



AICE Biology
Summer Review Packet
Mrs. Virginio

Dear Students and Parents,

Welcome to AICE Biology AS Level! I am thrilled to have you join this exciting and challenging course in the upcoming school year.

AICE Biology is an accelerated, college level course that delves into the fundamental concepts of biology, emphasizing both theoretical understanding and practical laboratory skills. This course is designed to prepare students for the Cambridge International AS Level Biology examination.

What You'll Explore:

- **Core Topics:** Cell structure, biological molecules, enzymes, cell membranes and transport, the mitotic cell cycle, nucleic acids and protein synthesis, transport in plants and mammals, gas exchange, infectious diseases, and immunity.
- **Laboratory Skills:** Hands-on experiments focusing on the scientific method, measurement, laboratory apparatus usage, and safety protocols.
- **Integrated Learning:** Reading from a wide range of informational texts and engaging in extensive research and writing opportunities, while applying critical thinking and logical reasoning skills in mathematical contexts.

Success in AICE Biology requires dedication, consistent effort, and effective study habits. Here are some key expectations:

- **Active Participation:** Engage actively in classroom discussions, laboratory experiments, and group activities.
- **Independent Study:** Allocate regular time outside of class for reviewing notes, reading assigned materials, and completing homework.
- **Effective Note-Taking:** Utilize note-taking methods such as the Cornell Note-Taking System to organize and review information efficiently.
- **Vocabulary Development:** Maintain a dedicated vocabulary journal to track and understand the extensive terminology used in biology.
- **Study Skills:** Employ various study techniques, including summarizing information, creating concept maps, and practicing past exam questions.

This is a college level course and as a result you will be expected to study both inside and outside of the classroom. Students are expected to possess strong executive functioning skills, including the ability to plan, organize, manage time effectively, and engage in self-regulated learning. These skills are crucial for managing the workload and responsibilities inherent in this course. Please note that while support will be provided for content-related inquiries, students are expected to independently manage their schedules, meet deadlines, and proactively seek assistance when needed.

Your first learning opportunity begins over the summer. To ensure a strong start, this review packet will help assist you to be better prepared for entering the first week of school. Students are encouraged to review the following prerequisite information over the summer and come back to school ready to be tested.

FOUNDATIONAL PREP: PREREQUISITE REVIEW WORKSHEET

Directions:

- Students are encouraged to print out the worksheet and hand write their responses directly on it. Handwriting aids in memory retention and reinforces learning. If printing is not feasible, students may create a dedicated journal using loose-leaf paper to complete the assignments. Ensure each entry is clearly labeled with the corresponding section title.
- All submissions should reflect pride in workmanship which entails:
 - Neat and legible handwriting
 - Thoughtful and complete answers
 - Organized and structured responses
 - Proper grammar and spelling

In a college-level course, such diligence indicates a student's commitment to academic excellence and readiness to engage deeply with the material.

- At the end of this packet, you will find exemplary Cornell Notes covering essential prerequisite practical skills. These notes serve as a model for effective note-taking and highlight key concepts you should be familiar with.
- Be prepared for an assessment during the first week of the upcoming school year based on the content of this review packet and the Cornell Notes provided. This will help gauge your preparedness and reinforce foundational knowledge.

I. PRACTICAL & SCIENTIFIC SKILLS

1. Observations & Hypothesis



Observation 1: Some caterpillar species are brightly colored and appear to be highly visible to predators such as insectivorous birds. Predators appear to avoid these caterpillar species. These caterpillars are often found in groups.



Observation 2: Some caterpillar species have excellent camouflage. When alerted to danger that are difficult to see because they blend into the background. These caterpillars are usually found alone.

Read the two observations about the caterpillars above and then answer the following questions:

- a. Generate a hypothesis to explain the observations that some caterpillars are brightly colored and highly visible while others are camouflaged and blend into their surroundings:
- b. Describe one of the assumptions being made in your hypothesis:
- c. Generate a prediction about the behavior of the insect eating birds towards caterpillars:

2. Measurement Accuracy

- a. Why are precise but inaccurate measurements not helpful in a biological investigation?

