AP Biology Scientific Practices

AP science courses incorporate six overarching practices that capture important aspects of the work of scientists. Science practices describe the knowledge and skills that students should learn and demonstrate to reach a goal or complete a learning activity. They are listed below for your reference.

Science Practice 1 – Concept Explanation

Explain biological concepts, processes, and models presented in written format.

Science Practice 2 – Visual Representations

Analyze visual representations of biological concepts and processes.

Science Practice 3 – Questions and Methods

Determine scientific questions and methods.

Science Practice 4 – Representing and Describing Data

Represent and describe data.

Science Practice 5 – Statistical Tests and Data Analysis

Perform statistical tests and mathematical calculations to analyze and interpret data.

Science Practice 6 - Argumentation

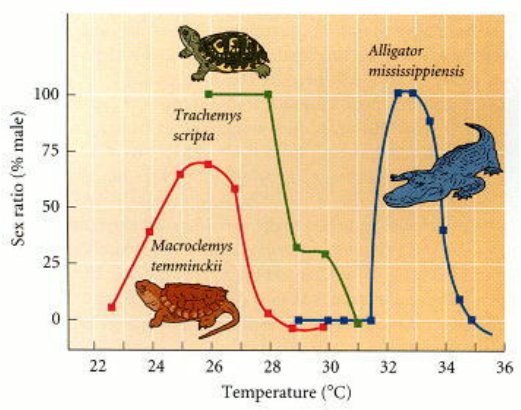
Develop and justify scientific arguments using evidence.

AP Biology Name: Period:

Science Practice 1 – Concept Explanation

Explain biological concepts, processes, and models presented in written format.

1. Describe biological concepts and/or processes.
2. Explain biological concepts and/or processes.
3. Explain biological concepts, processes, and/or models in applied contexts.



1. Describe the effect of temperature on sex determination for each of the three species of reptiles depicted above:

   a. *Macroclemys temminckii*:

   _____

   b. *Trachemys scripta*:

   _____

   c. *Alligator mississippiensis*:

   _____

2. As temperatures continue to rise, hypothesize the impact on each of the three reptile populations. Think beyond statements such as "more or less males." (so… then what?) And think on a global scale ☺

   a. _____

   _____

   b. _____

   _____

   c. _____

   _____

AP Biology Name: Period:

Science Practice 2 – Visual Representations

Analyze visual representations of biological concepts and processes.

1. Describe characteristics of a biological concept, process, or model represented visually.
2. Explain relationships between different characteristics of biological concepts, processes, or models represented visually.
    a. In theoretical contexts.
    b. In applied contexts.
3. Explain how biological concepts or processes represented visually relate to larger biological principles, concepts, processes, or theories.
4. Represent relationships within biological models, including
    a. Mathematical models
    b. Diagrams
    c. Flow charts

A theory used in AP Biology is the Law of Competitive Exclusion. Review the graphs of *Paramecium aurelia* (solid line) and *Paramecium caudatum* (dashed line) below to learn more:

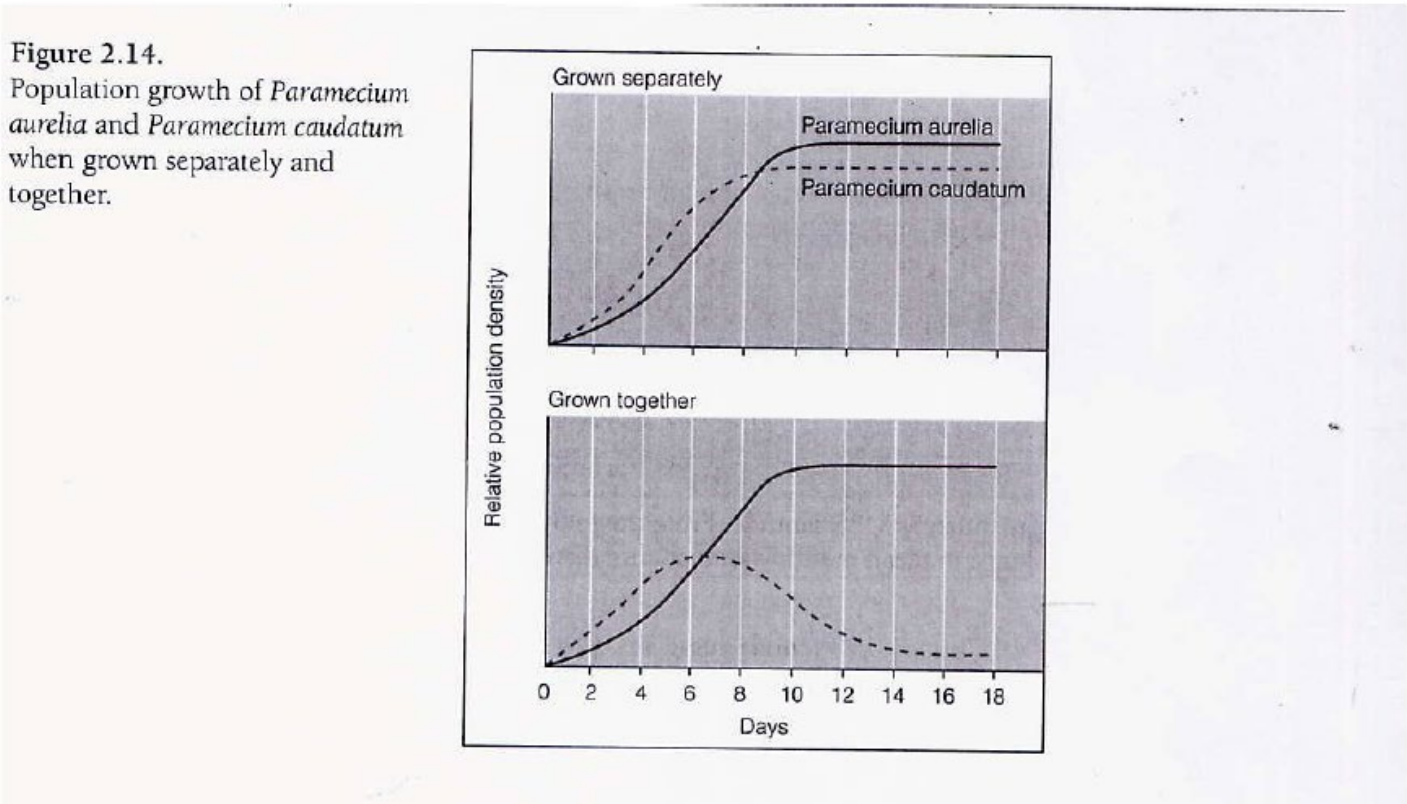


Figure 2.14.
Population growth of *Paramecium aurelia* and *Paramecium caudatum* when grown separately and together.

1. Describe the results of the experiment depicted in graph 1.

_____

_____

2. Describe the results of the experiment depicted in graph 2.

_____

_____

3. Based on these "trends," postulate what the Law of Competitive Exclusion states regarding population growth of these two species of paramecium.

_____

_____

_____

AP Biology Name: Period:

Science Practice 3 – Questions and Methods

Determine scientific questions and methods.

1. Identify or pose a testable question based on an observation, data, or a model.
2. State the null and alternative hypotheses, or predict the results of an experiment.
3. Identify experimental procedures that are aligned to the question, including
    a. Identifying dependent and independent variables.
    b. Identifying appropriate controls.
    c. Justifying appropriate controls.
4. Make observations, or collect data from representations of laboratory setups or results
5. Propose a new/next investigation based on
    a. An evaluation of the evidence from an experiment
    b. An evaluation of the design/methods.

Part I: Identify the independent (IV) and dependent (DV) variables for each of the experiments below.

1. Guinea pigs are kept at different temperatures for 6 weeks. Percent weight gain is recorded.

    IV= _____, DV=_____

2. The diversity of algal species is calculated for a coastal area before and after an oil spill.

    IV= _____, DV=_____

3. The light absorption by a pigment is measured for red, blue, green and yellow light.

    IV= _____, DV=_____

4. Batches of seeds are soaked in salt solutions of different concentrations, and germination is counted for each batch.

    IV= _____, DV=_____

5. An investigator hypothesizes that the adult weight of a dog is higher when it has fewer littermates.

    IV= _____, DV=_____

Part II: Identify a control group for each of the following examples. Remember, control group = **without** the IV.

