and stay on task.

Students are encouraged to verbalize their thinking with multiple opportunities for shared discussion.

Students are given ample opportunities to practice new skills.

RESOURCES:

- *New York Science Grade 8*. Chapter 16. New York, NY: Glencoe/McGraw-Hill, 2008.

- Various video clips regarding Newton's laws can be found at http://vital.thirteen.org

- This task suggests using Pitsco straw rockets, but could be adapted for most objects that can move, for example, toy cars, balloon rockets, or paper planes. http://www.pitsco.com/store/default.aspx?CategoryID=85&searchtype=0&c=2-1|17-2|85-3&t=&l=&loc=mm1

- Pitsco Straw Rockets Video: http://www.pitsco.com/store/detail.aspx?CategoryID=85&pt=13&ID=6372&c=2-1|17-2|85-3&t=13-4&l=

- Pitsco Straw Rockets Teacher's Guide: http://www.pitsco.com/store/detail.aspx?KeyWords=straw%20rocket%20teacher%20guide&ID=4005&c=&t=&l=

For tools and strategies that help guide the investigation process (for example, the four-question strategy):

- Cothron, Julia H., Ronald N. Giese, and Richard J. Rezba. *Students and Research: Practical Strategies for Science Classrooms and Competitions*. Dubuque, IA: Kendall/Hunt Pub. 2000. Print.

- Graphic organizers such as the IDD and DSET as well as many other resources can be found at http://www.urbanadvantagenyc.org/ under Teachers/Investigation Design and Developing a Scientific Explanation.

Texts:

- Article: "What is a Rocket?" http://www.nasa.gov/audience/foreducators/rocketry/home/what-is-a-rocket-k4.html (Lexile 980)

- Article: "Special Delivery" http://www.timeforkids.com/news/special-delivery/40616 (Lexile 970)

- Article: "How Rocket Engines Work" http://www.howstuffworks.com/rocket.htm (Lexile 1090)

- Article: "NASA Launches New 'Black Hole Hunter'" http://news.nationalgeographic.com/news/2012/06/120613-nasa-nustar-launches-x-rays-black-holes-supernovas-space-science/ (Lexile 1510)

- Article: "Water Rocket Stability"
http://www.seeds2lrn.com/rocketSoftware.html (Lexile 1600)

- Article: "Mechanics and Motion"
http://www.physics4kids.com/files/motion_intro.html (Lexile 940)

- Article: "What a Drag: The Effect of Friction/Drag on Rocket Performance"
http://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_energy/cub_energy_lesson04.xml (Lexile 1000)

- Article: "What is Drag? Factors That Affect Aerodynamics"
http://www.grc.nasa.gov/WWW/K-12/airplane/drag1.html (Lexile 1140)

- Article: "Beginner's Guide to Propulsion: Balloon Rocket Car"
http://www.grc.nasa.gov/WWW/K-12/BGP/Ashlie/BalloonRocketCar_easy.html
(Lexile 1260)

- Article: "What is Aerodynamics?"
http://www.nasa.gov/audience/forstudents/5-8/features/what-is-aerodynamics-58.html (Lexile 690)

Task 1: Four-Question Strategy

Objective: How can we develop a question that can be investigated using a controlled experiment?

Time Frame: 2 or 3 class periods

NOTE: While this task bundle specifically uses Pitsco straw rockets, it can easily be applied to anything that students can make fly: paper planes, balloon rockets, etc.

Introduction:

Have students read the following article, "What Is a Rocket," and answer the following text-based questions:

http://www.nasa.gov/audience/foreducators/rocketry/home/what-is-a-rocket-k4.html (Lexile 980)

- What are the two definitions of a rocket?
- How are rocket engines different from jet engines? How does this difference help rockets fly in outer space?
- How does Newton's third law help explain how a rocket moves? (Be sure to use your own words!)
- The text uses an example of how rockets work with a person on a skateboard and a bowling ball. Sketch an illustration of what is being explained, using arrows and key words to label and explain your illustration.

Motivation:

Show Pitsco Straw Rocket Video: This five-minute video gives an over view of how a rocket can be designed and things that can be measured.

And/or

Launch a pre-made rocket and demonstrate a few times how it can be launched, using different amounts of force and different angles.

Development: Activity/Hands-on

In this activity, encourage students to follow brainstorming guidelines—no suggestion is a bad suggestion, there should be no critical analysis at this point, be creative, no negative feedback.

