Pre-AP Biology
Summer Work
2017-2018
Mr. Fuchs

*****There are <u>TWO</u> Parts to this assignment****

- **Part 1: <u>Language of Science-Scientific Prefixes and Suffixes</u>**
- **Part 2: <u>Spontaneous Generation & Scientific Method</u>**

<u>Important Information</u>:

1. **Failure to turn in flashcards from <u>Part I</u> <u>or</u> the questions from <u>Part II</u> of this assignment is considered an incomplete summer assignment. <u>The summer assignment must be completed to remain in Pre-AP Biology.</u>**

2. ***<u>Test:</u>***
   During the first week of school you will take a test over the prefixes and suffixes, there **<u>will also be</u>** questions over the spontaneous generation and scientific method. (Part 1 and 2 of your summer work)
   The test will consist primarily multiple choice along with a few short answer responses.

- If you have any questions during the summer, you can email me at fuchsj@needvilleisd.com. I will check this often and get back to you as soon as possible. If you need me to call you, please leave the number in the email and I will contact you that way.

- It is advised that you not wait until the end of summer to begin the assignment. Work on it throughout the summer in small pieces, it should go easier that way.
- **<u>STUDY</u> the flashcards and read the Scientific information sheet well!!** If you do this, you should have no problem with the test at the beginning of the year.

Part I: Language of Science-Scientific Prefixes and Suffixes

Background
The main reason students find it difficult to understand science is because of all the hard to read, write, and spell words. The majority of scientific terms originate from the Latin and Greek languages. By using these languages as a foundation, scientific terms are actually a hodge-podge of little words that are linked together to have different meanings. If you learn the meanings of the little words, you will find scientific vocabulary **MUCH** easier to understand.

Remember, your flashcards are due the first day of school.

For this assignment, you will:

- **A.** **create a flashcard for each term** a
- **B.** **assemble them into a set** of flashcards **connected by a notebook ring**.
- **C.** **study the terms for a test** over the meanings.

A. Creating the flashcards
Using a 3 x 5 note card , write a prefix/suffix on the front side and the corresponding definition(s) on the back side. The card may be white or colored, may be lined our unlined.

HAND WRITE **each card**. **DO NOT type, cut out, and then affix the information to the cards.** Handwriting information actually aids the learning process.

***B. Assembling the cards*:**

1. Punch a hole the **upper left** corner of each card
2. Put the cards in the same order in which the words are listed below.
3. Put the word **number** on each card.
4. In order to hold all the cards together keep them in order, put them on a notebook ring through the hole in the left hand corner

(notebook rings can be found at a teacher supply store or office supply store)

Prefix/suffix	**Meaning**
(on front of card)	(on back of card)

	Prefix/Suffix	Meaning		Prefix/Suffix	Meaning
1.	a or an	not or non	27.	hyper	above
2.	aero	needing oxygen or air	28.	hypo	below
3.	anti	against	29.	intra	within, inside
4.	amphi	both, double	30.	itis	disease, inflammation
5.	aqua	water	31.	lateral	side
6.	arthro	joint	32.	logy	study of
7.	auto	self	33.	lys	break down
8.	bi	two, twice, double	34.	meso	middle
9.	bio	life, living	35.	meter	measurement
10.	cephal	head	36.	mono	one, single
11.	chloro	color	37.	morph	form
12.	chromo	color	38.	micro	small
13.	cide	killer, kill, killing	39.	macro	large
14.	cyto	cell	40.	multi	many
15.	derm	skin	41.	pod	foot
16.	di	two, double	42.	phobia	dislike, fear
17.	ecto (exo)	outer, external	43.	philia	like
18.	endo	internal, inner	44.	proto	first
19.	epi	above	45.	photo	light
20.	gastro	stomach	46.	poly	many
21.	genesis	origin, beginning	47.	synthesis	to make
22.	herba	plants	48.	sub	lesser, below
23.	hetero	different	49.	troph	eat, consume
24.	homo	alike, similar	50.	therm	heat
25.	hydro	water	51.	tri	three
26.	hemo	blood	52.	zoo, zoa	animal

Summary Assignment **Name** ____________________________
Pre-AP Biology **Date** ______________________________
Mr. Fuchs

Part Two: Spontaneous Generation & Scientific Method

A. Reading Assignment:
You are to read the attached copy of a scientific article entitled
"Spontaneous Generation" D. B. Fankhauser and J. L. Stein Carter

B. Questions: After you have read over the material, answer the questions.

The answers will be turned in to me on the first day of school.*

1. The idea of spontaneous generation has been around since the time of Aristotle when he set forth the idea. What exactly is the basic idea of "spontaneous generation"?

