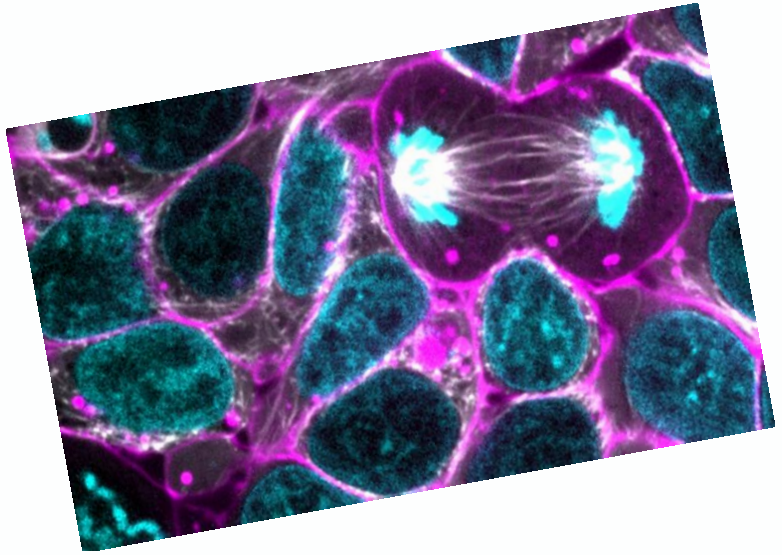
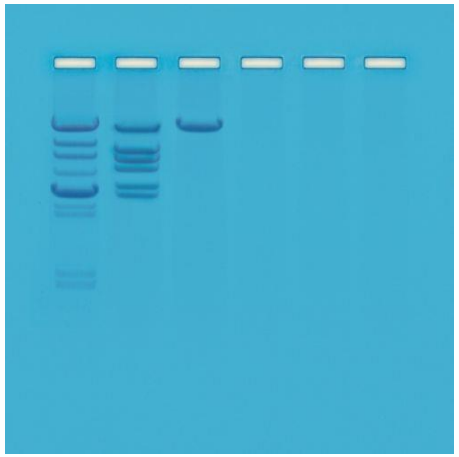
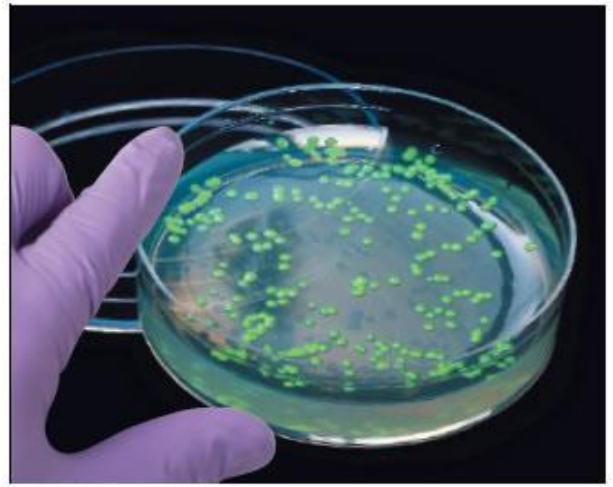


