emergency sub plans



biology roots

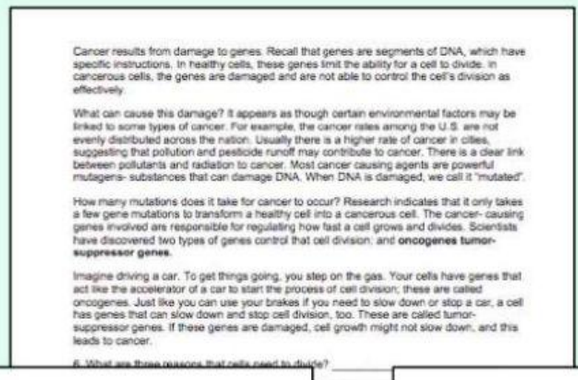
VOLUME I PLANS A-E
SET OF 5 SCIENCE PLANS

- Sub plans are long enough to last the entire class
- Relevant topics that relate to students
- CCSS aligned for literacy in science

PLAN "A": AN INSIDE LOOK AT CANCER

An Inside Look at Cancer

- -Reading and Graphing exercise
- -KWL, History of Cancer, What is Cancer, Graphing: Cancer Types Cases vs. Deaths
- 5 pages including graphing exercise



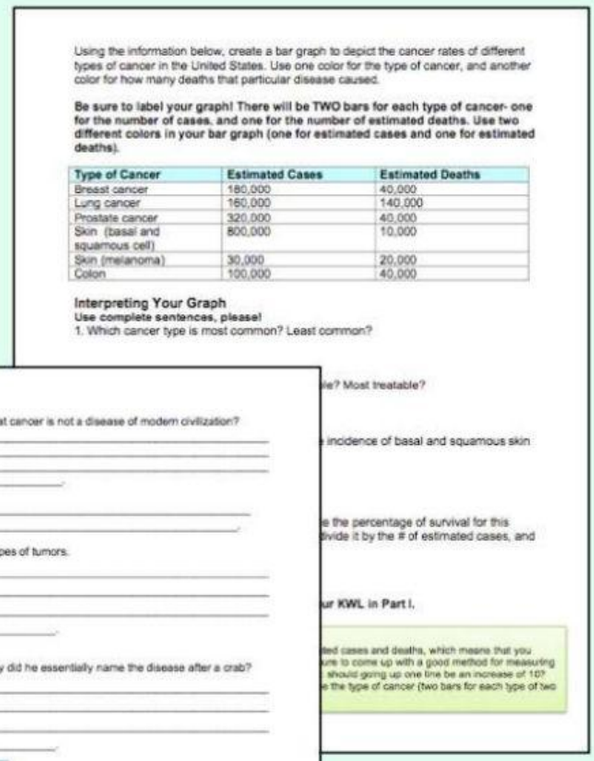
Cancer results from damage to genes. Recall that genes are segments of DNA, which have specific instructions. In healthy cells, these genes limit the ability for a cell to divide. In cancerous cells, the genes are damaged and are not able to control the cell's division as effectively.

What can cause this damage? It appears as though certain environmental factors may be linked to some types of cancer. For example, the cancer rates among the U.S. are not evenly distributed across the nation. Usually there is a higher rate of cancer in cities, suggesting that pollution and pesticide runoff may contribute to cancer. There is a clear link between pollutants and radiation to cancer. Most cancer causing agents are powerful mutagens- substances that can damage DNA. When DNA is damaged, we call it "mutated".

How many mutations does it take for cancer to occur? Research indicates that it only takes a few gene mutations to transform a healthy cell into a cancerous cell. The cancer- causing genes involved are responsible for regulating how fast a cell grows and divides. Scientists have discovered two types of genes control that cell division: and **oncogenes tumor-suppressor genes**.

Imagine driving a car. To get things going, you step on the gas. Your cells have genes that act like the accelerator of a car to start the process of cell division; these are called oncogenes. Just like you can use your brakes if you need to slow down or stop a car, a cell has genes that can slow down and stop cell division, too. These are called tumor-suppressor genes. If these genes are damaged, cell growth might not slow down, and this leads to cancer.

6. What are three reasons that cells need to divide? _____

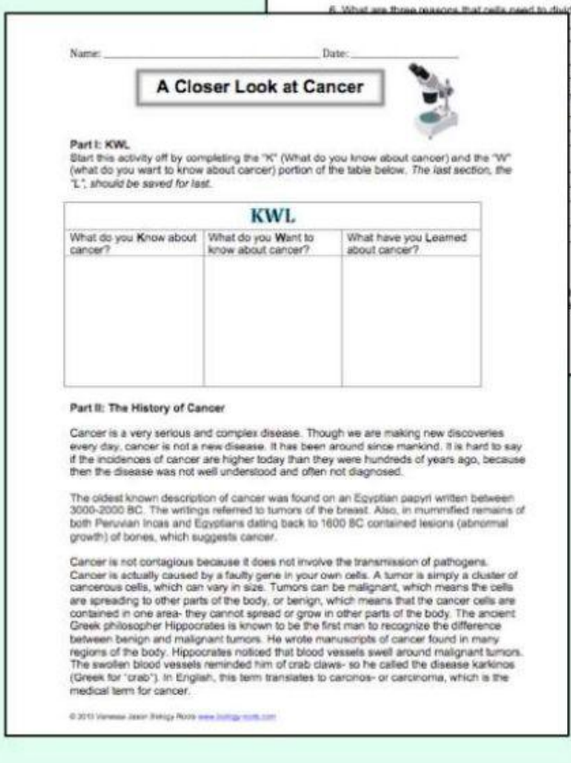


Using the information below, create a bar graph to depict the cancer rates of different types of cancer in the United States. Use one color for the type of cancer, and another color for how many deaths that particular disease caused.

Be sure to label your graph! There will be TWO bars for each type of cancer- one for the number of cases, and one for the number of estimated deaths. Use two different colors in your bar graph (one for estimated cases and one for estimated deaths).

Type of Cancer	Estimated Cases	Estimated Deaths
Breast cancer	180,000	40,000
Lung cancer	160,000	140,000
Prostate cancer	320,000	40,000
Skin (basal and squamous cell)	800,000	10,000
Skin (melanoma)	30,000	20,000
Colon	100,000	40,000

Interpreting Your Graph
Use complete sentences, please!
1. Which cancer type is most common? Least common?



Name: _____ Date: _____

A Closer Look at Cancer

Part I: KWL
Start this activity off by completing the "K" (What do you know about cancer) and the "W" (what do you want to know about cancer) portion of the table below. *The last section, the "L", should be saved for last.*

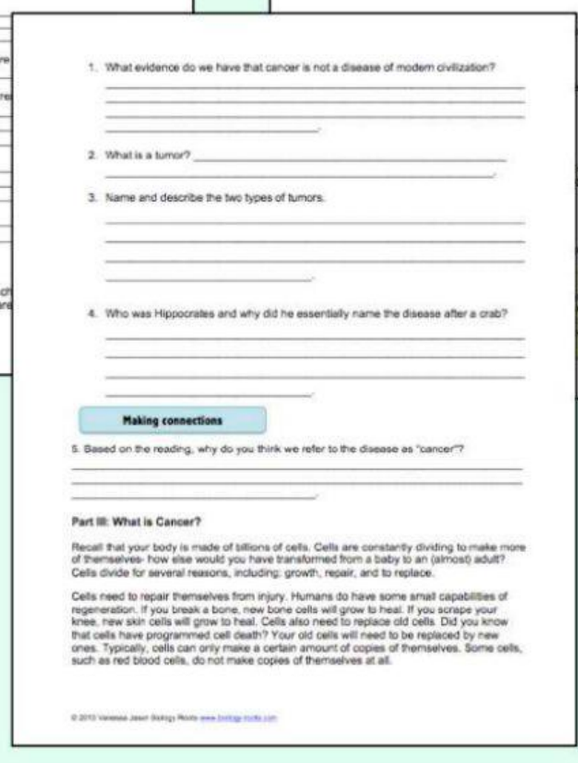
KWL		
What do you **K**now about cancer?	What do you **W**ant to know about cancer?	What have you **L**earned about cancer?

Part II: The History of Cancer

Cancer is a very serious and complex disease. Though we are making new discoveries every day, cancer is not a new disease. It has been around since mankind. It is hard to say if the incidences of cancer are higher today than they were hundreds of years ago, because then the disease was not well understood and often not diagnosed.

The oldest known description of cancer was found on an Egyptian papyri written between 3000-2000 BC. The writings referred to tumors of the breast. Also, in mummified remains of both Peruvian Incas and Egyptians dating back to 1600 BC contained lesions (abnormal growth) of bones, which suggests cancer.

Cancer is not contagious because it does not involve the transmission of pathogens. Cancer is actually caused by a faulty gene in your own cells. A tumor is simply a cluster of cancerous cells, which can vary in size. Tumors can be malignant, which means the cells are spreading to other parts of the body, or benign, which means that the cancer cells are contained in one area- they cannot spread or grow in other parts of the body. The ancient Greek philosopher Hippocrates is known to be the first man to recognize the difference between benign and malignant tumors. He wrote manuscripts of cancer found in many regions of the body. Hippocrates noticed that blood vessels swell around malignant tumors. The swollen blood vessels reminded him of crab claws- so he called the disease karkinos (Greek for "crab"). In English, this term translates to carcinos- or carcinoma, which is the medical term for cancer.



1. What evidence do we have that cancer is not a disease of modern civilization?
_____
_____
_____
_____.

2. What is a tumor? _____
_____.

3. Name and describe the two types of tumors.
_____
_____
_____
_____.

4. Who was Hippocrates and why did he essentially name the disease after a crab?
_____
_____
_____
_____.

Making connections

5. Based on the reading, why do you think we refer to the disease as "cancer"?
_____
_____
_____.

Part III: What is Cancer?

Recall that your body is made of billions of cells. Cells are constantly dividing to make more of themselves- how else would you have transformed from a baby to an (almost) adult? Cells divide for several reasons, including: growth, repair, and to replace.

Cells need to repair themselves from injury. Humans do have some small capabilities of regeneration. If you break a bone, new bone cells will grow to heal. If you scrape your knee, new skin cells will grow to heal. Cells also need to replace old cells. Did you know that cells have programmed cell death? Your old cells will need to be replaced by new ones. Typically, cells can only make a certain amount of copies of themselves. Some cells, such as red blood cells, do not make copies of themselves at all.

Using the information below, create a bar graph to depict the cancer rates of different types of cancer in the United States. Use one color for the type of cancer, and another color for how many deaths that particular disease caused.

Be sure to label your graph! There will be TWO bars for each type of cancer- one for the number of cases, and one for the number of estimated deaths. Use two
or estimated cases and one for estimated

ses	Estimated Deaths
	40,000
	140,000
	40,000
	10,000
	20,000
	40,000

ast common?

atable? Most treatable?

the incidence of basal and squamous skin

ulate the percentage of survival for this
rs, divide it by the # of estimated cases, and

your KWL in Part I.

timated cases and deaths, which means that you
be sure to come up with a good method for measuring
nple: should going up one line be an increase of 10?
ld be the type of cancer (two bars for each type of two

Name: _____ Date: _____

A Closer Look at Cancer



Part I: KWL
Start this activity off by completing the "K" (What do you know about cancer) and the "W" (what do you want to know about cancer) portion of the table below. *The last section, the "L", should be saved for last.*

KWL		
What do you **K**now about cancer?	What do you **W**ant to know about cancer?	What have you **L**earned about cancer?

Part II: The History of Cancer

Cancer is a very serious and complex disease. Though we are making new discoveries every day, cancer is not a new disease. It has been around since mankind. It is hard to say if the incidences of cancer are higher today than they were hundreds of years ago, because then the disease was not well understood and often not diagnosed.

The oldest known description of cancer was found on an Egyptian papyri written between 3000-2000 BC. The writings referred to tumors of the breast. Also, in mummified remains of both Peruvian Incas and Egyptians dating back to 1600 BC contained lesions (abnormal growth) of bones, which suggests cancer.

Cancer is not contagious because it does not involve the transmission of pathogens. Cancer is actually caused by a faulty gene in your own cells. A tumor is simply a cluster of cancerous cells, which can vary in size. Tumors can be malignant, which means the cells are spreading to other parts of the body, or benign, which means that the cancer cells are contained in one area- they cannot spread or grow in other parts of the body. The ancient Greek philosopher Hippocrates is known to be the first man to recognize the difference between benign and malignant tumors. He wrote manuscripts of cancer found in many regions of the body. Hippocrates noticed that blood vessels swell around malignant tumors. The swollen blood vessels reminded him of crab claws- so he called the disease karkinos (Greek for "crab"). In English, this term translates to carcinos- or carcinoma, which is the medical term for cancer.

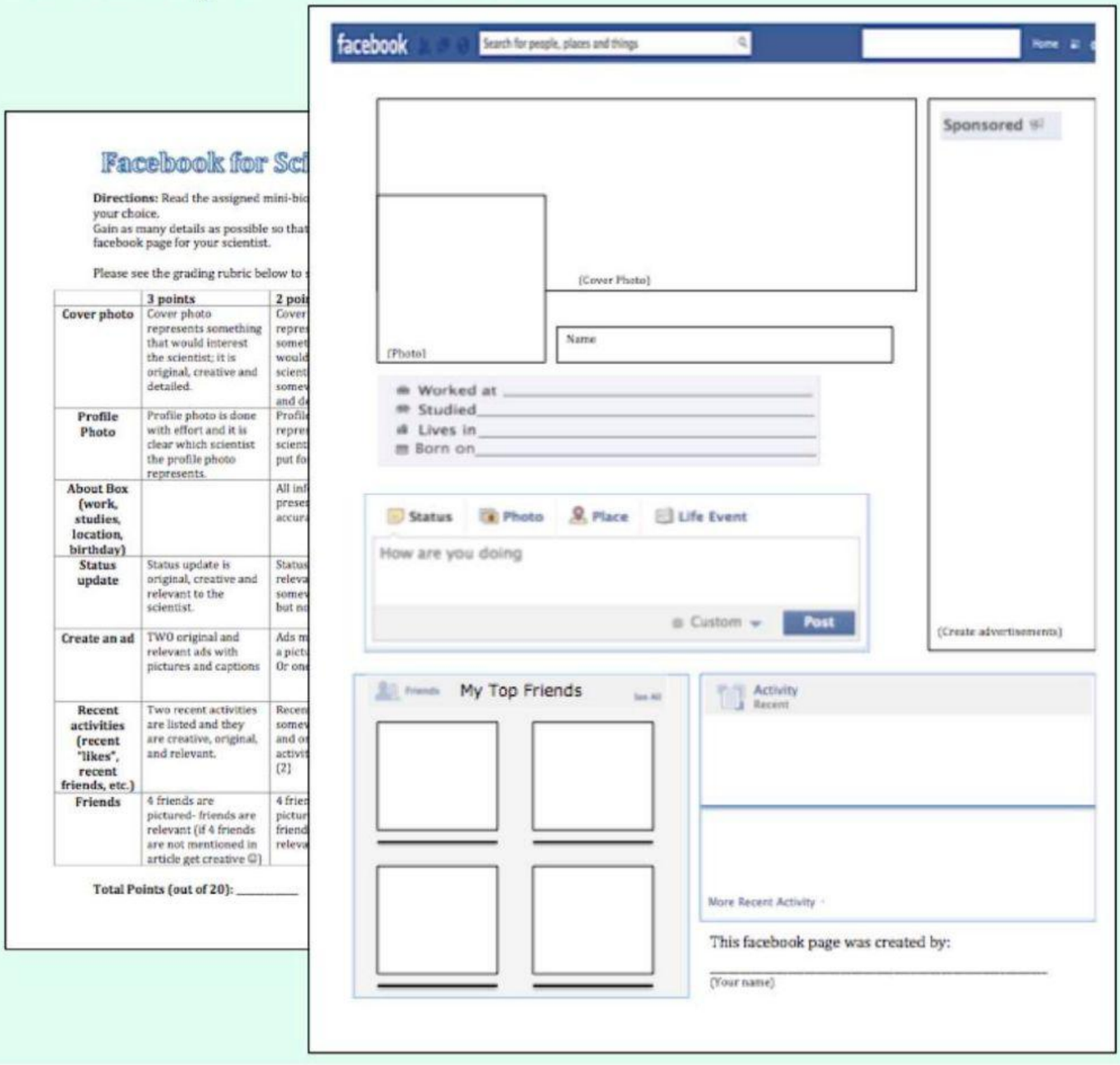
© 2013 Vanessa Jason Biology Roots www.biology-roots.com

Students learn all about cancer (including the history and cause). A bar graph is included with easy-to-follow, clear directions.

PLAN "B": SOCIAL MEDIA FOR SCIENTISTS

Facebook page for scientists

- -Students must make Facebook pages for one (or two) of the following scientists: Gregor Mendel, Charles, Darwin, Isaac Newton, Marie Curie.



Facebook for Sci

Directions: Read the assigned mini-bio
your choice.
Gain as many details as possible so that
facebook page for your scientist.

Please see the grading rubric below to

	3 points	2 poi
Cover photo	Cover photo represents something that would interest the scientist; it is original, creative and detailed.	Cover repre somet would scient somev and d
Profile Photo	Profile photo is done with effort and it is clear which scientist the profile photo represents.	Profil repre scient put fo
About Box (work, studies, location, birthday)		All inf prese accura
Status update	Status update is original, creative and relevant to the scientist.	Status releva somev but no
Create an ad	TWO original and relevant ads with pictures and captions	Ads m a pict Or one
Recent activities (recent "likes", recent friends, etc.)	Two recent activities are listed and they are creative, original, and relevant.	Recen somev and o activi (2)
Friends	4 friends are pictured- friends are relevant (if 4 friends are not mentioned in article get creative ☺)	4 frie pictur friend releva

Total Points (out of 20): _____

facebook Search for people, places and things Home

[Cover Photo]

[Photo]

Name

Worked at _____
Studied _____
Lives in _____
Born on _____

Status Photo Place Life Event

How are you doing

Custom Post

Sponsored

(Create advertisements)

My Top Friends

Activity
Recent

More Recent Activity

This facebook page was created by:

_____
(Your name)

- Students use the biographies to create the scientist's Facebook page (1 per student).
- Rubrics also included.



SIR ISAAC NEWTON was born on January 4th, 1643 in Woolsthorpe, Lincolnshire (England). In 1661, he went to Cambridge University where he studied mathematics, physics and astronomy. In October 1665, the university was forced to shut down due to a plague epidemic. Newton returned to Woolsthorpe for two years. There, he spent his time thinking about gravity. You may be familiar with this the story of Newton sitting under an apple tree, when suddenly, an apple fell on his head and the idea of gravity suddenly came to him! Though the story is just a tale, he did spend many hours thinking and observing. He also devoted time to optics and mathematics, working out his ideas about calculus.

In 1667, Newton returned to Cambridge. Two years later he was appointed professor of mathematics. In 1668, Newton designed a type of telescope that brought him to the attention of the scientific community. Inn1672 he was made a fellow of the Royal Society (the most prestigious scientific community founded in Britain in 1660).

GREGOR MENDEL was born on July 22nd, 1822, in Heizendorf, Austria. Growing up was a hardship; his parents were farmers and did not have a lot of money. Mendel decided to join a monastery in order to find a better life for himself.



Mendel attended the University of Vienna to acquire an education. It was there that Mendel was introduced to a biologist by the name of Frank Unger. Mendel was impressed with Unger because he had a practical view of inheritance, rather than the traditional spiritual view.

Mendel, growing up on a farm, had a background in botany and wanted to experiment with Unger's ideas using plants. He had to ask to do this very carefully, though, because usually monks were not allowed to study or teach biology. It took about two years until Mendel finally began experimenting with variation, heredity and evolution in plants. He chose to study in detail the common garden pea, which he grew in the monastery garden.



MARIE CURIE was born on November 7th, 1867, in Warsaw, Poland. She received a general education from local schools, however, was able to learn science from her father, Wladyshaw Sklodowski, who was a high school teacher.

In 1891, she continued her studies at the Sorbonne University in Paris where she earned degrees in Physics and the Mathematical Sciences. There she met Pierre Curie, Professor in the School of Physics, and in 1895 they were married. Marie became the Head of the Physics Laboratory at the Sorbonne, gained her Doctor of Science degree in 1903. Early in her career she and her husband worked under difficult conditions. The laboratory was arrangements were poor and under stocked. Both herself and her husband had to teach at the Sorbonne to earn income (Marie did private tutoring at night and researched during the day).

In 1896 Henri Becquerel, a French physicist, discovered radioactivity. This discovery inspired the Curies in to further experiment with radioactivity, which led to the isolation of two elements: radium and polonium, (named after Poland, the country of Marie's birth). Marie Curie developed methods for the separation of radium from radioactive residues in large quantities. Madame Curie also studied many of its properties including therapeutic properties, such as cancer treatment. In 1903, Marie and Pierre Curie, as well as Henri Becquerel were awarded the Nobel Prize.

Sadly, her husband Pierre died in a tragic accident, 1906, after which she immediately took his place as Professor of General Physics- making her the first woman to hold the position of Professor at the University. Throughout her life Curie promoted the use of radium to alleviate suffering. Marie and her daughter, Irene (who also won a Nobel Prize) worked together during World War I to help promote radium. Through the effort of Marie and her colleagues, the University of Paris opened the Radium Institute's Curie Laboratory, which Marie Curie became the director of in the year 1914.
Marie retained her enthusiasm for science throughout her life and did much to establish a radioactivity laboratory in her native city of Warsaw. In 1929 President Hoover of the United States presented her with a gift of $ 50,000, donated by American friends of science, to purchase radium for use in the laboratory in Warsaw.

Curium, element 96, is named in honor of Marie Curie. Francium, element 87, is named for France, site of the Curie Institute where it was discovered. Marie died at the age of 66 on July 4th, 1934 in Paris.



CHARLES DARWIN was born in Shrewsbury, England on Feb. 12th, 1809. The son of a doctor, Dr. Robert Darwin, Charles was born into a modestly wealthy family. Charles' mother died in 1817 when he was eight years old. Throughout his childhood, Charles was interested in animals, horse riding and hunting. He had a fondness for biology.

In 1828 Charles went to Cambridge to study theology. There, Charles developed a friendship with a professor of botany, John Henslow, with whom he enjoyed discussing the natural world. In 1831, Charles received his Bachelor of Arts degree from Cambridge.

His Majesty's Ship, the *HMS Beagle* was soon to leave on a two year, around the world voyage. Its mission was to map the coast of South America. The ship's captain, Robert Fitzroy, wanted a naturalist to accompany him on the voyage. Henslow had recommended Darwin as "qualified for collecting, observing and noting anything worthy." Darwin decided to join the crew because he wanted to expand his research as a naturalist.

HMS Beagle reached the Galápagos Islands on September 17th 1835. On the Galápagos, he found many fossils of extinct organisms. He also saw giant tortoises whose shells varied from island to island. After a while, Darwin noticed that there were two varieties of iguanas on the island, one species adapted for sea and one for land. He noticed over twenty species of finches, each with a different beak, suited for its native island. Darwin began to think that perhaps species could change to suit their environment.

In 1842 Darwin wrote a thirty five-page essay on his idea, though he kept it a great secret. In 1844 he increased it to two hundred and thirty pages, still a secret. He did not publish his results due to the impact of religion his findings may have. However, in 1848 the book "Vestiges of Natural History and Creation" by Robert Chambers was published anonymously. This book, suggesting species could change, caused a great scandal and many claimed it was lacking in clear, scientific evidence. Charles decided that using his knowledge from the Voyage of the Beagle, he could support his claims and theories of natural selection.

Darwin worked long and hard on his book until he received a letter from a younger friend, Alfred Wallace. Wallace had sent Darwin an essay outlining his theory of evolution, strikingly similar to Darwin's. Also, the Captain of the Beagle, Caption Fitzroy, had published his findings. These circumstances may have lead Darwin to finally publish his findings.

