FOCUS ON 2014 GED® CONTENT: THE WONDERFUL WORLD OF SCIENCE

Bonnie Goonen
bv73008@aol.com
Susan Pittman
skptvs@aol.com

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Overview of Science Themes and Example Content

		Science Example Content Topics		
		Life Science (40%)	**Physical Science (40%)**	**Earth & Space Science (20%)**
Focusing Themes	***Human Health and Living Systems***	• Human body and health • Organization of life • Molecular basis for heredity • Evolution	• Chemical properties and reactions related to human systems	• Interactions between Earth's systems and living things
	Energy and Related Systems	• Relationships between life functions and energy intake • Energy flows in ecologic networks (ecosystems)	• Conservation, transformation, and flow of energy • Work, motion, and forces	• Earth and its system components • Structure and organization of the cosmos

Activity 1 – What Reading Strategies Do You Use When Reading Science Texts?

Activity 2 – Time Reading

Second Hand Smoke

Most everyone knows that smoking is harmful, but the effects of secondhand smoke are not as clearly understood. Secondhand smoke, which is also called environmental tobacco smoke, is the combination of smoke that is exhaled by a smoker and the smoke that comes from the burning end of a tobacco product. Most secondhand smoke comes from cigarettes, but some also comes from pipes and cigars. With secondhand smoke, people are exposed to smoke without choosing to smoke themselves.

Many times when people are exposed to secondhand smoke it is against their will. Children are especially at risk for being exposed to it against their wishes. People can breathe secondhand smoke in their homes, cars, at work, and at places such as bars and restaurants. Recently many new laws have **banned** smoking in public places. This has helped reduce the effects of secondhand smoke.

Secondhand smoke has many harmful effects. There are over 250 harmful chemicals found in secondhand smoke; 50 of these are cancer causing chemicals. According to the U.S. Surgeon General and the U.S. Environmental Protection Agency, secondhand smoke causes lung cancer in nonsmoking adults. It is also linked to many other forms of cancer. It is important to make people aware of this, especially smokers, so that there can be a continued effort to reduce secondhand smoke exposure.

In addition to cancer, secondhand smoke can cause other health problems. The smoke can irritate airways and damage the heart and blood vessels. It increases the risk of heart disease, and there may also be a link between secondhand smoke and strokes.

Children who are exposed to secondhand smoke have additional risks. For these kids, there is an increased risk for Sudden Infant Death Syndrome (SIDS), ear infections, colds, bronchitis, pneumonia, and asthma. Secondhand smoke exposure for kids even

slows the growth of their lungs and causes coughing, wheezing and shortness of breath. Smoking should never occur around children, especially in enclosed areas.

There is no excuse for putting innocent nonsmokers at risk to the harmful effects of smoking. Positive changes to protect against the danger of secondhand smoke have begun. More efforts need to follow in order to stop the terrible effects of smoking.

Source: www.cancer.gov

Reading Skills for Today's Adult. Marshall Adult Education.
http://resources.marshalladulteducation.org/rs/l8/smoke_timed1.htm

Activity 3 – Close Reading

“Untangling the Roots of Cancer” by W. Wayt Gibbs

Recent evidence challenges long-held theories of how cells turn malignant—and suggests new ways to stop tumors before they spread.

What causes cancer?

Tobacco smoke, most people would say. Probably too much -- alcohol, sunshine or grilled meat, infection with cervical papillomaviruses; asbestos. All have strong links to cancer, certainly. But they cannot be root causes. Much of the population is exposed to these carcinogens, yet only a tiny minority suffers dangerous tumors as a consequence.

A cause, by definition, leads invariably to its effect. The immediate cause of cancer must be some combination of insults and accidents that induces normal cells in a healthy human body to turn malignant, growing like weeds and sprouting in unnatural places.

At this level, the cause of cancer is not entirely a mystery. In fact, a decade ago many geneticists were confident that science was homing in on a final answer: cancer is the result of cumulative mutations that alter specific locations in a cell’s DNA and thus change the particular proteins encoded by cancer-related genes at those spots. The mutations affect two kinds of cancer genes.

The first are called tumor suppressors. They normally restrain cells’ ability to divide, and mutations permanently disable the genes. The second variety, known as oncogenes, stimulate growth—in other words, cell division. Mutations lock oncogenes into an active state. Some researchers still take it as axiomatic that such growth-promoting changes to a small number of cancer genes are the initial event and root case of every human cancer.

Gibbs, W. Wayt. “Untangling the Roots of Cancer.” *Scientific American Special Edition.* June 2008.

Text Dependent Questions

Activity 4 – Find the Words

Develop as many vocabulary words in the area of the solar system as possible using the list of letters below.

a, c, e, h, j, i, l, m, n, o, p, r, s, t, u.

Remember, you cannot use other letters, but you can repeat letters within words as often as necessary. If challenged, you should be prepared to state how the word is related to the solar system.

Sample Words: solar, planet, sun

Activity 5 – Science Excerpt, Prompt, and Scoring Guide

Tropical rain forests contain diverse communities of organisms with many interesting relationships. One such relationship connects parasitic fungi and their insect hosts. A type of parasitic fungus, called *Ophiocordyceps unilateralis*, disperses spores onto the forest floor, but cannot successfully grow on the ground. The fungus requires specific conditions and must grow inside of a specific ant species, called the host, to reproduce. The ants, various species of carpenter ant, make nests in the trees.

O. unilateralis feeds on and grows inside the insect host, and within a few days the fungus affects the insect's brain. The insect exhibits unusual behaviors such as wandering away from the colony to where light and humidity favor fungal growth. Just before dying, the insect bites into and firmly attaches itself to a plant. Then, the fungus slowly grows outward from the dead insect's head, producing a pod of spores that eventually bursts open. The spores fall to the ground, restarting the life cycle of the fungus.

Though this relationship may sound gruesome, researchers note that these parasitic fungi may help maintain biodiversity in the tropical rain forest. Some parasitic fungi may be host-specific, meaning that a fungus species only infects a particular type of insect. Scientists have observed that if an insect population begins to grow, more fungal infections occur, and then the insect population levels off again. This relationship may prevent overpopulation of the habitat by any one insect species.

Prompt

Deforestation, or clearing away trees, is occurring in tropical rain forests.

Explain how deforestation could disrupt the life cycle of *Ophiocordyceps unilateralis* in tropical rain forests. Include multiple pieces of evidence from the text to support your answer.

Type your response in the box. This task may require approximately 10 minutes to complete.

Scoring Guide

3-Point Response
Response contains

- A clear and well-developed explanation of how deforestation could disrupt the life cycle of *Ophiocordyceps unilateralis* in tropical rain forests
- Complete support from the passage

2-Point Response
Response contains

- An adequate or partially articulated explanation of how deforestation could disrupt the life cycle of *Ophiocordyceps unilateralis* in tropical rain forests
- Partial support from the passage

1-Point Response
Response contains

- A minimal or implied explanation of how deforestation could disrupt the life cycle of *Ophiocordyceps unilateralis* in tropical rain forests
- Minimal or implied support from the passage

0-Point Response
Response includes

- No explanation of how deforestation could disrupt the life cycle of *Ophiocordyceps unilateralis* in tropical rain forests
- No support from the passage

Sample Anchor Papers for Science Short Answer

Sample Paper 1

Deforestation destroys the environment where thousands of species of animals flourish including Ophiocordyceps. Ophiocordyceps rely heavily on the environment to survive for two major reasons. First of all, Ophiocordyceps often find hosts in Carpenter Ants which build their nests high up in the trees of rainforests. When deforestation occurs, Carpenter Ants lose their nests and homes which would likely result in the diminishment of their species. This would disrupt the Ophiocordyceps species significantly as Ophiocordyceps cannot survive without a host – without the Carpenter Ants, there would be no Ophiocordyceps. The other reason that Ophiocordyceps would suffer is because with the trees, there would be nothing for them to climb to reach greater amounts of light and less humidity. While a lack of trees would lead to more light reaching the ground, the issue of humidity affecting the Ophiocordyceps would still exist. With tall trees, the Ophiocordyceps are able to reach heights with less humidity ultimately slowing the growth of fungus. In conclusion, deforestation would have a very significant impact on the life cycle of the Ophiocordyceps for without trees there would be no hosts for the Ophiocordyceps to grown and without a way to escape humidity there would be a slowing of growth.

Sample Paper 2

Ophiocordyceps unilateralis feed off of the carpenter ant, which nests in the trees. Deforestation will cause many carpenter ants to die out because of the lack of homes. As a result, O. unilateralis lose many hosts to feed off of, and in turn reproduction is disrupted.

