AP Biology Summer Assignment: 2026-2027

Hello! Welcome to AP Biology! We are excited to be your teachers next year as you continue your study of the biological world.

Over the summer, we would like you to review experimental design (independent and dependent variables, controlled variables, graphing, etc.). We will use these skills almost every day in class, especially with each lab experiment that you design. The scientific inquiry process is essential for you to master! We will review these concepts the first few days of school, but you are expected to come in with a solid foundation of this concept.

The AP Biology course is rigorous. It is a college level course. Expect to do homework every night. You will get out what you put into the course. You will be given the tools needed to get a 4 or 5 on the AP Biology exam by taking this course, but it will be up to you to use them and employ them. During the year we will complete multiple required AP labs as well as many additional labs and activities. You will gain practice in writing lab reports ("CER" versions) and AP Free Response Questions, and in answering AP level multiple choice questions.

The summer assignment is due to us on the first day of school at the beginning of class (Tuesday September 8, 2026). This will count as your first quiz grade of the semester.

Have a great summer! Can't wait to see you in September! -Mrs. Jones and Dr. Nielson

Part I: Video Learning with Bozeman Science

You will learn about key practices to succeed in AP biology by watching videos and answering questions about each. We will be using a lot of videos for Bozeman science this year, so this will give you a good introduction to the host, Mr. Anderson, and his videos. Each video is about 10 minutes long, but allow yourself 30 minutes for each to pause video and answer questions

Each video centers on the 4 Big Ideas of AP Biology:
1) **Big Idea 1: EVOLUTION** The process of evolution drives the diversity and unity of life.

2) **Big Idea 2: Cellular Processes: ENERGY and COMMUNICATION** Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

3) **Big Idea 3: GENETICS and INFORMATION TRANSFER** Living systems store, retrieve, transmit, and respond to information essential to life processes.

4) **Big Idea 4: INTERACTIONS of SYSTEMS** Biological systems interact, and these systems and their interactions possess complex properties.

The 5 videos are as follows (they are hyperlinked):

1) Video 1 – Models and Representation
2) Video 2 – Using Mathematics
3) Video 3 – Beginner's Guide for Graphing Data
4) Video 4 – Scientific Questioning
5) Video 5- Chi Square Test

Please answer the following questions for each video as you watch.

Video 1 – Models and Representation

A) What is a model?

B) A ______________________ of how it works is a "Conceptual Model".

C) What are the four Big Ideas we will be discussing in AP Biology? List below along with the associated example:

1. __________________________ - example:

2. Free ______________________ - example:

3. ________________________________ - example:

4. ______________________________ - example:

D) What are the 5 things you will need to be able to do using models and visual representations? [Please keep in mind, some of the examples that he uses may be unknown to you at this time, focus on the "practice" not the content.]

1. ______________
    a. Relating to beetles, draw/label the final graph he created below:

    b. Why do you think there were fewer light-colored beetles when the trees became dark?

2. ______________

    What is going to move in his example?

3. ______________
    They will give you a model and then __________________ based on that.

4. ______________
    Means that you are _________________ your knowledge to a visual representation.

5. ______________
    Asking you to __________ the knowledge that you have.

E) Models allow us to make __________ of a _____________ model.

F) What is the most famous model of all? ____
    That was created by _______________________

Video 2 – Using Mathematics
YOU NEED A CALCULATOR!!!

A) All sciences have what at their core?

B) What is "Mathematical Biology" driven by:

1. __________________________: sequencing DNA – what is the trend?

2. ____________________ Theory: being used to predict what?

3. Computing _____________________: computers are getting what?

4. Laboratory experiments in silico (define the following):

   a. In vitro:

   b. In vivo:

   c. In silico: simulating what?

C) Four equations in the four big ideas → you want to be familiar with these:

1. Evolution:

2. Free energy:

3. Information:

4. Systems:

D) Understandings in Using Mathematics:

1. ______________ the ________________ of a Mathematical Routine:

   Pause video, try and do it and then check it. Show your work below:

2. Apply ___________________________ Routines:

   Again, try this problem, showing your work below.

3. ________________________ quantities that ________________ natural phenomena.

a. You can absolutely do this, show work.

b. Potatoes: you can do this too! Show work. _________M Sucrose

Video 3 – Beginner's Guide for Graphing Data

1. What type of graph uses a best fit line?

2. Explain the difference between a bar graph and a histogram.

3. What type of graph shows change over time?

4. Which type of graph displays a correlation of variables?

5. Distinguish between the independent and dependent variables in an experiment, and where their axes are on a graph.

6. Which type of graph is best for comparing 2 or more different groups?

7. Which type of graph is better for showing distribution of data?

8. Explain when a pie chart/graph should be used and give (draw, label) any example.

9. State at least 5 elements that any graph should always display.

Video 4 – Scientific Questioning

1. I should be able to ask you, "How do we...." what?

2. Students should be able to answer, "This is how...." what?

3. What is a good example of how you ask questions all the time?

4. What is the problem with:
   a. Smallest bird question?

   b. Universe question?

   c. Genetically modified food question?