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2. Give two examples that were used as support for this idea.

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3. What was the hypothesis of Redi's experiment?

   ____

   ____

4. What exactly did Redi's outcome teach us about the flies?

   ____

   ____

5. Was his hypothesis correct or incorrect? Justify you answer!

   ____

   ____

6. In the reading article it said that some consider this the first **"real"** experiment. This is because it contains the elements of a good controlled experiment. **Describe which parts of his experimental design would fit each of these parts of a controlled experiment.**

a. **Control group:**

b. **Experimental group(s):**

c. **Independent variable: (same thing as a manipulated variable)**

d. **Dependent variable (same thing as a responding variable).**

7. After Redi, people began to acknowledge that perhaps larger animals were not spontaneously generated after all.

a. **BUT**—the development of what instrument caused new questions regarding spontaneous generation? ______________________________

b. What was now the new concern?

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8. Did **Robert Needham** believe in spontaneous generation? ______________________________
What was the hypothesis of **his** experiment?

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a. What did Needham say the result of his experiment showed?

____

____

b. Did **Spallanzani** believe in spontaneous generation? ________________________________
What was the hypothesis of his experiment?

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____

What did Spallanzani do **<u>differently</u>** than Needham?

____

____

What was Spallanzani's conclusion?

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9. Louis Pasteur's experiment was designed to address this problem discussed in the debate. In **<u>YOUR</u>** words, describe/explain how Pasteur's experiment <u>was designed/set up</u> **<u>-and</u>** how it attempted to overcome Needham's argument. **<u>DO NOT just copy paragraphs of work from the reading material.</u>** You may reference some of the information but I am looking for YOUR description You may draw pictures to **<u>help</u>** your answer, if you wish. **Read over the material and then talk about it in your own way-<u>but</u>-be sure you are answering the question.**

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10. What did Pasteur's experiment show us?

____

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11. Was his hypothesis correct or incorrect? ______________________Justify you answer.

____

____

Questions: If you can answer the following questions you indicate a good understanding of this material. **<u>May have to do a little research here!! (hint, hint!)</u>**

12. In Redi's experiment, **why** did the flies lay their eggs on the netting?

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13. How has the information from these scientists been used to protect our food from going bad, spoiling?

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What <u>process</u> was named after Pasteur?

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14. Approximately how many years apart were the experiments of these three four scientists? (Redi, Needham/Spallanzani, and Pasteur)

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15. Is the theory of spontaneous generation considered today to be correct or incorrect? **Justify you answer!**

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SPONTANEOUS GENERATION

I. OBJECTIVES:

1. To recreate Pasteur's experiment disproving spontaneous generation.
2. To investigate conditions under which bacteria will/will not grow.

II. BACKGROUND:

Today, we take many things in science for granted. Many experiments have been performed and much knowledge has been accumulated that people didn't always know. For centuries, people based their beliefs on their interpretations of what they saw going on in the world around them without testing their ideas to determine the validity of these theories – in other words, they didn't use the **scientific method** to arrive at answers to their questions. Rather, their conclusions were based on untested observations.

Among these ideas, for centuries, since at least the time of Aristotle (4th Century BC), people (including scientists) believed that simple living organisms could come into being by **spontaneous generation**. This was the idea that non-living objects can give rise to living organisms. It was common "knowledge" that simple organisms like worms, beetles, frogs, and salamanders could come from dust, mud, etc., and food left out, quickly "swarmed" with life. For example:

Observation: Every year in the spring, the Nile River flooded areas of Egypt along the river, leaving behind nutrient-rich mud that enabled the people to grow that year's crop of food. However, along with the muddy soil, large numbers of frogs appeared that weren't around in drier times.
Conclusion: It was perfectly obvious to people back then that muddy soil gave rise to the frogs.

Observation: In many parts of Europe, medieval farmers stored grain in barns with thatched roofs (like Shakespear's house). As a roof aged, it was not uncommon for it to start leaking. This could lead to spoiled or moldy grain, and of course there were lots of mice around.
Conclusion: It was obvious to them that the mice came from the moldy grain.