AP Biology in MCPS

What you can expect

May 8th
Wootton High School





Outcomes

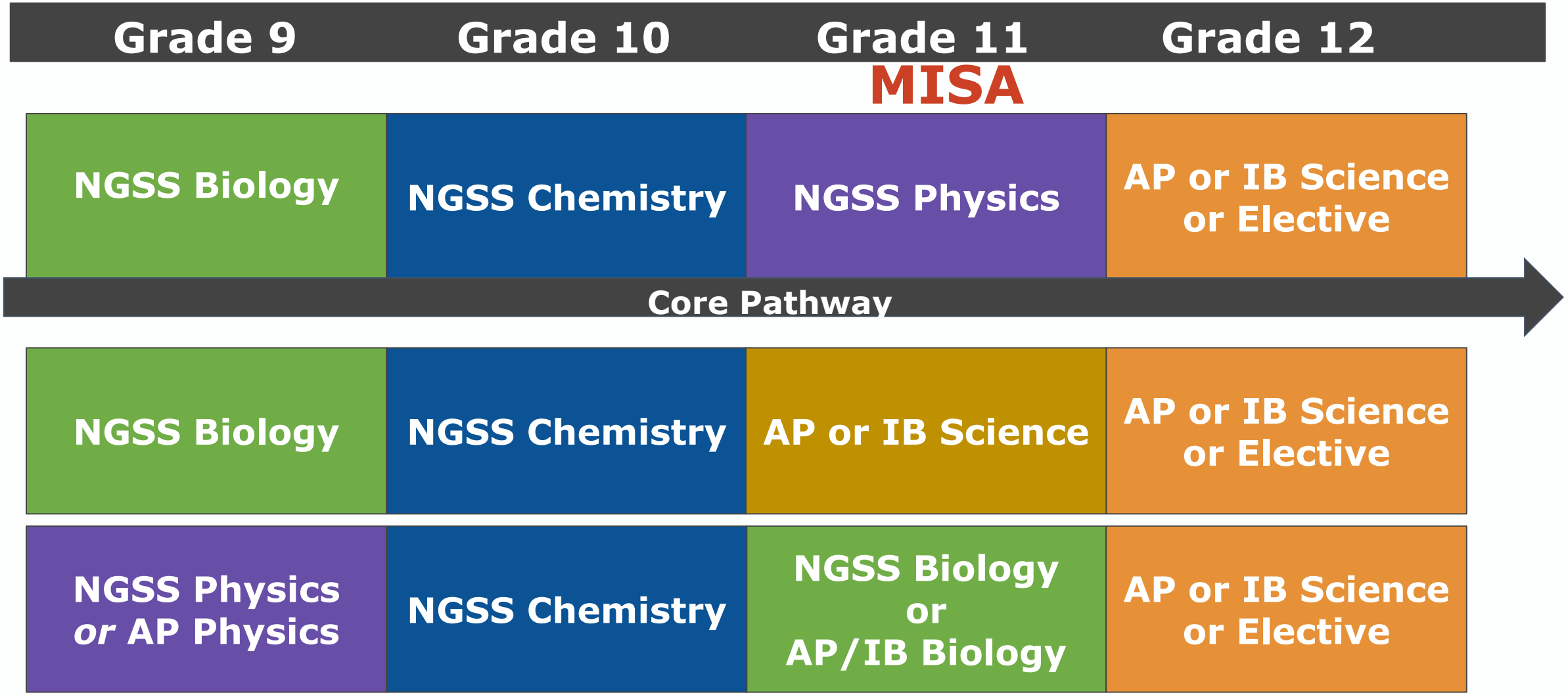
By the end of this session, we will:

- Explain the paradigm shifts in AP Biology,
- Explore the breadth and depth of content within the course,
- Examine the pacing of the course,
- Discuss how this course prepares students for the MISA, college and career.

Jacki Bragg

- National Board Certified teacher - 23 years teaching with MCPS
- 16 years teaching AP Biology
- MCPS NGSS Biology curriculum and assessment writer.

High School Course Pathways



Alignment with NGSS

AP Enduring Understanding	AP Essential Knowledge Focus	NGSS Disciplinary Core Idea Element(s)	NGSS Performance Expectation(s)	Comments about the Connections
1.A Change in the genetic makeup of a population over time is evolution.	**1.A.1** Natural selection is a major mechanism of evolution.	**HS.LS2.C: Ecosystem Dynamics, Functioning, and Resilience** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. **HS.LS3.B: Variation of Traits** In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. **HS.LS4.B: Natural Selection** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the	**HS-LS2-6** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. **HS-LS3-2** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. **HS-LS3-3** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. **HS-LS4-2** Construct an explanation based on evidence that the	The NGSS build a foundation for students to understand the theory of natural selection and how it is a mechanism for evolution. **AP EK 1.A.1** goes beyond the NGSS by including details about how environmental conditions can affect evolutionary rate and direction, the Hardy-Weinberg equilibrium, and the mathematical calculations involved for changes in allele frequency.

Redesigned curriculum in 2012 and 2019

Hallmarks of the redesigned course and exam:

- A greater emphasis on discipline-specific inquiry, reasoning, and communication skills
- Rigorous, research-based curricula, modeled on introductory college courses, that strike a balance between breadth of content coverage and depth of understanding.
- Standards based objectives
- Detailed curriculum frameworks, which tie the discipline-specific concepts, themes, and skills to a set of key learning objectives and emphasize conceptual understanding
- Exam questions designed to elicit evidence of student achievement for each learning objective.