Sample Paper 3

WITHOUT THE TRESS OPHIOCORDYCEPS UNILATERALIS CANNOT GROW BECAUSE THEY EED THE TRESS TO DISPERSE SPORES ONTO THE FOREST FLOOR IN ORDER TO GROW AND REPRODUCE

Annotations

Annotation for Sample Paper 1: Score Point 3

This 3-point response explains how deforestation could disrupt the life cycle of Ophiocordyceps unilateralis by stating, “Deforestation destroys the environment where thousands of species of animals flourish including Ophiocordyceps.” This statement makes the connection between the destruction of the environment and its negative effect on the life cycle of Ophiocordyceps unilateralis. The explanation is supported with the following piece of evidence, “Ophiocordyceps often find hosts in Carpenter Ants which build their nests high up in the trees of rainforests.” This piece of evidence links the trees with the living environment of the Ophiocordyceps. The explanation is further supported with a second piece of evidence, “The other reasons that Ophiocordyceps would suffer is because without the trees, there would be nothing for them to climb to reach greater amounts of light and less humidity. This piece of evidence links the explanation of a loss of environment back to this statement in the passage which describes how the insects need the light and humidity because those conditions favor growth.

Annotation for Sample Paper 2: Score Point 2

This response explains how deforestation could disrupt the life cycle of Ophiocordyceps unilateralis by stating, “Deforestation will cause many carpenter ants to die because of the lack of homes.” This statement describes how the destruction of the habitat or “home” of the Ophiocordyceps unilateralis has a negative effect on the life cycle of Ophiocordyceps. The explanation is supported with the following piece of evidence, “. . . feed of the carpenter ant, which nests in trees.” This evidence, which is taken from the last sentence of the paragraph, provides an indirect reference as to how deforestation will destroy the “home” of the carpenter ant, which will in turn affect the Ophiocordyceps unilateralis. However, this response contains only partial support from the passage and therefore it receives a score of 2.

Annotation for Sample Paper 2: Score Point 1

This response gives an explanation of how deforestation could disrupt the lifecycle of the Ophiocordyceps unilateralis by stating, ‘BECAUSE THEY NEED THE TREES TO DISPERSE SPORES ONTO THE FOREST FLOOR IN ORDER TO GROW AND REPRODUCE.” The response explains how the Ophiocordyceps unilateralis requires the trees in order to continue its lifecycle. However, it does not include any supporting textual evidence from the passage; therefore, this response receives a score of 1.

Science Excerpt, Prompt, and Scoring Guide

Prompt

A farmer purchased 30 acres of farmland. The farmer calculated that the average topsoil thickness on the farmland is about 20 centimeters.

The farmer wants to maintain the thickness of the soil on this farmland by reducing erosion. The farmer plans to test the effectiveness of two different farming methods for reducing soil erosion.

Method 1: No-till (planting crops without plowing the soil)

Method 2: Winter cover crop (growing plants during the winter that are plowed into the soil in spring)

The farmer hypothesizes that using either method will reduce erosion compared to using traditional farming methods (plowing and no cover crop).

Design a controlled experiment that the farmer can use to test this hypothesis. Include descriptions of data collection and how the farmer will determine whether his hypothesis is correct.

Type your response in the box. This task may require approximately 10 minutes to complete.

Scoring Guide

3-Point Response
Response contains

- A well-formulated, complete controlled experimental design
- A well-formulated data collection method
- A well-formulated, complete explanation of the criteria for evaluating the hypothesis

2-Point Response
Response contains

- A logical controlled experimental design
- A logical data collection method
- A logical explanation of the criteria for evaluating the hypothesis

1-Point Response
Response contains

- A minimal experimental design
- A minimal or poorly formulated data collection method
- A minimal or poorly formulated explanation of the criteria for evaluating the hypothesis

0-Point Response
Response includes

- An illogical or no experimental design
- An illogical or no data collection method
- An illogical or no explanation of the criteria for evaluating the hypothesis

Sample Anchor Papers for Science Short Answer

Sample Paper 1

The farmer would have to set up 3 experiments. The first would be a years worth of tratitional farming methods (plowing and no cover crop) on a 5 x 5 acres of land. He would have to measure the top soil in every month throughout the year and record it in a data table. For the second experiment the farmer would have to farm a plot of land 5 x 5 acres of land with winter cover crop and measure the soil every month and record it in a lab table. At the end of the year the farmer would have to compare the 2 mehos against the traditional methid and determine if he is correct.

Sample Paper 2

The farmer could separate the land into two sections (15 acres each), and use mone method on each section over a two season period. Over the two season period he would record how much soil was left after using each method, comparing the results to each other and the traditional farming method.

Sample Paper 3

To test his hypothesis the farmer should divide his land into three equal parts one for the first method, one for the second method and one for the controle group. In the first part he divided he should test method one and keep a record of the process and the results. In the second part he divided he should test the second method and keep a record of the process and the results. In the third p5rt that he divided he should have the controle group where he would use the traditional method keep a record of tre process and the results, then compare the records he has collected identify the different results, make an annalasys and decide which method is the best way to prevent soil erosion.

Annotations

Annotation for Sample Paper 1: Score Point 3

The response earns all three points because it includes a complete description of the experiment and includes the controlled variable, “The farmer would have to set up 3 experiments. The first would be a years worth of tratitional farming methods (plowing and no cover crop) on a 5 x 5 acres of land.” The response also dexcribes data collection methods for the control group and experimental group by stating that the farmer “…He would have to meaure the top soil every month for a year and record it in a data table.” Finally, the response provides an explanation of how the farmer will determine if his hypothesis is correct, “At the end of the year the farmer would have to compare the 2 methos against the traditional methid and determine if he is correct.”

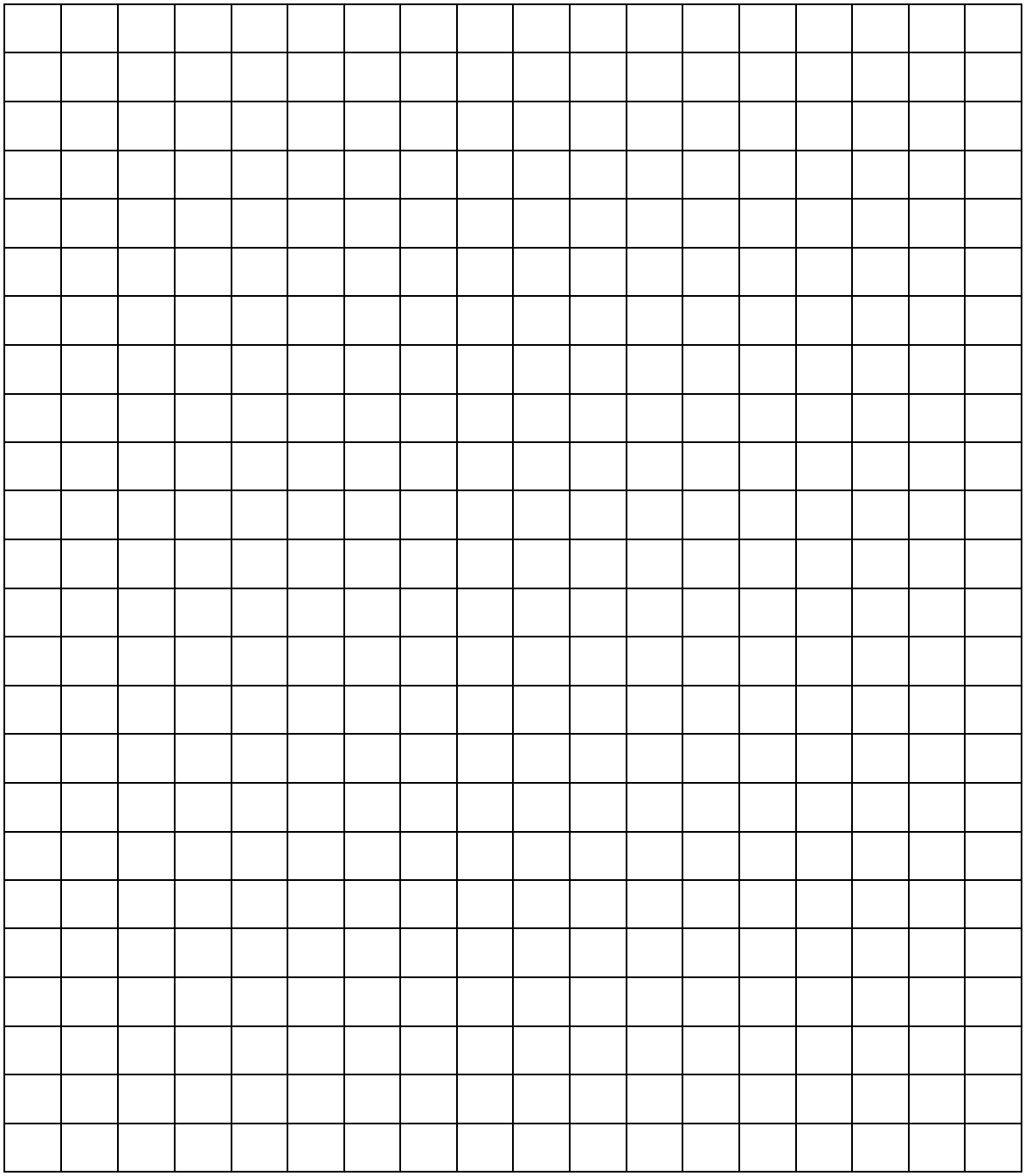
Annotation for Sample Paper 2: Score Point 2

The response includes a logical description of the experiment, “The farmer could separate the land into two sections (15 acres each) and use one method on each section…” While the response does not include the controlled variable in this initial description of the experiment, in the last sentence of the response the writer states, “comparing the results to each other and the traditional method.” This statement demonstrates that the writer understands the connection and importance of having the controlled variable as part of the experiment and data collection methods. The response also describes a logical data collection method by stating, “over the two season period he would record how much soil was left after using each method…” However, this response only provides an implied, logical explanation of the criteria for evaluating if the hypothesis is correct by stating, “comparing the results to each other and the traditional method.” While it is clear that the response is attempting to connect the results of the experiement with an evaluation of the hypothesis, this is not a complete statement.