Observation: In the cities, there were no sewers nor garbage trucks. Sewage flowed in the gutters along the streets, and the sidewalks were raised above the streets to give people a place to walk. In the intersections, raised stepping stones were strategically placed to allow pedestrians to cross the intersection, yet were spaced such that carriage wheels could pass between them. In the morning, the contents of the chamber pots were tossed out the nearest window. When people were done eating a meal, the bones were tossed out the window, too. A chivalrous gentleman always walked closest to the street when escorting a woman, so if a horse and carriage came by and splashed up this filth, it would land on him, and not the lady's expensive silk gown. Most of these cities also had major rat problems which contributed to the spread of Bubonic Plague (Black Death) – hence the story of the Pied Piper of Hamelin, Germany.
Conclusion: Obviously, all the sewage and garbage turned into the rats.

Observation: Since there were no refrigerators, the mandatory, daily trip to the butcher shop, especially in summer, meant battling the flies around the carcasses. Typically, carcasses were "hung by their heels," and customers selected which chunk the butcher would carve off for them.
Conclusion: Obviously, the rotting meat that had been hanging in the sun all day was the source of the flies.

From this came a number of interesting recipes, such as:

Recipe for bees: Kill a young bull, and bury it in an upright position so that its horns protrude from the ground. After a month, a swarm of bees will fly out of the corpse.

Jan Baptista van Helmont's recipe for mice: Place a dirty shirt or some rags in an open pot or barrel containing a few grains of wheat or some wheat bran, and in 21 days, mice will appear. There will be adult males and females present, and they will be capable of mating and reproducing more mice.

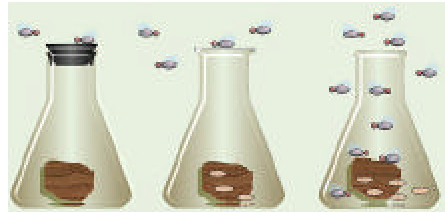
In 1668, Francesco Redi, an Italian physician, did an **experiment** with flies and wide-mouth jars containing meat. This was a true scientific experiment – many people say this was the first *real* experiment – containing the following elements:

Observation: There are flies around meat carcasses at the butcher shop.

Question: Where do the flies come from? Does rotting meat turn into or produce the flies?

Hypothesis: Rotten meat does not turn into flies. Only flies can make more flies.

Prediction: If meat cannot turn into flies, rotting meat in a sealed (fly-proof) container should not produce flies or maggots.



Testing: Wide-mouth jars each containing a piece of meat were subjected to several variations of "openness" while all other variables were kept the same.

! *control group* – These jars of meat were set out without lids so the meat would be exposed to whatever it might be in the butcher shop.
! *experimental group(s)* – One group of jars were sealed with lids, and another group of jars had gauze placed over them.
! *replication* – Several jars were included in each group.

Data: Presence or absence of flies and maggots seen in each jar was recorded. In the control group of jars, flies were seen entering the jars. Later, maggots, then more flies were seen on the meat. In the gauze-covered jars, no flies were seen in the jars, but were observed around and on the gauze, and later a few maggots were seen on the meat. In the sealed jars, no maggots or flies were ever seen on the meat.

Conclusion(s): Only flies can make more flies. In the uncovered jars, flies entered and laid eggs on the meat. Maggots hatched from these eggs and grew into more adult flies. Adult flies laid eggs on the gauze on the gauze-covered jars. These eggs or the maggots from them dropped through the gauze onto the meat. In the sealed jars, no flies, maggots, nor eggs could enter, thus none were seen in those jars. Maggots arose only where flies were able to lay eggs. This experiment disproved the idea of spontaneous generation for larger organisms.

After this experiment, people were willing to acknowledge that "larger" organisms didn't arise by spontaneous generation, but had to have parents. With the development and refinement of the microscope in the 1600s, people began seeing all sorts of new life forms such as yeast and other fungi, bacteria, and various protists. No one knew from where these organisms came, but people figured out they were associated with things like spoiled broth. This seemed to add new evidence to the idea of spontaneous generation – it seemed perfectly logical that these minute organisms should arise spontaneously. When Jean Baptiste Lamarck proposed his theory of evolution, to reconcile his ideas with Aristotle's Scala naturae, he proposed that as creatures strive for greater perfection, thus move up the "ladder," new organisms arise by spontaneous generation to fill the vacated places on the lower rungs.