On November 24th, 1859, Darwin's book was finally published. *The Origin of the Species* was five hundred pages long, and sold its initial print run of 1250 copies in one day. Darwin's book was incredibly successful, and, although receiving at the time much criticism, is the basis of today's evolutionary theories

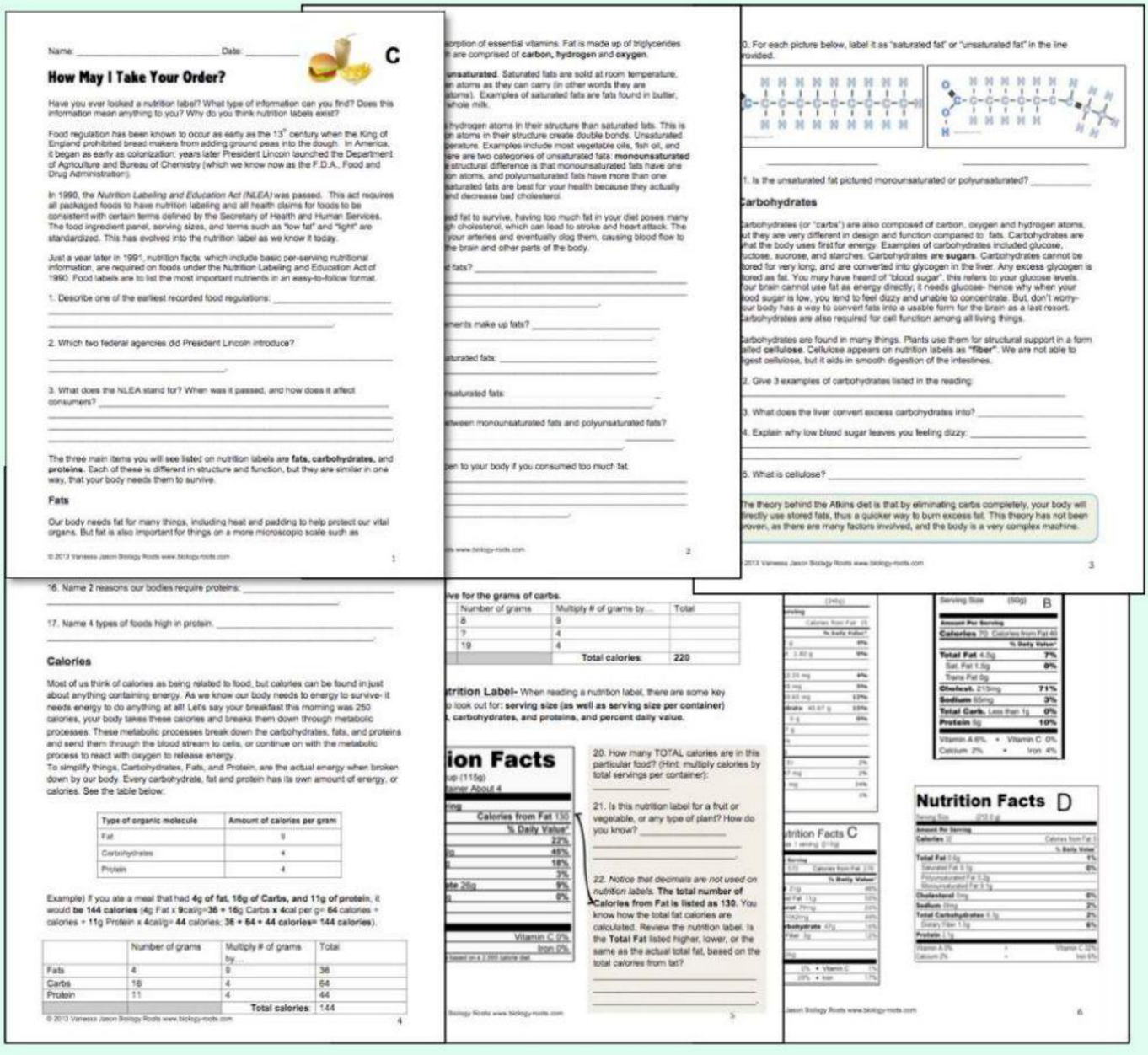
Darwin died in 1882, and never lived to see how much impact his findings would have on the scientific world. At the time of his studies, his findings mostly had an impact on religion. It was not for another fifty years that his findings would have an impact on biology.

Students can have fun being creative in science class while learning about different scientists!

PLAN "C": NUTRITION LABELS AND ORGANIC COMPOUNDS

How May I Take Your Order?

- Students learn about fats, carbs, and proteins, and how the numbers add up on nutrition labels.



Name: _____ Date: _____ C

How May I Take Your Order?

Have you ever looked a nutrition label? What type of information can you find? Does this information mean anything to you? Why do you think nutrition labels exist?

Food regulation has been known to occur as early as the 13th century when the King of England prohibited bread makers from adding ground peas into the dough. In America, it began as early as colonization; years later President Lincoln launched the Department of Agriculture and Bureau of Chemistry (which we know now as the F.D.A., Food and Drug Administration).

In 1990, the *Nutrition Labeling and Education Act (NLEA)* was passed. This act requires all packaged foods to have nutrition labeling and all health claims for foods to be consistent with certain terms defined by the Secretary of Health and Human Services. The food ingredient panel, serving sizes, and terms such as "low fat" and "light" are standardized. This has evolved into the nutrition label as we know it today.

Just a year later in 1991, nutrition facts, which include basic per-serving nutritional information, are required on foods under the Nutrition Labeling and Education Act of 1990. Food labels are to list the most important nutrients in an easy-to-follow format.

1. Describe one of the earliest recorded food regulations: _____

2. Which two federal agencies did President Lincoln introduce?

3. What does the NLEA stand for? When was it passed, and how does it affect consumers? _____

The three main items you will see listed on nutrition labels are **fats, carbohydrates,** and **proteins**. Each of these is different in structure and function, but they are similar in one way, that your body needs them to survive.

Fats

Our body needs fat for many things, including heat and padding to help protect our vital organs. But fat is also important for things on a more microscopic scale such as

© 2013 Vanessa Jason Biology Roots www.biology-roots.com 1

sorption of essential vitamins. Fat is made up of triglycerides
ll are comprised of **carbon, hydrogen** and **oxygen**.

unsaturated. Saturated fats are solid at room temperature,
en atoms as they can carry (in other words they are
atoms). Examples of saturated fats are fats found in butter,
whole milk.

hydrogen atoms in their structure than saturated fats. This is
on atoms in their structure create double bonds. Unsaturated
perature. Examples include most vegetable oils, fish oil, and
ere are two categories of unsaturated fats: **monounsaturated**
structural difference is that monounsaturated fats have one
on atoms, and polyunsaturated fats have more than one
saturated fats are best for your health because they actually
and decrease bad cholesterol.

ed fat to survive, having too much fat in your diet poses many
gh cholesterol, which can lead to stroke and heart attack. The
your arteries and eventually clog them, causing blood flow to
the brain and other parts of the body.

d fats? _____

ments make up fats? _____

aturated fats: _____

saturated fats: _____

etween monounsaturated fats and polyunsaturated fats?

en to your body if you consumed too much fat.

www.biology-roots.com 2

0. For each picture below, label it as "saturated fat" or "unsaturated fat" in the line rovided.

1. Is the unsaturated fat pictured monounsaturated or polyunsaturated? _____

Carbohydrates

Carbohydrates (or "carbs") are also composed of carbon, oxygen and hydrogen atoms, ut they are very different in design and function compared to fats. Carbohydrates are hat the body uses first for energy. Examples of carbohydrates included glucose, ructose, sucrose, and starches. Carbohydrates are **sugars**. Carbohydrates cannot be tored for very long, and are converted into glycogen in the liver. Any excess glycogen is tored as fat. You may have heard of "blood sugar", this refers to your glucose levels. our brain cannot use fat as energy directly, it needs glucose- hence why when your lood sugar is low, you tend to feel dizzy and unable to concentrate. But, don't worry- our body has a way to convert fats into a usable form for the brain as a last resort. Carbohydrates are also required for cell function among all living things.

Carbohydrates are found in many things. Plants use them for structural support in a form alled **cellulose**. Cellulose appears on nutrition labels as **"fiber"**. We are not able to igest cellulose, but it aids in smooth digestion of the intestines.

2. Give 3 examples of carbohydrates listed in the reading: _____

3. What does the liver convert excess carbohydrates into? _____

4. Explain why low blood sugar leaves you feeling dizzy: _____

5. What is cellulose? _____

The theory behind the Atkins diet is that by eliminating carbs completely, your body will directly use stored fats, thus a quicker way to burn excess fat. This theory has not been proven, as there are many factors involved, and the body is a very complex machine.

© 2013 Vanessa Jason Biology Roots www.biology-roots.com 3

16. Name 2 reasons our bodies require proteins: _____

17. Name 4 types of foods high in protein. _____

Calories

Most of us think of calories as being related to food, but calories can be found in just about anything containing energy. As we know our body needs to energy to survive- it needs energy to do anything at all! Let's say your breakfast this morning was 250 calories, your body takes these calories and breaks them down through metabolic processes. These metabolic processes break down the carbohydrates, fats, and proteins and send them through the blood stream to cells, or continue on with the metabolic process to react with oxygen to release energy.
To simplify things, Carbohydrates, Fats, and Protein, are the actual energy when broken down by our body. Every carbohydrate, fat and protein has its own amount of energy, or calories. See the table below:

Type of organic molecule	Amount of calories per gram
Fat	9
Carbohydrates	4
Protein	4

Example) If you ate a meal that had **4g of fat, 16g of Carbs, and 11g of protein**, it would **be 144 calories** (4g Fat x 9cal/g=**36** + 16g Carbs **x 4**cal per g= **64** calories + calories + 11g Protein x 4cal/g= **44** calories; **36 + 64 + 44 calories= 144 calories**).

	Number of grams	Multiply # of grams by…	Total
Fats	4	9	36
Carbs	16	4	64
Protein	11	4	44
		Total calories:	144

© 2013 Vanessa Jason Biology Roots www.biology-roots.com 4

ve for the grams of carbs.

Number of grams	Multiply # of grams by…	Total
8	9	
?	4	
19	4	
	Total calories:	220

trition Label- When reading a nutrition label, there are some key o look out for: **serving size (as well as serving size per container) , carbohydrates, and proteins, and percent daily value.**

ion Facts

up (115g)
iner About 4

Calories from Fat 130	
	% Daily Value*
	22%
	48%
	18%
	3%
ate 26g	9%
	0%
Vitamin C 0%	
Iron 0%	

20. How many TOTAL calories are in this particular food? (Hint: multiply calories by total servings per container): _____

21. Is this nutrition label for a fruit or vegetable, or any type of plant? How do you know? _____

22. *Notice that decimals are not used on nutrition labels.* **The total number of Calories from Fat is listed as 130.** You know how the total fat calories are calculated. Review the nutrition label. Is the **Total Fat** listed higher, lower, or the same as the actual total fat, based on the total calories from fat?

Biology Roots www.biology-roots.com 5

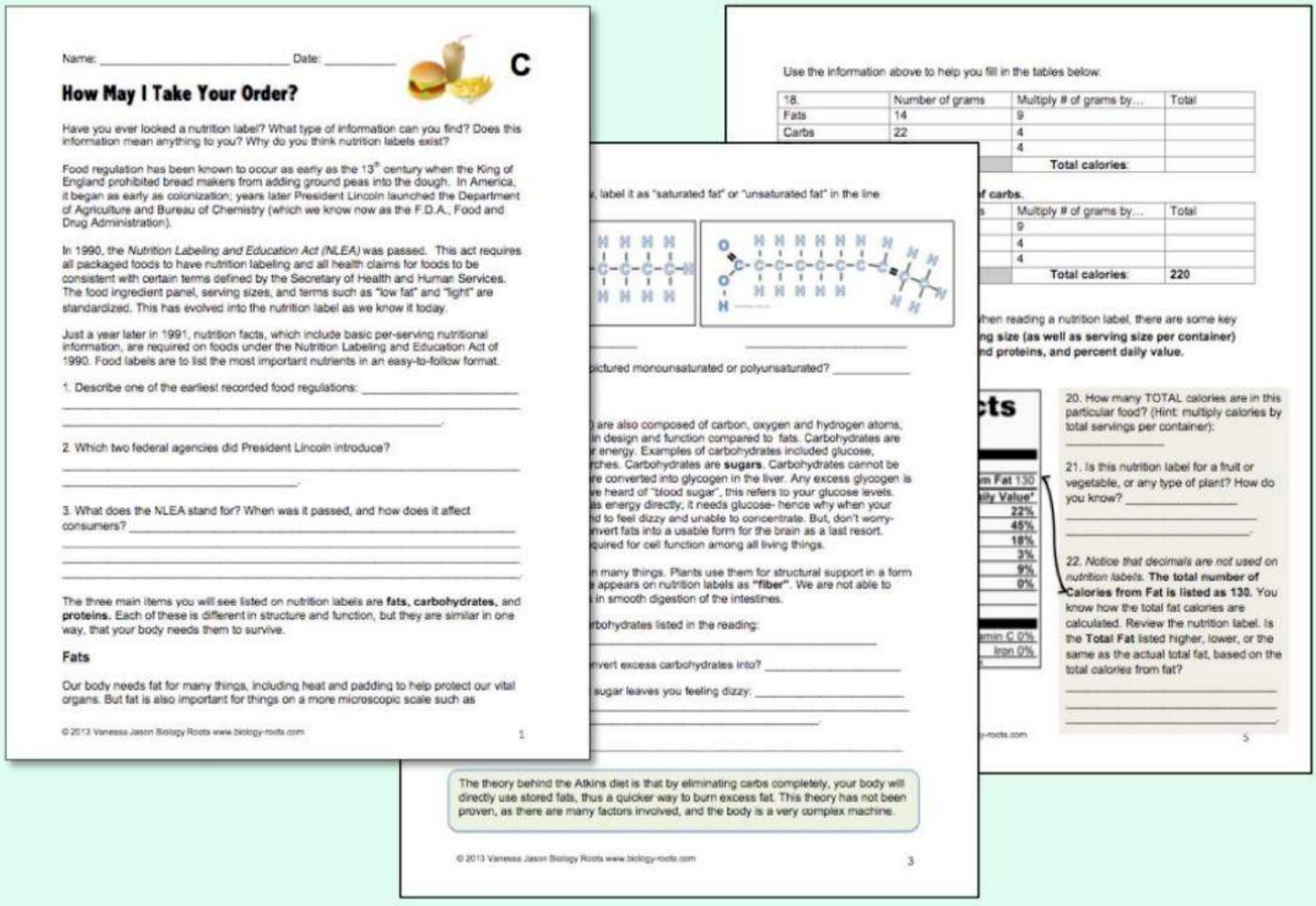
Serving Size (50g) B

Amount Per Serving	
Calories 70 Calories from Fat 40	
	% Daily Value*
Total Fat 4.5g	7%
Sat. Fat 1.5g	8%
Trans Fat 0g	
Cholest. 215mg	71%
Sodium 65mg	3%
Total Carb. Less than 1g	0%
Protein 6g	10%
Vitamin A 6% • Vitamin C 0%	
Calcium 2% • Iron 4%	

trition Facts C

Nutrition Facts D

Jason Biology Roots www.biology-roots.com 6



Name: _____ Date: _____

C

How May I Take Your Order?

Have you ever looked a nutrition label? What type of information can you find? Does this information mean anything to you? Why do you think nutrition labels exist?

Food regulation has been known to occur as early as the 13th century when the King of England prohibited bread makers from adding ground peas into the dough. In America, it began as early as colonization; years later President Lincoln launched the Department of Agriculture and Bureau of Chemistry (which we know now as the F.D.A., Food and Drug Administration).

In 1990, the *Nutrition Labeling and Education Act (NLEA)* was passed. This act requires all packaged foods to have nutrition labeling and all health claims for foods to be consistent with certain terms defined by the Secretary of Health and Human Services. The food ingredient panel, serving sizes, and terms such as "low fat" and "light" are standardized. This has evolved into the nutrition label as we know it today.

Just a year later in 1991, nutrition facts, which include basic per-serving nutritional information, are required on foods under the Nutrition Labeling and Education Act of 1990. Food labels are to list the most important nutrients in an easy-to-follow format.

1. Describe one of the earliest recorded food regulations: _____

2. Which two federal agencies did President Lincoln introduce?

3. What does the NLEA stand for? When was it passed, and how does it affect consumers? _____

The three main items you will see listed on nutrition labels are **fats, carbohydrates,** and **proteins.** Each of these is different in structure and function, but they are similar in one way, that your body needs them to survive.

Fats

Our body needs fat for many things, including heat and padding to help protect our vital organs. But fat is also important for things on a more microscopic scale such as

© 2013 Vanessa Jason Biology Roots www.biology-roots.com 1

Use the information above to help you fill in the tables below:

18.	Number of grams	Multiply # of grams by…	Total
Fats	14	9	
Carbs	22	4	
		4	
		Total calories:	

f carbs.

	Multiply # of grams by…	Total
	9	
	4	
	4	
	Total calories:	**220**

hen reading a nutrition label, there are some key
ng size (as well as serving size per container)
nd proteins, and percent daily value.

cts

m Fat 130
ily Value*
22%
45%
18%
3%
9%
0%
amin C 0%
Iron 0%

20. How many TOTAL calories are in this particular food? (Hint: multiply calories by total servings per container):

21. Is this nutrition label for a fruit or vegetable, or any type of plant? How do you know? _____

22. *Notice that decimals are not used on nutrition labels.* **The total number of Calories from Fat is listed as 130.** You know how the total fat calories are calculated. Review the nutrition label. Is the **Total Fat** listed higher, lower, or the same as the actual total fat, based on the total calories from fat?

5

, label it as "saturated fat" or "unsaturated fat" in the line

pictured monounsaturated or polyunsaturated? _____

] are also composed of carbon, oxygen and hydrogen atoms, in design and function compared to fats. Carbohydrates are r energy. Examples of carbohydrates included glucose, tches. Carbohydrates are **sugars**. Carbohydrates cannot be re converted into glycogen in the liver. Any excess glycogen is ve heard of "blood sugar", this refers to your glucose levels. as energy directly; it needs glucose- hence why when your d to feel dizzy and unable to concentrate. But, don't worry- nvert fats into a usable form for the brain as a last resort. quired for cell function among all living things.

n many things. Plants use them for structural support in a form appears on nutrition labels as **"fiber"**. We are not able to in smooth digestion of the intestines.

rbohydrates listed in the reading:

nvert excess carbohydrates into? _____

sugar leaves you feeling dizzy: _____

The theory behind the Atkins diet is that by eliminating carbs completely, your body will directly use stored fats, thus a quicker way to burn excess fat. This theory has not been proven, as there are many factors involved, and the body is a very complex machine.

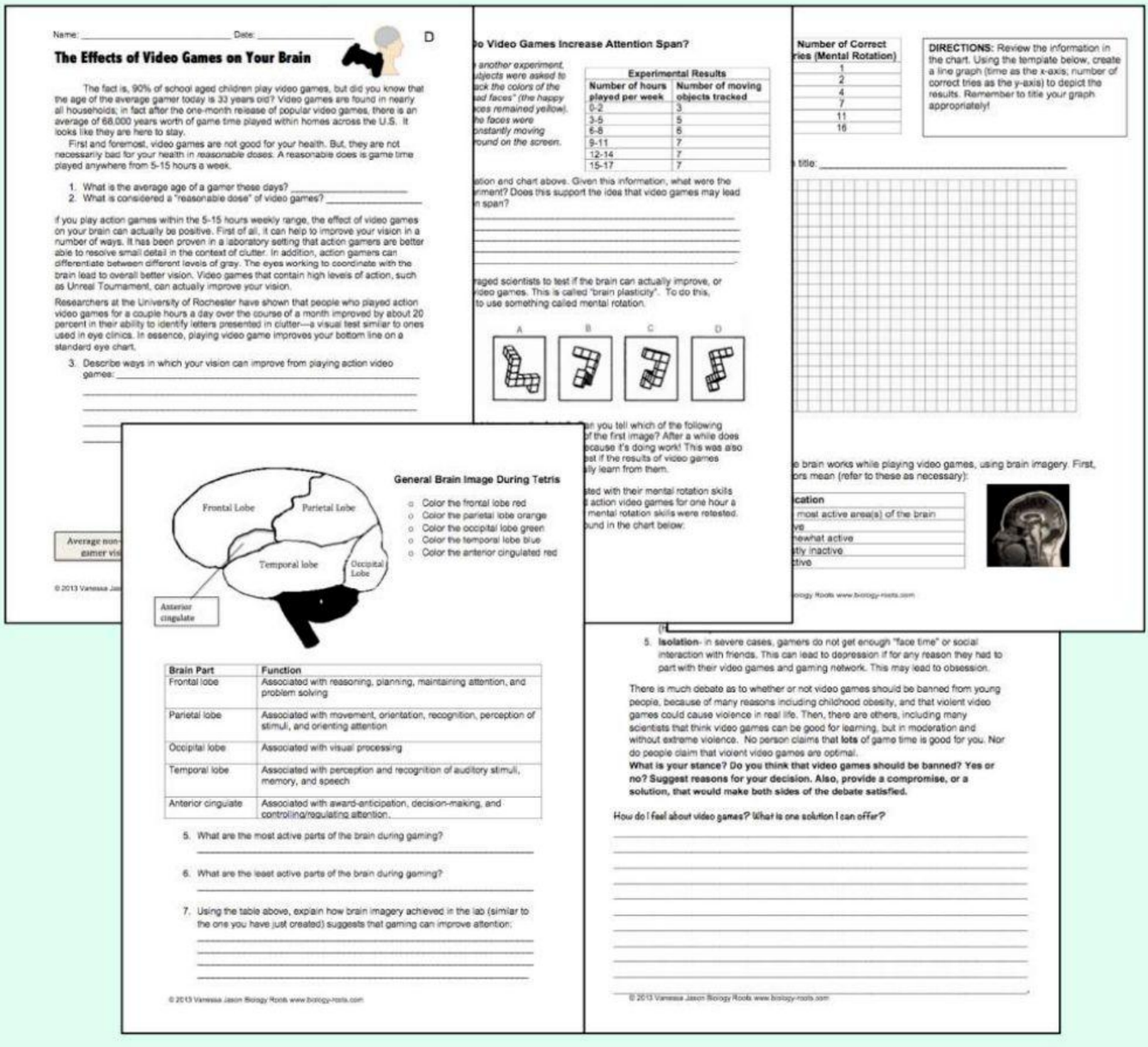
© 2013 Vanessa Jason Biology Roots www.biology-roots.com 3

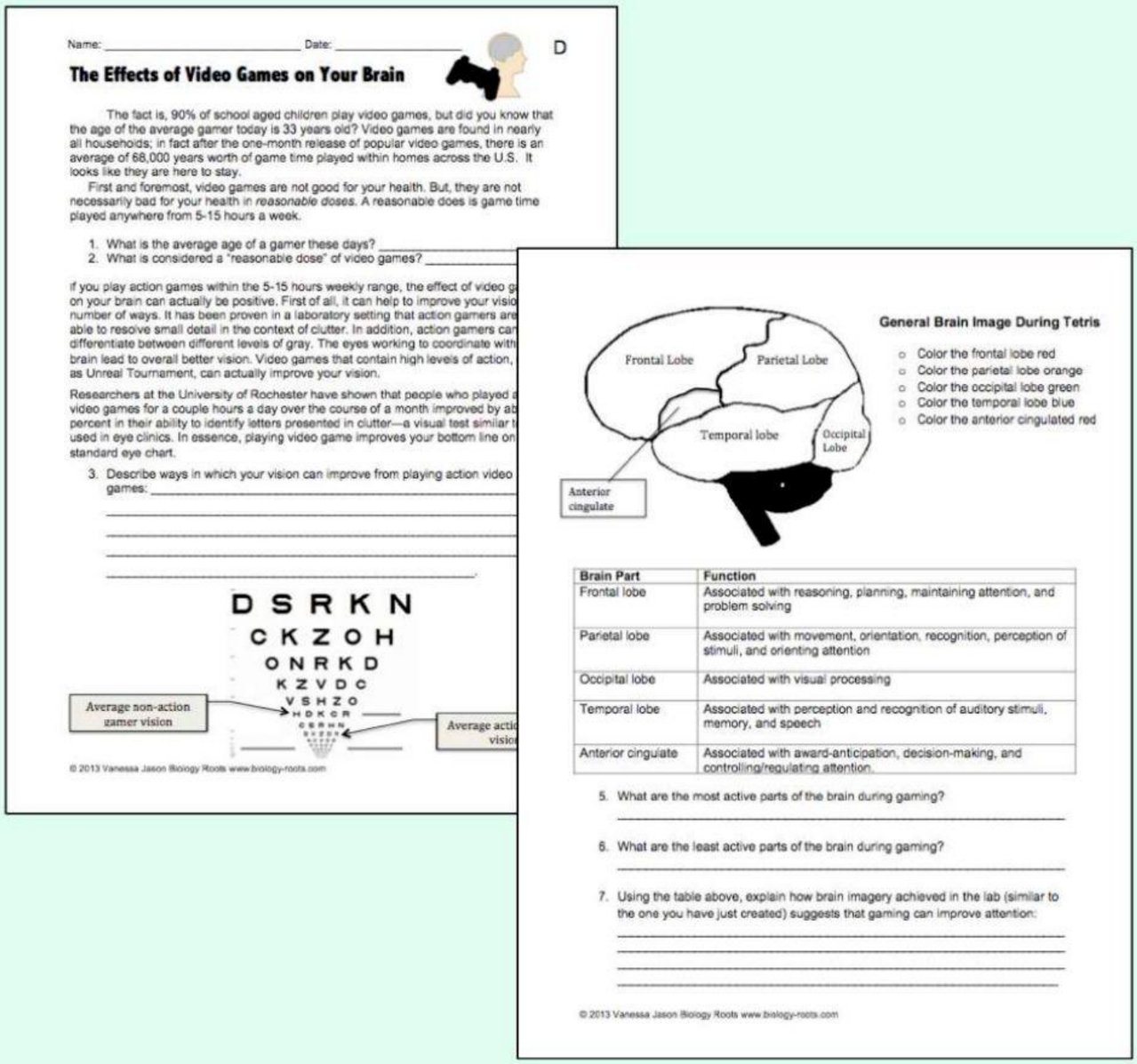
6 pages total (6th page is optional- can be reduced to 5 pages)
Students will leave the class knowing how to read a nutrition label and will be able to tell you why we have nutrition labels!
They will also have a basic understanding of carbohydrates, proteins, and fats.

PLAN "D": THE EFFECT OF VIDEO GAMES ON YOUR BRAIN

The Effects of Video Games on Your Brain

Based on results in Daphne Bavelier's lab. This activity enforces that games can improve vision and attention if played in reasonable doses. Includes reading, coloring and graphing.





Name: _____ Date: _____ D

The Effects of Video Games on Your Brain

The fact is, 90% of school aged children play video games, but did you know that the age of the average gamer today is 33 years old? Video games are found in nearly all households; in fact after the one-month release of popular video games, there is an average of 68,000 years worth of game time played within homes across the U.S. It looks like they are here to stay.

First and foremost, video games are not good for your health. But, they are not necessarily bad for your health in *reasonable doses*. A reasonable does is game time played anywhere from 5-15 hours a week.

1. What is the average age of a gamer these days? _____
2. What is considered a "reasonable dose" of video games? _____

if you play action games within the 5-15 hours weekly range, the effect of video g on your brain can actually be positive. First of all, it can help to improve your visio number of ways. It has been proven in a laboratory setting that action gamers are able to resolve small detail in the context of clutter. In addition, action gamers car differentiate between different levels of gray. The eyes working to coordinate with brain lead to overall better vision. Video games that contain high levels of action, as Unreal Tournament, can actually improve your vision.

Researchers at the University of Rochester have shown that people who played video games for a couple hours a day over the course of a month improved by ab percent in their ability to identify letters presented in clutter—a visual test similar t used in eye clinics. In essence, playing video game improves your bottom line on standard eye chart.