AP Biology Curriculum Is Framed Around Four Big Ideas

BIG IDEA 1	The process of evolution drives the diversity and unity of life.
BIG IDEA 2	Biological systems utilize energy and molecular building blocks to grow, reproduce, and maintain homeostasis.
BIG IDEA 3	Living systems retrieve, transmit, and respond to information essential to life processes.
BIG IDEA 4	Biological systems interact, and these interactions possess complex properties.

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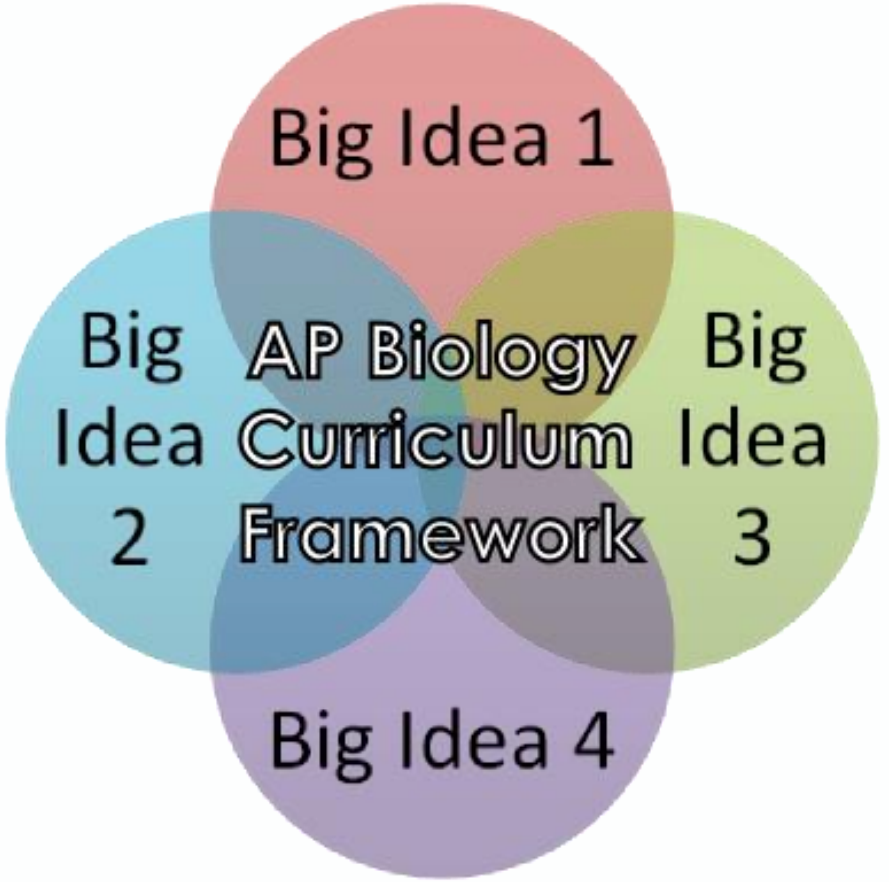
Course Pacing

- AP Biology covers topics regularly covered in a college biology course for MAJORS.
- As such, the textbook used, the range and depth of topics covered, the type of laboratory work, and the time and effort required of students will differ significantly from the student's first high school biology course.

Course Overview

General Topics within the Big Idea Framework

- Evolution and Ecology
- Biochemistry
- Cell Structure and Function
- Molecular Genetics
- Classical Genetics
- Energetics and Ecosystems
- Cell Signaling and Communication
  - Signal Transduction Pathways
  - Immune System
  - Endocrine System
  - Nervous System
- Energetics and Ecosystems



Emphasis on Science Practices

The science practices enable students to establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena

SCIENCE PRACTICES

- 1.0 The student can use representations and models to communicate scientific phenomena and solve scientific problems
- 2.0 The student can use mathematics appropriately
- 3.0 The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course
- 4.0 The student can plan and implement data collection strategies appropriate to a particular scientific question
- 5.0 The student can perform data analysis and evaluation of evidence
- 6.0 The student can work with scientific explanations and theories
- 7.0 The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains

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2018 AP® BIOLOGY FREE-RESPONSE QUESTIONS