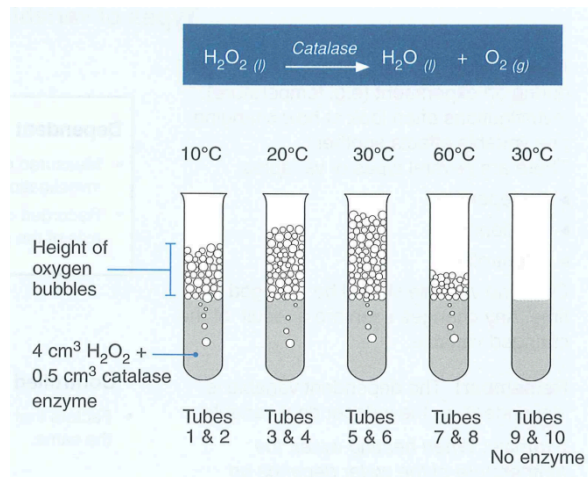
II. CASE STUDY

1. Investigation: Catalase Activity

Catalase is an enzyme that converts hydrogen peroxide (H_2O_2) to oxygen and water. An experiment investigated the effect of temperature on the rate of the catalase reactions.

10 cm^3 test tubes were used for the reactions, each tube contained 0.5 cm^3 of catalase enzyme and 4 cm^3 of hydrogen peroxide. Reaction rates were measured at four temperatures (10 °C, 20 °C, 30 °C, and 60 °C). For each temperature, there were two reaction tubes (e.g. tubes 1 and 2 were both kept at 10 °C).

The height of oxygen bubbles present after one minute reaction was used as a measure of the reaction rate; a faster reaction rate produced more bubbles than a slower reaction rate. The entire experiment was repeated on two separate days.



- Write a suitable aim/driving question for this experiment:
- Write a hypothesis for this experiment:
- What is the independent variable in this experiment?
- Name the unit for the independent variable:
- List the equipment needed to set the independent variable, and describe how it was used:
- What is the dependent variable in this experiment?
- Name the unit for the dependent variable:
- List the equipment needed to measure the dependent variable, and describe how it was used:
- Which tubes are the control for this experiment?

III. DATA HANDLING & MATH SKILLS

1. Transformation & Calculations

Complete the transformations for each of the tables below. The first value, and their working, is provided for each example.

- a. TABLE: Incidence of red clover in different areas:

Working: $124 / 159 = 0.78 = 78\%$

**This is the number of red clovers out of the total.*

Incidence of red and white clover in different areas

Clover plant type	Frost free area		Frost prone area		Totals
	Number	%	Number	%	
Red	124	78	26		
White	35		115		
Total	159				

- b. TABLE: Plant water loss using a bubble potometer:

Working: $(9.0 - 8.0) / 5 \text{ min} = 0.2$

**This is the distance the bubble moved over the first five minutes. Note that there is no data entry possible for the first reading (0 min) because no difference can be calculated.*

Plant water loss using a bubble potometer

Time (min)	Pipette arm reading (cm ³)	Plant water loss (cm ³ min ⁻¹)
0	9.0	-
5	8.0	0.2
10	7.2	
15	6.2	
20	4.9	

- c. TABLE: Frequency of size classes in a sample of eels:

Working: $(7 / 270) \times 100 = 2.6\%$

**This is the number of individuals out of the total that appear in the size class 0-50 mm. The relative frequency is rounded to one decimal place.*