3. Describe ways in which your vision can improve from playing action video games: _____

D S R K N
C K Z O H
O N R K D
K Z V D C
V S H Z O

Average non-action gamer vision

Average acti vision

© 2013 Vanessa Jason Biology Roots www.biology-roots.com

General Brain Image During Tetris

- Color the frontal lobe red
- Color the parietal lobe orange
- Color the occipital lobe green
- Color the temporal lobe blue
- Color the anterior cingulated red

Frontal Lobe
Parietal Lobe
Temporal lobe
Occipital Lobe
Anterior cingulate

Brain Part	Function
Frontal lobe	Associated with reasoning, planning, maintaining attention, and problem solving
Parietal lobe	Associated with movement, orientation, recognition, perception of stimuli, and orienting attention
Occipital lobe	Associated with visual processing
Temporal lobe	Associated with perception and recognition of auditory stimuli, memory, and speech
Anterior cingulate	Associated with award-anticipation, decision-making, and controlling/regulating attention.

5. What are the most active parts of the brain during gaming?
_____

6. What are the least active parts of the brain during gaming?
_____

7. Using the table above, explain how brain imagery achieved in the lab (similar to the one you have just created) suggests that gaming can improve attention:
_____
_____
_____
_____

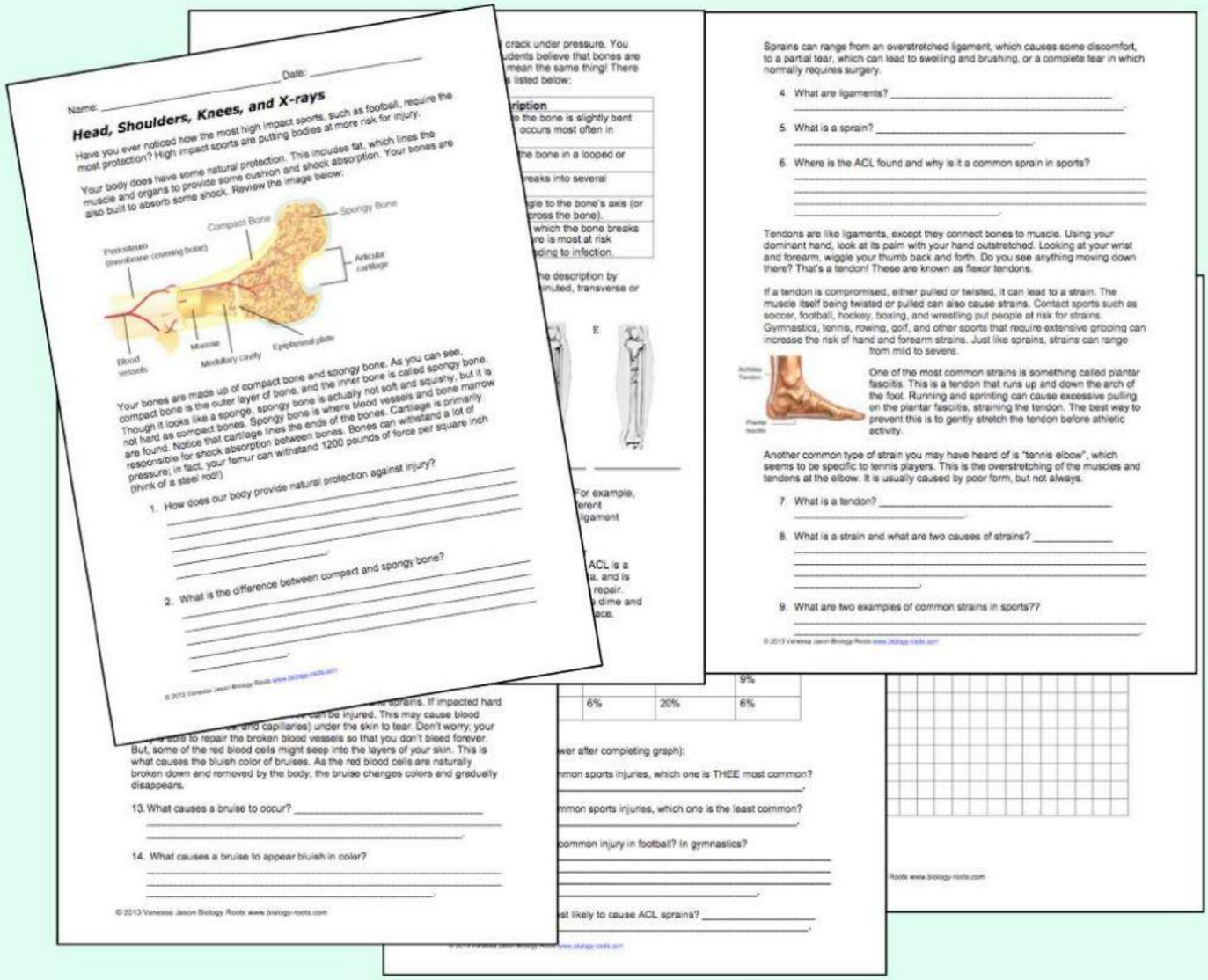
© 2013 Vanessa Jason Biology Roots www.biology-roots.com

5 pages- fifth page is optional (can be reduced to 4 pages)
This is a fun one! Students get to analyze diagrams, color parts of the brain, and do a short graphing segment.

PLAN "E": HEAD, SHOULDERS, KNEES AND X-RAYS

Head, Shoulders, Knees and X-rays

Explores common sports injuries. What is a fracture? What is a sprain? What is a strain? What causes swelling and bruising? Bar graph: Common Injuries Among Sports (8 common injuries found among 4 different sports).



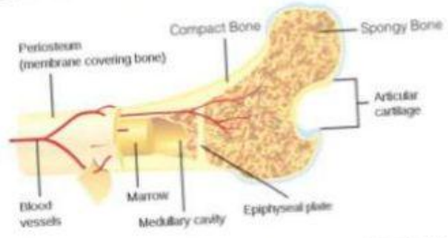
6 pages including 2 pages of graphing (directions and grid). **Can be reduced to 4 pages** (graphing is optional).

Name: _____ Date: _____

Head, Shoulders, Knees, and X-rays

Have you ever noticed how the most high impact sports, such as football, require the most protection? High impact sports are putting bodies at more risk for injury.

Your body does have some natural protection. This includes fat, which lines the muscle and organs to provide some cushion and shock absorption. Your bones are also built to absorb some shock. Review the image below:



Your bones are made up of compact bone and spongy bone. As you can see, compact bone is the outer layer of bone, and the inner bone is called spongy bone. Though it looks like a sponge, spongy bone is actually not soft and squishy, but it is not hard as compact bones. Spongy bone is where blood vessels and bone marrow are found. Notice that cartilage lines the ends of the bones. Cartilage is primarily responsible for shock absorption between bones. Bones can withstand a lot of pressure; in fact, your femur can withstand 1200 pounds of force per square inch (think of a steel rod!)

1. How does our body provide natural protection against injury?

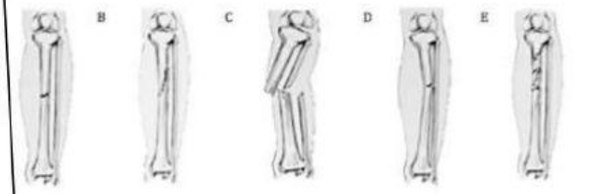
2. What is the difference between compact and spongy b

© 2013 Vanessa Jason Biology Roots www.biology-roots.com

Though bones do offer some support, they will crack under pressure. You have heard the term "fracture" before. Many students believe that bones are either fractured or broken- but really, the terms mean the same thing! There are actually many different types of fractures, as listed below:

Type of Fracture	Description
Greenstick	An incomplete fracture where the bone is slightly bent (hence "greenstick" [flexible]; occurs most often in children.
Spiral	A fracture that wraps around the bone in a looped or curved fashion.
Comminuted	A fracture in which the break breaks into several fragments.
Transverse	A bone that occurs at a right angle to the bone's axis (or in other words it breaks clean across the bone).
Compound	This is a very serious fracture in which the bone breaks in half and separates. This fracture is most at risk breaking through the skin and leading to infection.

3. Use the table below to try to match each picture to the description by labeling pictures A-E as either greenstick, spiral, comminuted, transverse or compound.



_____ _____ _____ _____ _____

Bones are connected to each other with structures called ligaments. For example, our patella (knee cap) is connected to your femur and tibia by three different ligaments: the anterior cruciate ligament (or ACL), the posterior cruciate ligament (PCL) and the medial cruciate ligament (MCL).

Graph: Most Common Sports Injuries

Directions: For this particular graph you will be creating a **bar graph using the chart below.** You will need 4 different colors. Look at the chart to determine which colors you will need! Be sure to **label your axes (y axis= percentage of total injuries; x axis= type of injury). Please make a key on the graph to indicate which sport is which color.** Please note that we will not be graphing all the sports injuries that take place in that sport, **only the most common ones throughout 4 different sports.**

Type of Injury	Football (blue)	Baseball (red)	Gymnastics (green)	Basketball (purple)
Fractures	10%	1%	2%	1%
ACL Sprain	5%	8%	10%	15%
Plantar fasciitis strain	20%	15%	6%	12%
Ankle Sprain	25%	20%	20%	20%
Quad Strain	10%	20%	10%	19%
Hamstring Pull (Strain)	15%	22%	12%	18%
Lower Back Pain	10%	10%	20%	9%
Achilles strain	5%	6%	20%	6%

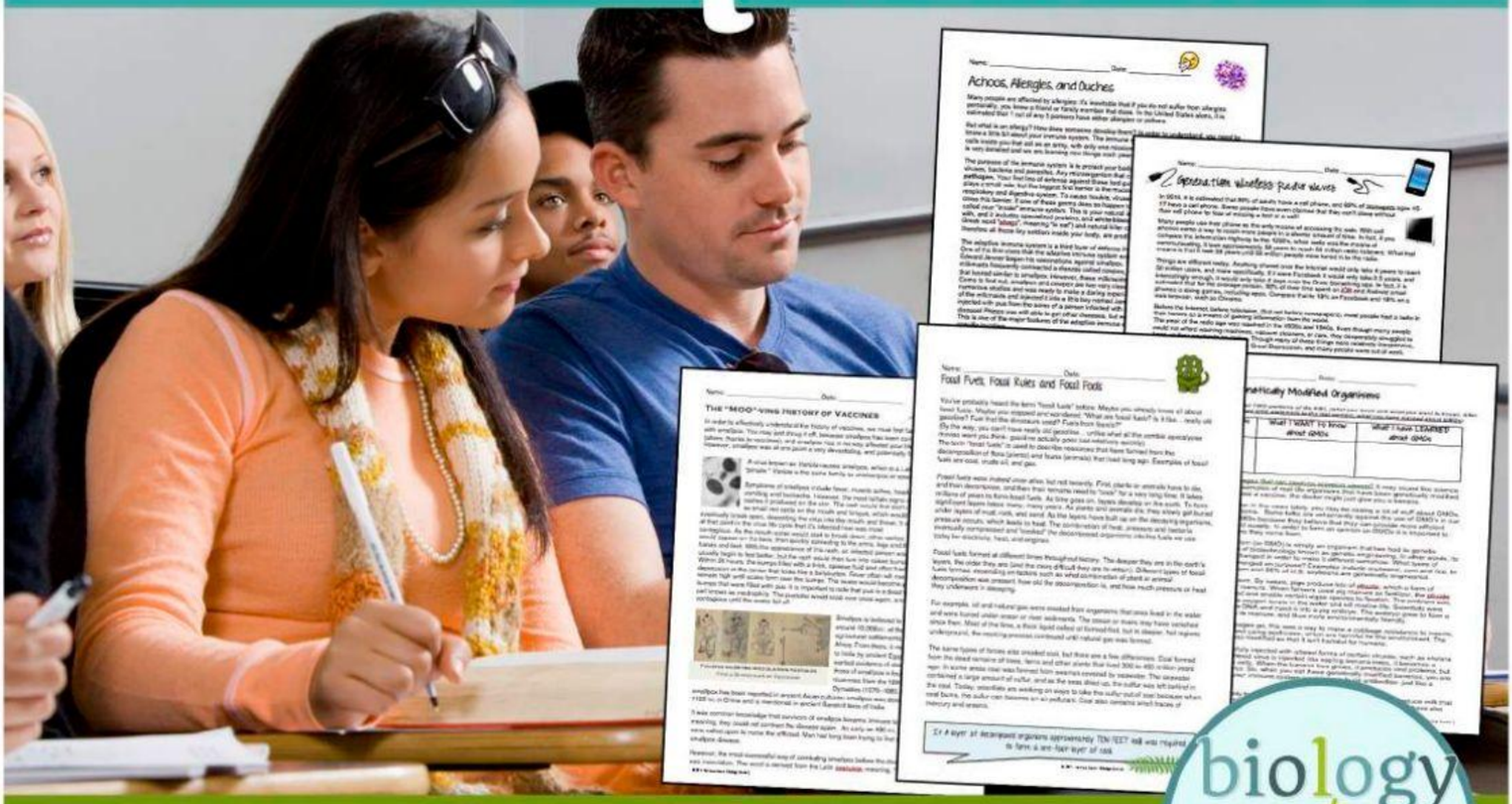
Analysis Questions (answer after completing graph):

1. Of the 8 most common sports injuries, which one is THEE most common? _____.
2. OF the 8 most common sports injuries, which one is the least common? _____.
3. What is the most common injury in football? In gymnastics? _____.
4. Which sport is most likely to cause ACL sprains? _____.

© 2013 Vanessa Jason Biology Roots www.biology-roots.com

OPTIONAL GRAPHING EXERCISE FOR EXTRA PRACTICE OR LONGER CLASSES.

emergency sub plans



VOLUME II F-J
5 ENGAGING SCIENCE SUB PLANS

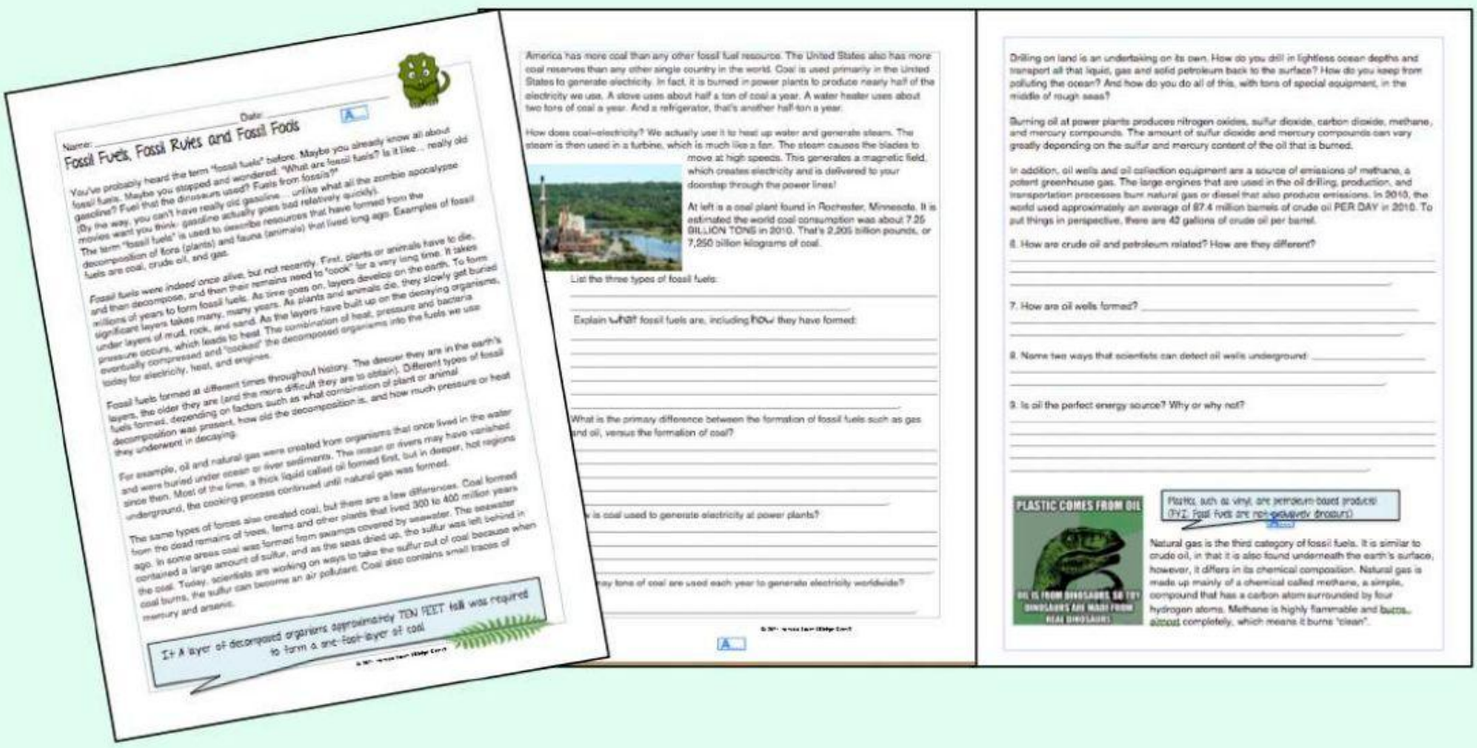
biology roots

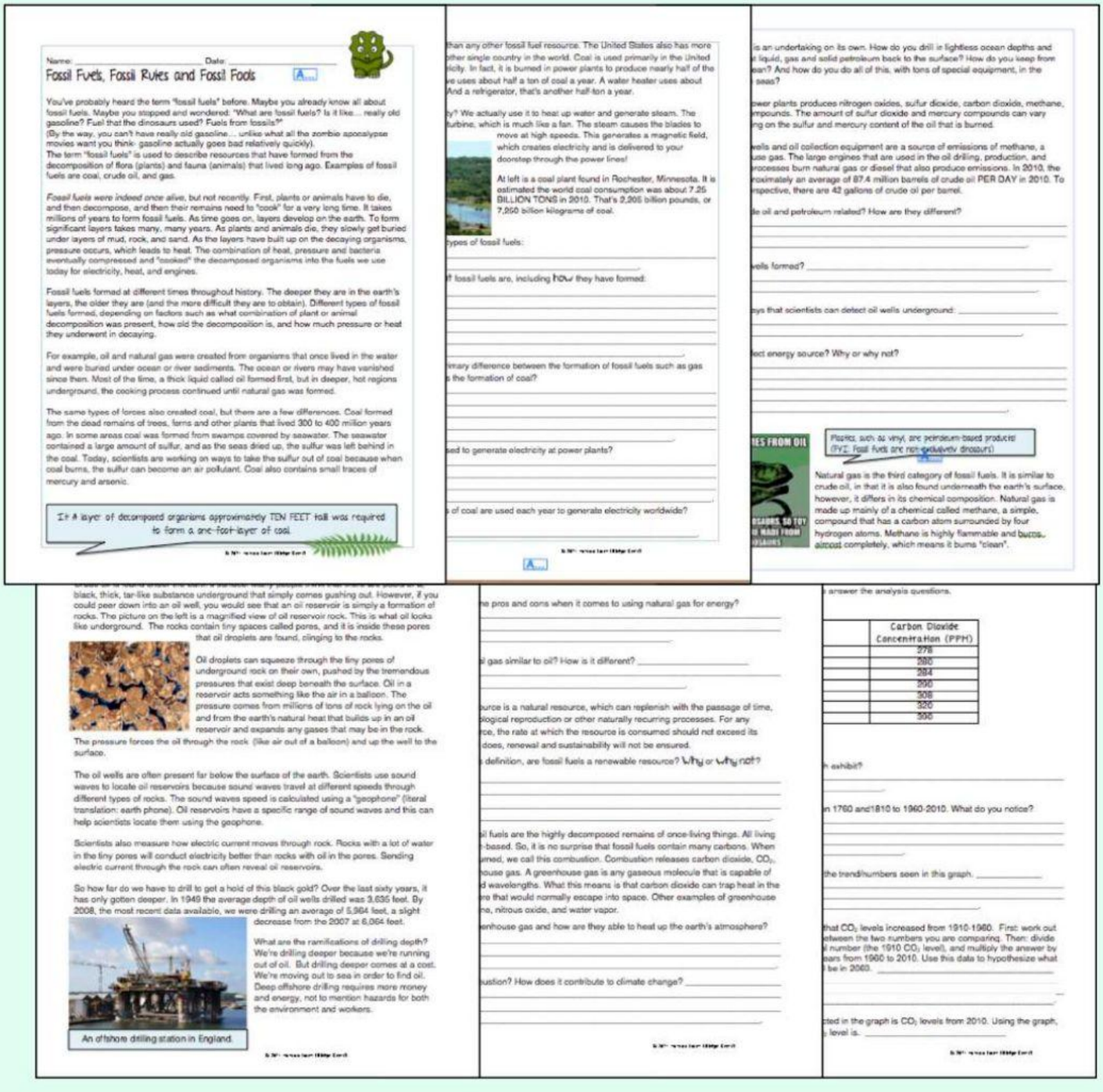
- Sub plans are long enough to last the entire class
- Relevant topics that relate to students
- CCSS aligned for literacy in science

PLAN "F": FOSSIL FUELS

Plan F: Fossil Fuels, Fossil Rules, and Fossil Fools

- A brief history of the oil and gasoline industry leading back to Rockefeller.
- Explores different types of fuels and what we use them for.
- Explains how each fuel is extracted and the ramifications of their use.





Name: _____ Date: _____

Fossil Fuels, Fossil Rules and Fossil Fools

You've probably heard the term "fossil fuels" before. Maybe you already know all about fossil fuels. Maybe you stopped and wondered: "What are fossil fuels? Is it like... really old gasoline? Fuel that the dinosaurs used? Fuels from fossils?"
(By the way, you can't have really old gasoline... unlike what all the zombie apocalypse movies want you think- gasoline actually goes bad relatively quickly).
The term "fossil fuels" is used to describe resources that have formed from the decomposition of flora (plants) and fauna (animals) that lived long ago. Examples of fossil fuels are coal, crude oil, and gas.

Fossil fuels were indeed once alive, but not recently. First, plants or animals have to die, and then decompose, and then their remains need to "cook" for a very long time. It takes millions of years to form fossil fuels. As time goes on, layers develop on the earth. To form significant layers takes many, many years. As plants and animals die, they slowly get buried under layers of mud, rock, and sand. As the layers have built up on the decaying organisms, pressure occurs, which leads to heat. The combination of heat, pressure and bacteria eventually compressed and "cooked" the decomposed organisms into the fuels we use today for electricity, heat, and engines.

Fossil fuels formed at different times throughout history. The deeper they are in the earth's layers, the older they are (and the more difficult they are to obtain). Different types of fossil fuels formed, depending on factors such as what combination of plant or animal decomposition was present, how old the decomposition is, and how much pressure or heat they underwent in decaying.

For example, oil and natural gas were created from organisms that once lived in the water and were buried under ocean or river sediments. The ocean or rivers may have vanished since then. Most of the time, a thick liquid called oil formed first, but in deeper, hot regions underground, the cooking process continued until natural gas was formed.

The same types of forces also created coal, but there are a few differences. Coal formed from the dead remains of trees, ferns and other plants that lived 300 to 400 million years ago. In some areas coal was formed from swamps covered by seawater. The seawater contained a large amount of sulfur, and as the seas dried up, the sulfur was left behind in the coal. Today, scientists are working on ways to take the sulfur out of coal because when coal burns, the sulfur can become an air pollutant. Coal also contains small traces of mercury and arsenic.

It A layer of decomposed organisms approximately TEN FEET tall was required to form a one-foot layer of coal.

than any other fossil fuel resource. The United States also has more
other single country in the world. Coal is used primarily in the United
ricity. In fact, it is burned in power plants to produce nearly half of the
ve uses about half a ton of coal a year. A water heater uses about
And a refrigerator, that's another half-ton a year.

y? We actually use it to heat up water and generate steam. The
turbine, which is much like a fan. The steam causes the blades to
move at high speeds. This generates a magnetic field,
which creates electricity and is delivered to your
doorstep through the power lines!

At left is a coal plant found in Rochester, Minnesota. It is estimated the world coal consumption was about 7.25 BILLION TONS in 2010. That's 2,205 billion pounds, or 7,260 billion kilograms of coal.

types of fossil fuels:

f fossil fuels are, including how they have formed:

imary difference between the formation of fossil fuels such as gas
s the formation of coal?

sed to generate electricity at power plants?

of coal are used each year to generate electricity worldwide?

is an undertaking on its own. How do you drill in lightless ocean depths and
t liquid, gas and solid petroleum back to the surface? How do you keep from
ean? And how do you do all of this, with tons of special equipment, in the
seas?

ower plants produces nitrogen oxides, sulfur dioxide, carbon dioxide, methane,
mpounds. The amount of sulfur dioxide and mercury compounds can vary
ng on the sulfur and mercury content of the oil that is burned.

wells and oil collection equipment are a source of emissions of methane, a
use gas. The large engines that are used in the oil drilling, production, and
processes burn natural gas or diesel that also produce emissions. In 2010, the
roximately an average of 87.4 million barrels of crude oil PER DAY in 2010. To
rspective, there are 42 gallons of crude oil per barrel.

le oil and petroleum related? How are they different?

wells formed? _____

ys that scientists can detect oil wells underground: _____

ect energy source? Why or why not?

ES FROM OIL

Plastics, such as vinyl, are petroleum-based products!
(FYI: Fossil fuels are not exclusively dinosaurs)

Natural gas is the third category of fossil fuels. It is similar to crude oil, in that it is also found underneath the earth's surface, however, it differs in its chemical composition. Natural gas is made up mainly of a chemical called methane, a simple, compound that has a carbon atom surrounded by four hydrogen atoms. Methane is highly flammable and burns almost completely, which means it burns "clean".

black, thick, tar-like substance underground that simply comes gushing out. However, if you could peer down into an oil well, you would see that an oil reservoir is simply a formation of rocks. The picture on the left is a magnified view of oil reservoir rock. This is what oil looks like underground. The rocks contain tiny spaces called pores, and it is inside these pores that oil droplets are found, clinging to the rocks.