1. An investigator studies the amount of alcohol produced by yeast when it is incubated with different types of sugar.

    _____

2. The effect of light intensity on photosynthesis is measured by collecting oxygen produced by a plant.

    _____

3. The effect of sweetener on tumor development in lab rats.

    _____

Part III: Read the following description of experiment. Identify the IV, DV, control, and constants. Report one way to improve each experiment. Remember – a constant is something kept the same IN EVERY GROUP.

1. A group of students hypothesizes that the amount of alcohol produced in fermentation depends on the amount of glucose supplied to yeast. They want to use 5%, 10%, 15%, 20%, 25% and 30% glucose solutions.

   IV =_____, DV = _____

   What control treatment should be used?

   _____

   What constants should be used?

   _____

2. A group of students wants to study the effect of temperature on bacterial growth. To get bacteria, they leave Petri dishes of nutrient agar open on a shelf. They then put the dishes in different places: an incubator (37^{O}C), a refrigerator (10^{O}C), and a freezer (0^{O}C). Bacterial growth is measured by estimating the percentage of each dish covered by bacteria at the end of a 3- day growth period.

   IV =_____, DV = _____

   What control group should be used?

   _____

   What constants should be used?

   _____

3. A team of scientists is testing a new drug, XYZ, on AIDS patients. They expect patients to develop fewer AIDS-related illnesses when given the drug, but they don't expect XYZ to cure AIDS.

   What hypothesis are they testing?

   _____

   IV =_____, DV = _____

   What control group should be used?

   _____

   What constants should be used?

   _____

The graph below shows the effect of fertilizer on peanut plant growth.

Figure 2.6.
Graph of peanut weight vs. amount of fertilizer applied.

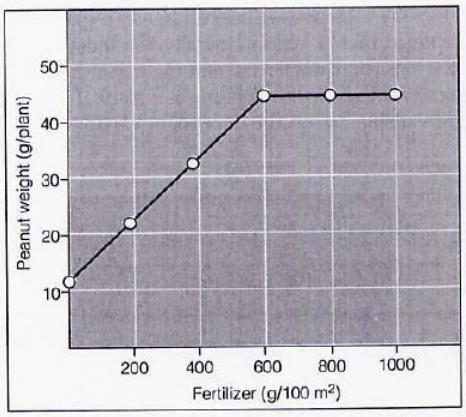


Figure 1. Weight of peanuts produced per plant when amount of fertilizer applied is varied. (Average seed weight per plant in 100 m^2 plots, 400 plants/plot.)

1. Describe the trends shown in the graph:

_____

_____

2. Develop a testable question and hypothesis that would explain the data (note: you will design an experiment for this hypothesis in the next section)

   a. Testable question: _____

   b. Hypothesis: _____

3. Using the testable question and hypothesis you developed above, design an experiment. Be sure to include specific data collection strategies.

   a. Independent variable: _____

   b. Dependent variable: _____

   c. Constants: _____

   d. Control Group: _____

   e. Data to collect / how you will collect: _____

_____

_____

Science Practice 4 – Representing and Describing Data

Represent and describe data.

1. Construct a graph, plot or chart
   a. Orientation
   b. Labeling
   c. Units
   d. Scaling
   e. Plotting
   f. Type
   g. Trend line
2. Describe data from a table or graph, including
   a. Identifying specific data points.
   b. Describing trends and/or patterns in data.
   c. Describing relationships between variables

An investigation was carried out to measure the rate of activity of catalase, an enzyme that breaks down hydrogen peroxide. Five 40-mL solutions of the enzyme at concentrations of 20%, 40%, 60%, 80%, and 100% were prepared. A filter paper disk was placed in each enzyme solution. Each soaked disk from the different enzyme concentrations was then added to different cups containing 30 mL of 1% hydrogen peroxide. The rate of catalase activity was inferred from measurements of how fast the disks rose from the bottom to the top of each cup. The following data were obtained: 40%–12.1 seconds, 80%–5.8 seconds, 100%–4.1 seconds, 20%–15.8 seconds, and 60%–9.9 seconds.