5. Why is the plant growth question more scientific? But what is a problem with it too?

6. Why is the CO_2 question a good scientific question?

7. A good question is going to lead to:

a.

b.

8. What are the three things you have to be able to do during the practice of "Scientific Questioning"?

9. Write out one of the three questions he "posed" concerning the phylogenetic tree. (You are just asking, not answering.)

10. When you "refine" a question, you are taking it to another _____________.

11. What is the third part of scientific questioning?

12. What can you then do if you are good at scientific questioning?

Video 5 – Chi Square Test

Note: Even though this video is about chi-square testing, Paul Andersen does a fantastic job in the first few minutes explaining what a null hypothesis is. Our first lab of the year is an animal behavior lab in which you will use the chi square test to evaluate your null hypothesis.

1. In your own words, what is a null hypothesis?

2. For each situation below, **write a proper null hypothesis** — remember: you're assuming **no difference** or **no effect**.

   a. A scientist thinks a new fertilizer will make plants grow taller than those without fertilizer.

b. A student believes that playing classical music while studying will improve their test scores.

c. A researcher hypothesizes that a new drug will lower blood pressure more than an existing drug.

d. A company claims their new running shoes make people run faster than competitors' shoes.

3. Circle **YES** if the statement below is a correct null hypothesis. **Circle NO** if it's wrong, and quickly explain why.

a. "The new fertilizer causes plants to grow taller than without fertilizer." (YES / NO)
b. "There is no significant difference in test scores whether students listen to classical music or not." (YES / NO)
c. "The new shoes will make people much faster than regular shoes." (YES / NO)

Part 2: Applying What You Learned- Experimental Design

In an experiment, a **control group** provides data to which the experimental results can be compared. There are two types of useful controls:

A **positive control** is expected to produce results. It provides evidence that the experimental setup worked properly and results are possible.	A **negative control** is expected to produce NO results. It provides evidence that the independent variable is required for the intended outcome.

Read the descriptions of experiments below and practice identifying positive and negative controls.

Experiment 1. Students want to know the effect of limiting the color of light that reaches a plant on its growth. They buy five plants of the same species. They place one in white light, one in blue light, one in green light, one in red light and one in total darkness. After two weeks, the students observe the plants and take measurements.

Independent Variable: ____________________________

Dependent Variable: _____________________________

Null hypothesis (H_o):____

____

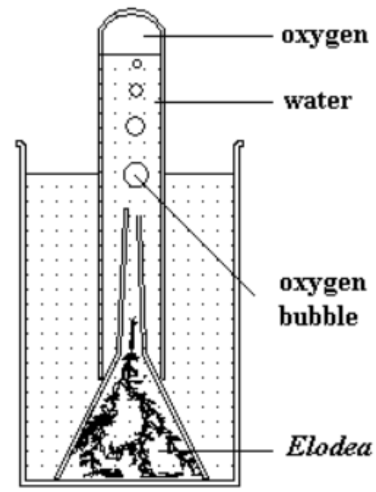
Which plant serves as a **positive** control? ____

What is this plant intended to demonstrate? ____

Which plant serves as a **negative** control? ____

What is this plant intended to demonstrate? ____

Experiment 2. Students want to know the effect of carbon dioxide availability on the rate of photosynthesis in a water plant called Elodea. They prepare three solutions containing 1%, 2%, and 3% bicarbonate (a carbon dioxide source) and add each solution to one of three beakers. In a fourth beaker, they place water without any bicarbonate added. They place an Elodea plant underwater in each beaker and cover it with an upside-down funnel. They place an upside-down test tube over each funnel to capture any gas released by the plant. All four beakers are placed near a light source. After 24 hours, the students measure the height of the gas bubble trapped in each test tube.



Independent Variable: ___________________________

Dependent Variable: ____________________________

Null hypothesis (H_o):____

____

Which beaker(s) serve(s) as a control? ____

What will the control demonstrate? ____

Is this a positive or negative control? ____

Experiment 3. BTB is a blue solution known to turn yellow in the presence of carbon dioxide. Students plan to use BTB to determine if exercise increases the carbon dioxide exhaled by humans. One student is assigned to be a test subject. While sitting down and resting, he uses a straw to blow continuously into a 50 mL sample of blue BTB solution. His lab partner uses a stopwatch to time how long it takes the BTB solution to change color. A second 50 mL sample of blue (unchanged) BTB solution is used for color comparison. Next, the student stands and does jumping jacks for 90 seconds, and immediately upon stopping, uses a straw to blow continuously into a third 50 mL sample of blue BTB solution. His lab partner uses a stopwatch to time how long it takes the BTB solution to change color, as compared to the unchanged sample.