Annotation for Sample Paper 3: Score Point 1

The response includes a description of the experiment, “the farmer should divide his land into three equal parts one for the first method, one for the second method and one for the controle group…” The response also describes a poorly formulated data collection method by stating, “In the first part he divided he should test method one and keep a record of the process and the results. In the second part he divided he should test the second method and keep a record of the process and the results. In the third p5rt that he divided he should have th controle group where he would use the traditional method keep a record of tre process and the results…” While the response is describing the collection of data in all three sections of land, the phrase “keep a record of tre process and the results” is NOT a clear statement describing what data will be collected. The response also describes a minimal explanation of the criteria for evaluating the hypothesis by stating “then compare the records he has collected identify the different results, make an annalasys and decide which method…”.

Activity 6: Checking Your Heart Rate Grid Paper



Activity 7: Scientific Inquiry

Which shape of paper falls fastest: An unfolded sheet of paper, a paper folded in fourths, or a sheet of crumpled paper? Or can you create a different shape with paper that falls even faster?

Make Your Plan:

What is your independent (manipulated variable)?	
What is your dependent (responding) variable	
What is your question?	
What is your hypothesis?	If, then . . .
What are the constants (name at least 3)	

Data:

Identify your dependent and independent variables for each trial.

- Independent variables are the variables that are changed in a given model or equation. One can also think of them as the 'input' which is then modified by the model to change the 'output' or dependent variable.
- Dependent variables are considered to be functions of the independent variables, changing only as the independent variable does.

Dependent Variables _____

Independent Variables _____

	Unfolded paper	Paper in Fourths	Crumpled Paper	Unique Shape
Trial 1				
Trial 2				
Trial 3				
Trial 4				
Average				

Calculations: Show work below:

Average for _____ paper:
_____ + _____ + _____ + _____ = _____÷ 4 =

Average for _____ paper:
_____ + _____ + _____ + _____ = _____÷ 4 =

Average for _____ paper:
_____ + _____ + _____ + _____ = _____÷ 4 =

Average for _____ paper:
_____ + _____ + _____ + _____ = _____÷ 4 =

Find your largest difference:
_____ paper fell in the slowest average time which was _____s.

_____ paper fell in the fastest average time which was _____s.

The difference between these two number (use subtraction) is =_____s

Is this Qualitative or Quantitative Data? Why?

Conclusion:

Based on the data from my experiment, I reject or accept the hypothesis that (Restate your hypothesis WORD FOR WORD)_____
_____
_____.

The evidence to support this is that the average time for an unfolded piece of paper was _____ s, for a sheet folded in fourths was _____s, and a crumpled sheet of paper was _____s. The difference between the _____ piece of paper and _____ piece of paper was _____s. This difference does or does not seem significant to me. Therefore, I conclude that _____ paper

Activity 8: Bubble Gum Trivia Challenge

Test your knowledge of bubble gum!

____ 1. How many sticks of gum does the average American chew in a year?

A. 200 B. 300 C. 400

____ 2. How many tons of gum are chewed every year?

A. 50,000 B. 75,000 C. 100,000

____ 3. If all the five-chunk packs of Bubble Yum ever chewed in the U.S. since it's introduction in 1975 were laid end-to-end, how many times would it circle the earth at the equator?

A. 2 B. 5 C. 7

____ 4. San Luis Obispo, California, is the home of 'Bubble Gum Alley'. What is it?

A. An alley with brick walls covered with ABC (already-been-chewed) gum wads.
B. The place where bubble gum was invented.
C. The home of the largest collection of bubble gum machines.

____ 5. Richard Walker holds the record for the Chomp Title by chewing 135 sticks of gum for the longest time. How long did he chomp?

A. 5 hours B. 6 hours C. 8 hours

____ 6. The Topps company holds the record for having made the largest single piece of bubble gum. How many pieces of normal-sized Bazooka did it equal?

A. 5000 B. 8000 C. 10, 000

____ 7. The 1952 Mickey Mantle rookie card is the most valuable Topps Company card. How much did it sell for at auction?

A. $75,000 B. $120,000 C. $1,000,000

____ 8. What is the Official Gum of Major League Baseball?

A. Bubble Yum B. Bazooka C. Topps/

____ 9. When was the first successful bubble gum invented?

A. 1891 B. 1906 C. 1928

____ 10. Susan Mont"Gum"ery Williams is the Guinness Record Holder Of the Worlds Largest Gum Bubble. How big was it?

A. 19 inches B. 23 Inches C. 27 inches

Activity 8: Bubble Gum Physics

Obtain a piece of bubble gum from your teacher and start chewing to get ready for the experiments!

Part A: Chomper Challenge

For this experiment, you will conduct five trials to determine the number of chomps you can do in 30 seconds. A chomp is defined as a "big chew", or the kind that usually causes you to get caught with gum!

Use a timer to determine the number of chomps you can do in 30 seconds. Record your data in the chart. Repeat the same process for the other trials.

Trial	Chomps	Time	Speed
1			
2			
3			
4			
5			

Speed = # of Chomps ÷ Time
Round speeds to the nearest hundredth.

What is your average speed? Round answers to the hundredth. _____ chomps/second

Based on your average chomping speed, how many chomps could you do in five minutes, one hour, or one day? Show your work!

5 min = _____ chomps 1 hour = _____ chomps 1 day = _____ chomps

Part B: Speedy Chompers

Use a timer to determine the number of chomps you can do in 1 minute. As the time reaches each point, record the number of chomps you have completed. Do not stop the timer as you record your data. You may want to practice a few times before running an "official" trial.

Time	Chomps
20 sec.	
40 sec.	
60 sec.	

Round speeds to the nearest hundredth!

Calculate your chomping speed at each point (20 sec., 40 sec., and 60 sec) using the data from your experiment. Show your work! Round all answers to the nearest hundredth!

Speed at T = 20 sec = _____ chomps ÷ 20 sec = _____ chomps/sec

Speed at T = 40 sec = _____ chomps ÷ 40 sec = _____ chomps/sec

Speed at T = 60 sec = _____ chomps ÷ 60 sec = _____ chomps/sec

Did you maintain a constant rate? Explain.

Think About It!

Write a paragraph to summarize the results of your experiments.
Are your results accurate and reliable? Why or why not?
What other experiments could you do with bubble gum?

Answer Key to Trivia Challenge

1. How many sticks of gum does the average American chew in a year? Answer: B. 300
2. How many tons of gum are chewed every year? Answer: C. 100,000
3. If all the five-chunk packs of Bubble Yum ever chewed in the U.S. since it's introduction in 1975 were laid end-to-end, how many times would it circle the earth at the equator? Answer: C. 7 (and a little more!)
4. San Luis Obispo, California, USA is the home of 'Bubble Gum Alley'. What is it? Answer: A. An alley with brick walls covered with ABC (already-been-chewed) gum wads.
5. Richard Walker holds the record for the Chomp Title by chewing 135 sticks of gum for the longest time. How long did he chomp? Answer: C. 8 hours
The first person to win the 'Chomp Title' was Sue Jordan, who chewed eighty pieces of Doublemint gum for five hours and twelve minutes! Clyde Steward McGehee, of North Carolina, broke that record by chewing 105 sticks of Juicy Fruit for six hours and Richard Walker broke that record by chewing 135 sticks of gum for eight hours.
6. The Topps company holds the record for having made the largest single piece of bubble gum. How many pieces of normal-sized Bazooka did it equal? C. 10,000
Topps presented the gum to baseball player Willie Mays in 1974. Mays then cut it into small chunks and gave it to children in nearby hospitals.
7. The 1952 Mickey Mantle rookie card is the most valuable Topps Company card. How much did it sell for at auction? Answer: B. $120,000
8. What is the Official Gum of Major League Baseball? Answer: A. Bubble Yum
9. When was the first successful bubble gum invented? Answer: C. 1928
The first known bubble gum, "Blibber Blubber," appeared in 1906. It failed to catch on because it was too sticky and too brittle so it didn't hold together when it was chewed. The first successful bubble gum was invented by Walter E. Diemer in the summer of 1928. A 23-year-old accountant who knew nothing about chemistry, Diemer created his invention in a tiny laboratory in Philadelphia. The only food coloring he had on hand was pink. "It was an accident," Mr. Diemer said in an interview with The Lancaster Intelligencer Journal in 1996. "I was doing something else and ended up with something with bubbles."
10. Susan Mont"Gum"ery Williams is the Guinness Record Holder Of the Worlds Largest Gum Bubble. How big was it? Answer: B. 23 Inches

Many of the facts for the questions were found at Bubble Gum Fact page at http://mmwww.northville.k12.mi.us/STUDENTS/2005/dugganla/Hpage4.htm. Scientific Inquiry Lab

Activity 9: Distances in the Solar System

Take one sheet of toilet paper as a test sheet for the pens. Make sure the ink is not too wet, that the pens don't easily tear the paper. Make a dot on the seam between the first two sheets of toilet paper. This is the Sun. Write the word Sun beside the dot.