Frequency of size classes in a sample of eels

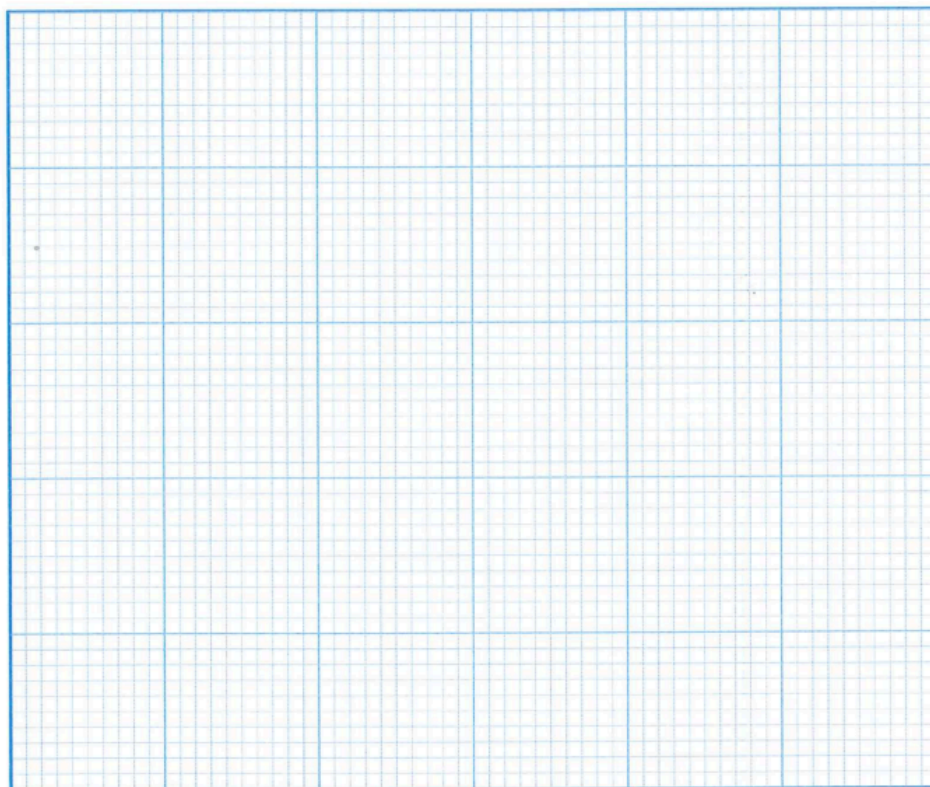
Size class (mm)	Frequency	Relative Frequency (%)
0-50	7	2.6
50-99	23	
100-149	59	
150-199	98	
200-249	50	
250-299	30	
300-349	3	
Total	270	

2. Graphing

The results below were collected in a study investigating the effect of temperature on the activity of an enzyme.

- Using the results provided, plot a line graph on the graph paper or the grid below.
- Estimate the rate of reaction at 15 °C:

Temperature (°C)	Rate of reaction (mg of product formed per minute)
10	1.0
20	2.1
30	3.2
35	3.7
40	4.1
45	3.7
50	2.7
60	0



3. Statistics

A researcher measures the mass (in mg) of 12 leaf samples affected by a fungal infection to find patterns in the data.

Leaf mass (mg)		
8.2	9.3	8.4
7.5	8.5	7.8
9.0	7.9	8.6
8.7	9.1	9.2

Calculate the following statistics for the leaf data (show all calculations)

- Mean:
- Median:
- Mode:
- Range:
- Standard deviation:
- Q_1 (median of lower half):
- Q_2 (median of upper half):
- IQR:
- Based on this dataset, are the sizes of infected leaves fairly consistent or highly variable? Give support using range and IQR:

IV. CELLULAR BIOLOGY

1. Cell Structures and Functions

Recognize on a diagram the following cell structures and outline their functions:

- a. Cell membrane
- b. Nucleus, nuclear envelope, nucleolus
- c. Rough endoplasmic reticulum
- d. Smooth endoplasmic reticulum
- e. Golgi apparatus
- f. Mitochondria
- g. Ribosomes
- h. Lysosomes
- i. Centrioles and microtubules
- j. Chloroplasts
- k. Cell wall
- l. Plasmodesmata
- m. Large permanent vacuole

**You will need to know about the organelles all year; I suggest that you make flash cards.*

2. Plant vs Animal Cells

Research 7 detailed differences between plant and animal cells.

3. Prokaryotes vs Eukaryotes

Compare and contrast Prokaryotes and Eukaryotes.