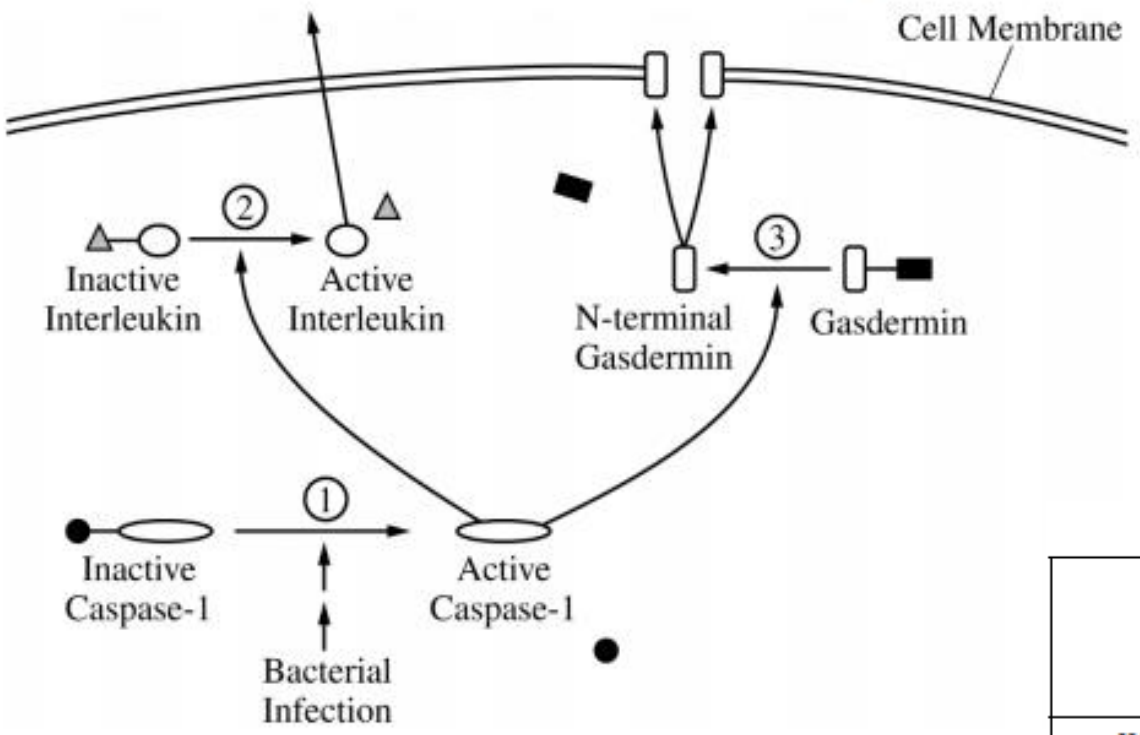


Figure 1. Cellular response to infection by pathogenic bacteria

Some pathogenic bacteria enter cells, replicate, and spread to other cells, causing illness in the host organism. Host cells respond to these infections in a number of ways, one of which involves activating particular enzymatic pathways (Figure 1). Cells normally produce a steady supply of inactive caspase-1 protein. In response to intracellular pathogens, the inactive caspase-1 is cleaved and forms an active caspase-1 (step 1). Active caspase-1 can cleave two other proteins. When caspase-1 cleaves an inactive interleukin (step 2), the active portion of the interleukin is released from the cell. An interleukin is a signaling molecule that can activate the immune response. When caspase-1 cleaves gasdermin (step 3), the N-terminal portions of several gasdermin proteins associate in the cell membrane to form large, nonspecific pores.

Researchers created the model in Figure 1 using data from cell fractionation studies. In the experiments, various parts of the cell were separated into fractions by mechanical and chemical methods. Specific proteins known to be located in different parts of the cell were used as markers to determine the location of other proteins. The table below shows the presence of known proteins in specific cellular fractions.

CELL FRACTIONS CONTAINING DIFFERENT CELLULAR PROTEINS

	Aconitase (Krebs cycle protein)	DNA polymerase	GAPDH (glycolytic protein)	Sodium-potassium pump	NF-κB (Immune response protein)
Whole cell sample	+	+	+	+	+
Fraction 1	+				
Fraction 2		+			+
Fraction 3			+		+
Fraction 4				+	
+ = presence of protein					

Students must read, process, and respond in 22.5 minutes

(a) **Describe** the effect of inhibiting step 3 on the formation of pores AND on the release of interleukin from the cell.