Oil droplets can squeeze through the tiny pores of underground rock on their own, pushed by the tremendous pressures that exist deep beneath the surface. Oil in a reservoir acts something like the air in a balloon. The pressure comes from millions of tons of rock lying on the oil and from the earth's natural heat that builds up in an oil reservoir and expands any gases that may be in the rock. The pressure forces the oil through the rock (like air out of a balloon) and up the well to the surface.

The oil wells are often present far below the surface of the earth. Scientists use sound waves to locate oil reservoirs because sound waves travel at different speeds through different types of rocks. The sound waves speed is calculated using a "geophone" (literal translation: earth phone). Oil reservoirs have a specific range of sound waves and this can help scientists locate them using the geophone.

Scientists also measure how electric current moves through rock. Rocks with a lot of water in the tiny pores will conduct electricity better than rocks with oil in the pores. Sending electric current through the rock can often reveal oil reservoirs.

So how far do we have to drill to get a hold of this black gold? Over the last sixty years, it has only gotten deeper. In 1949 the average depth of oil wells drilled was 3,535 feet. By 2008, the most recent data available, we were drilling an average of 5,964 feet, a slight decrease from the 2007 at 6,064 feet.

What are the ramifications of drilling depth? We're drilling deeper because we're running out of oil. But drilling deeper comes at a cost. We're moving out to sea in order to find oil. Deep offshore drilling requires more money and energy, not to mention hazards for both the environment and workers.

An offshore drilling station in England.

he pros and cons when it comes to using natural gas for energy?

l gas similar to oil? How is it different? _____

urce is a natural resource, which can replenish with the passage of time,
iological reproduction or other naturally recurring processes. For any
rce, the rate at which the resource is consumed should not exceed its
does, renewal and sustainability will not be ensured.
definition, are fossil fuels a renewable resource? Why or why not?

il fuels are the highly decomposed remains of once-living things. All living
-based. So, it is no surprise that fossil fuels contain many carbons. When
rned, we call this combustion. Combustion releases carbon dioxide, CO_2,
house gas. A greenhouse gas is any gaseous molecule that is capable of
d wavelengths. What this means is that carbon dioxide can trap heat in the
re that would normally escape into space. Other examples of greenhouse
ne, nitrous oxide, and water vapor.
enhouse gas and how are they able to heat up the earth's atmosphere?

uestion? How does it contribute to climate change? _____

answer the analysis questions.

	Carbon Dioxide Concentration (PPM)
	278
	280
	284
	290
	308
	320
	390

h exhibit?

n 1760 and 1810 to 1960-2010. What do you notice?

the trend/numbers seen in this graph. _____

that CO_2 levels increased from 1910-1960. First: work out
etween the two numbers you are comparing. Then: divide
l number (the 1910 CO_2 level), and multiply the answer by
ars from 1960 to 2010. Use this data to hypothesize what
be in 2060. _____

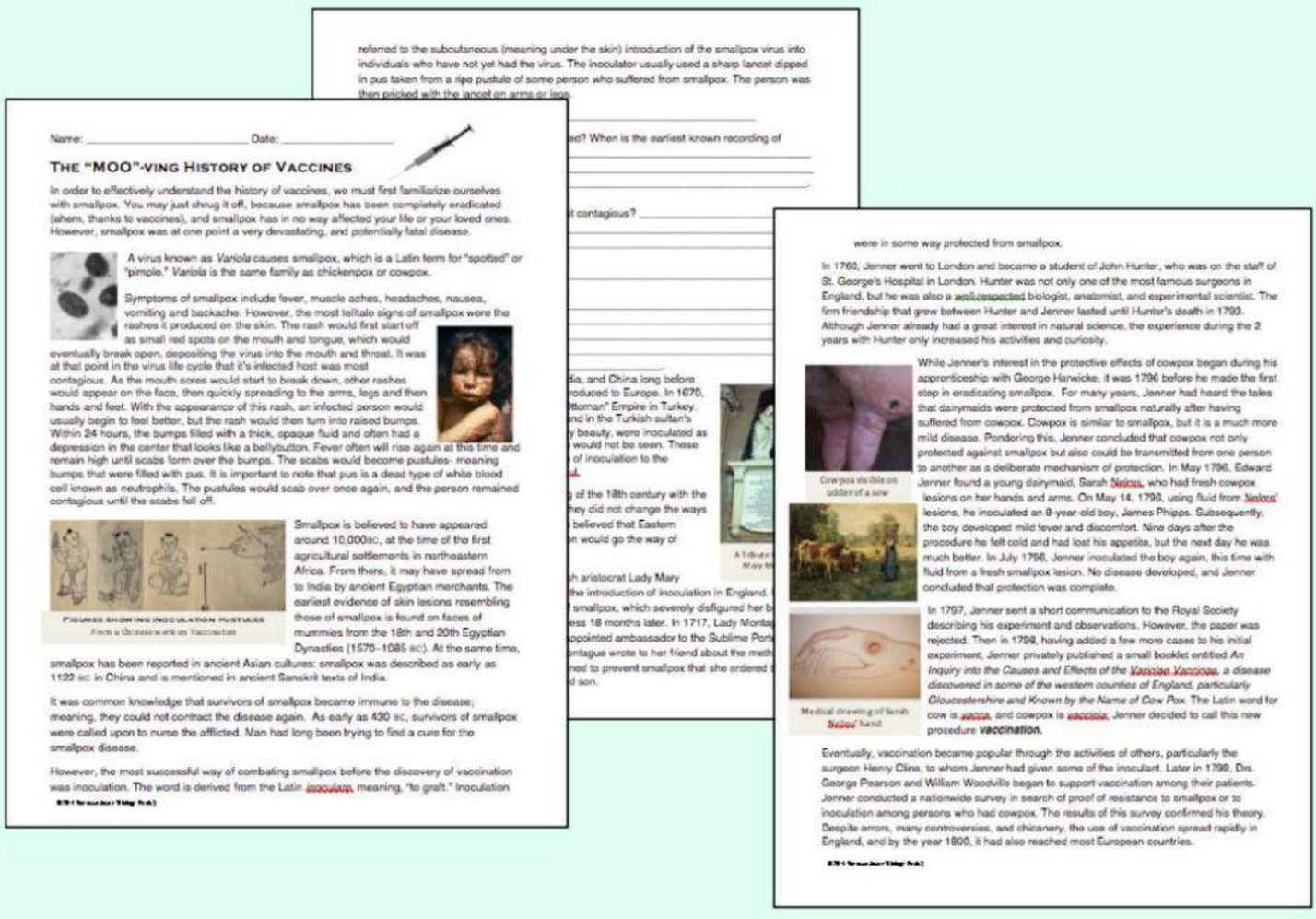
cted in the graph is CO_2 levels from 2010. Using the graph,
level is. _____

6 pages including analysis of the text and a chart examining carbon dioxide concentrations- students pull information from the text and analyze a chart on carbon dioxide concentrations over time.

As with many of my sub plans, you can shorten if if necessary. The last page can be omitted and saved for another day.

PLAN "G": HISTORY OF VACCINATIONS

The "Moo-ving" History of Vaccines: Explores the fascinating history in making a vaccine for smallpox, courtesy of Edward Jenner and James Phipps. Optional timeline can spread this assignment over 2 days if necessary.



referred to the subcutaneous (meaning under the skin) introduction of the smallpox virus into individuals who have not yet had the virus. The inoculator usually used a sharp lancet dipped in pus taken from a ripe pustule of some person who suffered from smallpox. The person was then pricked with the lancet on arms or legs.

Name: _____ Date: _____

THE "MOO"-VING HISTORY OF VACCINES

In order to effectively understand the history of vaccines, we must first familiarize ourselves with smallpox. You may just shrug it off, because smallpox has been completely eradicated (ahem, thanks to vaccines), and smallpox has in no way affected your life or your loved ones. However, smallpox was at one point a very devastating, and potentially fatal disease.

A virus known as *Variola* causes smallpox, which is a Latin term for "spotted" or "pimple." Variola is the same family as chickenpox or cowpox.

Symptoms of smallpox include fever, muscle aches, headaches, nausea, vomiting and backache. However, the most telltale signs of smallpox were the rashes it produced on the skin. The rash would first start off as small red spots on the mouth and tongue, which would eventually break open, depositing the virus into the mouth and throat. It was at that point in the virus life cycle that it's infected host was most contagious. As the mouth sores would start to break down, other rashes would appear on the face, then quickly spreading to the arms, legs and then hands and feet. With the appearance of this rash, an infected person would usually begin to feel better, but the rash would then turn into raised bumps. Within 24 hours, the bumps filled with a thick, opaque fluid and often had a depression in the center that looks like a bellybutton. Fever often will rise again at this time and remain high until scabs form over the bumps. The scabs would become pustules- meaning bumps that were filled with pus. It is important to note that pus is a dead type of white blood cell known as neutrophils. The pustules would scab over once again, and the person remained contagious until the scabs fell off.

FIGURES SHOWING INOCULATION PUSTULES
From a Chinese work on Vaccination

Smallpox is believed to have appeared around 10,000BC, at the time of the first agricultural settlements in northeastern Africa. From there, it may have spread from to India by ancient Egyptian merchants. The earliest evidence of skin lesions resembling those of smallpox is found on faces of mummies from the 18th and 20th Egyptian Dynasties (1570–1085 BC). At the same time, smallpox has been reported in ancient Asian cultures: smallpox was described as early as 1122 BC in China and is mentioned in ancient Sanskrit texts of India.

It was common knowledge that survivors of smallpox became immune to the disease; meaning, they could not contract the disease again. As early as 430 BC, survivors of smallpox were called upon to nurse the afflicted. Man had long been trying to find a cure for the smallpox disease.

However, the most successful way of combating smallpox before the discovery of vaccination was inoculation. The word is derived from the Latin *inoculare*, meaning, "to graft." Inoculation

ad? When is the earliest known recording of

t contagious? _____

dia, and China long before
roduced to Europe. In 1670,
Ottoman" Empire in Turkey.
nd in the Turkish sultan's
y beauty, were inoculated as
would not be seen. These
of inoculation to the

g of the 18th century with the
hey did not change the ways
believed that Eastern
n would go the way of

h aristocrat Lady Mary
the introduction of inoculation in England.
smallpox, which severely disfigured her b
ess 18 months later. In 1717, Lady Monta
ppointed ambassador to the Sublime Port
ontague wrote to her friend about the meth
ed to prevent smallpox that she ordered
d son.

were in some way protected from smallpox.

In 1760, Jenner went to London and became a student of John Hunter, who was on the staff of St. George's Hospital in London. Hunter was not only one of the most famous surgeons in England, but he was also a well-respected biologist, anatomist, and experimental scientist. The firm friendship that grew between Hunter and Jenner lasted until Hunter's death in 1793. Although Jenner already had a great interest in natural science, the experience during the 2 years with Hunter only increased his activities and curiosity.

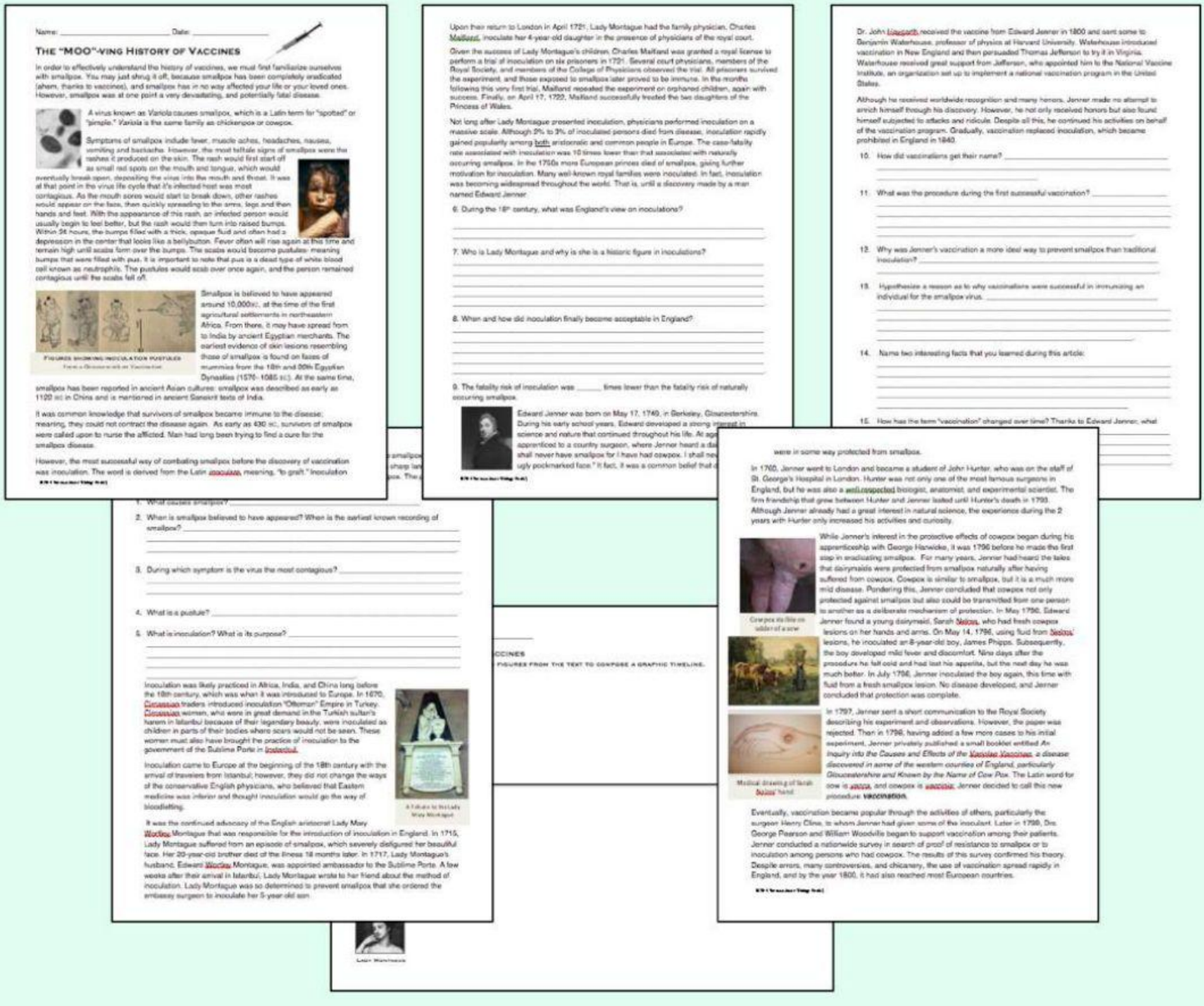
Cowpox visible on udder of a cow

While Jenner's interest in the protective effects of cowpox began during his apprenticeship with George Harwicke, it was 1796 before he made the first step in eradicating smallpox. For many years, Jenner had heard the tales that dairymaids were protected from smallpox naturally after having suffered from cowpox. Cowpox is similar to smallpox, but it is a much more mild disease. Pondering this, Jenner concluded that cowpox not only protected against smallpox but also could be transmitted from one person to another as a deliberate mechanism of protection. In May 1796, Edward Jenner found a young dairymaid, Sarah Nelmes, who had fresh cowpox lesions on her hands and arms. On May 14, 1796, using fluid from Nelmes' lesions, he inoculated an 8-year-old boy, James Phipps. Subsequently, the boy developed mild fever and discomfort. Nine days after the procedure he felt cold and had lost his appetite, but the next day he was much better. In July 1796, Jenner inoculated the boy again, this time with fluid from a fresh smallpox lesion. No disease developed, and Jenner concluded that protection was complete.

Medical drawing of Sarah Nelmes' hand

In 1797, Jenner sent a short communication to the Royal Society describing his experiment and observations. However, the paper was rejected. Then in 1798, having added a few more cases to his initial experiment, Jenner privately published a small booklet entitled *An Inquiry into the Causes and Effects of the Variolae Vaccinae, a disease discovered in some of the western counties of England, particularly Gloucestershire and Known by the Name of Cow Pox.* The Latin word for cow is *vacca*, and cowpox is *vaccinae*. Jenner decided to call this new procedure **vaccination.**

Eventually, vaccination became popular through the activities of others, particularly the surgeon Henry Cline, to whom Jenner had given some of the inoculant. Later in 1798, Drs. George Pearson and William Woodville began to support vaccination among their patients. Jenner conducted a nationwide survey in search of proof of resistance to smallpox or to inoculation among persons who had cowpox. The results of this survey confirmed his theory. Despite errors, many controversies, and chicanery, the use of vaccination spread rapidly in England, and by the year 1800, it had also reached most European countries.



Name: _____ Date: _____

THE "MOO"-VING HISTORY OF VACCINES

In order to effectively understand the history of vaccines, we must first familiarize ourselves with smallpox. You may just shrug it off, because smallpox has been completely eradicated (ahem, thanks to vaccines), and smallpox has in no way affected your life or your loved ones. However, smallpox was at one point a very devastating, and potentially fatal disease.

A virus known as Variola causes smallpox, which is a Latin term for "spotted" or "pimple." Variola is the same family as chickenpox or cowpox.

Symptoms of smallpox include fever, muscle aches, headaches, nausea, vomiting and backache. However, the most telltale signs of smallpox were the rashes it produced on the skin. The rash would first start off as small red spots on the mouth and tongue, which would eventually break open, depositing the virus into the mouth and throat. It was at that point in the virus life cycle that it's infected host was most contagious. As the mouth sores would start to break down, other rashes would appear on the face, then quickly spreading to the arms, legs and then hands and feet. With the appearance of this rash, an infected person would usually begin to feel better, but the rash would then turn into raised bumps. Within 24 hours, the bumps filled with a thick, opaque fluid and often had a depression in the center that looks like a bellybutton. Fever often will rise again at this time and remain high until scabs form over the bumps. The scabs would become pustules- meaning bumps that were filled with pus. It is important to note that pus is a dead type of white blood cell known as neutrophils. The pustules would scab over once again, and the person remained contagious until the scabs fell off.

FIGURES SHOWING INOCULATION PUSTULES

Smallpox is believed to have appeared around 10,000BC, at the time of the first agricultural settlements in northeastern Africa. From there, it may have spread from to India by ancient Egyptian merchants. The earliest evidence of skin lesions resembling those of smallpox is found on faces of mummies from the 18th and 20th Egyptian Dynasties (1570- 1085 BC). At the same time, smallpox has been reported in ancient Asian cultures: smallpox was described as early as 1120 BC in China and is mentioned in ancient Sanskrit texts of India.

It was common knowledge that survivors of smallpox became immune to the disease; meaning, they could not contract the disease again. As early as 430 BC, survivors of smallpox were called upon to nurse the afflicted. Man had long been trying to find a cure for the smallpox disease.

However, the most successful way of combating smallpox before the discovery of vaccination was inoculation. The word is derived from the Latin *inoculare*, meaning, "to graft." Inoculation

Upon their return to London in April 1721, Lady Montague had the family physician, Charles Maitland, inoculate her 4-year-old daughter in the presence of physicians of the royal court.

Given the success of Lady Montague's children, Charles Maitland was granted a royal license to perform a trial of inoculation on six prisoners in 1721. Several court physicians, members of the Royal Society, and members of the College of Physicians observed the trial. All prisoners survived the experiment, and those exposed to smallpox later proved to be immune. In the months following this very first trial, Maitland repeated the experiment on orphaned children, again with success. Finally, on April 17, 1722, Maitland successfully treated the two daughters of the Princess of Wales.

Not long after Lady Montague presented inoculation, physicians performed inoculation on a massive scale. Although 2% to 3% of inoculated persons died from disease, inoculation rapidly gained popularity among both aristocratic and common people in Europe. The case-fatality rate associated with inoculation was 10 times lower than that associated with naturally occurring smallpox. In the 1750s more European princes died of smallpox, giving further motivation for inoculation. Many well-known royal families were inoculated. In fact, inoculation was becoming widespread throughout the world. That is, until a discovery made by a man named Edward Jenner.

6. During the 18th century, what was England's view on inoculations?

7. Who is Lady Montague and why is she is a historic figure in inoculations?

8. When and how did inoculation finally become acceptable in England?

9. The fatality risk of inoculation was _____ times lower than the fatality risk of naturally occurring smallpox.

Edward Jenner was born on May 17, 1749, in Berkeley, Gloucestershire. During his early school years, Edward developed a strong interest in science and nature that continued throughout his life. At age apprenticed to a country surgeon, where Jenner heard a da shall never have smallpox for I have had cowpox. I shall ne ugly pockmarked face." In fact, it was a common belief that

Dr. John Haygarth received the vaccine from Edward Jenner in 1800 and sent some to Benjamin Waterhouse, professor of physics at Harvard University. Waterhouse introduced vaccination in New England and then persuaded Thomas Jefferson to try it in Virginia. Waterhouse received great support from Jefferson, who appointed him to the National Vaccine Institute, an organization set up to implement a national vaccination program in the United States.

Although he received worldwide recognition and many honors, Jenner made no attempt to enrich himself through his discovery. However, he not only received honors but also found himself subjected to attacks and ridicule. Despite all this, he continued his activities on behalf of the vaccination program. Gradually, vaccination replaced inoculation, which became prohibited in England in 1840.

10. How did vaccinations get their name?

11. What was the procedure during the first successful vaccination?

12. Why was Jenner's vaccination a more ideal way to prevent smallpox than traditional inoculation?

13. Hypothesize a reason as to why vaccinations were successful in immunizing an individual for the smallpox virus.

14. Name two interesting facts that you learned during this article:

15. How has the term "vaccination" changed over time? Thanks to Edward Jenner, what

1. What causes smallpox?
2. When is smallpox believed to have appeared? When is the earliest known recording of smallpox?
3. During which symptom is the virus the most contagious?
4. What is a pustule?
5. What is inoculation? What is its purpose?

Inoculation was likely practiced in Africa, India, and China long before the 18th century, which was when it was introduced to Europe. In 1670, Circassian traders introduced inoculation "Ottoman" Empire in Turkey. Circassian women, who were in great demand in the Turkish sultan's harem in Istanbul because of their legendary beauty, were inoculated as children in parts of their bodies where scars would not be seen. These women must also have brought the practice of inoculation to the government of the Sublime Porte in Istanbul.

A Tribute to the Lady Mary Montague

Inoculation came to Europe at the beginning of the 18th century with the arrival of travelers from Istanbul; however, they did not change the ways of the conservative English physicians, who believed that Eastern medicine was inferior and thought inoculation would go the way of bloodletting.

It was the continued advocacy of the English aristocrat Lady Mary Wortley Montague that was responsible for the introduction of inoculation in England. In 1715, Lady Montague suffered from an episode of smallpox, which severely disfigured her beautiful face. Her 20-year-old brother died of the illness 18 months later. In 1717, Lady Montague's husband, Edward Wortley Montague, was appointed ambassador to the Sublime Porte. A few weeks after their arrival in Istanbul, Lady Montague wrote to her friend about the method of inoculation. Lady Montague was so determined to prevent smallpox that she ordered the embassy surgeon to inoculate her 5-year-old son.

Lady Montague

CCINES

FIGURES FROM THE TEXT TO COMPOSE A GRAPHIC TIMELINE.

were in some way protected from smallpox.

In 1760, Jenner went to London and became a student of John Hunter, who was on the staff of St. George's Hospital in London. Hunter was not only one of the most famous surgeons in England, but he was also a well-respected biologist, anatomist, and experimental scientist. The firm friendship that grew between Hunter and Jenner lasted until Hunter's death in 1793. Although Jenner already had a great interest in natural science, the experience during the 2 years with Hunter only increased his activities and curiosity.

Cowpox vesicle on udder of a cow

While Jenner's interest in the protective effects of cowpox began during his apprenticeship with George Harwicke, it was 1796 before he made the first step in eradicating smallpox. For many years, Jenner had heard the tales that dairymaids were protected from smallpox naturally after having suffered from cowpox. Cowpox is similar to smallpox, but it is a much more mild disease. Pondering this, Jenner concluded that cowpox not only protected against smallpox but also could be transmitted from one person to another as a deliberate mechanism of protection. In May 1796, Edward Jenner found a young dairymaid, Sarah Nelmes, who had fresh cowpox lesions on her hands and arms. On May 14, 1796, using fluid from Nelmes' lesions, he inoculated an 8-year-old boy, James Phipps. Subsequently, the boy developed mild fever and discomfort. Nine days after the procedure he felt cold and had lost his appetite, but the next day he was much better. In July 1796, Jenner inoculated the boy again, this time with fluid from a fresh smallpox lesion. No disease developed, and Jenner concluded that protection was complete.

Medical drawing of Sarah Nelmes' hand

In 1797, Jenner sent a short communication to the Royal Society describing his experiment and observations. However, the paper was rejected. Then in 1798, having added a few more cases to his initial experiment, Jenner privately published a small booklet entitled *An Inquiry into the Causes and Effects of the Variolae Vaccinae, a disease discovered in some of the western countries of England, particularly Gloucestershire and Known by the Name of Cow Pox*. The Latin word for cow is *vacca*, and cowpox is *vaccinia*. Jenner decided to call this new procedure **vaccination**.

Eventually, vaccination became popular through the activities of others, particularly the surgeon Henry Cline, to whom Jenner had given some of the inoculant. Later in 1798, Drs. George Pearson and William Woodville began to support vaccination among their patients. Jenner conducted a nationwide survey in search of proof of resistance to smallpox or to inoculation among persons who had cowpox. The results of this survey confirmed his theory. Despite errors, many controversies, and chicanery, the use of vaccination spread rapidly in England, and by the year 1800, it had also reached most European countries.