Independent Variable: ___________________________

Dependent Variable: ____________________________

Null hypothesis (H_o):____

____

Which sample serves as a **positive** control? ____

What is this sample intended to demonstrate? ____

Which sample serves as a **negative** control? ____

What is this sample intended to demonstrate? ____

Experiment 4. Students want to know the effect of temperature on the rate of cellular respiration of yeast. They add 20 mL of a sugar solution into each of ten test tubes, to provide an energy source for yeast. To each of the first five tubes, they add 1 gram of dry yeast cells. To the remaining five tubes, the students do not add any yeast. A small balloon is placed over the top of each test tube to collect any gas produced. They then incubate the test tubes at 5°C, 15°C, 25°C, 35°C, and 45°C, placing one tube with yeast and one tube without yeast at each temperature. After 24 hours, the students observe the size of each balloon to determine how much carbon dioxide gas the yeast produced.

Independent Variable: ___________________________

Dependent Variable: ____________________________

Null hypothesis (H_o):____

____

Which test tube(s) serve(s) as a control? ____

What will the control demonstrate? ____

Is this a positive or negative control? ____

Experiment 4, continued. The students' results weren't very helpful—none of the test tubes ended up producing carbon dioxide. Concerned, the teacher places some yeast (from the same source) in a test tube with 20 mL of sugar solution. She observes bubbles forming on the surface and confirms that the yeast are alive and producing carbon dioxide. Annoyed, she concludes that the students' experimental setup has somehow killed all their yeast cells.

Is the teacher's test a positive or negative control? ______________________________________

What does the control demonstrate? ____

Part 3: Applying What You Learned- Graphing

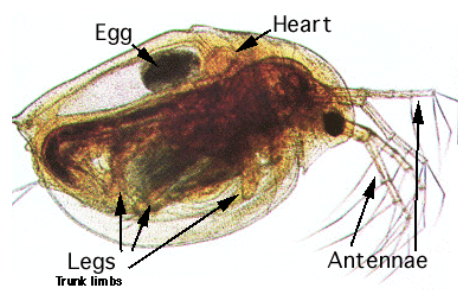
Instructions: Read each scenario so you understand how the experimental data was generated. Using the data, plot an appropriate graph that clearly and succinctly demonstrates the trends in the data.

1) A plant was placed at various depths of water in an aquarium and light shone on it from above to allow for it to photosynthesize. When aquatic plants undergo photosynthesis, they produce oxygen which will be released as bubbles by the plant. The number of bubbles that the plant produced in a minute was recorded at each depth in the table to the right.

Process and plot the data below in an appropriate graph. (Use the graph on the next page.)

Depth in meters	Bubble released in a minute
2	29
5	41
10	45
16	35
25	20
30	10

2) *Daphnia* are small water fleas that are relatively transparent and thus their heart beat can be monitored under a microscope.
In a series of experiments, 3 different *Daphnia* fleas were exposed to either water (control) or dilute solutions of different drugs (shown in the table below). After a brief period of equilibration after exposure to the drug, the heartbeat of the flea was counted for 1 minute and recorded in the table below:



	Control	Adrenaline	Nicotine	Alcohol	Caffeine
Flea 1	50	80	30	27	38
Flea 2	28	74	35	28	24
Flea 3	55	64	34	27	50

Process and plot the data below in an appropriate graph. (Use the graph on the next page.)

3) Catalase is an enzyme that that breaks down hydrogen peroxide into water and oxygen gas:

$$2H_2O_2 \xrightarrow{\text{catalase}} 2H_2O + O_2$$

In an effort to determine how differing pH affects the function of catalase, an experiment was set up where a catalase enzyme solution was placed in a fixed percentage of H_2O_2 mixed with different pH buffers. The researcher recorded both the volume of oxygen gas that was produced by the reaction and the length of time of the reaction. The data is recorded to the right.

pH	oxygen collected in mls	time in seconds
2	15	53
2	25	130
4	53	21
4	42	22
7	42	9
7	30	5
9	50	7
9	42	5
13	32	25
13	34	16

Process and plot the data below in an appropriate graph to show how pH affects reaction rate. (Use the graph on the next page.)

Note: We will learn how to draw standard error bars (+/- 2SEM) and interpret their significance the first week of school! Lots of statistics to come!