AP BIOLOGY

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In the end, we will conserve only what we love.
We will love only what we understand.
We will understand only what we are taught.

– Baba Dioum
Conservationist

Directions:

1. Read the following chapters on Biochemistry from the *Campbell Biology In Focus* textbook and complete the attached study guide.

   Chapter 2: *The Chemical Context of Life*
   Chapter 3: *Carbon and the Molecular Diversity of Life*

   NOTE: If you have not received copies of the assigned chapters, then you MUST notify me via e-mail immediately.

2. View each of the following *Bozeman Science* videos and take careful notes to supplement the information in your textbook.

   http://www.bozemanscience.com/ap-biology

   Water: A Polar Molecule
   Acids, Bases, and pH
   Biological Molecules

3. Read and annotate the attached scientific study, *Transgenic pollen harms monarch larvae,* and complete the corresponding tasks.

4. Be prepared to discuss and apply the information by the first day of school. You will take an *Experimental Design and Biochemistry Exam* on the first block day once school resumes.

Biochemistry

AP Biology—Mrs. D. Escobar

Chapter 2: The Chemical Context of Life

Briefly define the following terms.

- atom
- molecule
- compound
- ion
- isotope
- valence electrons
- chemical reactions
- electronegativity

Describe each of the following attractions and note their relative strength.

- covalent bonds
- ionic bonds
- hydrogen bonds
- Van der Waals interactions

Define the following terms and provide an example of each.

- ion
- cation
- anion
- ionic compound

Living systems depend on properties of water that result from its polarity and hydrogen bonding. Refer to Figure 2.16 to provide a detailed sketch of a water molecule (label all components and their charges) and explain why it is considered a *polar molecule*.

Complete the following table on the Properties of Water by referring to your textbook.

Identification of Property (name the property)	**Definition**	**Explanation** (in terms of the physical/ chemical nature of water)	**Significance to Life**

- What is *chemical equilibrium*?

Provide three examples under each of the categories listed below.

Polar/Hydrophilic/Water-soluble substances

1.
2.
3.

Non-polar/Hydrophobic/Water-insoluble substances

1.
2.
3.

Define the following terms <u>and</u> provide an example of each.

- acid
- base

Respond to the following questions by referring to the information provided in your textbook and in Figure 2.25.

- Describe the connection between a *solvent*, *solute*, and *solution*.
- What is an aqueous solution?
- Differentiate between the following terms: *molecular mass, mole (mol), and molarity.*
- What is meant by the *pH* of a solution?
- Write the equation used to determine the pH of a solution.
- How is pH impacted by an increase in H^+ ion concentration?
- Why is pure water considered neutral?
- What is a buffer? Provide an example.
- Discuss the causes and effects of acidification.

Chapter 3: Carbon and the Molecular Diversity of Life

- Carbon is said to be unparalleled in its ability to form molecules that are large, complex, and diverse. Explain what makes this possible.
- What is a carbon skeleton? Identify the four ways in which they vary.
- Name the seven most important chemical groups in biological processes. Study Figure 3.6 on page 48.
- What is the connection between a *chemical group* and a *functional group*?
- What is the meaning of the prefix *macro*- ?
- The large biological molecules listed on the following page are *organic compounds*. Explain the meaning of an organic compound.

Complete the following table by referring to your textbook.

Organic Compound	Composition	Monomers	Functions	Examples
carbohydrates			short-term energy storage	
	carbon, hydrogen, and oxygen			
		amino acids		
				DNA and RNA

- Of the 92 natural elements, about 20 to 25% are *essential elements*. Identify the four elements that make up 96% of living matter.

Sketch the structure of each of the four macromolecules in the spaces provided.

Proteins	Lipids
Carbohydrates	**Nucleic Acids**

- What is adenosine triphosphate (ATP)?

- Provide a detailed sketch of the ATP molecule.

- Differentiate between a *dehydration reaction* and *hydrolysis*. Describe the function of each process and its specific connection to water.

Carbohydrates

- What role do carbohydrates play in photosynthesis? In cellular respiration? (use the terms *reactant* and *product*)

- Write the reaction for photosynthesis in symbols on the lines provided <u>and</u> in words underneath. Then, circle the carbohydrate.

______________ + ______________ + ______________ → ______________+ ______________

- Write the chemical reaction for cellular respiration in symbols on the lines provided <u>and</u> in words underneath. Then, circle the carbohydrate.

______________+ ______________ → ______________ + ______________ + ______________

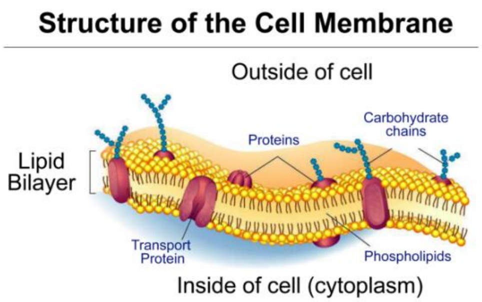
Provide a brief description and example of each of the following types of sugars.