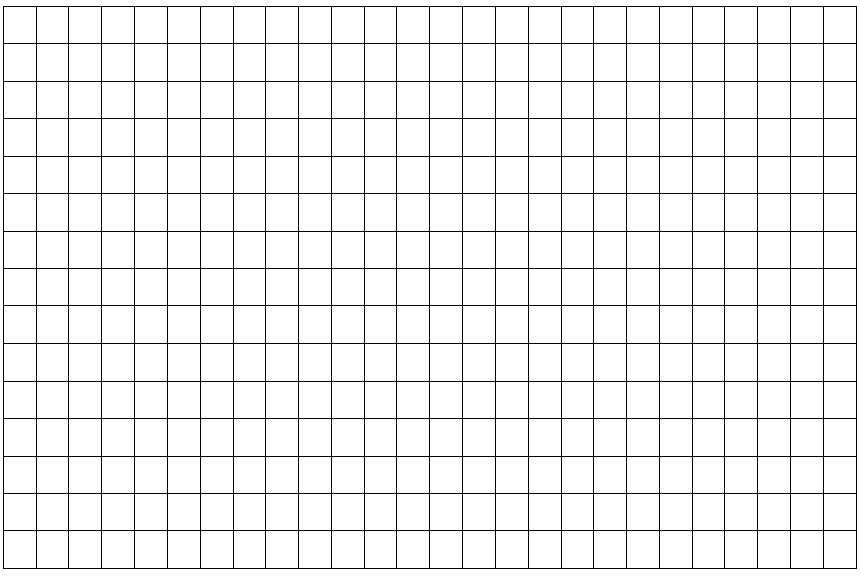
Directions: Organize the data by completing the data table, according to the directions below.

Enzyme Concentration (percent)	

1. Label the second column of the data table with an appropriate heading and record that label on the *y*-axis of the graph. [Be sure to include units.]

2. Complete the data table so that the percent enzyme *increases* from the top to the bottom of the table.

3. Make a line graph of the data on the grid below.



Be sure your graph has:
Title
Axes labeled
Units on axis
Clear data points
Best fit line/curve

The independent variable in the experiment is: _____

The dependent variable in the experiment is: _____

State one valid conclusion that relates enzyme concentration to reaction rate:

_____

_____

_____

_____

Science Practice 5 – Statistical Tests and Data Analysis

Perform statistical tests and mathematical calculations to analyze and interpret data.

1. Perform mathematical calculations, including
    a. Mathematical equations in the curriculum
    b. Means.
    c. Rates.
    d. Ratios.
    e. Percentages.
2. Use confidence intervals and/or error bars (both determined using standard errors) to determine whether sample means are statistically different.
3. Perform chi-square hypothesis testing.
4. Use data to evaluate a hypothesis (or prediction), including
    a. Rejecting or failing to reject the null hypothesis.
    b. Supporting or refuting the alternative hypothesis.

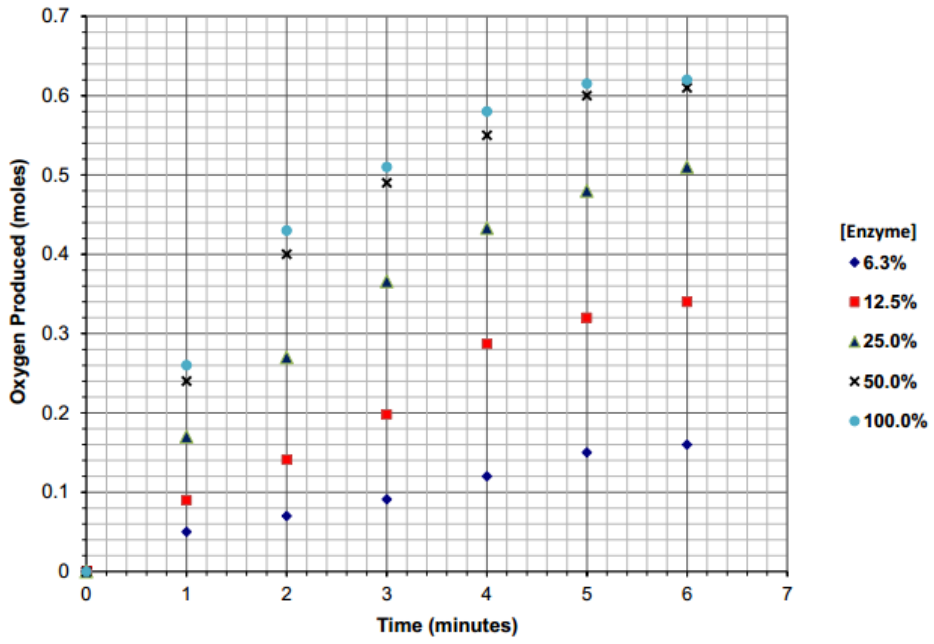
The enzyme peroxidase was isolated from fresh turnips. This enzyme is a slight variation on the catalase you have used in your protein study. In both cases each enzyme breaks down hydrogen peroxide to oxygen gas and water. In this case, however, the oxygen produced reacts with guaiacol, bringing about a color change.