AICE Biology	
Summer Review Notes	Prerequisite Practical Skills
<p>Scientific Method <i>How does the scientific method help us investigate and explain natural phenomena?</i></p> <p>Prediction, Hypotheses, & Theories <i>What is the difference between a hypothesis, a prediction, and a scientific theory?</i></p> <p>Systems and System Models <i>How do models help us understand complex biological systems?</i></p> <p>Observations and Assumptions <i>How can scientists distinguish between observations and assumptions in an investigation?</i></p> <p>Accuracy and Precision <i>Why are both accuracy and precision important when collecting scientific data?</i></p>	<p>The scientific method involves making a hypothesis based on observation, and testing it using carefully controlled experiments to gain scientific knowledge.</p> <p>Series of steps that starts with an observation and a question</p> <ul style="list-style-type: none"> ● Make an Observation & Ask a Question ● Background Research ● Formulate Hypothesis & Make Prediction ● Design and Conduct Experiment ● Collect, Interpret, & Analyze Data ● Draw Conclusion ● Peer Review & Publish <p>Prediction: an expected outcome of an event that can either be correct/incorrect</p> <ul style="list-style-type: none"> ● Only addresses the answer to “What will happen?” <p>Hypothesis: a proposed & testable explanation for an observation</p> <ul style="list-style-type: none"> ● Addresses the answers to “What will happen?” & “Why will it happen?” ● A good hypothesis, includes a prediction ● Based on observations and prior knowledge ● Written as a definite statement, not a question ● Has only one independent variable ● Can be tested <p>Theory: a testable and broad hypothesis of many observations, supported by a large body of evidence</p> <p>Scientists use models to learn about biological systems. Models usually study one small part of a system, so that the system can be more easily understood.</p> <p>System: a set of interrelated components that work together</p> <ul style="list-style-type: none"> ● <i>Ex: energy flow in an ecosystem, gene regulation, interactions between organ systems</i> <p>Model: a representation of a system; useful for breaking a complex system down into smaller parts that can be studied more easily</p> <p>Common examples of models:</p> <ul style="list-style-type: none"> ● Visual models ● Analogy ● Mathematical models <p>Observations: watching or noticing what is happening; the basis for forming hypotheses and making predictions about systems.</p> <p>Assumption: features of the system you are studying that you assume to be true but you do not (or cannot) test; something that is accepted as true.</p> <p>Accuracy: refers to how close a measured value is to its true value</p> <ul style="list-style-type: none"> ● Correctness of the measurement <p>Precision: refers to the closeness of repeated measurements to each other</p> <ul style="list-style-type: none"> ● The ability to be exact

Types of Data

How do scientists decide whether to collect qualitative or quantitative data?

Data is information collected during an investigation. Data may be quantitative or qualitative.

Quantitative data: Characteristics for which measurements or counts can be made

- It is best to collect quantitative data, b/c it is easier to analyze it objectively

Qualitative data: Non-numerical and descriptive

Variable and Controls

Why must scientists control variables when designing a valid experiment?

Variables may be dependent, independent, or controlled. Controls make sure an experiment is running properly.

Variable: a factor that can be changed during an experiment. Investigations often look at how changing one variable affects another.

Only one variable should be changed at a time. Any changes seen are a result of the changed variable.

Independent variable:

- Set by the experimenter, it is the variable that is changed
- Recorded on the graph's x-axis

Dependent variable:

- Measured during the investigation
- Recorded on the graph's y-axis

Experimental control: the standard/reference treatment in an experiment

- Controls make sure that the results of an experiment are due to the variable being tested and not due to another factor

**Remember! The dependent variable is 'dependent' on the independent variable*

Recording Results

What strategies help scientists record and organize experimental results effectively?

Accurately recording results makes it easier to understand and analyze your data later. A table is a good way to record data.

The labels on the columns and rows are chosen to represent the design features of the investigation; dependent variable and its units and the range of values for the independent variable.

- Include space for repeats of the experiment design (trials)

Transforming Raw Data

How can raw data be transformed to reveal patterns or trends?

Unprocessed data is called raw data. Data often needs to be transformed to make it easier to understand and to identify important features.

Raw data: data collected by measuring/counting in the field or laboratory

Basic calculations, such as totals, are commonly used to compare replicates or are performed before other data transformations can be carried out.

Common data transformations include:

- Tally charts
- Percentages
- Rates

Drawing Graphs

How do scientists choose the most appropriate type of graph to display their data?

Graphs provide a way to visually see data trends.

Line graphs: used to plot continuous data when one variable, the independent variable, affects another, the dependent variable.