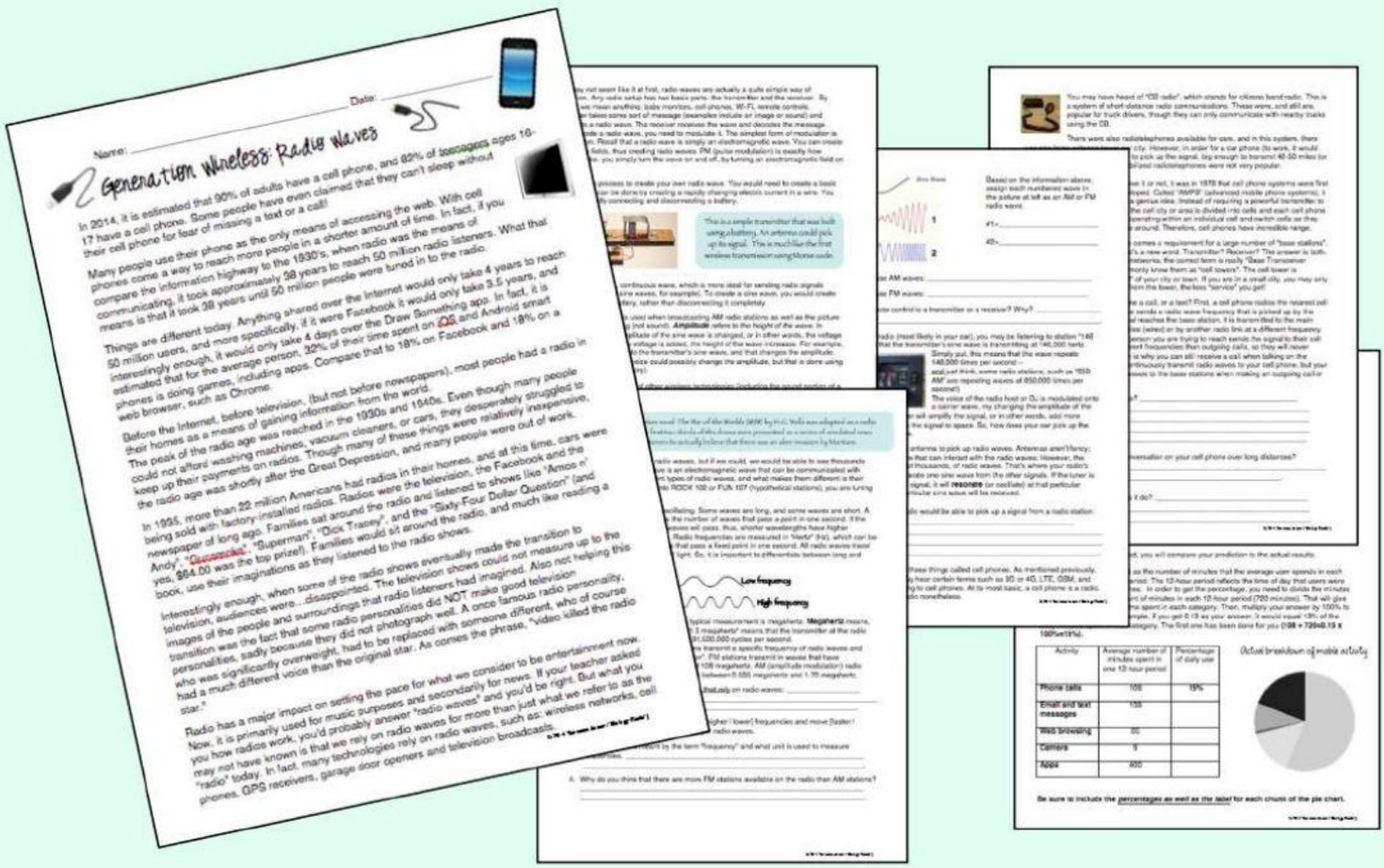
5 pages plus optional timeline. Use of the text and timeline is perfect for a two-day absence!

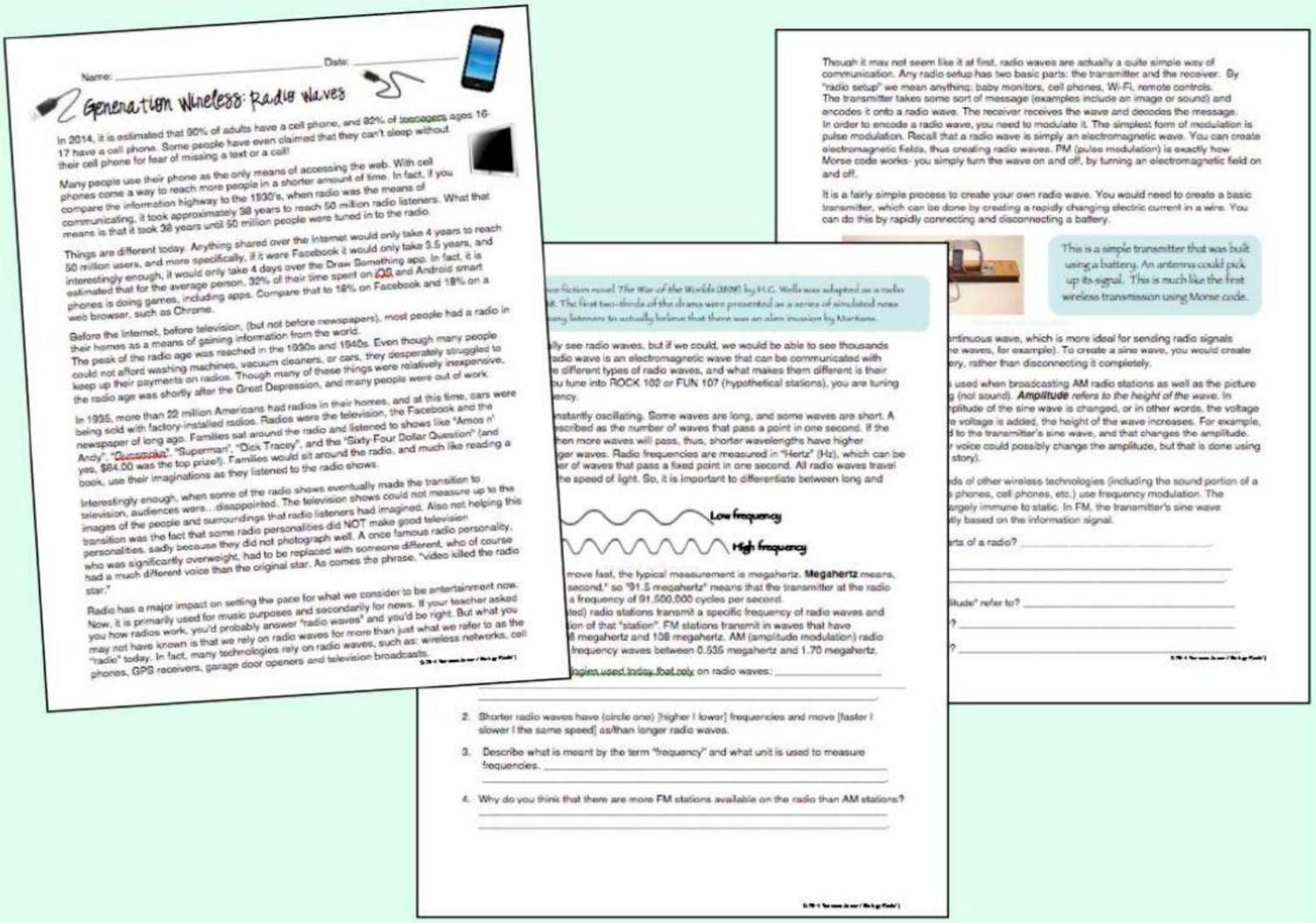
This is a fascinating read and it helps students to appreciate the medical phenomena of today!

PLAN "H": RADIO WAVES

Generation Wireless (Radio Waves):

- History of radio and how fast news could travel
- Why did video kill the radio star?
- How radios work; frequency, FM, AM, oscillation, etc.
- Why are they called "cell" phones and how do they work?





Name: _____ Date: _____

Generation Wireless: Radio Waves

In 2014, it is estimated that 90% of adults have a cell phone, and 82% of teenagers ages 16-17 have a cell phone. Some people have even claimed that they can't sleep without their cell phone for fear of missing a text or a call!

Many people use their phone as the only means of accessing the web. With cell phones come a way to reach more people in a shorter amount of time. In fact, if you compare the information highway to the 1930's, when radio was the means of communicating, it took approximately 38 years to reach 50 million radio listeners. What that means is that it took 38 years until 50 million people were tuned in to the radio.

Things are different today. Anything shared over the Internet would only take 4 years to reach 50 million users, and more specifically, if it were Facebook it would only take 3.5 years, and interestingly enough, it would only take 4 days over the Draw Something app. In fact, it is estimated that for the average person, 32% of their time spent on iOS and Android smart phones is doing games, including apps. Compare that to 18% on Facebook and 18% on a web browser, such as Chrome.

Before the Internet, before television, (but not before newspapers), most people had a radio in their homes as a means of gaining information from the world.
The peak of the radio age was reached in the 1930s and 1940s. Even though many people could not afford washing machines, vacuum cleaners, or cars, they desperately struggled to keep up their payments on radios. Though many of these things were relatively inexpensive, the radio age was shortly after the Great Depression, and many people were out of work.

In 1935, more than 22 million Americans had radios in their homes, and at this time, cars were being sold with factory-installed radios. Radios were the television, the Facebook and the newspaper of long ago. Families sat around the radio and listened to shows like "Amos n' Andy", "Gunsmoke", "Superman", "Dick Tracey", and the "Sixty-Four Dollar Question" (and yes, $64.00 was the top prize!). Families would sit around the radio, and much like reading a book, use their imaginations as they listened to the radio shows.

Interestingly enough, when some of the radio shows eventually made the transition to television, audiences were...disappointed. The television shows could not measure up to the images of the people and surroundings that radio listeners had imagined. Also not helping this transition was the fact that some radio personalities did NOT make good television personalities, sadly because they did not photograph well. A once famous radio personality, who was significantly overweight, had to be replaced with someone different, who of course had a much different voice than the original star. As comes the phrase, "video killed the radio star."

Radio has a major impact on setting the pace for what we consider to be entertainment now. Now, it is primarily used for music purposes and secondarily for news. If your teacher asked you how radios work, you'd probably answer "radio waves" and you'd be right. But what you may not have known is that we rely on radio waves for more than just what we refer to as the "radio" today. In fact, many technologies rely on radio waves, such as: wireless networks, cell phones, GPS receivers, garage door openers and television broadcasts.

Though it may not seem like it at first, radio waves are actually a quite simple way of communication. Any radio setup has two basic parts: the transmitter and the receiver. By "radio setup" we mean anything: baby monitors, cell phones, Wi-Fi, remote controls. The transmitter takes some sort of message (examples include an image or sound) and encodes it onto a radio wave. The receiver receives the wave and decodes the message. In order to encode a radio wave, you need to modulate it. The simplest form of modulation is pulse modulation. Recall that a radio wave is simply an electromagnetic wave. You can create electromagnetic fields, thus creating radio waves. PM (pulse modulation) is exactly how Morse code works- you simply turn the wave on and off, by turning an electromagnetic field on and off.

It is a fairly simple process to create your own radio wave. You would need to create a basic transmitter, which can be done by creating a rapidly changing electric current in a wire. You can do this by rapidly connecting and disconnecting a battery.

This is a simple transmitter that was built using a battery. An antenna could pick up its signal. This is much like the first wireless transmission using Morse code.

Low frequency

High frequency

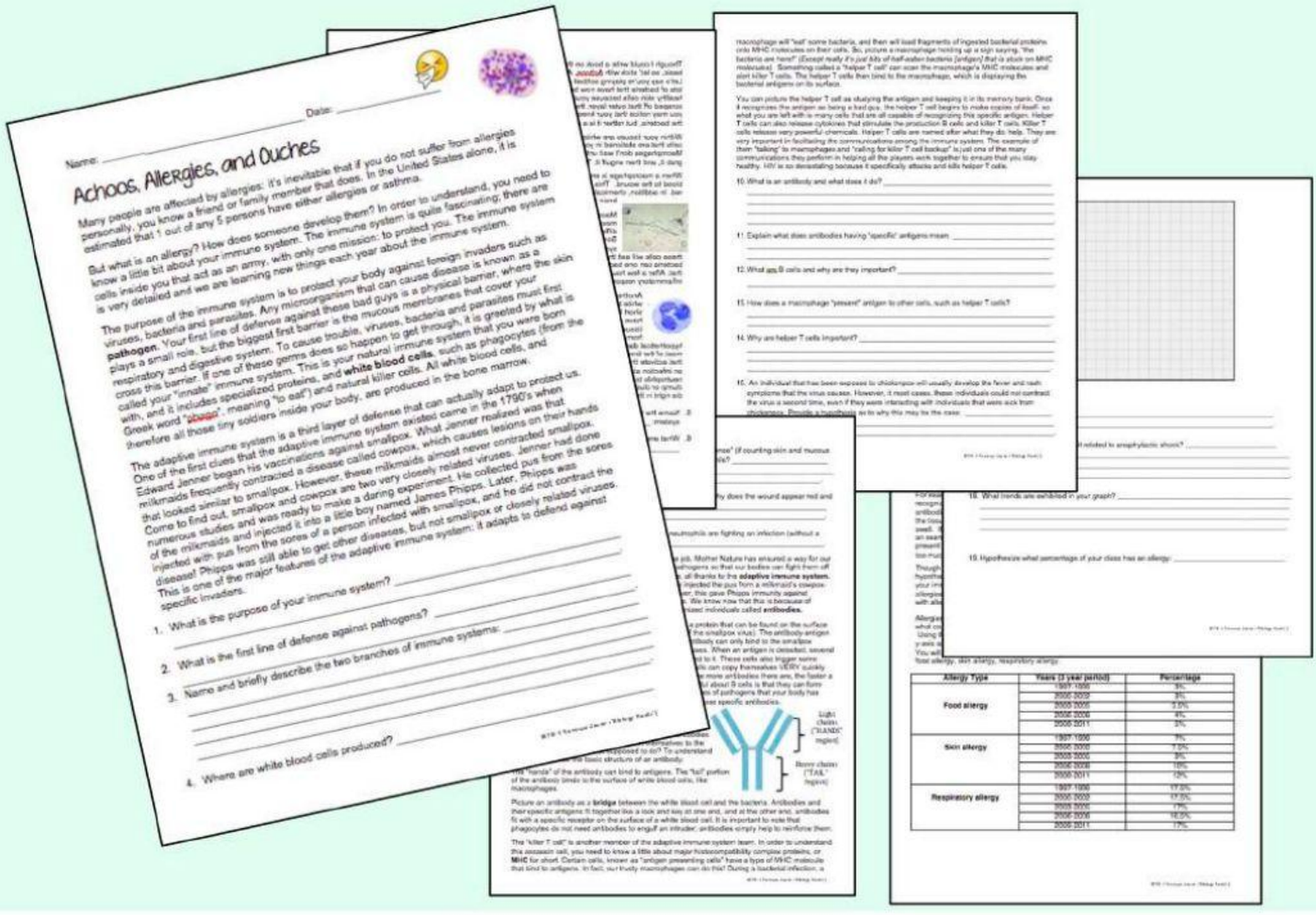
2. Shorter radio waves have (circle one) [higher / lower] frequencies and move [faster / slower / the same speed] as/than longer radio waves.
3. Describe what is meant by the term "frequency" and what unit is used to measure frequencies. _____
4. Why do you think that there are more FM stations available on the radio than AM stations?

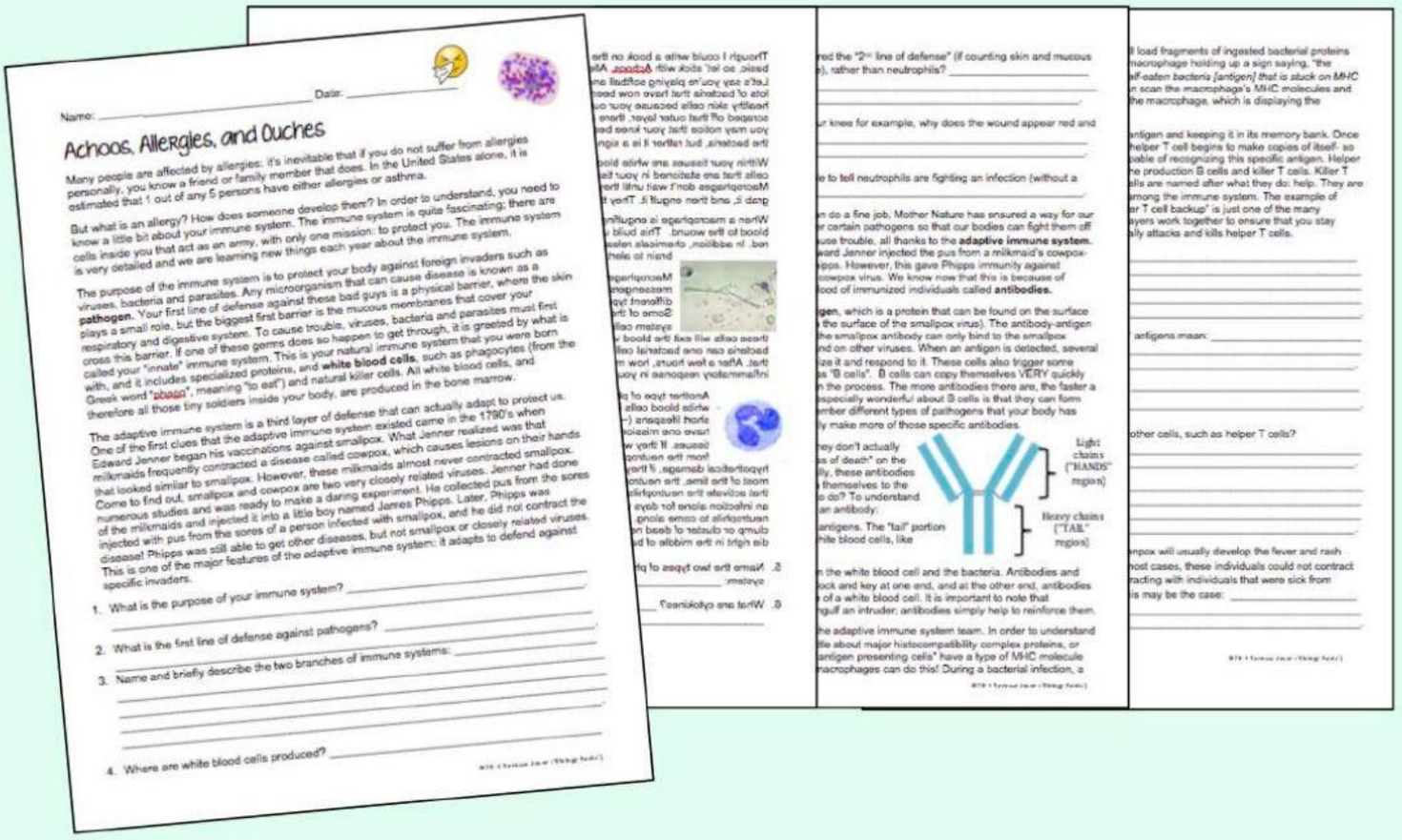
Generation Y has been exposed to radio waves all their life, and some may even say they rely on it. Yet, most of them do not realize their cell phones, Wi-Fi, and video games all operate in the invisible world of radio waves. Explores a brief history of radio, how radios work, how cell phones work, and finally they must analyze a pie chart about cell phone use.

PLAN "I": IMMUNE SYSTEM

Achoos, Allergies, and Ouches

- Why is there pain and swelling when we skin our knee?
- What causes an allergic response?
- Are allergies on the rise?
- What are the key players in our immune system and how are they so awesome?





Name: _____ Date: _____

Achoos, Allergies, and Ouches

Many people are affected by allergies: it's inevitable that if you do not suffer from allergies personally, you know a friend or family member that does. In the United States alone, it is estimated that 1 out of any 5 persons have either allergies or asthma.

But what is an allergy? How does someone develop them? In order to understand, you need to know a little bit about your immune system. The immune system is quite fascinating; there are cells inside you that act as an army, with only one mission: to protect you. The immune system is very detailed and we are learning new things each year about the immune system.

The purpose of the immune system is to protect your body against foreign invaders such as viruses, bacteria and parasites. Any microorganism that can cause disease is known as a **pathogen**. Your first line of defense against these bad guys is a physical barrier, where the skin plays a small role, but the biggest first barrier is the mucous membranes that cover your respiratory and digestive system. To cause trouble, viruses, bacteria and parasites must first cross this barrier. If one of these germs does so happen to get through, it is greeted by what is called your "innate" immune system. This is your natural immune system that you were born with, and it includes specialized proteins, and **white blood cells**, such as phagocytes (from the Greek word "phago", meaning "to eat") and natural killer cells. All white blood cells, and therefore all those tiny soldiers inside your body, are produced in the bone marrow.

The adaptive immune system is a third layer of defense that can actually adapt to protect us. One of the first clues that the adaptive immune system existed came in the 1790's when Edward Jenner began his vaccinations against smallpox. What Jenner realized was that milkmaids frequently contracted a disease called cowpox, which causes lesions on their hands that looked similar to smallpox. However, these milkmaids almost never contracted smallpox. Come to find out, smallpox and cowpox are two very closely related viruses. Jenner had done numerous studies and was ready to make a daring experiment. He collected pus from the sores of the milkmaids and injected it into a little boy named James Phipps. Later, Phipps was injected with pus from the sores of a person infected with smallpox, and he did not contract the disease! Phipps was still able to get other diseases, but not smallpox or closely related viruses. This is one of the major features of the adaptive immune system: it adapts to defend against specific invaders.

1. What is the purpose of your immune system? _____
2. What is the first line of defense against pathogens? _____
3. Name and briefly describe the two branches of immune systems: _____
4. Where are white blood cells produced? _____

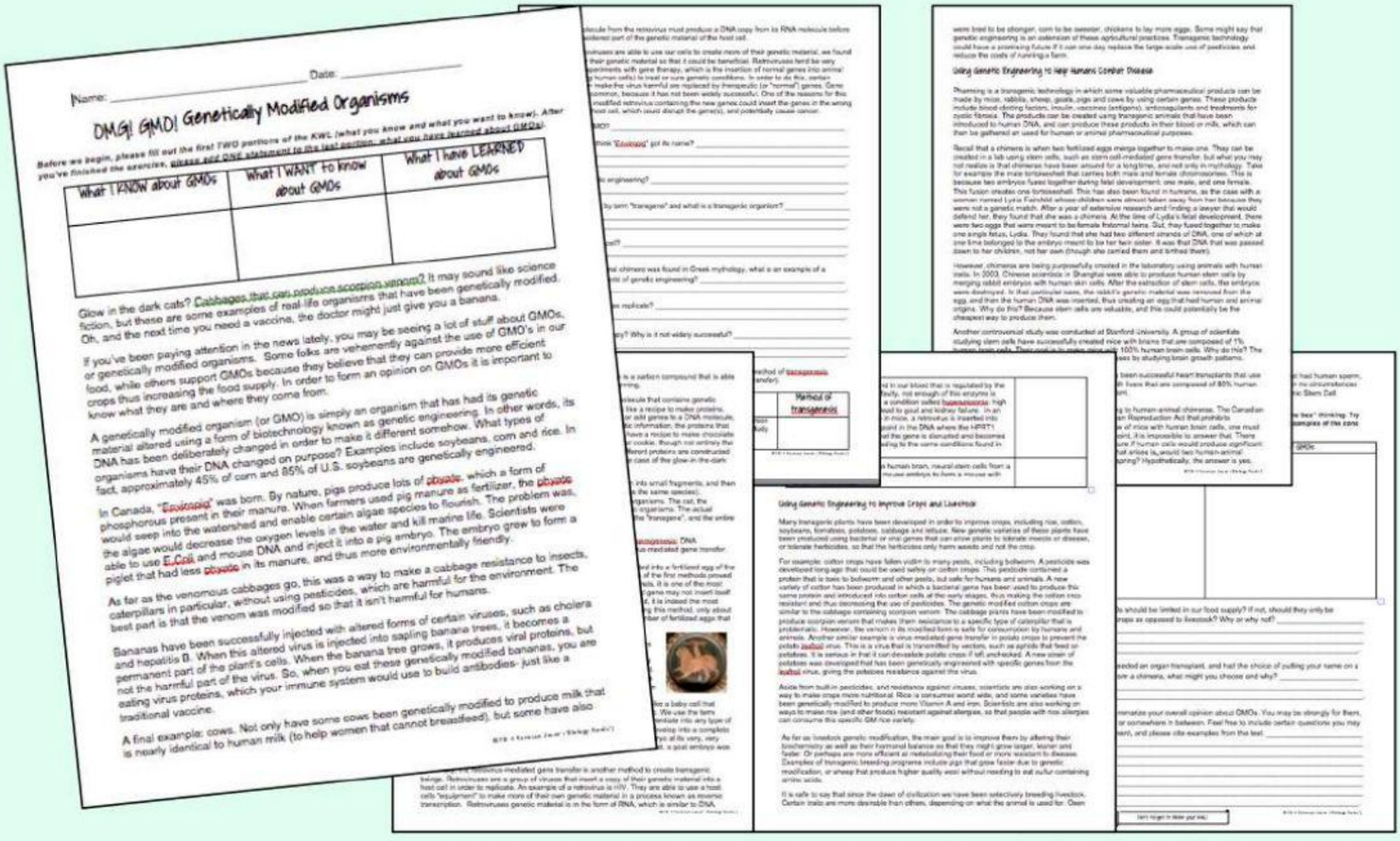
Allergies, Achoos, and Ouches- this is a compact introduction to the mysterious world of the immune system. Students read about macrophages, killer T cells, antigens and antibodies and then from there can understand a bit more about allergies. Line graph required (specific directions included).