Use the table of numbers to mark off the distances to each of the planets. The number in the table is the number of sheets of toilet paper needed to reach the orbit of each planet. It is important to realize that the counts in the table are starting from the Sun, not from the previous planet. (Thus, after you get to Mercury, you need 1.7 more sheets to get to Venus.) Make a dot and write the appropriate planet name on the toilet paper at the distance indicated. Ceres, the largest asteroid, is used to represent the asteroid belt.

Note:

- Keep a running count as you work on this. Each distance is from your starting point, the Sun
- 200 sheets of toilet paper stretch out to nearly 84 feet. Make sure you have room for your model before you start.
- Use colored pens to mark the distance to the planet's orbit from the Sun and label the orbit with the planet's name on the toilet paper.

Planet	Distance from the Sun (km)	Squares of Toilet Paper from the Sun
Mercury	57,910,000 km	2.0
Venus	108,200,000 km	3.7
Earth	149,600,000 km	5.1
Mars	227,940,000 km	7.7
Ceres	414,436,363 km	14.0
Jupiter	778,330,000 km	26.4
Saturn	1,429,400,000 km	48.4
Uranus	2,870,990,000 km	97.3
Neptune	4,504,000,000 km	152.5
Pluto	5,913,520,000 km	200

Resources

Introduction to Science and the Scientific Method

I. What is Science?

A. The goal of science is to investigate and understand the natural world, to explain events in the natural world, and to use those explanations to make useful predictions.

B. Science:

1. Science deals only with the natural world.
2. Scientists collect and organize information in a careful, orderly way, looking for patterns and connections between events.
3. Scientists propose explanations that can be tested by examining evidence.
4. Science is an organized way of using evidence to learn about the natural world.

C. How is science done?

1. Science begins with an observation. This is the process of gathering information about events or processes in a careful, orderly way. Data is the information gathered from making observations.
2. There are two types of data:
   a) Quantitative data are numbers and are obtained by counting or measuring.
   b) Qualitative data are descriptions and involve characteristics that cannot be counted.

3. Hypothesis

   a) A hypothesis is a scientific explanation for a set of observations.
   b) A hypothesis must be stated in a way that makes it “testable”. The hypothesis is just a possible answer to a question, and it must be thoroughly tested.

II. Scientific Methods

A. The scientific method is a series of steps used by scientists to solve a problem or answer a question.
B. The Steps to the Scientific Method

Step 1: Observation / Asking a Question

1. A problem or a question must first be identified.
2. Examples: How much water can a root hair absorb? Why does a plant stem bend toward the light? What effect does temperature have on heart rate?

Step 2: Form a Hypothesis

1. Hypothesis: A possible explanation to the question or problem. It is simply a prediction and has not yet been proven or disproven.
2. It must be stated in a way that is testable. A statement is considered "testable" if evidence can be collected that either does or does not support it.

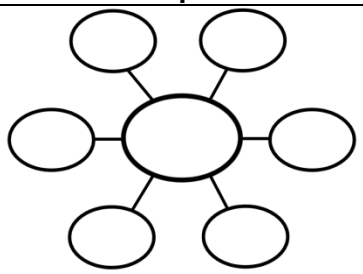
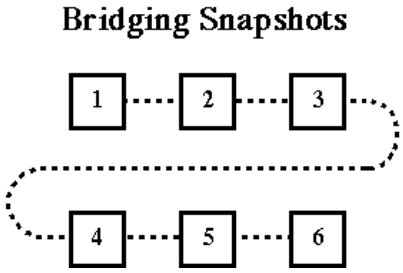
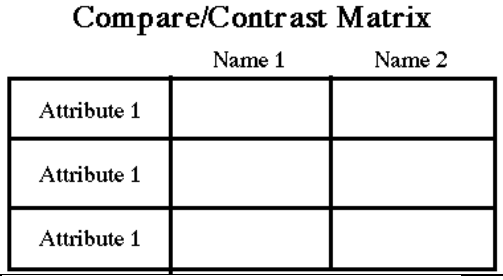
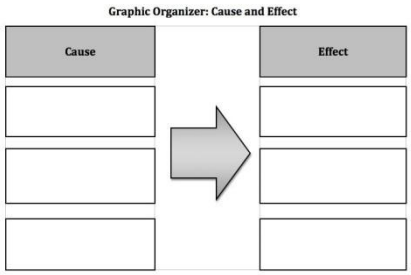
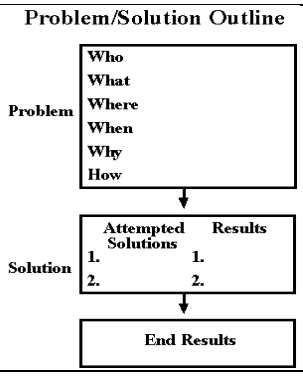
Step 3: Designing a Controlled Experiment

1. The factors in an experiment that can be changed are called variables. Some example of variables would be: changing the temperature, the amount of light present, time, concentration of solutions used.
2. A controlled experiment works with one variable at a time. If several variables were changed at the same time, the scientist would not know which variable was responsible for the observed results.
3. In a "controlled experiment" only one variable is changed at a time. All other variables should be unchanged or "controlled".

Inquiry Method Recording Sheet

Step 1 – Observations, Questions, and Hypotheses	
Observations	Questions
Hypothesis	
Step 2 – Scientific Testing	
Investigation & Data	
Step 3 – Analysis and Conclusion	
Discuss data & draw conclusion	
Step 4 - Communication	
We communicated our results by	

Nonfiction Text Structures

Text Structure	Definition	Signal Words	Graphic
Description	Provides main ideas and supports them with descriptive details.	for example, in describing, properties of, for instance, characteristics include, specifically, in addition, in particular	
Sequence and Order	Gives information in a specific order.	before, in the beginning, to start, first, next, during, after, then, finally, last, in the middle, in the end	
Compare and Contrast	Presents ideas and examines how they are alike/different	similar, alike, same, just like, both, different, unlike, in contrast, on the other hand, whereas, although	
Cause and Effect	Provides reasons for why or how something happens.	because, so, so that, if… then, consequently, thus, since, for, for this reason, as a result of, therefore, due to, this is how, leads to, nevertheless, and accordingly.	
Problem and Solution	Identifies a problem and offers solutions	problem, dilemma, solution, issue, cause, since, consequently, therefore, as a result, because of, leads to, due to, solve, so, then	

Steps for Drafting a Constructed Response

Although the steps for drafting a constructed response may look simple, the process requires numerous skills (and strategies) to produce effective writing. Often, instructors use a graphic organizer to assist students in drafting the information necessary to complete their answer.

1. **Read** the passage and question
2. **Unpack** the prompt (identify key words)
3. **Rewrite** the question and turn the question into a thesis statement
4. **Collect** relevant details from passage
5. **Organize** details into a logical order. Use a graphic organizer if that helps.
6. **Draft** an answer
7. **Re-read** and **edit/revise** the answer making sure all parts of the question are answered

Adapted from WritingFix - http://writingfix.com

Unpack the Prompt

Do	What

Do	What

Sample Thesis Frames

A thesis is an answer to a specific question. A thesis statement makes a claim or proposition that reflects a specific point of view. The thesis statement should recognize both sides of a question, yet focus on two to three specific points (discussion points) sometimes called points of analyses. A thesis statement is the roadmap for the written response. The placement of the thesis statement is generally located in the introduction and summarized in the conclusion of a writing sample.

Start with sample thesis frames.

The general argument made by _____ in his/her work _____ is that _____.

Although _____ (believes, demonstrates, argues) that _____, _____ supports/provides the clearest evidence _____.

A key factor in both _____ can be attributed to _____.

When comparing the two positions in this article, _____ provides the clearest evidence that _____.

Looking at the arguments regarding _____, it is clear that _____.