For each group, place several materials that could be used for building a rocket: straws, several types of paper, tin foil, foam sheets, clay, etc. Have students examine materials to see how they might be used with a straw to build a rocket.

- Each group should have a copy of the four-question strategy handout (preferably enlarged or written on chart paper).
- Have groups generate a list of materials that could be used for the cone. Remember: no critiques—be creative!

- Have groups share their list and write on the board.
- Continue filling out the graphic organizer in this manner until all four questions have been completed.
- Now, go back and have a class discussion about the limitations of some of the items listed for each, such as using food items (not sanitary, too messy) or measuring the stability of a rocket (how do you quantify "wobble"?).

Post-Assessment:

With materials in front of them and the graphic organizer filled out, have the group members discuss and decide on which independent variable they will use and which dependent variable they will measure, and have them generate their question in the following format:

"How does the (Independent Variable) affect the (Dependent Variable)?"

Ex: How does the size of the fin affect how far the rocket travels?

Hint: Students can choose from Box 3 for independent variables, and Box 4 for dependent variables.

Have them also list the constants—many will be listed in Box 3, so there should be an extensive list.

Differentiation:

For more tactile learners, it might be useful to allow them to experiment with the materials and rocket launcher throughout the task. This will help them eliminate impractical variables and identify constants.

Measuring speed requires collecting two sets of data (time and distance) and more calculations. You might want to consider encouraging advanced students or students with strong math skills to use this as their dependent variable.

Resources:

Four-Question Strategy: Cothron, Julia H., Ronald N. Giese, and Richard J. Rezba. *Students and Research: Practical Strategies for Classrooms and Science Competitions*. Dubuque, IA: Kendall/Hunt Pub., 2006. Print.

Pitsco Straw Rockets

http://shop.pitsco.com/store/detail.aspx?CategoryID=17&by=9&ID=4005&c=1&t=&l=

http://shop.pitsco.com/store/detail.aspx?CategoryID=17&by=9&c=1&bhcp=1&ID=2547

Projects Involving Flight

http://www.sciencebuddies.org/science-fair-projects/Intro-Aerodynamics.shtml

http://www.sciencekids.co.nz/lessonplans/flight.html

http://www.easy-science-fair-projects.net/science-fair-projects.html

Name_____

Four-Question Strategy
Topic: Straw Rockets

1. What materials can be used to build a straw rocket? Cone Fins Body	2. How do rockets act? What do they do?
3. What can we change about the materials a rocket is made out of?	4. What can we measure about how a rocket acts?

Task 2: Paraphrasing

Objective: How can I demonstrate understanding of scientific texts using paraphrasing skills?

Time Frame: 2 or 3 class periods

Activity/Hands-on
"Paraphrasing Telephone"
In the same small groups, students will play a game of "Telephone" using a short text. In a line, the first student will read the excerpt, and then tell the next person what the text is about. The last person will write down what has been passed along as the "gist" of the text. Students will share out and compare the accuracy of each explanation and paraphrase.

Sample short text:
At 9:47 a.m. on February 20, 1962, John Herschel Glenn Jr. lifted off from Cape Canaveral, Florida, in *Friendship 7*. He was ready to do something that no American had done before—fly a spacecraft around the Earth. After nearly five hours in space, orbiting the Earth three times, Glenn landed the spacecraft safely in the Atlantic Ocean. He was an instant hero. 2012 marks the fiftieth anniversary of the historic flight.
http://www.timeforkids.com/photos-video/video/historic-space-flight-28511

Questions:

- **What did you observe in this activity?**
- **What happened to the explanation as it was passed along?**
- **How accurate do you think the paraphrase was? How can you improve it? What were the difficulties for the first reader? The middle listeners? The writer?**

Motivation/Pre-Assessment:
In groups, students will do a jigsaw reading of a *National Geographic* or other scientific publication article related to rocketry or aviation. Using sticky notes, students will write down two important facts that they read. In a share-out, students will state the facts from their part of the reading, and explain why they feel this is important. A group reporter will take notes for the large group share-out.

Sample Articles:

http://www.timeforkids.com/news/special-delivery/40616 (Lexile 970)

http://www.howstuffworks.com/rocket.htm (Lexile 1090)

http://news.nationalgeographic.com/news/2012/06/120613-nasa-nustar-launches-x-rays-black-holes-supernovas-space-science/ (Lexile 1510)

Large Group Discussion Questions:

- Why were the facts that you found important? How did you know?
- What words were difficult for you?
- What does ***paraphrasing*** mean?