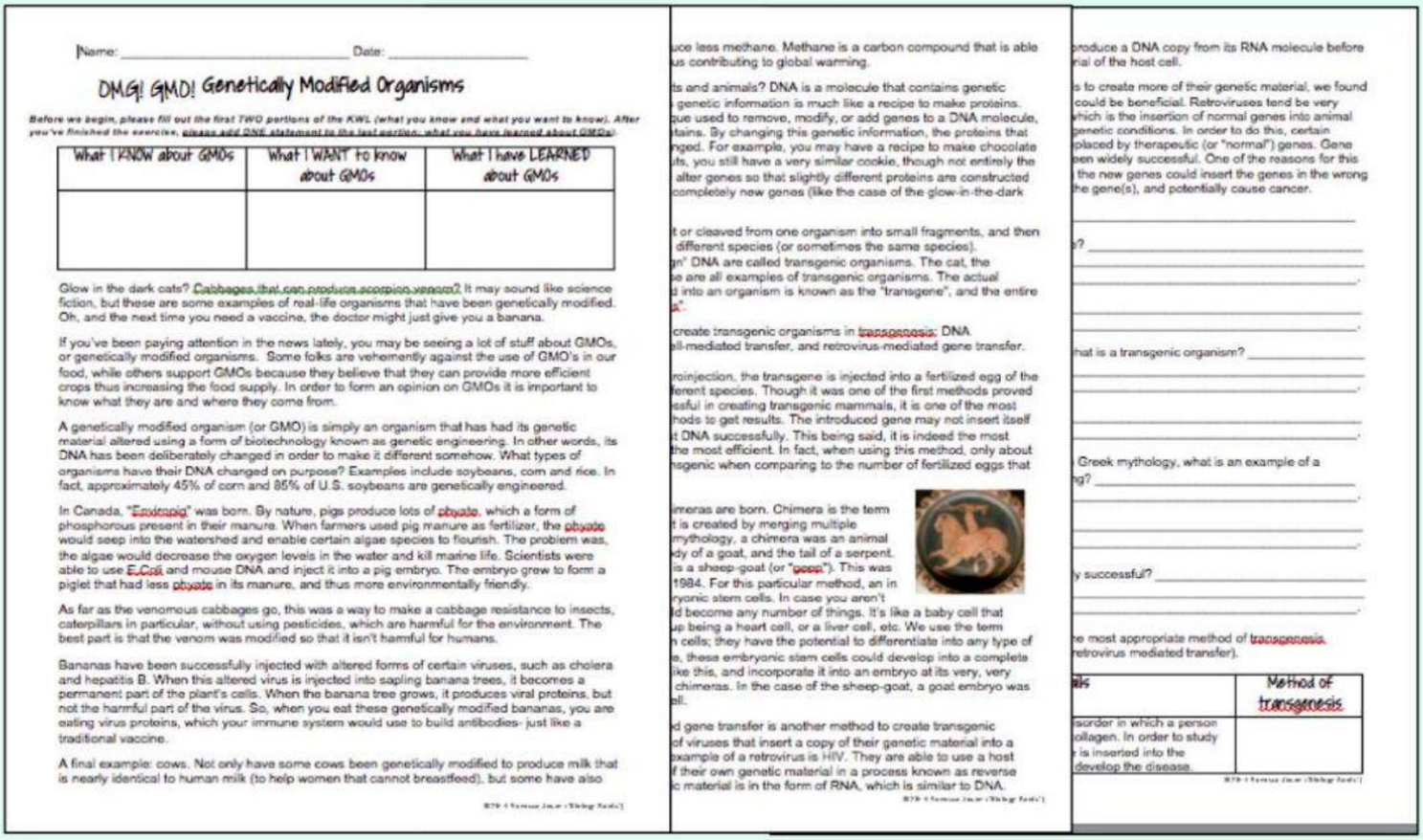
Can be reduced to 4 pages by omitting the graphing exercise).

PLAN "J": GENETICALLY MODIFIED ORGANISMS

OMG! GMO! Genetically Modified Organisms

- What is a GMO?
- Are GMOs harmful or helpful?
- When might we use a GMO?
- Are GMOs ethical?
- How are GMOs produced (genetic engineering)





Name: _____ Date: _____

DMG! GMO! Genetically Modified Organisms

Before we begin, please fill out the first TWO portions of the KWL (what you know and what you want to know). After you've finished the exercise, please add ONE statement to the last portion: what you have learned about GMOs!

What I KNOW about GMOs	What I WANT to know about GMOs	What I have LEARNED about GMOs

Glow in the dark cats? Cabbages that can produce scorpion venom? It may sound like science fiction, but these are some examples of real-life organisms that have been genetically modified. Oh, and the next time you need a vaccine, the doctor might just give you a banana.

If you've been paying attention in the news lately, you may be seeing a lot of stuff about GMOs, or genetically modified organisms. Some folks are vehemently against the use of GMO's in our food, while others support GMOs because they believe that they can provide more efficient crops thus increasing the food supply. In order to form an opinion on GMOs it is important to know what they are and where they come from.

A genetically modified organism (or GMO) is simply an organism that has had its genetic material altered using a form of biotechnology known as genetic engineering. In other words, its DNA has been deliberately changed in order to make it different somehow. What types of organisms have their DNA changed on purpose? Examples include soybeans, corn and rice. In fact, approximately 45% of corn and 85% of U.S. soybeans are genetically engineered.

In Canada, "Enviropig" was born. By nature, pigs produce lots of phytate, which a form of phosphorous present in their manure. When farmers used pig manure as fertilizer, the phytate would seep into the watershed and enable certain algae species to flourish. The problem was, the algae would decrease the oxygen levels in the water and kill marine life. Scientists were able to use E.Coli and mouse DNA and inject it into a pig embryo. The embryo grew to form a piglet that had less phytate in its manure, and thus more environmentally friendly.

As far as the venomous cabbages go, this was a way to make a cabbage resistance to insects, caterpillars in particular, without using pesticides, which are harmful for the environment. The best part is that the venom was modified so that it isn't harmful for humans.

Bananas have been successfully injected with altered forms of certain viruses, such as cholera and hepatitis B. When this altered virus is injected into sapling banana trees, it becomes a permanent part of the plant's cells. When the banana tree grows, it produces viral proteins, but not the harmful part of the virus. So, when you eat these genetically modified bananas, you are eating virus proteins, which your immune system would use to build antibodies- just like a traditional vaccine.

A final example: cows. Not only have some cows been genetically modified to produce milk that is nearly identical to human milk (to help women that cannot breastfeed), but some have also

uce less methane. Methane is a carbon compound that is able us contributing to global warming.

ts and animals? DNA is a molecule that contains genetic genetic information is much like a recipe to make proteins. ue used to remove, modify, or add genes to a DNA molecule, tains. By changing this genetic information, the proteins that nged. For example, you may have a recipe to make chocolate its, you still have a very similar cookie, though not entirely the alter genes so that slightly different proteins are constructed completely new genes (like the case of the glow-in-the-dark

t or cleaved from one organism into small fragments, and then different species (or sometimes the same species). n" DNA are called transgenic organisms. The cat, the e are all examples of transgenic organisms. The actual d into an organism is known as the "transgene", and the entire e".

create transgenic organisms in transgenesis: DNA ll-mediated transfer, and retrovirus-mediated gene transfer.

roinjection, the transgene is injected into a fertilized egg of the ferent species. Though it was one of the first methods proved ssful in creating transgenic mammals, it is one of the most hods to get results. The introduced gene may not insert itself t DNA successfully. This being said, it is indeed the most the most efficient. In fact, when using this method, only about nsgenic when comparing to the number of fertilized eggs that

imeras are born. Chimera is the term t is created by merging multiple mythology, a chimera was an animal dy of a goat, and the tail of a serpent. is a sheep-goat (or "geep"). This was 1984. For this particular method, an in ryonic stem cells. In case you aren't ld become any number of things. It's like a baby cell that up being a heart cell, or a liver cell, etc. We use the term h cells; they have the potential to differentiate into any type of e, these embryonic stem cells could develop into a complete like this, and incorporate it into an embryo at its very, very chimeras. In the case of the sheep-goat, a goat embryo was ll.

d gene transfer is another method to create transgenic of viruses that insert a copy of their genetic material into a xample of a retrovirus is HIV. They are able to use a host f their own genetic material in a process known as reverse c material is in the form of RNA, which is similar to DNA.

produce a DNA copy from its RNA molecule before rial of the host cell.

s to create more of their genetic material, we found could be beneficial. Retroviruses tend be very hich is the insertion of normal genes into animal enetic conditions. In order to do this, certain placed by therapeutic (or "normal") genes. Gene en widely successful. One of the reasons for this the new genes could insert the genes in the wrong he gene(s), and potentially cause cancer.

hat is a transgenic organism? _____

Greek mythology, what is an example of a g? _____

y successful? _____

e most appropriate method of transgenesis. retrovirus mediated transfer).

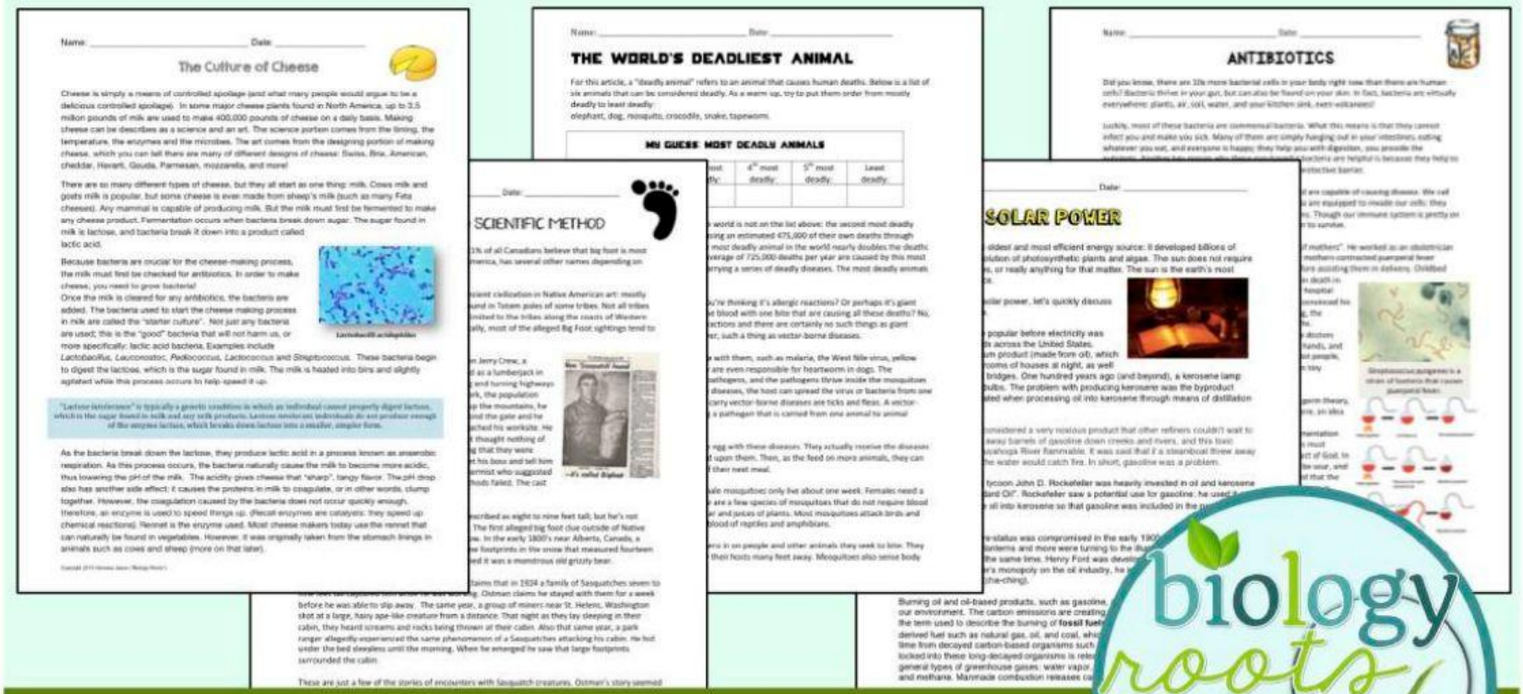
als	Method of transgenesis
isorder in which a person collagen. In order to study is inserted into the develop the disease.	

OMG! GMO! Genetically Modified Organisms- This is an article about genetically modified organisms, or GMOs. The article sheds an unbiased light on GMOs; it includes how they are made, what they are used for. Students do a KWL as well as an ending statement on where they stand, and some questions on the ethics of chimeras.

This is perfect for a 2-day absence!

Can be shortened if necessary to make it 3.5 pages.

emergency sub plans



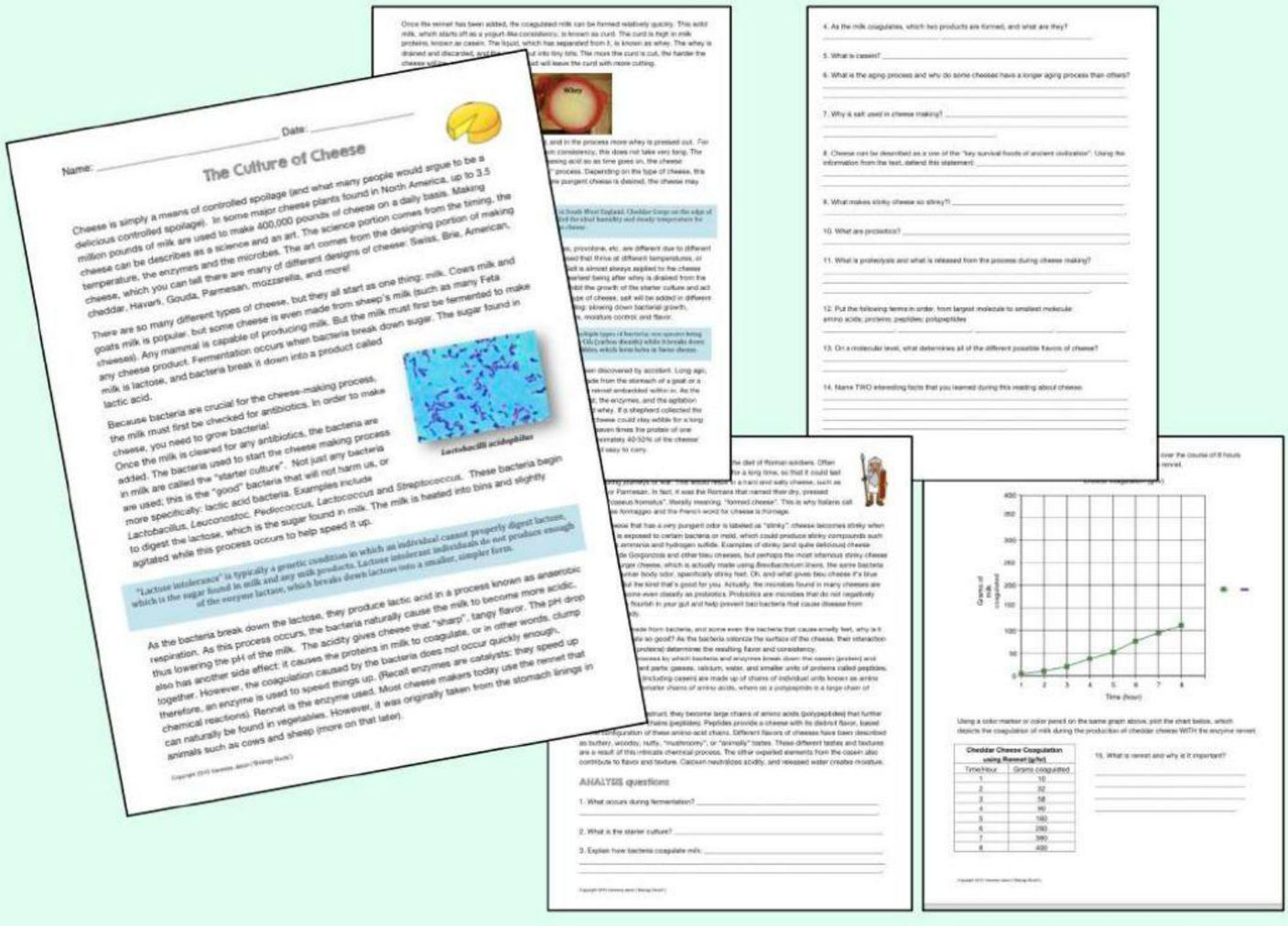
VOLUME III PLANS K-O
SET OF 5 SCIENCE PLANS

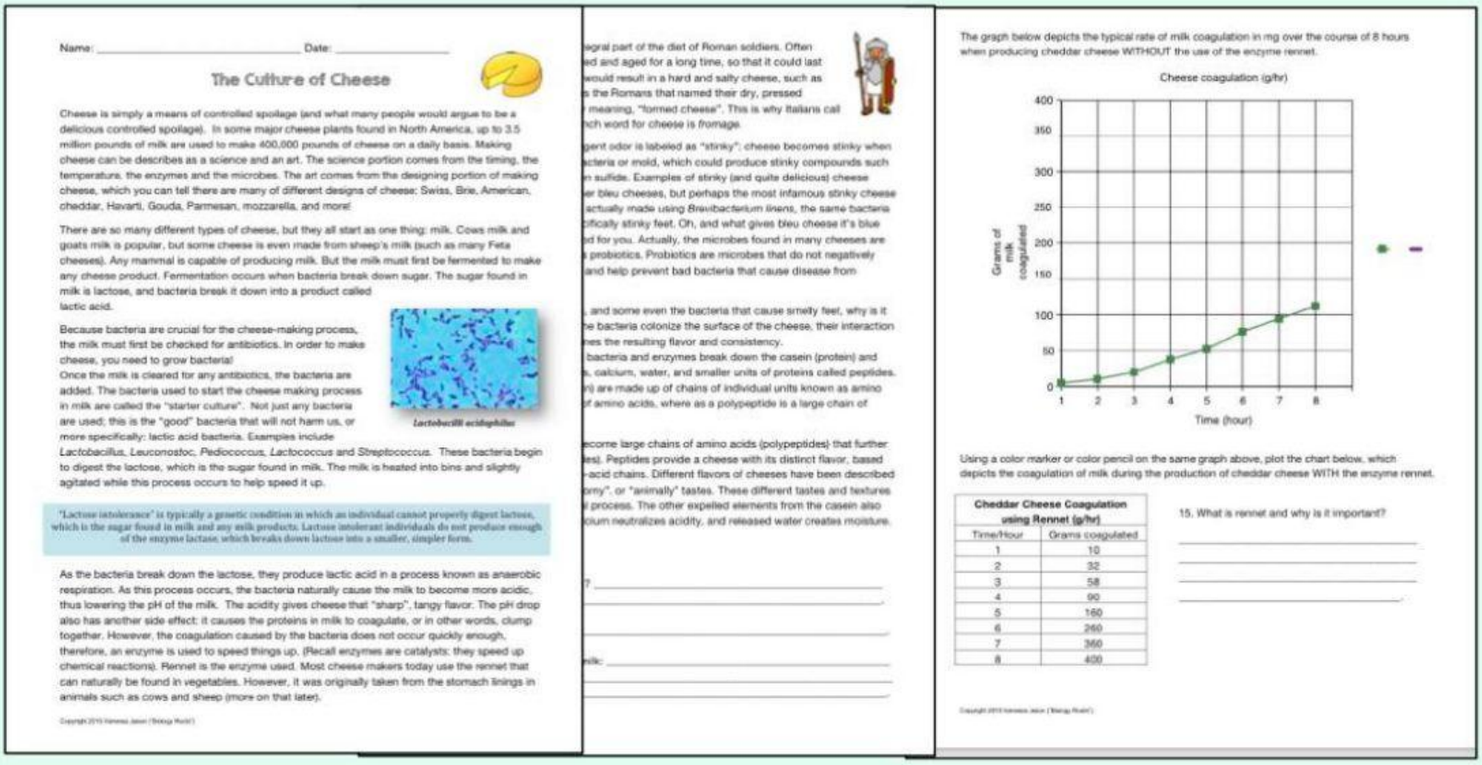
- Sub plans are long enough to last the entire class
- Relevant topics that relate to students
- CCSS aligned for literacy in science

PLAN "K": ENZYMES, FERMENTATION

The Culture of Cheese:
explores the cheese making process and the history of cheese making, including bacteria, enzymes, and fermentation.

- History of Cheese
- Science behind the cheese making process
    - Fermentation, lactic acid, the role of bacteria
    - Enzymes and proteins





Name: _____ Date: _____

The Culture of Cheese

Cheese is simply a means of controlled spoilage (and what many people would argue to be a delicious controlled spoilage). In some major cheese plants found in North America, up to 3.5 million pounds of milk are used to make 400,000 pounds of cheese on a daily basis. Making cheese can be describes as a science and an art. The science portion comes from the timing, the temperature, the enzymes and the microbes. The art comes from the designing portion of making cheese, which you can tell there are many of different designs of cheese: Swiss, Brie, American, cheddar, Havarti, Gouda, Parmesan, mozzarella, and more!

There are so many different types of cheese, but they all start as one thing: milk. Cows milk and goats milk is popular, but some cheese is even made from sheep's milk (such as many Feta cheeses). Any mammal is capable of producing milk. But the milk must first be fermented to make any cheese product. Fermentation occurs when bacteria break down sugar. The sugar found in milk is lactose, and bacteria break it down into a product called lactic acid.

Because bacteria are crucial for the cheese-making process, the milk must first be checked for antibiotics. In order to make cheese, you need to grow bacteria!
Once the milk is cleared for any antibiotics, the bacteria are added. The bacteria used to start the cheese making process in milk are called the "starter culture". Not just any bacteria are used; this is the "good" bacteria that will not harm us, or more specifically: lactic acid bacteria. Examples include *Lactobacillus, Leuconostoc, Pediococcus, Lactococcus* and *Streptococcus*. These bacteria begin to digest the lactose, which is the sugar found in milk. The milk is heated into bins and slightly agitated while this process occurs to help speed it up.

Lactobacilli acidophilus

"Lactose intolerance" is typically a genetic condition in which an individual cannot properly digest lactose, which is the sugar found in milk and any milk products. Lactose intolerant individuals do not produce enough of the enzyme lactase, which breaks down lactose into a smaller, simpler form.

As the bacteria break down the lactose, they produce lactic acid in a process known as anaerobic respiration. As this process occurs, the bacteria naturally cause the milk to become more acidic, thus lowering the pH of the milk. The acidity gives cheese that "sharp", tangy flavor. The pH drop also has another side effect: it causes the proteins in milk to coagulate, or in other words, clump together. However, the coagulation caused by the bacteria does not occur quickly enough, therefore, an enzyme is used to speed things up. (Recall enzymes are catalysts: they speed up chemical reactions). Rennet is the enzyme used. Most cheese makers today use the rennet that can naturally be found in vegetables. However, it was originally taken from the stomach linings in animals such as cows and sheep (more on that later).

Copyright 2015 Vanessa Jaton (Biology Roots!)

egral part of the diet of Roman soldiers. Often
ed and aged for a long time, so that it could last
would result in a hard and salty cheese, such as
s the Romans that named their dry, pressed
meaning, "formed cheese". This is why Italians call
ch word for cheese is *fromage*.

gent odor is labeled as "stinky": cheese becomes stinky when
cteria or mold, which could produce stinky compounds such
n sulfide. Examples of stinky (and quite delicious) cheese
er bleu cheeses, but perhaps the most infamous stinky cheese
actually made using *Brevibacterium linens*, the same bacteria
fically stinky feet. Oh, and what gives bleu cheese it's blue
d for you. Actually, the microbes found in many cheeses are
probiotics. Probiotics are microbes that do not negatively
and help prevent bad bacteria that cause disease from

, and some even the bacteria that cause smelly feet, why is it
e bacteria colonize the surface of the cheese, their interaction
nes the resulting flavor and consistency.
bacteria and enzymes break down the casein (protein) and
, calcium, water, and smaller units of proteins called peptides.
n) are made up of chains of individual units known as amino
f amino acids, where as a polypeptide is a large chain of

ecome large chains of amino acids (polypeptides) that further
les). Peptides provide a cheese with its distinct flavor, based
-acid chains. Different flavors of cheeses have been described
ony", or "animally" tastes. These different tastes and textures
process. The other expelled elements from the casein also
cium neutralizes acidity, and released water creates moisture.

?

ilk:

The graph below depicts the typical rate of milk coagulation in mg over the course of 8 hours when producing cheddar cheese WITHOUT the use of the enzyme rennet.

Cheese coagulation (g/hr)

Using a color marker or color pencil on the same graph above, plot the chart below, which depicts the coagulation of milk during the production of cheddar cheese WITH the enzyme rennet.

Cheddar Cheese Coagulation using Rennet (g/hr)	
Time/Hour	Grams coagulated
1	10
2	32
3	58
4	90
5	160
6	260
7	360
8	400

15. What is rennet and why is it important?

_____
_____
_____
_____.

Copyright 2015 Vanessa Jaton (Biology Roots!)

The Culture of Cheese

5 pages- the last page is a graphing exercise "Coagulation over time" that can be omitted if you'd prefer to cut it down to 4 pages.

This lesson covers the basics behind cheese-making: bacteria, lactose, fermentation, lactic acid, proteolysis, coagulation.