In discussion of _____, one controversial issue has been _____. _____ believes that _____. On the other hand, _____ asserts that _____. _____ is clearly the best supported argument on the issue of _____.

Explaining the Evidence

Teach students how to identify evidence through direct quotes, paraphrase the information, and explain how the evidence supports the claim/thesis.

Claim	**Using a Direct Quote** (What direct quote supports the claim?)	**Paraphrasing** (How can you rewrite the direct quote in your own words?)	**Explanation** (How does the evidence support the claim?)

Ideas to Teach Vocabulary

KWLH

Another technique is KWLH. The first column is completed prior to the lesson being taught. A student is asked to list what he/she knows about a topic. Next, the student writes in what he/she would like to know about the topic from the lesson, and finally, after the lesson is completed, the student writes down what he/she has learned.

K What I **Know** for Sure About This Topic	**W** **What** I Think I Know, But Am Not Sure About This Topic	**L** What I would Like to **Learn** About This Topic	**H** **How** I Can Form Connections Between This Topic and Other Things I Know

Find the Words

Provide students with specific letters of the alphabet. Tell them that their task is to create as many words as possible with the letters provided in the area in which they are studying. If challenged, students should be prepared to state how the word is related to the selected topic.

Science Vocabulary Example

Provide a group of students with the letters: a, c, e, h, j, i, l, m, n, o, p, r, s, t, u. Have them come up with as many vocabulary words in the area of the solar system as possible from the list of letters provided. Remember, they cannot use other letters, but they can repeat letters within words as often as necessary. If challenged, they should be prepared to state how the word is related to the solar system.

Sample Words: solar, planet, sun, star, Jupiter, Uranus, Saturn, Mars, Pluto, earth, moon.

The Narrative Chain

A narrative chain requires that students link words in a list together into a sentence or paragraph. By using the words and associating them they create a firmer connection between the new words and those already stored in their memory.

Science Narrative Chain Example

Provide students with the words: temperatures, southern, glacier, earth, tropical, rainforest, jungle, ice cap, moderate

A sample narrative chain might be as follows:

Although some of the places on the earth experience moderate temperature changes throughout the year, there are also areas where the temperatures are quite drastic. In some of the southern regions, one might experience a tropical rainforest or jungle-like atmosphere which is very hot and humid. Some parts of the earth are very cold all year long and are composed of glaciers or ice caps.

K. I. M. (Key Idea – Information - Memory Clue)

K. I. M. is a great strategy for new words or concepts. Write the term or key idea (K) in the left column, the information (I) that goes along with it in the center column, and draw a picture of the idea, a memory clue, (M) in the right column.

K (Key Idea)	I (Information)	M (Memory Clue)
drought	Little or no rain over a period of time	

Sample Questions for Guiding Scientific Thinking

Question Type	Sample Question Starters
Recalling	Who, what, when, where, how ____?
Comparing	How is _____ similar to/different from_____?
Identifying Attributes and Components	What are the characteristics/parts of _____?
Classifying	How might we organize _____ into categories?
Ordering	Arrange _____ into sequence according to _____.
Identifying Relationships and Patterns	Develop an outline/diagram/web of _____.
Representing	In what other ways might we show/illustrate _____?
Identifying Main Ideas	What is the key concept/issue in _____? Retell the main idea of _____ in your own words.
Identifying Errors	What is wrong with _____?
Inferring	What might we infer from _____? What conclusions might be drawn from _____?
Predicting	What might happen if _____?
Elaborating	What ideas/details can you add to _____? Give an example of _____. Summarizing Can you summarize _____?
Establishing Criteria	What criteria would you use to judge/evaluate _____?
Verifying	What evidence supports _____? How might we prove/confirm _____?

Using Task Cards

One technique for initiating technology-enhanced lessons is to develop task cards for each activity. A task card is simply a developed activity for a specific website that is to be used with the class.

Task cards can be used:

- As a resource for teaching using technology
- For a classroom activity
- For individualized instruction
- For students who were absent for a lesson
- To differentiate instruction

Although there are many ways to integrate technology, developing task cards can get you started. The following is an example of a simple task card in the area of science.

Task Card – GED® Science: Physics

Topic: Recognize simple machines (i.e., inclined plane, lever, and pulley)

Website URL: http://www.edheads.org/activities/simple-machines/index.htm

Activity: You will need a pencil and paper for this activity. To begin, click on the button that looks like this picture: Move your mouse on the House. Select one of the places to visit. Click on the *Start* button to begin. Identify the Simple Machines by clicking on them. Answer the questions that go along with the items you clicked. Click on the *Continue* button at the bottom until all questions are answered. Now click on another item. Take notes of the different types of machines and objects that you identify.

Follow-Up Activity: Go back to your seat and draw three types of simple machines that you found in the lesson. Make a list of the six different simple machine types. Name three items in your own home that are simple machines. When you are done, place your work into the work basket.

Sample Lessons and a Few Classroom Ideas to Get Started

Understanding the Forces of Flight: An Integrated Lesson

Throughout history, man has longed to fly. We can run, jump, crawl, and even swim, but our bodies are not made to soar with the birds. That did not stop inventors from trying. They created human-sized wings and flapped as hard as they could. Some even jumped from very high places, but human muscles are not strong enough to keep us in the air. Today we still cannot fly as freely as birds, but we can travel in airplanes, helicopters, and hang gliders. It took hundreds of years, and much experimenting before scientists learned that there are four forces that affect flight. Scientists call the study of flight and its forces aerodynamics. Without these forces working together, we would never get off the ground.

Travelers who must go long distances often prefer airplanes, because planes are much faster than cars. However, planes do not move quickly just to keep airline customers happy. A plane must move forward at a very fast rate in order to take off and stay in the air. The high speed of a moving airplane is caused by the first force of flight, thrust. **Thrust** is the force that keeps the plane moving forward. It can be created by a powerful jet engine, airplane propellers, or rocket engine.

Drag is the second force of flight. **Drag** is the force that pushes against the plane and slows it down. It may look like planes are flying through empty space, but that space is full of air. Like everything else on Earth, air has weight. Air creates drag, because the plane has to work to push through it. If the drag created by the air is greater than the thrust, the plane will not be able to fly.

The third force of flight has a name you may know very well-gravity. **Gravity** is the force that holds everything to the Earth. Gravity is what causes people and things to fall down, toward the Earth, instead of floating up and away. Without it, we would have a hard time keeping our feet on the ground! Gravity also affects airplanes. Like any object, airplanes are held on the surface of the planet by gravity. In order to take off, the plane must overcome this force.

Fighting against gravity takes a lot of thrust. It also requires the fourth force of flight. **Lift** is the force that allows a plane to *lift* off the ground and stay in the air. Lift is created when air passes very quickly over and under the wings of the airplane. Airplane wings are perfectly shaped so that air passes over a wing much faster than it passes under. This creates low air pressure above the wing, and high pressure below the wing. The result is lift.

Summing Up

Airplanes are complex machines. Despite their size and thousands of parts, they only need four forces to get lift off and stay in flight. Thrust moves a plane forward. Drag slows it down. Gravity pulls a plane down toward the Earth, and lift raises it up into the sky. To stay in the air, the plane must have enough thrust to fight against the drag. It must also have enough lift to overcome the Earth's gravity. To slow down and land, the plane will need more drag than thrust, and the lift must be weaker than gravity. Thrust, drag, gravity, and lift all work together to get heavy airplanes- and their passengers- safely around the world.

Understanding the Four Forces of Flight Questions

Read the questions below and circle the letter of the correct answer.

1. How does thrust help a plane fly?

a. Thrust lifts the plane up.
b. Thrust gives the plane speed.
c. Thrust slows the plane down so it can land.
d. Thrust lifts air beneath the wings.

2. If drag is greater than thrust, what will happen to the plane?

a. The plane will go faster.
b. The plane will travel slower and higher.
c. The plane will go faster and higher.
d. The plane will go slower and be unable to fly.

3. How do wings help airplanes fly?

a. The shape of airplane wings helps create lift.
b. Wings create thrust, which speeds the plane up.
c. Wings fight drag and keep the plane moving forward.
d. Wings slow the plane down.

4. If lift is greater than gravity, what will happen to the airplane?

a. The plane will fly downward.
b. The plane will fly upward.
c. The plane's flight will not change.
d. The plane will not be able to fly.

5. Where does an airplane get its thrust?

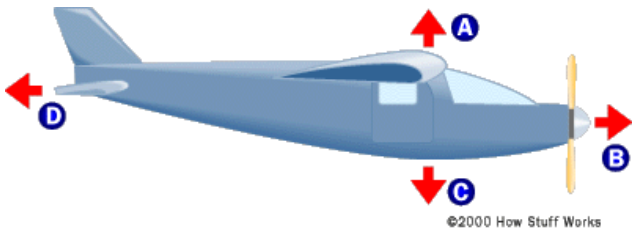
a. wings
b. tail
c. wheels
d. engine or propeller

Draw a line to connect the name of the force to its definition.