(b) **Make a claim** about how cleaving inactive caspase-1 results in activation of caspase-1. A student claims that preinfection production of inactive precursors shortens the response time of a cell to a bacterial infection. **Provide ONE reason** to support the student's claim.

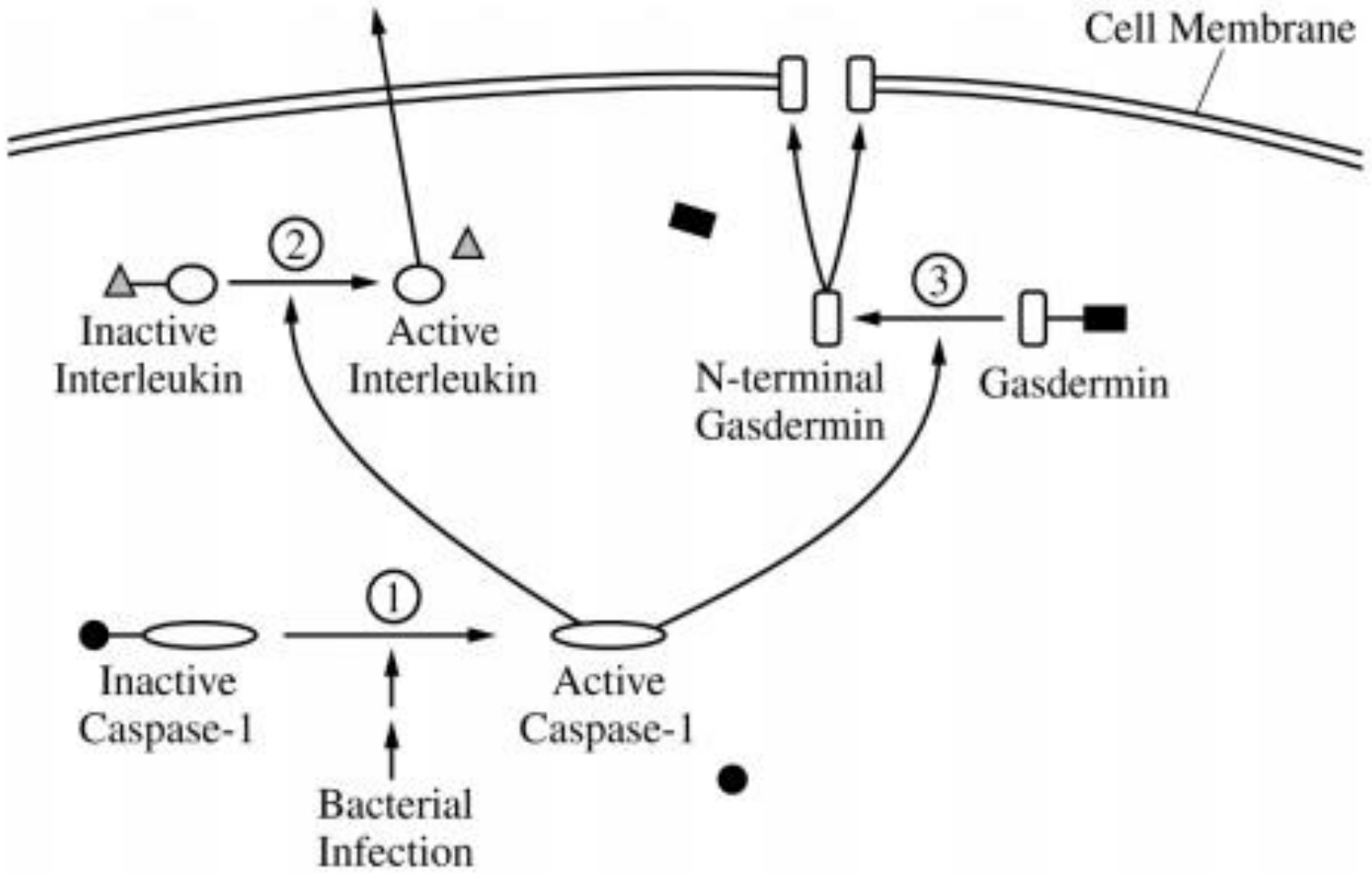
(c) A student claims that the NF-κB protein is located in the cytoplasm until the protein is needed for transcription. **Justify** the student's claim with evidence. **Identify TWO** fractions where N-terminal gasdermin would be found in cells infected with pathogenic bacteria.