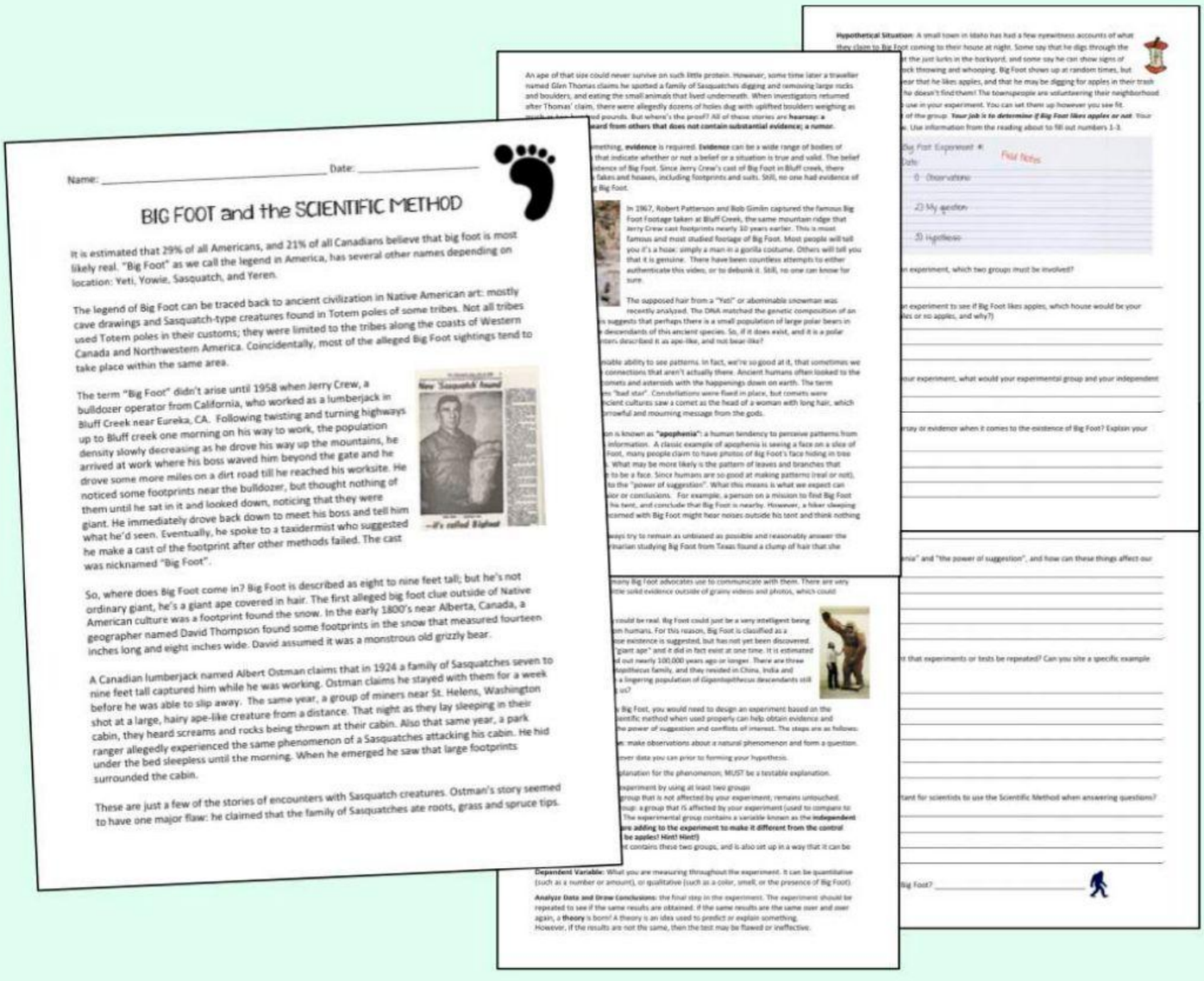
There is also a brief and interesting history portion!

As always, these lessons are designed to captivate a secondary audience!

PLAN "L": SCIENTIFIC METHOD

Big Foot and the Scientific Method –

- Brief history of "Big Foot"
- Evidence, hearsay, apophenia, the power of suggestion
- Observations
- Variables
- Setting up an Experiment



Name: _____ Date: _____

BIG FOOT and the SCIENTIFIC METHOD

It is estimated that 29% of all Americans, and 21% of all Canadians believe that big foot is most likely real. "Big Foot" as we call the legend in America, has several other names depending on location: Yeti, Yowie, Sasquatch, and Yeren.

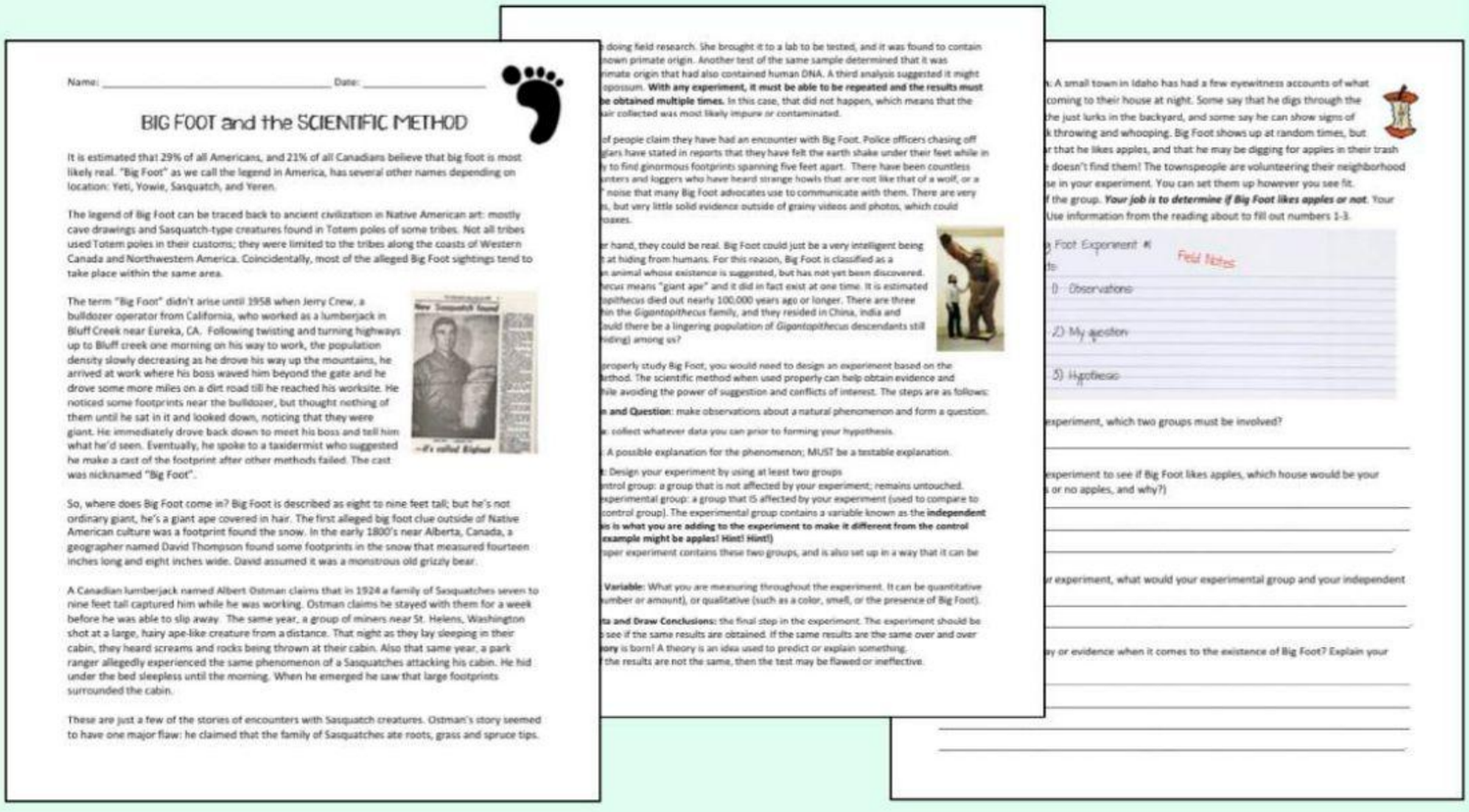
The legend of Big Foot can be traced back to ancient civilization in Native American art: mostly cave drawings and Sasquatch-type creatures found in Totem poles of some tribes. Not all tribes used Totem poles in their customs; they were limited to the tribes along the coasts of Western Canada and Northwestern America. Coincidentally, most of the alleged Big Foot sightings tend to take place within the same area.

The term "Big Foot" didn't arise until 1958 when Jerry Crew, a bulldozer operator from California, who worked as a lumberjack in Bluff Creek near Eureka, CA. Following twisting and turning highways up to Bluff creek one morning on his way to work, the population density slowly decreasing as he drove his way up the mountains, he arrived at work where his boss waved him beyond the gate and he drove some more miles on a dirt road till he reached his worksite. He noticed some footprints near the bulldozer, but thought nothing of them until he sat in it and looked down, noticing that they were giant. He immediately drove back down to meet his boss and tell him what he'd seen. Eventually, he spoke to a taxidermist who suggested he make a cast of the footprint after other methods failed. The cast was nicknamed "Big Foot".

So, where does Big Foot come in? Big Foot is described as eight to nine feet tall; but he's not ordinary giant, he's a giant ape covered in hair. The first alleged big foot clue outside of Native American culture was a footprint found the snow. In the early 1800's near Alberta, Canada, a geographer named David Thompson found some footprints in the snow that measured fourteen inches long and eight inches wide. David assumed it was a monstrous old grizzly bear.

A Canadian lumberjack named Albert Ostman claims that in 1924 a family of Sasquatches seven to nine feet tall captured him while he was working. Ostman claims he stayed with them for a week before he was able to slip away. The same year, a group of miners near St. Helens, Washington shot at a large, hairy ape-like creature from a distance. That night as they lay sleeping in their cabin, they heard screams and rocks being thrown at their cabin. Also that same year, a park ranger allegedly experienced the same phenomenon of a Sasquatches attacking his cabin. He hid under the bed sleepless until the morning. When he emerged he saw that large footprints surrounded the cabin.

These are just a few of the stories of encounters with Sasquatch creatures. Ostman's story seemed to have one major flaw: he claimed that the family of Sasquatches ate roots, grass and spruce tips.



Name: _____ Date: _____

BIG FOOT and the SCIENTIFIC METHOD

It is estimated that 29% of all Americans, and 21% of all Canadians believe that big foot is most likely real. "Big Foot" as we call the legend in America, has several other names depending on location: Yeti, Yowie, Sasquatch, and Yeren.

The legend of Big Foot can be traced back to ancient civilization in Native American art: mostly cave drawings and Sasquatch-type creatures found in Totem poles of some tribes. Not all tribes used Totem poles in their customs; they were limited to the tribes along the coasts of Western Canada and Northwestern America. Coincidentally, most of the alleged Big Foot sightings tend to take place within the same area.

The term "Big Foot" didn't arise until 1958 when Jerry Crew, a bulldozer operator from California, who worked as a lumberjack in Bluff Creek near Eureka, CA. Following twisting and turning highways up to Bluff creek one morning on his way to work, the population density slowly decreasing as he drove his way up the mountains, he arrived at work where his boss waved him beyond the gate and he drove some more miles on a dirt road till he reached his worksite. He noticed some footprints near the bulldozer, but thought nothing of them until he sat in it and looked down, noticing that they were giant. He immediately drove back down to meet his boss and tell him what he'd seen. Eventually, he spoke to a taxidermist who suggested he make a cast of the footprint after other methods failed. The cast was nicknamed "Big Foot".

So, where does Big Foot come in? Big Foot is described as eight to nine feet tall; but he's not ordinary giant, he's a giant ape covered in hair. The first alleged big foot clue outside of Native American culture was a footprint found the snow. In the early 1800's near Alberta, Canada, a geographer named David Thompson found some footprints in the snow that measured fourteen inches long and eight inches wide. David assumed it was a monstrous old grizzly bear.

A Canadian lumberjack named Albert Ostman claims that in 1924 a family of Sasquatches seven to nine feet tall captured him while he was working. Ostman claims he stayed with them for a week before he was able to slip away. The same year, a group of miners near St. Helens, Washington shot at a large, hairy ape-like creature from a distance. That night as they lay sleeping in their cabin, they heard screams and rocks being thrown at their cabin. Also that same year, a park ranger allegedly experienced the same phenomenon of a Sasquatches attacking his cabin. He hid under the bed sleepless until the morning. When he emerged he saw that large footprints surrounded the cabin.

These are just a few of the stories of encounters with Sasquatch creatures. Ostman's story seemed to have one major flaw: he claimed that the family of Sasquatches ate roots, grass and spruce tips.

doing field research. She brought it to a lab to be tested, and it was found to contain known primate origin. Another test of the same sample determined that it was imate origin that had also contained human DNA. A third analysis suggested it might opossum. **With any experiment, it must be able to be repeated and the results must be obtained multiple times.** In this case, that did not happen, which means that the air collected was most likely impure or contaminated.

of people claim they have had an encounter with Big Foot. Police officers chasing off gars have stated in reports that they have felt the earth shake under their feet while in y to find ginormous footprints spanning five feet apart. There have been countless nters and loggers who have heard strange howls that are not like that of a wolf, or a " noise that many Big Foot advocates use to communicate with them. There are very s, but very little solid evidence outside of grainy videos and photos, which could oaxes.

r hand, they could be real. Big Foot could just be a very intelligent being at hiding from humans. For this reason, Big Foot is classified as a n animal whose existence is suggested, but has not yet been discovered. ecus means "giant ape" and it did in fact exist at one time. It is estimated opithecus died out nearly 100,000 years ago or longer. There are three hin the *Gigantopithecus* family, and they resided in China, India and ould there be a lingering population of *Gigantopithecus* descendants still iding) among us?

properly study Big Foot, you would need to design an experiment based on the ethod. The scientific method when used properly can help obtain evidence and hile avoiding the power of suggestion and conflicts of interest. The steps are as follows:

n and Question: make observations about a natural phenomenon and form a question.

e. collect whatever data you can prior to forming your hypothesis.

. A possible explanation for the phenomenon; MUST be a testable explanation.

: Design your experiment by using at least two groups

ntrol group: a group that is not affected by your experiment; remains untouched.
xperimental group: a group that IS affected by your experiment (used to compare to control group). The experimental group contains a variable known as the **independent is what you are adding to the experiment to make it different from the control example might be apples! Hint! Hint!)**

per experiment contains these two groups, and is also set up in a way that it can be

Variable: What you are measuring throughout the experiment. It can be quantitative umber or amount), or qualitative (such as a color, smell, or the presence of Big Foot).

ta and Draw Conclusions: the final step in the experiment. The experiment should be see if the same results are obtained. If the same results are the same over and over **ory** is born! A theory is an idea used to predict or explain something.
the results are not the same, then the test may be flawed or ineffective.

. A small town in Idaho has had a few eyewitness accounts of what coming to their house at night. Some say that he digs through the the just lurks in the backyard, and some say he can show signs of k throwing and whooping. Big Foot shows up at random times, but r that he likes apples, and that he may be digging for apples in their trash doesn't find them! The townspeople are volunteering their neighborhood se in your experiment. You can set them up however you see fit.
f the group. ***Your job is to determine if Big Foot likes apples or not***. Your Use information from the reading about to fill out numbers 1-3.

Foot Experiment #1 Field Notes

1) Observations

2) My question

3) Hypothesis

experiment, which two groups must be involved?

experiment to see if Big Foot likes apples, which house would be your s or no apples, and why?)

r experiment, what would your experimental group and your independent

y or evidence when it comes to the existence of Big Foot? Explain your

Big Foot and the Scientific Method – 5 pages
This takes a psychological spin on Big Foot's suggested existence and why it is so important that we use the scientific method. Students form an experiment trying to lure Big Foot with apples.

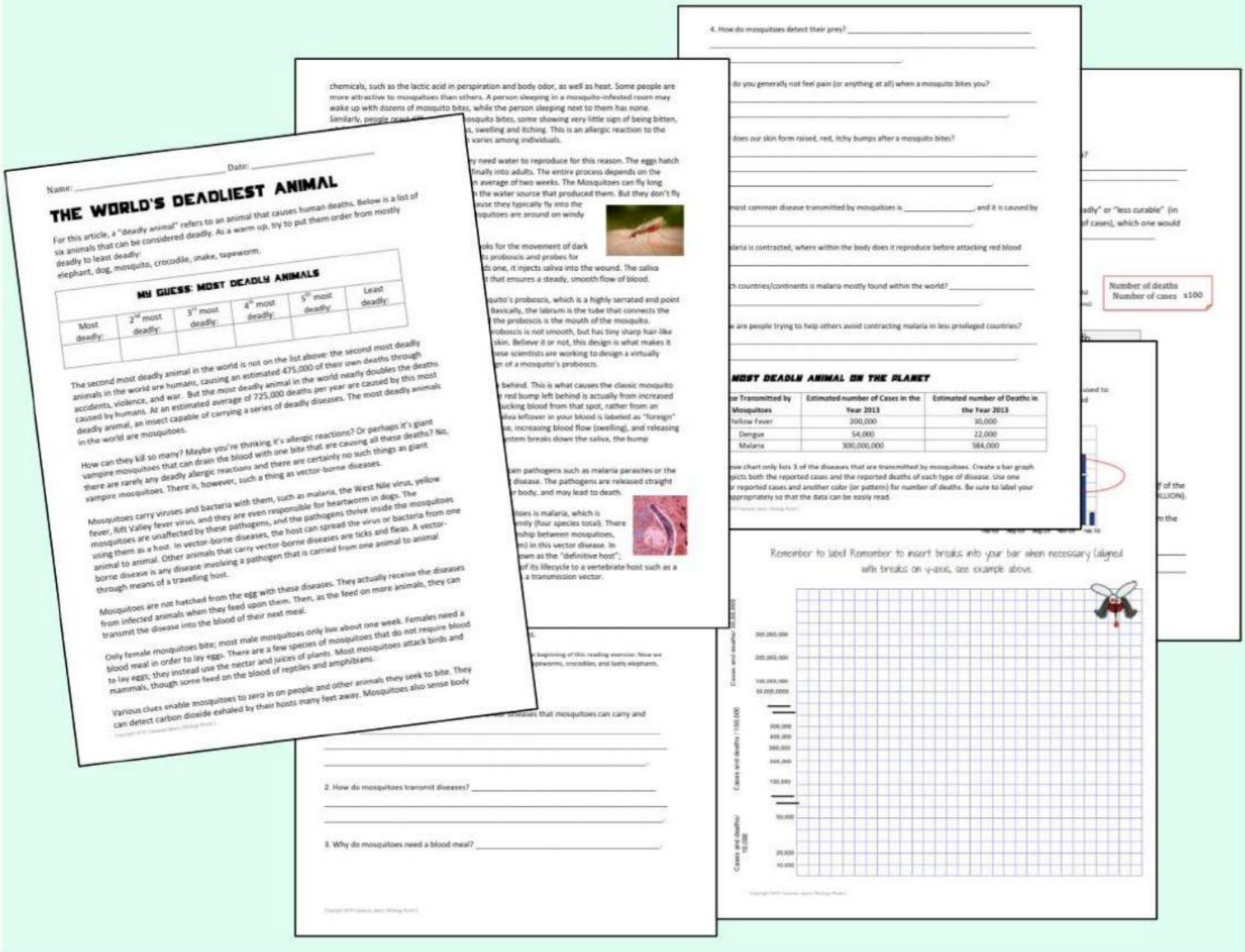
This does not try to dismiss the idea of Big Foot nor convince students that he exists. Rather, it focuses on the legend, and why it would be so hard to actually prove he exists.

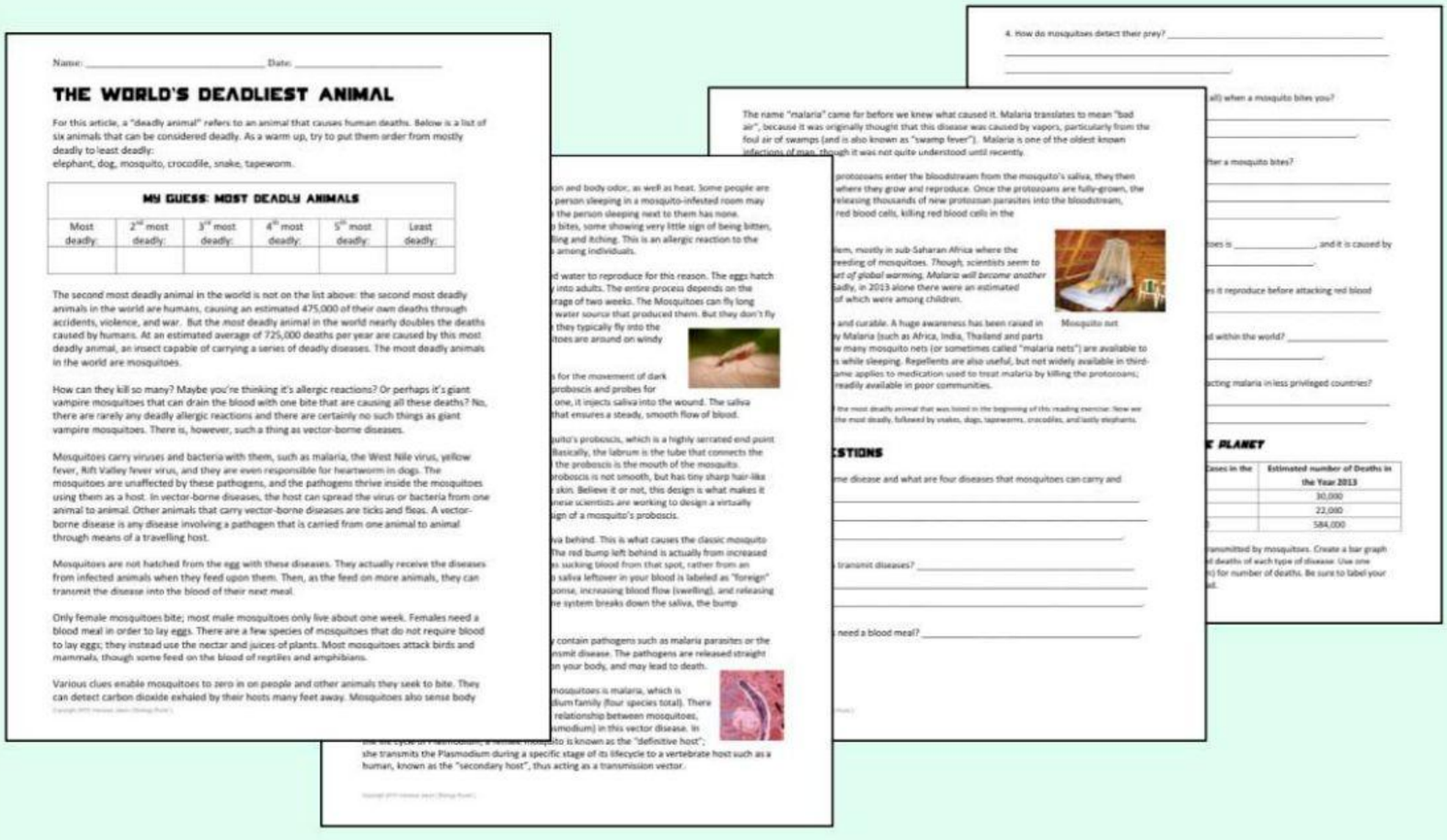
Students must try to design an experiment using their "field notes".

PLAN "M": MOSQUITOES AND VECTOR DISEASES

The World's Deadliest Animal –

- All about mosquitoes and the misery they cause!
- Vector-borne diseases
- Why mosquitoes bite
- How diseases are transmitted
- Focus on malaria





Name: _____ Date: _____

THE WORLD'S DEADLIEST ANIMAL

For this article, a "deadly animal" refers to an animal that causes human deaths. Below is a list of six animals that can be considered deadly. As a warm up, try to put them order from mostly deadly to least deadly:
elephant, dog, mosquito, crocodile, snake, tapeworm.

MY GUESS: MOST DEADLY ANIMALS					
Most deadly:	2nd most deadly:	3rd most deadly:	4th most deadly:	5th most deadly:	Least deadly:

The second most deadly animal in the world is not on the list above: the second most deadly animals in the world are humans, causing an estimated 475,000 of their own deaths through accidents, violence, and war. But the *most* deadly animal in the world nearly doubles the deaths caused by humans. At an estimated average of 725,000 deaths per year are caused by this most deadly animal, an insect capable of carrying a series of deadly diseases. The most deadly animals in the world are mosquitoes.

How can they kill so many? Maybe you're thinking it's allergic reactions? Or perhaps it's giant vampire mosquitoes that can drain the blood with one bite that are causing all these deaths? No, there are rarely any deadly allergic reactions and there are certainly no such things as giant vampire mosquitoes. There is, however, such a thing as vector-borne diseases.

Mosquitoes carry viruses and bacteria with them, such as malaria, the West Nile virus, yellow fever, Rift Valley fever virus, and they are even responsible for heartworm in dogs. The mosquitoes are unaffected by these pathogens, and the pathogens thrive inside the mosquitoes using them as a host. In vector-borne diseases, the host can spread the virus or bacteria from one animal to animal. Other animals that carry vector-borne diseases are ticks and fleas. A vector-borne disease is any disease involving a pathogen that is carried from one animal to animal through means of a travelling host.

Mosquitoes are not hatched from the egg with these diseases. They actually receive the diseases from infected animals when they feed upon them. Then, as the feed on more animals, they can transmit the disease into the blood of their next meal.

Only female mosquitoes bite; most male mosquitoes only live about one week. Females need a blood meal in order to lay eggs. There are a few species of mosquitoes that do not require blood to lay eggs; they instead use the nectar and juices of plants. Most mosquitoes attack birds and mammals, though some feed on the blood of reptiles and amphibians.

Various clues enable mosquitoes to zero in on people and other animals they seek to bite. They can detect carbon dioxide exhaled by their hosts many feet away. Mosquitoes also sense body

The name "malaria" came for before we knew what caused it. Malaria translates to mean "bad air", because it was originally thought that this disease was caused by vapors, particularly from the foul air of swamps (and is also known as "swamp fever"). Malaria is one of the oldest known infections of man, though it was not quite understood until recently.