Types of Sugars

	Description	**Example**
Monosaccharides		
Disaccharides		
Polysaccharides		

Lipids

- Circle one lipid molecule in the diagram of the phospholipid bilayer that comprises the cell (plasma) membrane. Then, in the box provided, sketch the phospholipid symbol shown in Figure 3.15c (page 56).



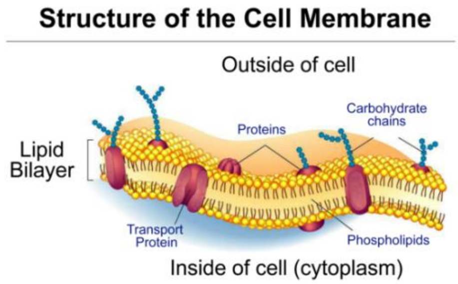
- Why does a phospholipid bilayer occur? (include the terms *hydrophilic* and *hydrophobic* in your discussion)

- What is the function of the phospholipid bilayer?

- Lipids are found in fat cells in our bodies. Why do fat cells store lipid molecules?

Proteins

- Circle a protein molecule in the diagram below.



- What is the function of the proteins embedded in the cell membrane?

- Briefly describe the four levels of protein structure.

- Differentiate between denaturation and renaturation of a protein.

- Enzymes are a type of protein. Explain how enzymes work.

- Define the terms *catalyst* and *enzyme* and explain how they are related.

- Describe the *Lock and Key* analogy (address the number of chemical reactions an enzyme can catalyze).

- How are enzymes named? What is the significance of the suffix –*ase*?

- What are substrates? What is an active site?

- How are amino acids grouped?

- Name the eight protein functions presented in chapter 3:

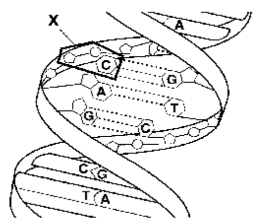
1.
2.
3.
4.
5.
6.
7.
8.

Nucleic Acids

- Do all organisms contain nucleic acids?

- How are nucleic acids used in evolutionary theory?

- Is the molecule below an example of DNA or RNA? What is the name given to its structure?



- Letter X in the diagram above shows a(n)

  a. amino acid
  b. nucleotide
  c. nitrogenous base
  d. ion

- The two winding strands depicted in the structure above are referred to as *antiparallel*. What is meant by this term?

- Which nitrogenous base below indicates the nucleic acid featured is RNA?

  a. uracil
  b. guanine
  c. cytosine
  d. adenine

- List two other differences between DNA and RNA.

- Show the correct sequence of the transfer of information in most organisms by using the following terms: *Protein, DNA, RNA.*

Experimental Design: *Transgenic pollen harms monarch larvae*

Introduction

This 1999 study by Cornell University researchers Losey et al. was the first to claim that the use of Bt toxin on corn plants could have a negative impact on the monarch butterfly. The controversial report led to extensive discussion and experimentation within the scientific community and an existing skepticism towards the benefits of transgenic organisms by the public.

Directions

Read, highlight, and annotate the study by labeling the elements of experimental design. Then, complete the following tasks.

1. **Propose** the scientific question that the researchers were most likely investigating with the experiment.
2. **State** ONE hypothesis (as an *If…*, *then…* statement) that could have been tested to address the scientific question.
3. **Identify** the independent (manipulated) variable and unit.
4. **Identify** the dependent (responding) variable and unit.
5. **Identify** any equipment, chemicals, and organisms used for the experiment.
6. **List** each experimental procedure.
7. On a sheet of white unlined paper, **provide** a hand-drawn, labeled, and colored diagram of the experimental set-up.
8. **Identify** the control (the independent variable at some normal or standard value).
9. **Describe** what was measured and how it was quantified.
10. **List** any factors held constant.
11. **Discuss** how data was presented within this study (e.g. data tables, diagrams, graphs, written results).
12. **Discuss** the results as related to the hypothesis.
13. **Discuss** the researchers' conclusions.
14. **Determine** the sample size and number of times the trials were repeated.
15. **Define** reliability. **Determine** whether this study is reliable. **Justify** your response.
16. **Define** validity. **Determine** whether this study is valid. **Justify** your response.
17. **Propose** THREE specific improvements to the experimental design.
18. **Explain** how each modification you listed would affect the experiment.

Transgenic pollen harms monarch larvae

Although plants transformed with genetic material from the bacterium *Bacillus thuringiensis* (*Bt*) are generally thought to have negligible impact on non-target organisms[1], *Bt* corn plants might represent a risk because most hybrids express the *Bt* toxin in pollen[2], and corn pollen is dispersed over at least 60 metres by wind[3]. Corn pollen is deposited on other plants near corn fields and can be ingested by the non-target organisms that consume these plants. In a laboratory assay we found that larvae of the monarch butterfly, *Danaus plexippus*, reared on milkweed leaves dusted with pollen from *Bt* corn, ate less, grew more slowly and suffered higher mortality than larvae reared on leaves dusted with untransformed corn pollen or on leaves without pollen.