Development/Model:
Using the SMART board, the teacher will review the definition of *paraphrasing*, highlight key points to remember, and point out common pitfalls when trying to paraphrase in writing.

Definition:
par·a·phrase
n. **1.** A restatement of a text or passage in another form or other words, often to clarify meaning.
2. The restatement of texts in other words as a studying or teaching device.
v. **par·a·phrased**, **par·a·phras·ing**, **par·a·phras·es**
v.tr. To restate in a paraphrase
v.intr. To compose a paraphrase

Key Points:

1. The purpose of paraphrasing is

- *to present a writer's ideas, keeping as close as possible to their original meaning*
- *to repeat much of the original material, but without quoting directly*
- *to re-present a relatively short piece of written work*
- *to be sure to avoid plagiarism*

2. In essence, paraphrasing in writing involves

- *putting another writer's text into our own words*
- *adhering as closely as possible to the original*
- *keeping the same meaning*
- *making use of different words or phrases to capture the same idea*
- *re-phrasing a shorter text, and*
- *sometimes producing a longer rather than a shorter version of the original text*

Having identified the purpose and essence of paraphrasing, we now need to consider how paraphrasing is actually done.

The most useful tools for paraphrasing the text of another author are **synonyms**, **changes in voice** or perhaps in **word form**, and the **packing or unpacking of word groups**. These strategies enable us to acknowledge that the intellectual content of a text is someone else's, but the information is in our own words. Let's therefore consider what each of those involves

Plagiarism Pitfalls and Errors:

Paraphrasing

Paraphrase, according to Merriam Webster, is "a restatement of a text, passage, or work giving the meaning in another form." So to paraphrase is to put someone else's words into your own words. In many ways paraphrasing is a good thing and something faculty loves to see. It becomes a problem and act of plagiarism, though, when you paraphrase but fail to cite the original author and do not give credit where the words came from.

Purdue University's Online Writing Lab (OWL) is a great resource on academic writing. They have identified some steps to follow to effectively paraphrase.

6 Steps to Effective Paraphrasing

1. Reread the original passage until you understand its full meaning.
2. Set the original aside, and write your paraphrase on a note card.
3. Jot down a few words below your paraphrase to remind you later how you envision using this material. At the top of the note card, write a key word or phrase to indicate the subject of your paraphrase.
4. Check your rendition with the original to make sure that your version accurately expresses all the essential information in a new form.
5. Use quotation marks to identify any unique term or phraseology you have borrowed exactly from the source.
6. Record the source (including the page) on your note card so that you can credit it easily if you decide to incorporate the material into your paper.

(Purdue University's Online Writing Lab (OWL))

Here is an example of how a student could correctly use a source without plagiarizing.

Poor Practice	Better	Best
"The name 'Auraria'" (Stone, 1918, p. 140) means "'Gold Town'" (p. 140). It "was one of two suggested by Dr. L. J. Russell and appears for the first time in the... constitution" (p. 140). "Auraria was in this way the first town ... [to be] established at the mouth of the Cherry Creek and was the... [center] of the present City of Denver" (p. 140). "Many of the first features of Colorado" (p. 140) such as the first newspaper, church, and school were started in Auraria (p. 140.	According to Stone (1918), "the name 'Auraria,' meaning 'Gold Town,' was one of two suggested by Dr. L. J. Russell" (p. 140). Stone explains that the name Auraria "appears for the first time in the title of the constitution" (p. 140). He later points out that Auraria "was established at the mouth of Cherry Creek and was the nucleus of the present City of Denver" (p. 140). He concludes "many of the first features of Colorado, including the first newspaper, the first Protestant church and the first church school were started." (p. 140). So given these facts, it is obvious that Auraria played a key role in the history of Denver and Colorado.	Although long forgotten as a town, Auraria was ahead of the new town of Denver in many respects. According to Stone (1918), the area's first newspaper, church and school were all in Auraria (p. 140).