In 1745 to 1748, John Needham, a Scottish clergyman and naturalist showed that microorganisms flourished in various soups that had been exposed to the air. He claimed that there was a "life force" present in the molecules of all inorganic matter, including air and the oxygen in it, that could cause spontaneous generation to occur, thus accounting for the presence of bacteria in his soups. He even briefly boiled some of his soup and poured it into "clean" flasks with cork lids, and microorganisms still grew there.

A few years later (1765 to 1767), Lazzaro Spallanzani, an Italian abbot and biologist, tried several variations on Needham's soup experiments. First, he boiled soup for one hour, then sealed the glass flasks that contained it by melting the mouths of the flasks shut. Soup in those flasks stayed sterile. He then boiled another batch of soup for only a few minutes before sealing the flasks, and found that microorganisms grew in that soup. In a third batch, soup was boiled for an hour, but the flasks were sealed with real-cork corks (which, thus, were loose-fitting enough to let some air in), and microorganisms grew in that soup. Spallanzani concluded that while one hour of boiling would sterilize the soup, only a few minutes of boiling was not enough to kill any bacteria initially present, and the microorganisms in the flasks of spoiled soup had entered from the air.

This initiated a heated argument between Needham and Spallanzani over sterilization (boiled broth in closed vs. open containers) as a way of refuting spontaneous generation. Needham claimed that Spallanzani's "over-extensive" boiling used to sterilize the containers had killed the "life force." He felt that bacteria could not develop (by spontaneous generation) in the sealed containers because the life force could not get in, but in the open container, the broth rotted because it had access to fresh air, hence the life force inherent in its molecules, which contained and replenished the life force needed to trigger spontaneous generation. In the minimally-boiled flasks, he felt the boiling was not severe enough to destroy the life force, so bacteria were still able to develop.

By 1860, the debate had become so heated that the Paris Academy of Sciences offered a prize for any experiments that would help resolve this conflict. The prize was claimed in 1864 by Louis Pasteur, as he published the results of an experiment he did to disproved spontaneous generation in these microscopic organisms.

Observation(s): From Needham's and Spallanzani's experiments, it was known that soup that was exposed to the air spoiled – bacteria grew in it. Containers of soup that had been boiled for one hour, and then were sealed, remained sterile. Boiling for only a few minutes was not enough to sterilize the soup. Pasteur had previously demonstrated that the dust collected by drawing air through a cotton ball contained large numbers of bacteria, hence he knew that bacteria were present in the air and could be filtered out by using a cotton ball. He also knew that bacteria would settle out on the walls of a long, bent, glass tube as air was passed through it.

Question: Is there indeed a "life force" present in air (or oxygen) that can cause bacteria to develop by spontaneous generation? Is there a means of allowing air to enter a container, thus any life force, if such does exist, but not the bacteria that are present in that air?

Hypothesis: There is no such life force in air, and a container of sterilized broth will remain sterile, even if exposed to the air, as long as bacteria cannot enter the flask.

Prediction: If there is no life force, broth in swan-neck flasks should remain sterile, even if exposed to air, because any bacteria in the air will settle on the walls of the initial portion of the neck. Broth in flasks plugged with cotton should remain sterile because the cotton is able to filter bacteria out of the air.

Testing: Pasteur boiled broth in various-shaped flasks to sterilize it, then let it cool. As the broth and air in the containers cooled, fresh room air was drawn into the containers. None of the flasks were sealed – all were exposed to the outside air in one way or another.

! *control group* – Some flasks opened straight up, so not only air, but any bacteria present in that air, could get into them.

! *experimental group(s)* – Pasteur used some flasks with long, S-shaped necks (swan-neck flasks) and closed others with cotton plugs. This allowed air to enter these flasks, but the long, swan neck or the cotton balls filtered out any bacteria present in that air. He subsequently broke the long necks off some of the swan-neck flasks.

! *replication* – Pasteur used several flasks in each of his groups. According to one freshman biology text, some of his original flasks, on display (in France), still are sterile.

Data: Broth in flasks with necks opening straight up spoiled (as evidenced by a bad odor, cloudiness in previously clear broth, and microscopic examination of the broth confirming the presence of bacteria), while broth in swan-neck flasks did not, even though fresh air could get it. Broth in flasks with cotton plugs did not spoil, even though air could get through the cotton. If the neck of a swan-neck flask was broken off short, allowing bacteria to enter, then the broth became contaminated.