Gravity	keeps the plane moving forward
Thrust	pushes against the plane and slows it down
Lift	pulls everything toward the Earth
Drag	raises the airplane and keeps it in the air

Understanding the Four Forces of Flight Questions

Pilots are able to steer a plane by moving flaps on the wings up and down. These flaps are called elevators. For example, if the elevator on the right wing is up, and the elevator on the left wing is down, the right wing will have more drag. The plane will slow down on the right side. The left side of the plane will stay at the same speed, causing the plane to turn to the right. What do you think will happen if the elevators on both wings are in the up position? Use the space below to answer.



How Stuff Works. Retrieved from the World Wide Web at: Howstuffworks.com

Understanding the Four Forces of Flight Answers

Multiple Choice

1. B
2. D
3. A
4. B
5. D

Matching

Gravity	pulls everything toward the Earth
Thrust	keeps the plane moving forward
Lift	raises the airplane and keeps it in the air
Drag	pushes against the plane and slows it down

Short Answer

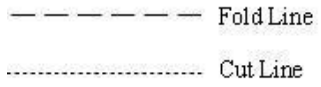
(Answers will vary. Points can be awarded based on reasoning and accuracy.)

If the flaps (or elevators) are bent up, there will be more drag on the top of the wing. If the drag is greater on top, the plane will be “slower” on top than it is on the bottom, the nose will point up and the plane will travel higher. For older students, this can also be explained in terms of air pressure. Elevators in the up position create lower pressure under the wings and greater pressure on top. The higher air pressure on top pushes down on the rear of the wings and causes the nose of the plane to turn upward.

Directions for Paper Airplanes

Folding Technique - Folding technique is **very** important for successful flights. Make each of the folds carefully and accurately according to the instructions. Creases should be made by applying pressure to the fold with the edge of your thumbnail. This is best achieved by holding your thumbnail on the fold, applying pressure, and pulling your thumb along the fold line toward you. This will produce clean, crisp folds that will allow for accurate paper planes. If you make a mistake on a fold that you cannot correct, don't be discouraged! Just print another template.

Line Types – There are two main types of lines referenced by the instructions: fold lines and cut lines. Fold lines are dashed and cut lines are dotted.



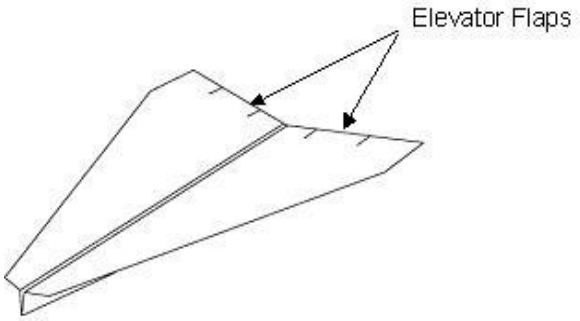
Model Adjustments – No matter what anyone tells you, EVERY paper airplane needs fine-tuning to achieve its best performance. There are several things you should keep in mind while making adjustments to your planes.

Dihedral – Dihedral is a slight upward tilt of the wing tips with respect to the fuselage or body of the airplane. This produces a slight V-shape to the wings when viewed from the front of the plane. Dihedral provides aerodynamic stability to your models by making them want to self-center during flight. Paper airplanes have no intelligent flight controls after they leave your hand, so the plane needs to be naturally stable or else it will crash. All designs on this site perform better when some dihedral is added to the wings.

Front View
With Dihedral, Good

Front View
No Dihedral, Bad

Elevator – Elevator is the aeronautical term for the hinged flap at the tail section of a plane that causes it to either climb (gain altitude) or dive (lose altitude). In paper airplanes these flaps are generally located on the trailing edge of the wings themselves, since there is rarely a separate tail. They are formed by making parallel cuts about 1 inch apart. This produces a small flap that can be folded slightly up or down. Tilting the elevator flaps up will cause the plane to climb. Tilting them down will make the plane want to dive. If you find that your models are heading nose-down toward the ground shortly after launch, you may need to add some up elevator. Likewise, if they are looping-up too quickly or stalling, you may need to add some down elevator. Adding slightly more elevator to one wing than the other will cause the plane to either turn to the right or left.



Fun Paper Airplanes. Retrieved from the World Wide Web at: http://www.funpaperairplanes.com/Plane%20Downloads.html

Sample Videos for the Classroom

How Airplanes Fly. Retrieved from the World Wide Web at: http://www.youtube.com/watch?v=gk6rNFVc1Gs

How Do Airplanes Fly? Retrieved from the World Wide Web at: http://www.youtube.com/watch?v=bv3m57u6ViE

History of Transportation: How Do Airplanes Work? Retrieved from the World Wide Web: http://videos.howstuffworks.com/hsw/18134-history-of-transportation-how-airplanes-work-video.htm

Flight Data Sheet

Build your airplane and complete the following flight data sheet.

Team Name:

Team Members:

Trial	**Distance**
Trial 1	
Trial 2	
Trial 3	
Trial 4	
Trial 5	

Graph your results.

Shortest Trial:

Next:

Next:

Next:

Longest Trial:

Average of the Five Trials:

Design Description:

Notes:

Time Out for Flight Math!

1. If Charles Lindbergh got nine people to sponsor his flight across the Atlantic Ocean and the Spirit of Saint Louis cost $27,000 how much would each person give to C.L.?

2. If an average small commercial jet airplane carries 73 people that all weigh 125 pounds, and has 1,967 pounds of gas, how much weight is the plan carrying?

3. If an airplane's wing span is 200 feet long, and an eagle's wing span is 7 feet, how many eagle's wing spans equal the wing span of an airplane?

4. If I fly 2000 miles in an airplane a day, how many miles will I fly in a year?

5. To fly around the world the trip would take 12000 miles. If you're plane travels at a top speed of 200 MPH how long would it take to fly around the world 5 times?

6. The missile fired 5750 miles down the Pacific to hit an island target. It was traveling at 250 miles a minute. How long did it take to reach its target?

7. There are 17 planes in a hangar on a small field. If 6 planes are missing from each of 2 hangars, and there are 27 hangars, how many planes are there in all?

8. There were 600 planes in an air show. 35 crash and 26 get lost. How many are left?

9. There are 40 kids on the island of Krakatoa and there are 20 husbands and 20 wives and Professor Sherman. There are also three mines of diamonds and in each mine there are 3965 diamonds. If every person on the island is entitled to an equal share of diamonds, how many will each person get?

10. Octave Chanute glided 927 feet, but Olga Klepkova has the record of 465 miles. How much farther did Klepkova go than Chanute? (1 mile = 5,280 feet)

11. Charles A. Lindbergh had 3 tanks in his plane. Each tank was filled with 160 gallons of gas. Amelia Earhart had 2 gas tanks. Each had 200 gallons of gas. How many gallons did everyone have?

Experiments for the Classroom

Earth and Space Science

Oil Spill! Clean It Up

When oil tankers accidentally spill their cargo of oil into the ocean they cause a huge environmental danger. Oil is extremely hard to remove from the water and the beaches, and the whole environment is damaged. In this experiment, you can see how hard it is to remove oil from sand. You will need:

- Large plastic cup
- Sand
- 2 tablespoons of vegetable oil

(This experiment can be messy, so you might want to do it outdoors.)

Step 1 – Observe - Fill a plastic cup with sand and oil and mix well. Observe the problem that you have.

Step 2 – Hypothesize - Based on your observations, make a guess at what tools you could use to get the oil off the sand.

Step 3 – Test the Hypothesis - Conduct an experiment. Use a spoon, a straw, paper towel, an old toothbrush, a sponge – anything that you can think of to get the oil off the sand and help save the environment!

Distances in the Solar System

Even in our own "cosmic neighborhood," distances in space are so vast that they are difficult to imagine. In this activity, we will build a scale model of the solar system using a roll of toilet paper.

Materials

- Planetary distances table
- Roll of toilet paper
- Gel pen or felt tip pen to write on toilet paper

Doing the Activity

Take one sheet of toilet paper as a test sheet for the pens. Make sure the ink is not too wet, that the pens don't easily tear the paper. Make a dot on the seam between the first two sheets of toilet paper. This is the Sun. Write the word Sun beside the dot.

Use the table of numbers to mark off the distances to each of the planets. The number in the table is the number of sheets of toilet paper needed to reach the orbit of each planet. It is important to realize that the counts in the table are starting from the Sun, not from the previous planet. (Thus, after you get to Mercury, you need 1.7 more sheets to get to Venus.) Make a dot and write the appropriate planet name on the toilet paper at the distance indicated. Ceres, the largest asteroid, is used to represent the asteroid belt.

Note:

- Keep a running count as you work on this. Each distance is from your starting point, the Sun
- 200 sheets of toilet paper stretch out to nearly 84 feet. Make sure you have room for your model before you start.
- Use colored pens to mark the distance to the planet's orbit from the Sun and label the orbit with the planet's name on the toilet paper.