While the first example isn't plagiarizing, it's awkward and considered poor academic writing. The second example is much better because everything is appropriately quoted and cited. But nearly every sentence includes a direct quote. There is little evidence of the student's own thinking or writing. The third example is better and clearly the best out of the three because it paraphrases the original source.

http://www.ucdenver.edu/academics/CUOnline/FacultyResources/AcademicHonesty/Documents/student/1Plagiarism/PlagiarismPitfallsParaphrase.htm

Model: Using the article "Special Delivery," read the first paragraph as whole class. Then, sentence by sentence, use paraphrasing strategies to re-write paragraph, and display on SMART board. Do this for as many paragraphs as needed.

Practice: Students will work first in pairs, then independently, paraphrasing the paragraphs set up in the text-paraphrasing worksheet, "What Is Aerodynamics?" (This text may be used in the next task to help support their hypotheses.)

Additional samples:
http://www.education.com/files/330801_330900/330809/paraphrasing-6-worksheet.pdf
http://www.education.com/files/330701_330800/330773/paraphrasing-5-worksheet.pdf
http://www.education.com/files/331901_332000/331909/paraphrasing-9-worksheet.pdf

Differentiation:

Teaching Strategies/Graphic Organizers:

- Own the Word vocabulary worksheets for struggling students and/or ELLs: wvde.state.wv.us/strategybank/documents/OwntheWord.doc

This worksheet/graphic organizer will help students better understand new vocabulary as well as to develop strategies to assist them with future vocabulary acquisition and paraphrasing.

Final Assessment: Hypothesis/Analysis portions of the final lab report for the straw rocket investigation.

Note: In the next task, students incorporate paraphrasing to cite text to help support their hypothesis in the straw rocket experiment.

Resources:
www.thefreedictionary.com/paraphrase
http://writingworkshop.edtec.unsw.edu.au/ownwords.html

http://www.ucdenver.edu/academics/CUOnline/FacultyResources/AcademicHonesty/Documents/student/1Plagiarism/PlagiarismPitfallsParaphrase.htm

wvde.state.wv.us/strategybank/documents/OwntheWord.doc

http://www.timeforkids.com/photos-video/video/historic-space-flight-28511
http://www.education.com/worksheets/writing

Own the Word

My Definition:

Part of Speech:

Synonyms:

Antonyms:

Word:

My Sentence:

A Picture to remind me of this word:

Task 3: Hypothesis

Objective: To develop a hypothesis that uses scientific principles to support the student's prediction.

Time Frame: 4 or 5 class periods

Pre-assessment

Examine these statements. Could they be hypotheses? Could they be predictions? Could they be conclusions?

Examples of hypotheses:

1. Ultraviolet light may cause skin cancer.
2. Temperature may cause leaves to change color.
3. The diameter of a rocket may affect its altitude performance.
4. Angled fins may affect the straightness of a rocket's boost.
5. Fins that have airfoil streamlining may affect the altitude the rocket reaches.
6. The thrust of a rocket may affect the duration of its flight.
7. The number of rocket fins may increase a rocket's stability.

Distinguish between predictive and concluding statements vs. hypothesis statements:

Ultraviolet light causes skin cancer. (Conclusion)
Tree leaves will change color when it gets cold. (Prediction)

There is a particular way in which a hypothesis should be written.
Today we will focus on one of the required elements.

For example: If *skin cancer* is **related** to ultraviolet light , **then** *people with a high exposure to UV light will have a higher frequency of skin cancer*.

If *leaf color change* is **related** to temperature , **then** *exposing plants to low temperatures will result in changes in leaf color.*

Notice that these statements contain the words, **if** and **then**. They are necessary in a hypothesis. Remember: if one thing is related to another, then you should be able to test it.

Development:

A hypothesis contains two variables. One is "independent" and the other is "dependent." The independent variable is the one you, the "scientist," control, and the dependent variable is the one that you observe and/or measure to determine the results. In the statements above, the *dependent variable is italicized* and the independent variable is underlined.

1. Rewrite hypotheses examples #3-7 using the style shown above. Circle the dependent variable and underline the independent variable in the If clause of each hypothesis.[1]

2. In small groups, complete the Hypothesis Worksheet. Each group should be assigned one question to present to the class.

Practice:

Students read two short scenarios of experiments and identify the key components of the scientific method (including correct phrasing of the hypothesis and identification of the independent variable and the dependent variable)

Handout: *Scientific Method in Action* (see *Scientific Method in Action Planner* for additional support)

More Practice (if needed):

1. Give pairs of students the following problem and have them evaluate it as a hypothesis statement.

   Will Brand A plastic wrap keep air away from the bean seed?