Conclusion(s): There is no such life force in air, and organisms do not arise by spontaneous generation in this manner. To quote Louis Pasteur, "Life is a germ, and a germ is Life. Never will the doctrine of spontaneous generation recover from the mortal blow of this simple experiment."

One very important point to note here is that Pasteur did not seek to find an answer to the broad question, "Has spontaneous generation ever occurred?" Rather, as any good scientist, he limited his scope to a very narrow piece of the picture: "Is it possible for spontaneous generation to occur given the *specific* conditions under which Needham (and others) claims it will occur, i.e. the 'life force?'" Interestingly, in 1936, when Alexander Ivanovich Oparin, a Russian scientist, published *The Origins of Life*, in which he described hypothetical conditions which he felt would have been necessary for life to first come into existence on early Earth, some scientists found it difficult to acknowledge that under the very different conditions which Oparin was proposing for early Earth, some form of "spontaneous generation" might indeed have taken place.

III. MATERIALS NEEDED:

low-salt broth (chicken or beef, home-made or purchased)
250-mL Erlenmeyer flasks
1-hole rubber stoppers (size 8) with bent glass tubing inserted (see diagram)

IV. SAFETY CONSIDERATIONS:

A. If Bunsen burners are used, refer to that protocol for important safety information.
B. If you will be bending your own glass, remember to observe these additional safety rules:
1. Goggles should be worn so unexpected pieces of glass don't get into your eyes.
2. When breaking glass tubing, first score the desired breaking point with a file. Then, WEARING THICK GLOVES or with the tubing WRAPPED IN A THICK TOWEL and the score mark facing away from you, gently "bend" the breaking point AWAY FROM YOU until it snaps.
3. The ends of the tubing you will be using should be fire-polished using a large (Fisher) burner. Glass tubing cools very slowly, so don't touch the hot ends accidentally. Wearing heat-resistant gloves is a good idea.
4. To bend a piece of glass, rotate the tubing while heating the desired location over a large (Fisher) burner until the glass softens. Keep the tubing in the flame while you make the desired bend, then remove the tubing from the flame so it will begin to cool.

C. Always use a lubricant when inserting glass tubing into a rubber stopper. A drop or two of glycerol or soapy water will make insertion fairly easy. When inserting glass into a stopper, always wear thick gloves that also protect your wrists, and hold the tubing near the stopper (not several inches away). To make insertion easier, twist/rotate the tubing as you gently push it into the stopper – if properly lubricated, insertion should be nearly "effortless."

V. PROCEDURE:

A. Students should work in teams of 2 to 3 people. Each team should perform the following steps.
B. Mark Erlenmeyer flasks accordingly:
1. flask with stopper and glass tube going straight up
2. flask with stopper and glass tube bent in S-curve
C. Place about 50 to 100 mL of broth in each Erlenmeyer flask.
D. Place appropriate lids on flasks.
E. Boil broth in flasks with appropriate lids on them for 30 min., then let cool.
F. For the next several lab periods, observe the flasks and record any changes in color, turbidity, smell, etc.
G. When you are finished observing your flasks, CLEAN UP! Make sure to thoroughly wash all glassware. Do NOT attempt to remove glass tubing from stoppers.

*** Note that these are general directions. Students are encouraged to design their own experiments. Glass tubing may be bent into any desired shape or left straight. Tubing may or may not be inserted, and/or a no-hole stopper may be used. Optionally, the end of a tube may be plugged with a bit of cotton. Beef or chicken broth (or other?) may be used. Broth may be unboiled or may be boiled for varying lengths of time, either in a "double boiler" in a pan of water or over a Bunsen burner. Stoppers may be inserted before or after boiling, and/or broth may be boiled in another container and poured into a clean flask. Broth could be stored at different temperatures (refrigerator, room temperature, incubator). PLEASE CLEARLY MARK ALL FLASKS AS TO CONTENTS, TREATMENT, AND OWNER(S).

VI. DATA:

Remember to record what you did and how you set up your experiment (draw pictures, too). Take notes on any changes in appearance or smell of your flask(s), and compare data with other students in your lab section.

VII. CONCLUSIONS:

Under what conditions did bacteria appear in the broth? What conditions appear to slow or stop the growth of bacteria? What evidence did you find to support or refute the idea of spontaneous generation?

VII. BIBLIOGRAPHY:

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