Pollen for our assay was collected from N4640-*Bt* corn and an unrelated, untransformed hybrid, and was applied by gently tapping a spatula of pollen over milkweed (*Asclepias curassavica*) leaves that had been lightly misted with water. Pollen density was set to visually match densities on milkweed leaves collected from corn fields. Petioles of individual leaves were placed in water-filled tubes that were taped into plastic boxes. Five three-day-old monarch larvae from our captive colony were placed on each leaf, and each treatment was replicated five times. Milkweed leaf consumption, monarch larval survival and final larval weight were recorded over four days.

Larval survival (56%) after four days of feeding on leaves dusted with *Bt* pollen was significantly lower than survival either on leaves dusted with untransformed pollen or on control leaves with no pollen (both 100%, $P = 0.008$) (Fig. 1a). Because there was no mortality on leaves dusted with untransformed pollen, all of the mortality on leaves dusted with *Bt* pollen seems to be due to the effects of the *Bt* toxin.

There was a significant effect of corn pollen on monarch feeding behaviour ($P = 0.0001$) (Fig. 1b). The mean cumulative proportion of leaves consumed per larva was significantly lower on leaves dusted with *Bt* pollen (0.57 ± 0.14, $P = 0.001$) and on leaves dusted with untransformed pollen (1.12 ± 0.09, $P = 0.007$) compared with consumption on control leaves without pollen (1.61 ± 0.09). The reduced rates of larval feeding on pollen-dusted leaves might represent a gustatory response of this highly specific herbivore to the presence of a 'non-host' stimulus. However, such a putative feeding deterrence alone could not explain the nearly twofold decrease in consumption rate on leaves with *Bt* pollen compared with leaves with untransformed pollen ($P = 0.004$).

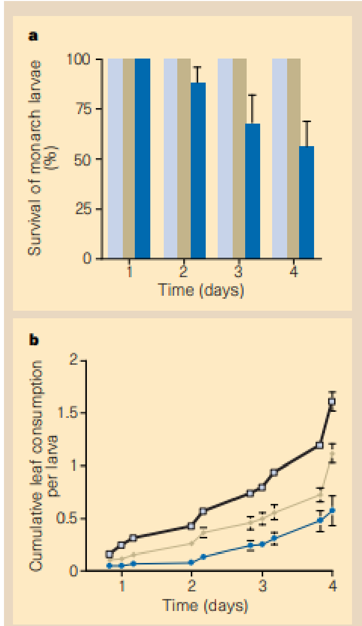


Figure 1 Survival and leaf consumption of second- to third-instar monarch larvae on each of three milkweed leaf treatments: leaves with no pollen (light blue), leaves treated with untransformed corn pollen (green) and leaves dusted with pollen from *Bt* corn (dark blue). **a**, Mean (±s.e.m.) survival based on the proportion of larvae surviving in five replicates of each treatment. **b**, Mean (±s.e.m.) cumulative leaf consumption based on the total amount of leaf area consumed per larva in five replicates of each treatment. The amount of leaf area consumed per larva in each experimental unit was calculated for each time interval by dividing the amount of leaf area consumed in that interval by the number of larvae alive during the time interval. Cumulative consumption was calculated by summing the leaf area consumed per larva at each interval. Colours of lines correspond to those of the bars in **a**.

The low consumption rates of larvae fed on leaves with *Bt* pollen led to slower growth rates: the average weight of larvae that survived to the end of the experiment on *Bt*-pollen leaves (0.16 ± 0.03 g) was less than half the average final weight of larvae that fed on leaves with no pollen (0.38 ± 0.02 g, $P = 0.0001$).

These results have potentially profound implications for the conservation of monarch butterflies. Monarch larvae feed exclusively on milkweed leaves[4]; the common milkweed, *A. syriaca*, is the primary host plant of monarch butterflies in the northern United States and southern Canada[5]. Milkweed frequently occurs in and around the edges of corn fields, where it is fed on by monarch larvae[6]. Corn fields shed pollen for 8–10 days between late June and mid-August, which is during the time when monarch larvae are feeding[7]. Although the northern range of monarchs is vast, 50% of the summer monarch population is concentrated within the midwestern United States, a region referred to as the 'corn belt' because of the intensity of field corn production[8]. The large land area covered by corn in this region suggests that a substantial portion of available milkweeds may be within range of corn pollen deposition.

With the amount of *Bt* corn planted in the United States projected to increase markedly over the next few years[9], it is imperative that we gather the data necessary to evaluate the risks associated with this new agrotechnology and to compare these risks with those posed by pesticides and other pest-control tactics.

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The mystery of female beauty

Yu and Shepard[1] have reported a preference for heavy women with high waist-to-hip ratios (WHR) in a culturally isolated population in southeast Peru. Their findings are interesting because a preference for low WHR is widespread in westernized populations[2–5]. However, we disagree with their argument that cultural invariance is necessary for an adaptionist interpretation of WHR preference.

WHR and waist circumference are positively correlated with testosterone and negatively associated with oestrogen[6]. Women with low WHR have better health and fertility than women with high WHR[5]. However, women in England and Texas with high