   (It's not in the correct format)

2. Have students re-write the problem in the accepted format for a hypothesis.
   Allow a few minutes for their conversations and then ask what difficulties they are having.
   One problem is how will they KNOW if the plastic wrap kept air away from the seed?
   Another concern might be WHY someone might think that plastic wrap would block air.
3. a) Elicit the use of plastic wrap (It helps preserve food) and explain that it blocks air (including oxygen) from combining with the food and causing it to decay.

   b) Explain that bean seeds will not sprout (germinate) if they are not exposed to the air.

4. Allow the students to again attempt to re-write the hypothesis. Emphasize that research is essential for conducting a credible experiment.

5. Have students complete their hypothesis by including a "because" phrase.

6. Write the completed hypothesis and show other examples:

   If bean plants are watered two times a week, then their growth will increase because plants need water for photosynthesis and each plant has a maximum capacity for water.

If acid rain is in the water, then the fish population will increase because a pH between 5.6 and 6.2 supports successful fertilization.

Activity

Put students in small groups and assign one of the hypothesis statements from the Hypothesis worksheet and the appropriate research text **(see websites for texts**):

1. **What effect does rocket fin size have on the stability of the rocket?**

Article: Water Rocket Stability

http://www.seeds2lrn.com/rocketSoftware.html (Lexile 1600)

2. **What effect does the mass of a rocket have on its acceleration?**

Article: Mechanics and Motion

http://www.physics4kids.com/files/motion_intro.html (Lexile 940)

3. **What effect does the surface finish (smooth or rough) of a rocket have on its altitude performance?**

Articles: Rockets: The Effect of Friction/Drag on Rocket Performance and Factors That Affect Aerodynamics

http://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_energy/cub_energy_lesson04.xml (Lexile 1000)

http://www.grc.nasa.gov/WWW/K-12/airplane/drag1.html (Lexile 1140)

***Note this requires two articles; might consider using this for advanced students.**

4. **What effect does the nozzle size have on the distance the rocket travels?**

Article: Beginner's Guide to Propulsion: Balloon Rocket Car

http://www.grc.nasa.gov/WWW/K-12/BGP/Ashlie/BalloonRocketCar_easy.html (Lexile 1260)

5. **What effect does the distance between the rocket's center of mass and its fins have on the direction of the rocket's flight?**

Article: Water Rocket Stability

http://www.seeds2lrn.com/rocketSoftware.html (Lexile 1600)

Formal Assessment: Rocket Experiment

Have students write a formal hypothesis in the form of "If . . . then . . . because . . ." Their hypothesis must include a citation from the text that supports their prediction. Note: require format used by ELA teacher (usually MLA at this grade level)

Individually have students complete the Investigative Design Diagram **IDD graphic organizer. (Handout)**

Differentiation:

Have students write their initial hypothesis on three sentence strips, one labeled "If", second "Then", and third "Because". Have students fill in strips using prompt questions like:

> "If" we change what? What are you changing on purpose in your experiment? (IV)
>
> "Then" what do you think will happen? What are you going to measure about the rocket? (DV)
>
> "Because" why do you think this will happen? What scientific laws, theories, or principles make you think that these changes will take place? Where did you read that information?

For advanced students, use hypothesis #3. Students are required to synthesize information from two sources to formulate a hypothesis.

Resources:

Chapter 16 *New York Science Grade 8*, New York, NY: Glencoe/McGraw-Hill 2008 Print

http://www.seeds2lrn.com/rocketSoftware.html (Hypothesis 1 and 5)

http://www.physics4kids.com/files/motion_intro.html (Hypothesis 2)

http://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_energy/cub_energy_lesson04.xml (Hypothesis 3)

http://www.grc.nasa.gov/WWW/K-12/airplane/drag1.html (Hypothesis 3)

http://www.grc.nasa.gov/WWW/K-12/BGP/Ashlie/BalloonRocketCar_easy.html (Hypothesis 4)

HYPOTHESIS WORKSHEET

Write a hypothesis for each of the following research problems. Identify the independent and dependent variable for each.