(d) **Describe** the most likely effect of gasdermin pore formation on water balance in the cell in a hypotonic environment.

(e) **Explain** how gasdermin pore formation AND interleukin release contribute to an organism's defense against a bacterial pathogen.

Students must read, process, and respond in 22.5 minutes

2018 AP® BIOLOGY FREE-RESPONSE QUESTIONS



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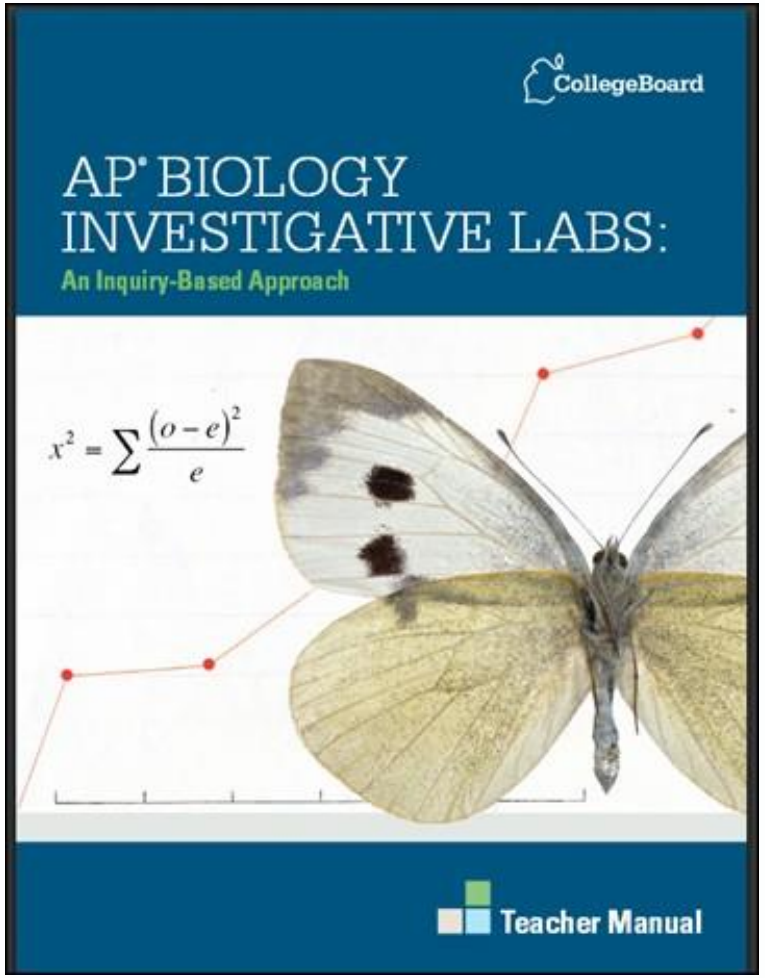
Whole cell sample	+	+	+	+	+
Fraction 1	+				
Fraction 2		+			+
Fraction 3			+		+
Fraction 4				+	

+ = presence of protein

Overview of Labs

- 13 recommended labs
- Student driven
- Inquiry approach
- Time intensive
- Teachers may substitute other activities
- Detailed lab notebooks are kept as colleges may ask to see lab work before awarding AP credit.



Lab Overview

Big Idea: Evolution

1. Artificial Selection
2. Mathematical Modeling (Hardy-Weinberg)
3. Comparing DNA sequences to determine evolutionary relatedness.