Mosquito net

4. How do mosquitoes detect their prey? _____

	Estimated number of Deaths in the Year 2013
	30,000
	22,000
	584,000

The World's Deadliest Animal

<u>2 versions:</u>

Version with graphing- 6 pages

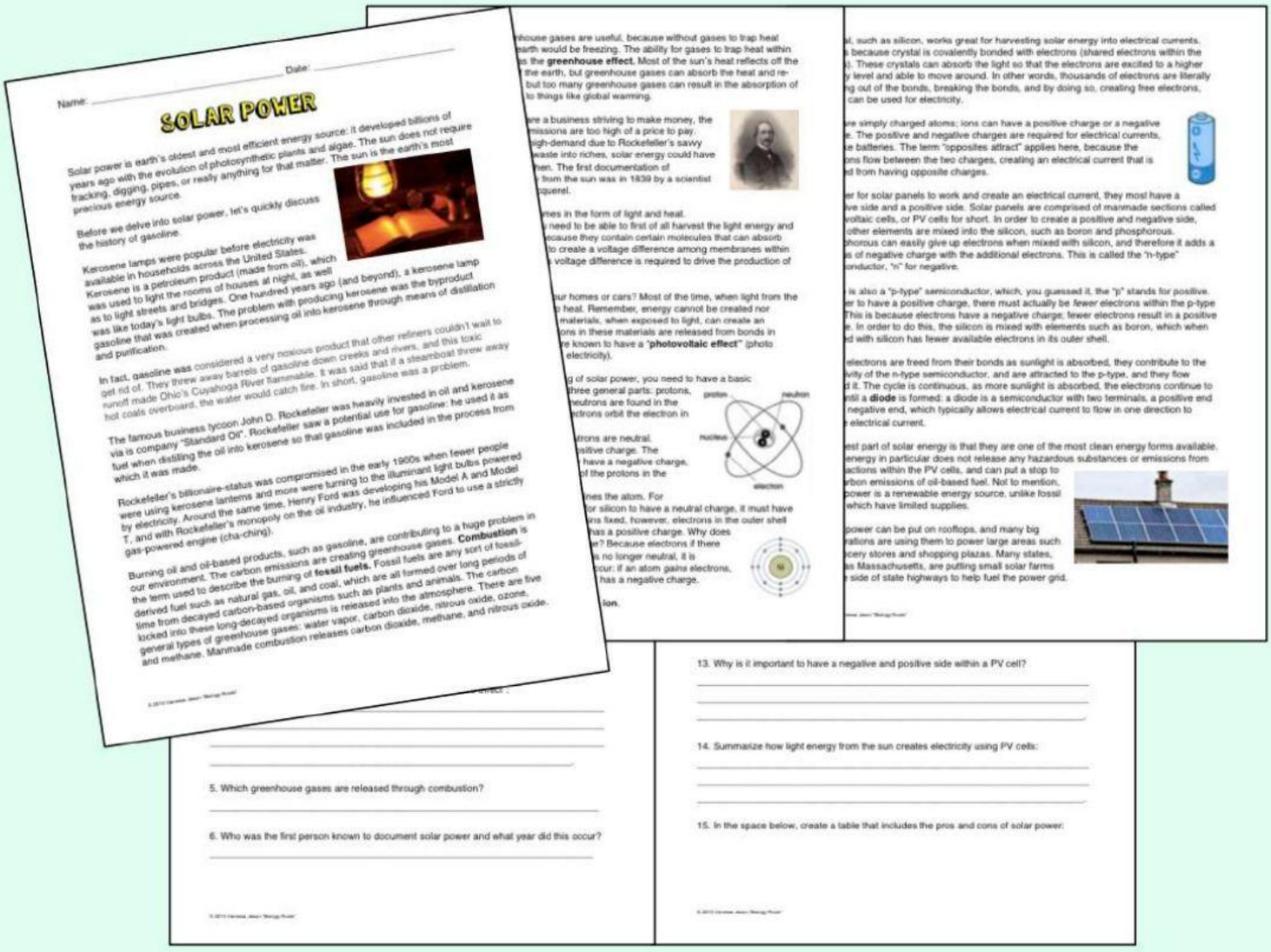
Version without graphing- 4 pages

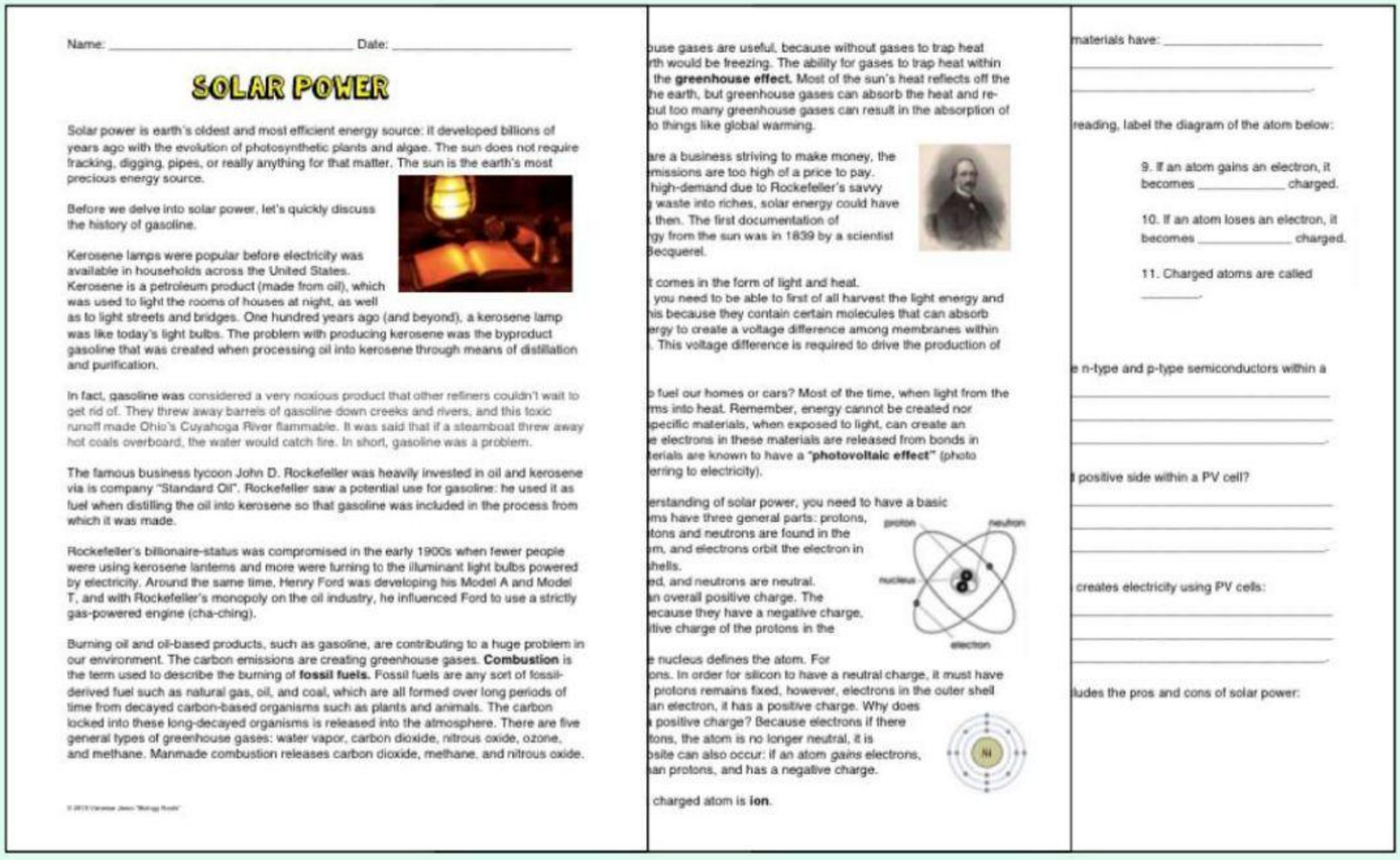
Students learn a little about mosquitoes- why they feed, how they feed, and how they transmit disease. Most of the focus is primarily on malaria. The graphing version includes cases of malaria each year. The graph deals with large numbers, so a graph-free version is also included.

PLAN "N": SOLAR POWER

Solar Power

- Brief history of the oil industry (Rockefeller; kerosene; gasoline).
- Repercussions of using fossil fuels
- What Solar Power is and how it works
- Pros and cons of solar power use





Name: _____ Date: _____

SOLAR POWER

Solar power is earth's oldest and most efficient energy source: it developed billions of years ago with the evolution of photosynthetic plants and algae. The sun does not require fracking, digging, pipes, or really anything for that matter. The sun is the earth's most precious energy source.

Before we delve into solar power, let's quickly discuss the history of gasoline.

Kerosene lamps were popular before electricity was available in households across the United States. Kerosene is a petroleum product (made from oil), which was used to light the rooms of houses at night, as well as to light streets and bridges. One hundred years ago (and beyond), a kerosene lamp was like today's light bulbs. The problem with producing kerosene was the byproduct gasoline that was created when processing oil into kerosene through means of distillation and purification.

In fact, gasoline was considered a very noxious product that other refiners couldn't wait to get rid of. They threw away barrels of gasoline down creeks and rivers, and this toxic runoff made Ohio's Cuyahoga River flammable. It was said that if a steamboat threw away hot coals overboard, the water would catch fire. In short, gasoline was a problem.

The famous business tycoon John D. Rockefeller was heavily invested in oil and kerosene via is company "Standard Oil". Rockefeller saw a potential use for gasoline: he used it as fuel when distilling the oil into kerosene so that gasoline was included in the process from which it was made.

Rockefeller's billionaire-status was compromised in the early 1900s when fewer people were using kerosene lanterns and more were turning to the illuminant light bulbs powered by electricity. Around the same time, Henry Ford was developing his Model A and Model T, and with Rockefeller's monopoly on the oil industry, he influenced Ford to use a strictly gas-powered engine (cha-ching).

Burning oil and oil-based products, such as gasoline, are contributing to a huge problem in our environment. The carbon emissions are creating greenhouse gases. **Combustion** is the term used to describe the burning of **fossil fuels.** Fossil fuels are any sort of fossil-derived fuel such as natural gas, oil, and coal, which are all formed over long periods of time from decayed carbon-based organisms such as plants and animals. The carbon locked into these long-decayed organisms is released into the atmosphere. There are five general types of greenhouse gases: water vapor, carbon dioxide, nitrous oxide, ozone, and methane. Manmade combustion releases carbon dioxide, methane, and nitrous oxide.

...use gases are useful, because without gases to trap heat ...rth would be freezing. The ability for gases to trap heat within ... the **greenhouse effect.** Most of the sun's heat reflects off the ...he earth, but greenhouse gases can absorb the heat and re-...but too many greenhouse gases can result in the absorption of ...o things like global warming.

...are a business striving to make money, the ...missions are too high of a price to pay. ... high-demand due to Rockefeller's savvy ... waste into riches, solar energy could have ... then. The first documentation of ...gy from the sun was in 1839 by a scientist ...Becquerel.

...t comes in the form of light and heat. ... you need to be able to first of all harvest the light energy and ...his because they contain certain molecules that can absorb ...ergy to create a voltage difference among membranes within ... This voltage difference is required to drive the production of

...o fuel our homes or cars? Most of the time, when light from the ...ms into heat. Remember, energy cannot be created nor ...pecific materials, when exposed to light, can create an ...e electrons in these materials are released from bonds in ...terials are known to have a "**photovoltaic effect**" (photo ...erring to electricity).

...erstanding of solar power, you need to have a basic ...ms have three general parts: protons, ...tons and neutrons are found in the ...m, and electrons orbit the electron in ...shells. ...ed, and neutrons are neutral. ...n overall positive charge. The ...ecause they have a negative charge. ...itive charge of the protons in the

...e nucleus defines the atom. For ...ons. In order for silicon to have a neutral charge, it must have ... protons remains fixed, however, electrons in the outer shell ...an electron, it has a positive charge. Why does ... positive charge? Because electrons if there ...ons, the atom is no longer neutral, it is ...osite can also occur: if an atom *gains* electrons, ...an protons, and has a negative charge.

... charged atom is **ion**.

...materials have: _____

reading, label the diagram of the atom below:

9. If an atom gains an electron, it becomes _____ charged.

10. If an atom loses an electron, it becomes _____ charged.

11. Charged atoms are called _____.

...e n-type and p-type semiconductors within a

... positive side within a PV cell?

... creates electricity using PV cells:

...ludes the pros and cons of solar power:

SOLAR POWER

Students read about the brief history of the oil industry to learn why we use primarily fossil fuels, then the lesson delves into the possibilities of solar power.

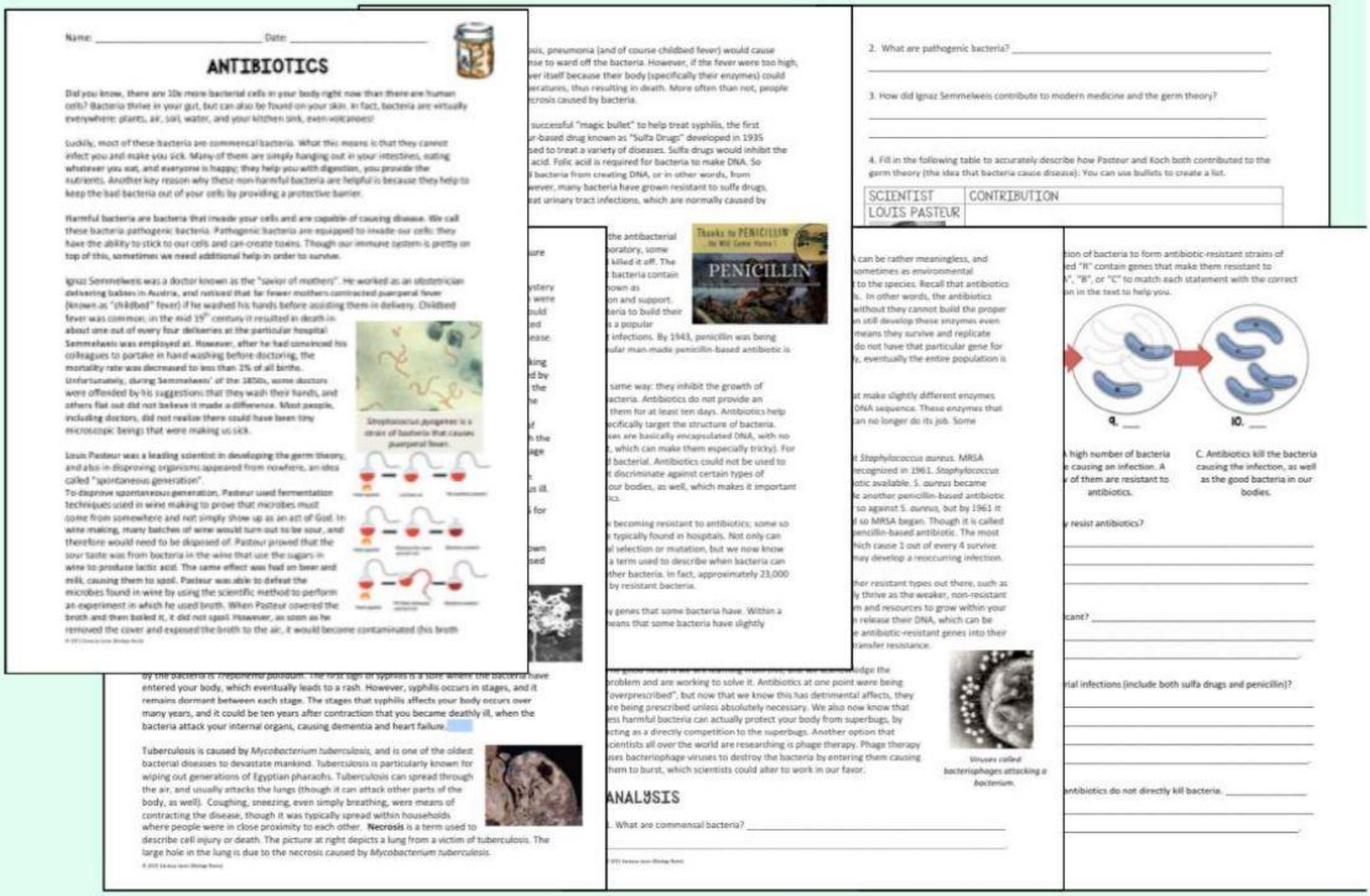
Included is how we can harvest energy from the sun using the photovoltaic effect and a brief lesson on the structure of atoms.

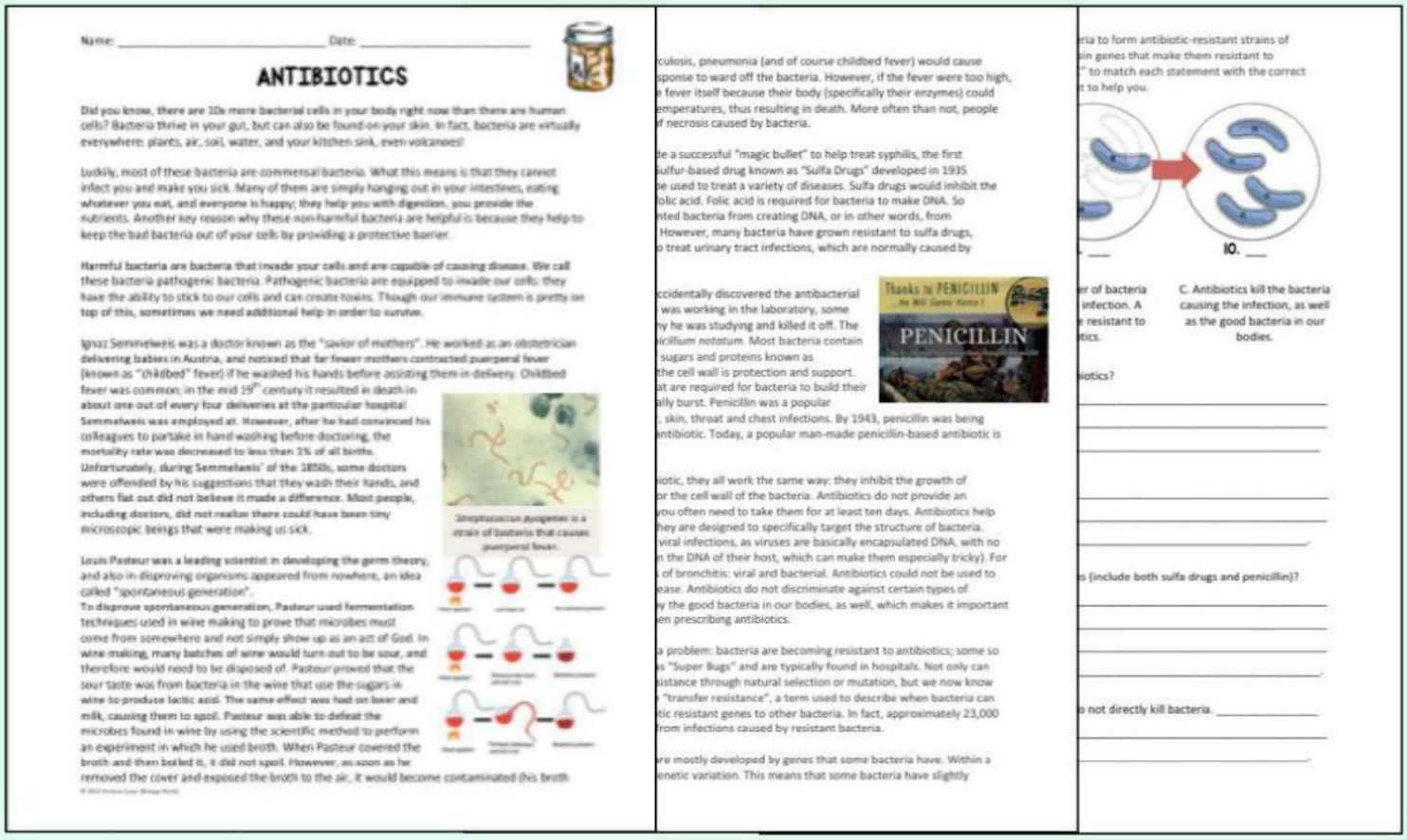
With this knowledge, a simple lesson on PV cells, diodes and semiconductors concludes this lesson, followed by 15 analysis questions.

PLAN "O": ANTIBIOTICS

Antibiotics

- Brief history of the germ theory
- History of antibiotics
- How antibiotics work
- Super Bugs and antibiotic resistance





Name: _____ Date: _____

ANTIBIOTICS

Did you know, there are 10x more bacterial cells in your body right now than there are human cells? Bacteria thrive in your gut, but can also be found on your skin. In fact, bacteria are virtually everywhere: plants, air, soil, water, and your kitchen sink, even volcanoes!

Luckily, most of these bacteria are commensal bacteria. What this means is that they cannot infect you and make you sick. Many of them are simply hanging out in your intestines, eating whatever you eat, and everyone is happy; they help you with digestion, you provide the nutrients. Another key reason why these non-harmful bacteria are helpful is because they help to keep the bad bacteria out of your cells by providing a protective barrier.

Harmful bacteria are bacteria that invade your cells and are capable of causing disease. We call these bacteria pathogenic bacteria. Pathogenic bacteria are equipped to invade our cells; they have the ability to stick to our cells and can create toxins. Though our immune system is pretty on top of this, sometimes we need additional help in order to survive.

Ignaz Semmelweis was a doctor known as the "savior of mothers". He worked as an obstetrician delivering babies in Austria, and noticed that far fewer mothers contracted puerperal fever (known as "childbed" fever) if he washed his hands before assisting them in delivery. Childbed fever was common; in the mid 19th century it resulted in death in about one out of every four deliveries at the particular hospital Semmelweis was employed at. However, after he had convinced his colleagues to partake in hand washing before doctoring, the mortality rate was decreased to less than 1% of all births. Unfortunately, during Semmelweis' of the 1850s, some doctors were offended by his suggestions that they wash their hands, and others flat out did not believe it made a difference. Most people, including doctors, did not realize there could have been tiny microscopic beings that were making us sick.

Streptococcus pyogenes is a strain of bacteria that causes puerperal fever.

Louis Pasteur was a leading scientist in developing the germ theory, and also in disproving organisms appeared from nowhere, an idea called "spontaneous generation".
To disprove spontaneous generation, Pasteur used fermentation techniques used in wine making to prove that microbes must come from somewhere and not simply show up as an act of God. In wine making, many batches of wine would turn out to be sour, and therefore would need to be disposed of. Pasteur proved that the sour taste was from bacteria in the wine that use the sugars in wine to produce lactic acid. The same effect was had on beer and milk, causing them to spoil. Pasteur was able to defeat the microbes found in wine by using the scientific method to perform an experiment in which he used broth. When Pasteur covered the broth and then boiled it, it did not spoil. However, as soon as he removed the cover and exposed the broth to the air, it would become contaminated (his broth

culosis, pneumonia (and of course childbed fever) would cause sponse to ward off the bacteria. However, if the fever were too high, e fever itself because their body (specifically their enzymes) could emperatures, thus resulting in death. More often than not, people f necrosis caused by bacteria.

de a successful "magic bullet" to help treat syphilis, the first Sulfur-based drug known as "Sulfa Drugs" developed in 1935 se used to treat a variety of diseases. Sulfa drugs would inhibit the folic acid. Folic acid is required for bacteria to make DNA. So nted bacteria from creating DNA, or in other words, from However, many bacteria have grown resistant to sulfa drugs, o treat urinary tract infections, which are normally caused by

Thanks to PENICILLIN ... the Will Carter Horse !

PENICILLIN

ccidentally discovered the antibacterial was working in the laboratory, some y he was studying and killed it off. The *icillium notatum*. Most bacteria contain sugars and proteins known as the cell wall is protection and support. at are required for bacteria to build their ally burst. Penicillin was a popular , skin, throat and chest infections. By 1943, penicillin was being ntibiotic. Today, a popular man-made penicillin-based antibiotic is

iotic, they all work the same way: they inhibit the growth of or the cell wall of the bacteria. Antibiotics do not provide an you often need to take them for at least ten days. Antibiotics help hey are designed to specifically target the structure of bacteria. viral infections, as viruses are basically encapsulated DNA, with no n the DNA of their host, which can make them especially tricky). For of bronchitis: viral and bacterial. Antibiotics could not be used to ease. Antibiotics do not discriminate against certain types of y the good bacteria in our bodies, as well, which makes it important en prescribing antibiotics.

a problem: bacteria are becoming resistant to antibiotics; some so s "Super Bugs" and are typically found in hospitals. Not only can istance through natural selection or mutation, but we now know "transfer resistance", a term used to describe when bacteria can tic resistant genes to other bacteria. In fact, approximately 23,000 rom infections caused by resistant bacteria.

re mostly developed by genes that some bacteria have. Within a enetic variation. This means that some bacteria have slightly

ria to form antibiotic-resistant strains of in genes that make them resistant to " to match each statement with the correct t to help you.

9. ___ 10. ___

er of bacteria infection. A e resistant to tics.

C. Antibiotics kill the bacteria causing the infection, as well as the good bacteria in our bodies.

iotics? _____

s (include both sulfa drugs and penicillin)? _____

o not directly kill bacteria. _____

ANTIBIOTICS

6 pages that explore a brief history of the germ theory (Semmelweis, Pasteur, Koch) and how devastating bacterial infections could be.

Also included are the history and discovery of antibiotics such as Sulfa-drugs and penicillin, and how antibiotics work.

Finally students are introduced to the development of Super Bugs: resistant bacteria and how they evolved to be that way.

biology roots

Classroom resources to promote *scientific literacy* and curiosity.

Thank you so much for supporting biology roots

I am so excited that you will be using my resources to *benefit* your classroom. Listed below are some categories of products that I offer in my TpT store:

Digital Interactive Notebooks	Complete Units- No prep!
Paper Interactive Notebooks	Super Duper Science Sub Plans
Captivating Presentations	Terrific Task Cards

Copyright Notice and Terms of Use © Vanessa Jason ("Biology Roots")

All rights reserved by author. This product is to be used by the original purchaser only. This purchase grants one license for personal use. Duplication for other classes or by other teachers or for use in school wide distribution is strictly forbidden. Posting Biology Roots products on the internet in any form is strictly forbidden and violates the DMCA. Not for public display, including ANY websites. Violations are subject to the penalties of the Digital Millennium Copyright Act.



It IS Okay to...	It is NOT Okay to...
Use this for *personal use only* in your classroom as often as you would like, every year!	• Share this resource with your coworkers or friends unless you buy additional licenses, • (1 per each additional teacher), which are offered at a discount. • Post this item to your school website, personal website, file-sharing website, ANY website, without consent from the author, Vanessa Jason.

biology roots

Sign up for my newsletter to receive exclusive offers.