1. **What effect does rocket fin size have on the stability of the rocket?**

   _____

   _____

   Independent variable: _____

   Dependent variable: _____

2. **What effect does the mass of a rocket have on its acceleration?**

   _____

   _____

   Independent variable: _____

   Dependent variable: _____

3. **What effect does the surface finish (smooth or rough) have on its altitude performance?**

   _____

   _____

   Independent variable: _____

   Dependent variable: _____

4. **What effect does the nozzle size have on the distance the rocket travels?**

   _____

   _____

   Independent variable: _____

   Dependent variable: _____

5. **What effect does the distance between the rocket's center of mass and its fins have on the direction of the rocket's flight?**

   _____

   _____

   Independent variable: _____

   Dependent variable: _____

Scientific Method in Action

Galileo's Discovery of Acceleration

Galileo was fascinated by objects in motion and conducted many experiments to refine his ideas. He took a board that measured 20 feet by 10 inches and cut a groove, as straight and smooth as possible, down the center. He inclined the plane and rolled brass balls down it, timing their descent with a water clock—a large vessel that emptied through a thin tube into a glass. After each run he would weigh the water that had flowed out—his measurement of elapsed time—and compare it with the distance the ball had traveled.

Aristotle would have predicted that the velocity of a rolling ball was constant: double its time in transit and you would double the distance it traversed. Galileo was able to show that the distance is actually proportional to the square of the time: double it and the ball would go four times as far. The reason is that it is being constantly accelerated by gravity.

1. State the problem.

2. What was the hypothesis?

3. How was the hypothesis tested?

4. Should the hypothesis be supported or rejected based on the experiment?

5. What could be a new hypothesis and how would you test it?

The Effect of Drag on a Car's Gas Mileage

A couple of students wanted to find out if cars actually used more gas when the drag on the car was increased. They occasionally went on family trips with bicycles on the roof of the car. They realized that the additional rack and the bicycles would increase the drag. They decided to test the gas mileage with and without a roof rack and bicycles on the car.

6. Identify the problem.

7. What was the hypothesis?

8. How was the hypothesis tested?

9. How would they know if their hypothesis should be supported or rejected?

10. What could be a new hypothesis and how might you test it?

Name_____

Investigation Design Diagram (IDD)

Question: (hint) **How will** the Independent Variable **affect** the Dependent Variable.

_____

_____

Hypothesis: (hint) **If** (describe how you will change the independent variable) **then** (describe the way you think the dependent variable will change) **because** (explain why you expect this result using prior knowledge and scientific reasoning).

_____

_____

_____

_____

_____

_____

_____

_____

Citation:_____

_____

IV: (Independent Variable/"You Change It Variable") _____

DV: (Dependent Variable/"You Measure It Variable") _____

Constants: (hint) factors in an experiment that are kept the same and not allowed to change or vary.

_____

_____

_____

_____

_____

Task 4: Procedure/Data Table

Objective: How can we create a procedure that demonstrates a step-by-step set of instructions that will elicit reliable data?

Time Frame: 4 class periods

Pre-Assessment/Motivation:
Have pairs of students write directions as to how to make a peanut butter and jelly sandwich that includes all materials and is in the correct sequence.

Ask a group to demonstrate their directions by having one student read the group's instructions exactly as written and have the other follow exactly as written. Have class give constructive criticism as each step is demonstrated. Have groups revise their directions and have another group demonstrate their directions. Continue having groups share their set of instructions until a fully detailed step-by-step of instructions is modeled.

Development: Activity/Hands-on
Note: Refer to "Come Fly with Me" Lab as to basic guidelines for testing paper planes.

As a whole class, discuss the variables and constants that should be considered when investigating the following question: "How does the type of paper affect how far a paper airplane flies?"

Independent Variable: type of paper
Dependent Variable: distance paper airplane travels
Constants: same size plane and construction, force applied to plane, starting point, angle of plane, height the plane flies, etc.

Materials: several different types of paper (construction, computer, cardstock, etc.)

Have groups of two or three students create a step-by-step procedure that would answer the question above. Have them construct at least two different paper planes made of different paper. Be sure that procedure includes specific construction directions to make each airplane as well as how to conduct each trial.

Have groups share their constructions and procedures by having groups conduct a "gallery walk."

As a collective group discuss how many trials would be appropriate for each airplane type. This can lead into a discussion about the greater number of trials gives more accurate results, and how data collection after a trial is crucial. A data table should be constructed prior to carrying out experiment so that data is collected in an organized fashion.