Planet	Distance from the Sun (km)	Squares of Toilet Paper from the Sun
Mercury	57,910,000 km	2.0
Venus	108,200,000 km	3.7
Earth	149,600,000 km	5.1
Mars	227,940,000 km	7.7
Ceres	414,436,363 km	14.0
Jupiter	778,330,000 km	26.4
Saturn	1,429,400,000 km	48.4
Uranus	2,870,990,000 km	97.3
Neptune	4,504,000,000 km	152.5
Pluto	5,913,520,000 km	200

Life Science

How Strong Are You?

The following is an experiment that shows how crumpling paper is not always as easy as it seems and how the disuse of muscles affects the human body.

- Get five full sheets of newspaper.
- Hold your arm out straight and hold one piece of newspaper in just one hand. If you're right-handed, use your left hand. If you're left handed, use your right hand.
- Now crumple up the paper into a tiny ball, using just one hand.
- Do it again with the next piece of paper, until you've crumpled up all five pieces of newspaper.
- What do you notice?

Pretzel Predictions

Students are challenged to predict how many pretzels they can eat in a minute.

Materials:

- Pretzels, bow-tie shaped
- Stop watch

Instructions:

Ask several students to stand in front of the class. Ask them to predict how many pretzels they can eat in a minute. Write the predicted number of pretzels after each student's name.
Before starting the "contest," give each contestant and audience member a small (1") piece of pretzel. Ask them to chew it slowly. After the experience, ask the contestants whether or not

they want to change their prediction. Give each student five pretzels. Tell them that you will give them more after the first five are chewed. Start the timer and see if the students met their predictions.

Discussion: Certain chemicals are added to pretzels during the manufacturing process to assure the complete dryness of the interior of the pretzel. Also, only a portion of one pretzel is needed to absorb all of the saliva in one's mouth.

Taking a Pulse

- Take your heart beat for one minute while sitting quietly. Jot down your heart rate.
- Next, walk in place for a minute and then take your heart rate for a minute. Jot this number down.
- Now, speed walk around the room. Stop and take your heart rate. Jot this number down.
- Finally, jog in place or do jumping jacks for a brief period of time. Stop and take your heart rate. Jot this number down.
- Using the four rates, create a graph, chart, or table that best depicts the different heart rates. Share the graphic information with the class and discuss the pros and cons of each type of graphic. Discuss that the heart beats faster after exercise in order to pump more blood (oxygen) to the working muscles.

Physical Science

Friction

Which is easier to spin – a smoother ball or a less smooth ball? For this experiment, you will need:

- A bowl of water
- Smooth rubber ball
- Tennis ball

Step 1 – Observe the two types of balls.

Step 2 – Hypothesize - Based on your observations, make a guess as to which ball will spin the longest and why.

Step 3 – Test the Hypothesis - Try spinning the rubber ball in the water. Next spin the tennis ball in the water. Which one is easier to spin? The smoother ball is easier to spin because the smooth surface causes less friction with the water.

Copper Caper – Teaching Chemical Reactions

- 20 dull, dirty pennies
- ¼ cup white vinegar
- 1 teaspoon salt
- Clear shallow bowl (not metal)
- 2 clean steel nails
- Clean steel screw or bolt
- Paper towels

1. Put the salt and vinegar in the bowl. Stir until the salt dissolves.
2. Dip one penny halfway into the liquid. Hold it there for about 10 seconds, and then pull it out. Ask students what they see.
3. Dump all of the pennies into the liquid. You can watch them change for the first few seconds. After that you won't see anything happen.
4. After 5 minutes, take half of the pennies out of the liquid. Put them on a paper towel to dry.
5. Take the rest of the pennies out of the liquid. Rinse them really well under running water and put them on a paper towel to dry. Write "rinsed" on the second paper towel.
6. Put a nail and a screw into the liquid. Lean another nail against the side of the bowl so that only part of it is in the liquid.
7. After 10 minutes, take a look at the nails. Are they a different color than they were before? Is the leaning nail 2 different colors? If not, leave the nails in the bowl and check on them again in an hour or so.
8. What's happening to the screw? You may see lots and lots of fizzing bubbles coming from the threads. Leave it in the liquid for a while and see what happens.
9. After about an hour, look at the pennies on the paper towels. Ask students what happened to the rinsed ones. What happened to the others? What color is the paper towel under the unrinsed pennies?

Discuss with students that everything is made up of tiny particles called atoms. Some things are made up of one type of atom, such as the copper of a penny is made up of copper atoms. However, sometimes atoms join to make molecules. Copper atoms can combine with oxygen atoms from the air to make a molecule called copper oxide. The pennies looked dull and dirty because they were covered with copper oxide.

Vinegar and salt cleaned the pennies because copper oxide dissolves in acid. The unrinsed pennies turned green because the copper atoms joined oxygen from the air and chlorine from the salt to make a blue-green compound called malachite. The nail and screw got coated with copper because of the action of protons, neutrons, and electrons or to put it another way – the action of positively and negatively charged particles. The bubbles are the result of hydrogen gas – another chemical reaction.

How Large Is an Atom?

Creating life-size models is an excellent strategy for teaching science concepts. To assist students in comprehending the size of atoms, have them complete the following activity.

Materials:

- 1 strip of paper 28 centimeters (11 inches long)
- 1 pair of scissors

Have students take the strip of paper and cut it into equal halves. Have them cut one of the remaining pieces of the paper into equal halves. Have students continue to cut the strip into

equal halves as many times as they can. Make sure that all cuts are parallel to the first one. When the width gets longer than the length, they can cut off the excess, but that does not count as a cut.

How far did they get? Is there anything smaller than an atom? Yes, the size of an atom nucleus would take about 41 cuts. We can not see anything smaller than an atom with our eyes, even with the electron microscope. Yet, scientists use advanced technology to explore the world of electrons and quarks that are 9,000 times smaller than a nucleus.

How Far Did You Get? Here are some comparisons to think about as you are cutting.			
Cut 1	14.0 cm	5.5”	Child’s hand, pockets
Cut 2	7.0 cm	2.75”	Fingers, ears, toes
Cut 3	3.5 cm	1.38”	Watch, mushroom, eye
Cut 4	1.75 cm	.69”	Keyboard keys, rings, insects
Cut 6	.44 cm	.17”	Poppy seeds
Cut 8	1mm	.04”	Thread. Congratulations if you are still in!
Cut 10	.25 mm	.01”	Still cutting? Most have quit by now.
Cut 12	.06 mm	.002”	Microscopic range, human hair
Cut 14	.015 mm	.006”	Width of paper, microchip components
Cut 18	1 micron	.0004”	Water purification openings, bacteria
Cut 19	.5 micron	.000018”	Visible light waves
Cut 24	.015 micron	.0000006”	Electron microscope range, membranes
Cut 31	.0001 micron	.0000000045”	The size of an atom!

Retrieved from the World Wide Web at: http://www.miamisci.org/af/.

Independent and Dependent Variable Examples

Generally speaking, in any given model or equation, variables can be divided into two categories:

- Independent variables are the variables that are changed in a given model or equation. One can also think of them as the 'input' which is then modified by the model to change the 'output' or dependent variable.
- Dependent variables are considered to be functions of the independent variables, changing only as the independent variable does.

Using Independent and Dependent Variables

While the definition is more-or-less universal, the application varies slightly between statistical experiments and mathematics.

For example:

- If a scientist conducts an experiment to test the theory that a vitamin could extend a person's life-expectancy, then the independent variable is the amount of vitamin that is given to the subjects within the experiment. This is controlled by the experimenting scientist.
- The dependent variable, or the variable being affected by the independent variable in this case, is life span.

It varies from person to person within each group, and is what is being tested; that is, whether or not the people given the vitamin live, on average, longer than the people not given the vitamin. The scientist might then conduct further experiments to increase the number of independent variables -- gender, ethnicity, overall health, etc. -- in order to narrow down the specific effects of the vitamin.

Here are some other examples of dependent and independent variables in science:

- A scientist studies the impact of a drug on cancer. The independent variable is the administration of the drug. The dependent variable is the impact the drug has on cancer.
- A scientist studies the impact of withholding affection on rats. The independent variable is the affection. The dependent variable is the reaction of the rats.
- A scientist studies how many days people can eat soup until they get sick. The independent variable is the number of days of consuming soup. The dependent variable is the onset of illness.

Thinking Like a Scientist Handout

Seeking Solutions Scenarios

Read through the observations below and choose one scenario that interests you. Brainstorm explanations for the observations and use the explanations to form several possible hypotheses. Then develop one or more experiments to test your hypotheses.

Scenario 1

You have often noticed that ants follow one another in a trail to food. How do they know to follow each other in the trail? Do they have a form of communication that we can't hear or see? Or do they follow the trail because they see other ants following the trail?