Guaiacol (*colorless*) + **Oxygen** → **Tetraguaiacol** (*brown*)

By using a spectrophotometer (or colorimeter), the amount of oxygen produced can be quantified by measuring the increasing amount of brown tetraguaiacol produced. Thus the amount of oxygen produced can be recorded by measuring the absorbance of the brown pigment. Using a standard curve, this can be converted to moles of oxygen. You have done similar measurements using colorimeters in chemistry.

Experiment C

This study was repeated, but this time the amount of enzyme was varied by the same dilution process. The oxygen produced was recorded for 6 minutes. The data from these trials are graphed below. Complete the graph by putting in best-fit curves.



Using your curves of best fit, calculate the initial rate of reaction and record in the table below.

H_2O_2 Percentage	Initial Rate of Reaction (t=0 to t=1)
6.25	
12.50	
25	
50	
100	

Science Practice 6 – Argumentation

Develop and justify scientific arguments using evidence.

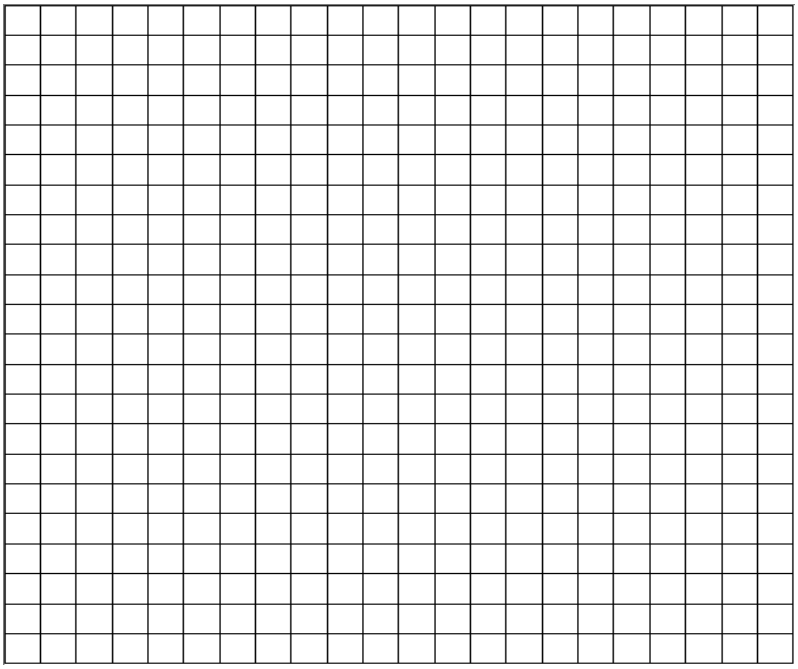
1. Make a scientific claim.
2. Support a claim with evidence from biological principles, concepts, processes, and/or data.
3. Provide reasoning to justify a claim by connecting evidence to biological theories.
4. Explain the relationship between experimental results and larger biological concepts, processes, or theories.
5. Predict the causes or effects of a change in, or disruption to, one or more components in a biological system based on
    a. Biological concepts or processes.
    b. A visual representation of a biological concept, process, or model.
    c. Data.

Germination Rates of Pinto Beans

Day	% Germination (15° C)	% Germination (20° C)	% Germination (25° C)
0	0	0	0
2	2	10	10
4	10	30	50
6	20	40	80
8	20	60	90
10	35	70	90

Table 4

Construct an appropriately labeled graph of the data in Table 4.



1. What conclusions can you draw from the graph?

_____

_____

_____

2. Give one suggestion for improvement for this experiment.

_____

_____

_____

_____