Data Table:
While there are no specific rules in designing a data table, in general the following can be used as a guideline:

- Independent variable is generally recorded in the left column.
- Dependent variable is generally recorded in the columns directly to the right of the independent variable, usually with multiple columns for multiple trials.
- Average is generally calculated to the far right column.
- Title should represent the purpose of the experiment.

Example:

Average Distance Airplane Flies

Paper Type	Trial 1	Trial 2	Trial 3	Trial 4	Average

Differentiation:

Have struggling students choose from a set of blueprints for construction the airplane.

Use a graphic organizer (see Resources).

Give student a checklist to keep them on track (see Resources).

If students are struggling with developing a detailed set of instructions, have them simulate a trial and have one student describe exactly what they are doing while the other records each action. Prompt students with questions like "How high above the floor?" "How will you know how much force is applied?" "How will you keep this constant?"

Post-Assessment
Students will create their procedure and data table for the rocket experiment.

Resources:
Come Fly with Me Lab:
http://sciencespot.net/Media/comefly_1.pdf
Airplane Blueprints:
http://www.10paperairplanes.com/
Graphic Organizer:
http://worksheetplace.com/mf/Procedural-Writing-Graphic-Organizer.pdf
Checklist:
http://worksheetplace.com/mf/Procedural-Writing-Checklist.pdf

Task 5: Conclusion/Analysis

Objective: How can we graph results to formulate a conclusion and analyze what can be concluded from our results?

Time Frame: 3 or 4 class periods

Pre-assessment:

Use page 3 in the following document to assess student's ability to read and analyze graphs:

http://www.hollandchristian.org/science.6th.links.dvos/files/07_drawingconclusions.pdf

Development: Using the paper airplane data from previous task to develop good graphing skills with students

Ask students if they know when to use a bar graph or a line graph. Discuss when each would be appropriate:

Bar Graph: Appropriate when Independent Variable is discrete data. This means when they are categorical, like days of the week, kind of animal, or brand of paper towel.

Line Graph: Appropriate when Independent Variable is continuous. This means they are equal intervals or a scale like height of a plant or number of days.

Generally, then, if Independent Variable is best described using words choose a bar graph; if the description uses numbers then choose a line graph.

Use graph from Pre-Assessment to reinforce this idea, as well as discuss other graphing skills, like labeling x-axis and y-axis. Elicit from students that the X-axis is labeled with the Independent variable and since this is continuous data (time) a line graph is used.

Activity: Use data from Paper Airplane experiment and have students:

Determine whether a line or bar graph is appropriate.

Determine what should be labeled on x-axis and y-axis.

Determine appropriate name for the graph.

Graph results.

Have students write a summary of what the graph shows (trends) under the graph itself.

Use the Developing Scientific Explanation Tool (DSET) to help formulate a conclusion that incorporates both data and the scientific reasoning to support it.

Post-Assessment: Students will graph the data for their rocket experiment as well as complete the DSET organizer to formulate a conclusion.

Differentiation:

Some students may require additional graphing practice. (See Resources)

Use larger-scaled boxed graph paper for students that have visual/writing difficulties. (See Resources)

Use spreadsheet program like Excel for data tables and graphs. (See Resources)

Resources:

Pre-Assessment:

http://www.hollandchristian.org/science.6th.links.dvos/files/07_drawingconclusions.pdf

Graphing Examples

http://staff.tuhsd.k12.az.us/gfoster/standard/bgraph2.htm

http://www.iteachbio.com/skills/Graphing/LineGraphs.pdf

http://www.iteachbio.com/skills/Graphing/BarGraphs.pdf

Graph Paper

http://www.printfreegraphpaper.com/

Graphing Using Excel

http://staff.tuhsd.k12.az.us/gfoster/standard/excelgra.htm

Developing a Scientific Explanation Tool (DSET)

What is your question?

Support for your explanation

Claim based on the evidence (What is the answer to your question based on your evidence?)	**Evidence (Observations/data that answer your question)**	**Scientific Reasoning (Why you think this happened based on background research)**

Scientific Explanation = Claim + Evidence + Science Reasoning

My claim is <u>(fill in with above claim)</u> because <u>(evidence and science reasoning)</u>

Adapted with information from Supporting Grade 5-8 Students in Constructing Explanations in Science: The Claim, Evidence, and Reasoning Framework for Talk and Writing by McNeill and Krajcik (2012) Boston: Pearson Education, Inc.