Make several hypotheses that could explain why ants follow one another in a trail to food. Then design an experiment to test one of your hypotheses. What results would you observe if your hypothesis is true? What results would you observe if your hypothesis is false?

Scenario 2

When opening a container of cranberry juice, you noticed the label "refrigerate after opening." You also notice this label on a variety of other food containers, such as mayonnaise bottles and tuna cans. Why does the food have to be refrigerated once the can or bottle is opened, but not before? What would happen if the food were not refrigerated after opening? What does refrigeration do?

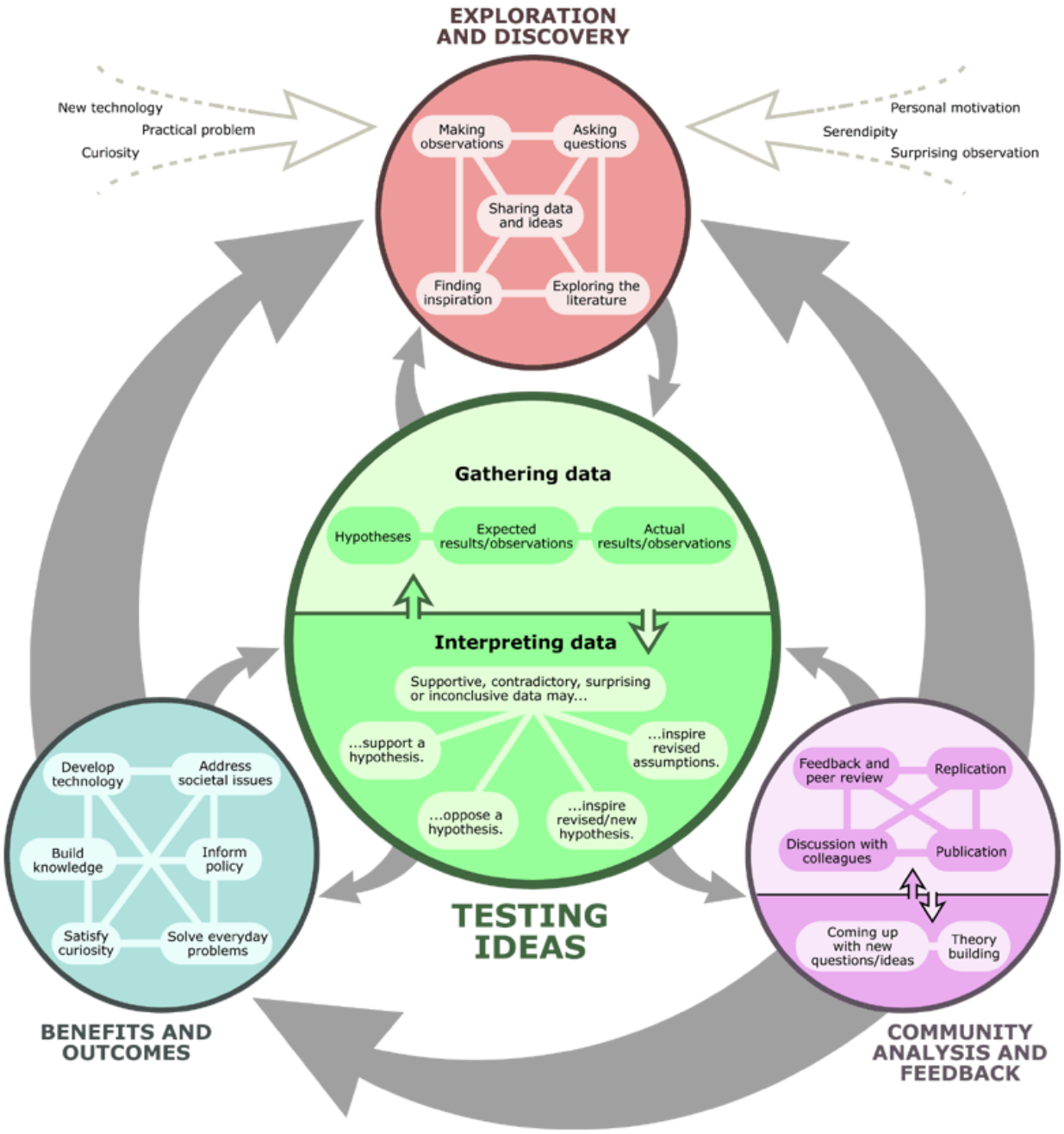
Make several hypotheses that could explain why certain foods can remain unrefrigerated before opening, but not after opening. Then design an experiment to test one of your hypotheses. What results would you observe if your hypothesis is true? What results would you observe if your hypothesis is false?

Scenario 3

You are at the top of Mt. Haleakala, a dormant volcano that rises over 10,000 feet above the island of Maui in Hawaii. You noticed that a person nearby is talking about starting to feel dizzy, while someone else is complaining about a sudden headache. You feel fine. Why are some people feeling sick when others are not? Is it the air around the volcano? Is it the altitude? Or are the problems completely unrelated to the location?

Make several hypotheses that could explain why certain people feel sick at the top of Mt. Haleakala while others do not. Then design an experiment to test one of your hypotheses. What results would you observe if your hypothesis is true? What results would you observe if your hypothesis is false?

http://www.accessexcellence.org/RC/AB/WYW/wkbooks/OBAS/thinkhand2.phpA



How Science Works
http://undsci.berkeley.edu/flowchart_noninteractive.php

A Few Websites in Science to Get You Started!

ABC Science. News, video clips, games, and lots of activities for the science classroom from the American Broadcasting Company. http://www.abc.net.au/science/

Annenberg: The Habitable Planet . The Habitable Planet is a multimedia course for high school teachers and adult learners interested in studying environmental science. The Web site provides access to course content and activities developed by leading scientists and researchers in the field. http://www.learner.org/channel/courses/envsci/index.html

Annenberg Science in Focus: Force and Motion. Explore science concepts in force and motion and come away with a deeper understanding that will help you engage your students in their own explorations. With science and education experts as your guides, learn more about gravity, friction, air resistance, magnetism, and tension through activities, discussions, and demonstrations. http://www.learner.org/channel/workshops/force/

BBC Science. From space to the human body to, this interactive site allows learners to discover many different facets of science. http://www.bbc.co.uk/sn/

Cells Alive. This site can be used by teachers and students. Lots of great interactivity and resources on the basics of cells. http://www.cellsalive.com/toc.htm

Discovery Channel. The website has lots more information than even the channel. Lots of interactivity with excellent videos, interactivity, and high-level games. http://www.discovery.com/

Exploratorium Online. Since 1993, the Exploratorium was one of the first science museums to build a site on the World Wide Web. The site contains over 15,000 articles and displays including interactivity regarding science. http://www.exploratorium.edu/

Franklin Institute. Excellent collection of online resources and activities designed to create curiosity and promote science in everyday life. http://www.fi.edu/explore.html

How Stuff Works. Ever wondered why a cd works? How about the ten myths about the brain? How about what would happen if you put sugar in your gas tank? An interesting science site filled with real-world information. http://www.howstuffworks.com/

Interactive Websites for Teaching Science. Just click on one of the topics and explore the myriad of resources on the World Wide Web. http://interactivesites.weebly.com/science.html

National Science Teachers Association. Don't forget the professional organization for science teachers. This site has lots of ideas, lessons, and scientific updates. http://www.nsta.org/

Newton's Apple. NEWTON'S APPLE is a production of Twin Cities Public Television from a grant from the 3M Foundation. The site is filled with free videos for use in many different areas. http://www.newtonsapple.tv/

Nye Labs.com This is indeed "Bill Nye, the science guy" with lots of activities and applications for science. http://www.billnye.com

PBS: Science & Nature. Highlights and background information on every Science-based PBS program on the air; check out the Science for the Classroom link. http://www.pbs.org/science/

Steve Spangler. This site has lots of free experiments and videos for use in the classroom. http://www.stevespanglerscience.com/lab

The Why Files. University of Wisconsin, Board of Regents. Real world articles to support all areas of science. Click on the "Why Files in Education." http://whyfiles.org/teach/

Understanding Science. The Understanding Science website is a fun, free resource that aims to accurately communicate what science is and how it really works. It provides "an inside look at the general principles, methods, and motivations that underlie all of science." http://undsci.berkeley.edu/

Weather Classroom. The Weather Classroom presents all kinds of online interactive resources for students and teachers; worth investigating. http://www.weatherclassroom.com/index.php

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- GED® Facebook – https://www.facebook.com/GEDTesting
- YouTube channel – http://www.youtube.com/gedtestingservice
- Common Core State Standards – http://corestandards.org
- College and Career Readiness Standards for Adult Education – http://lincs.ed.gov/publications/pdf/CCRStandardsAdultEd.pdf

  https://www.ed.gov/edblogs/ovae/2013/04/22/college-and-career-readiness-ccr-standards-for-adult-education/