Scatter graphs: used to plot continuous data where there is a relationship between two interdependent variables

Bar graphs: used to plot data that is non-numerical or discrete for at least one variable

Histograms: graphically show the frequency distribution of continuous data

Guidelines for graphing:

- Use at least half the grid provided, do NOT make graph too small
- Draw graph in pencil
- Independent variable should be plotted on the x-axis
- Dependent variable should be plotted on the y-axis
- Each axis should be marked with an appropriate scale; examine data critically to establish whether it is necessary to start the scale(s) at zero; you may have a displaced origin for one/both axes
- Each axis should be scaled using multiples of 1, 2, 5, or 10 ; NEVER use multiples of 3
- Each axis should be labelled clearly with the quantity and SI unit(s) or derived units
- Plotted points must be clearly marked and easily distinguishable from the grid lines; dots in small circles or small neatly drawn crosses should be used; dots on their own should NOT
- If you need to plot multiple lines, label each line carefully or use a key; use a pencil for all lines do NOT use pen or different colors

Descriptive Statistics

How do descriptive statistics help us interpret biological data?

Descriptive statistics are used to summarize a data set and describe its basic features. The type of statistic calculated depends on the type of data and its distribution.

Mean

- The average of all data entries
- Measures central tendency; best used for normally distributed data
- Sensitive to outliers (extremely high/low values)

Median

- The middle value in a ranked data set
- Good measure of central tendency; best for skewed distributions/when outliers are present

Mode

- The most common data value
- Useful for bimodal and qualitative data; best for identifying the most common observation

Range

- Difference between the highest and lowest value
- Shows the overall spread of the data
- Like the mean, it's affected by outliers

Standard Deviation (SD)

- A measure of how spread out the data are around the mean
- Indicates the consistency/variability of results
- A low standard deviation = data close to the mean; high standard deviations = more spread out data

Interquartile Range (IQR)

- Range between the 25th percentile (Q1) and 75th percentile (Q3)
- Measures the spread of the middle 50% of data; NOT influenced by outliers
- $IQR = Q3 - Q1$

Mean, median, mode → describe central tendency

Range, standard deviations, and IQR → describe variability

These tools allow scientists to interpret results, spot anomalies, and compare data sets meaningfully.

Metric System, SI Units, and Dimensional Conversions

Why is it important to use the metric system and correctly convert between units in scientific investigations?

Metric system: a decimal-based system used worldwide in science

SI Units (International System of Units): standard units used in scientific measurement

Quantity	SI Unit	Symbol
length	meter	m
mass	kilogram	kg
time	second	s
temperature	kelvin	K
volume	Cubic meter / liter	m ³ / L
Amount of substance	mole	mol

Metric Prefixes:

Prefix	Multiplying factor	Prefix	Multiplying factor
deca-	10X	deci-	1/10
hecta-	100X	centi-	1/100
kilo-	1,000X	milli-	1/1,000
mega-	1,000,000X	micro-	1/1,000,000
giga-	1,000,000,000X	nano-	1/1,000,000,000
tera-	1,000,000,000,000X	pico-	1/1,000,000,000,000

Biological Drawings

How do biological drawings differ from artistic sketches, and what makes them scientifically useful?

<https://www.youtube.com/watch?v=W8IPFOnFv8>

Good biological drawing provides an accurate record of a specimen you are studying, and enables you to make a record of its important features.

- Drawing something will help you remember its features as a later date
- Require you to pay attention to detail; it is important to draw what you see, and not what you think you should see
- Attention should be given to the symmetry and proportions of your specimen. Accurate labeling, a statement of magnification or scale, the view (section type), and type of stain used (if applicable) should all be noted on your drawing

Key points for making good biological drawings:

- Must include title
- Center drawing on the page, leaving room to place labels around the drawing
- Use stippling (dotting) to represent depth; Do NOT use shading
- Proportions should be accurate; If necessary, measure lengths of various parts with a ruler
- Use simple, narrow lines
- Use a sharp pencil; draw on white, plain paper
- All parts must be labelled accurately; labeling lines should be drawn with a ruler and should not cross over other label lines (try to use only vertical or horizontal lines)
- Must include a scale or magnification to indicate the size of your subject

Annotated diagrams: a diagram that includes a series of explanatory notes; provide important/useful information about your subject

Plan diagrams: drawings made of samples viewed under a microscope at a low or medium power; they are used to show the distribution of the different tissue types in a sample w/o any cellular detail

Summary

A solid foundation in basic scientific practices include understanding how to ask testable questions, design controlled experiments, collect accurate and precise data, and interpret results using appropriate graphs and statistics. Students should be comfortable identifying variables, using scientific reasoning, and applying math skills like calculating percentages, rates, and standard deviation.