- **Use this data to construct a cladogram of the major plant groups**

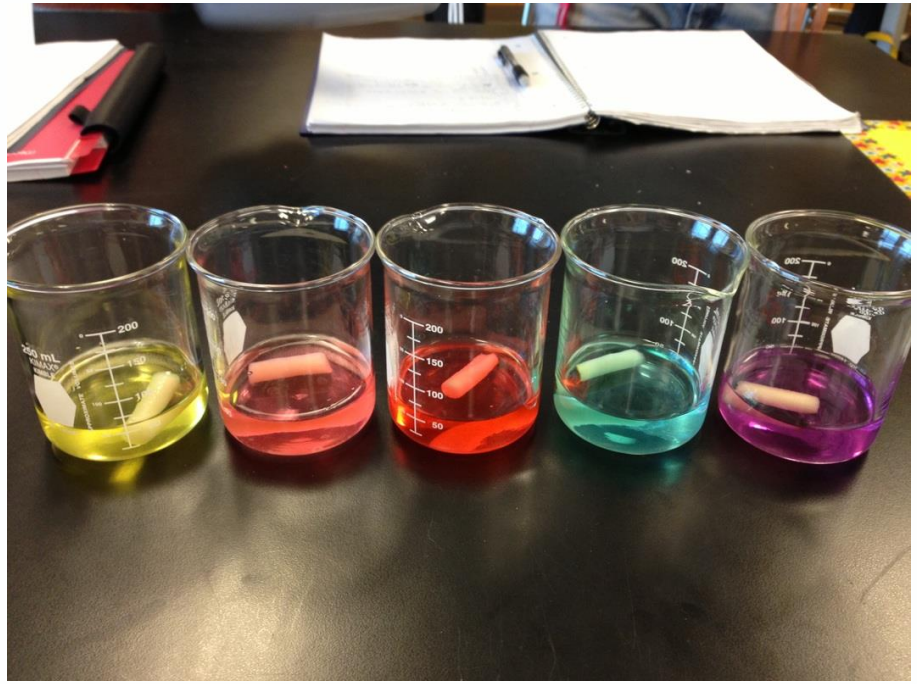
Table 1. Characteristics of Major Plant Groups

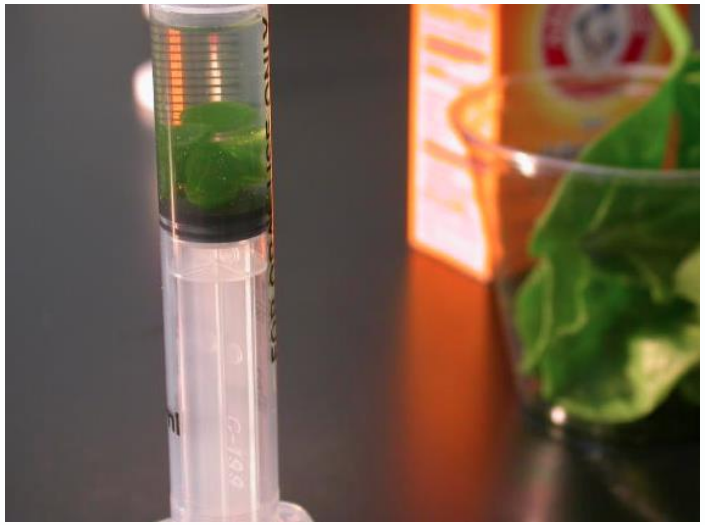
Organisms	Vascular Tissue	Flowers	Seeds
Mosses	0	0	0
Pine trees	1	0	1
Flowering plants	1	1	1
Ferns	1	0	0
Total	3	1	2

Lab Overview

Big Idea: Cellular Processes (Energy and Communication)

1. Diffusion and Osmosis
2. Photosynthesis
3. Cellular Respiration

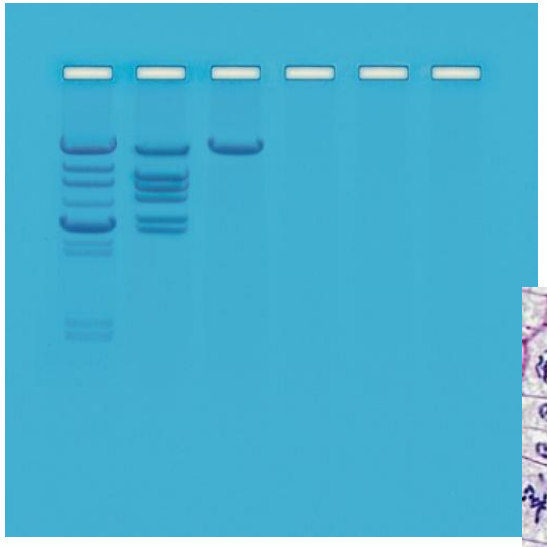


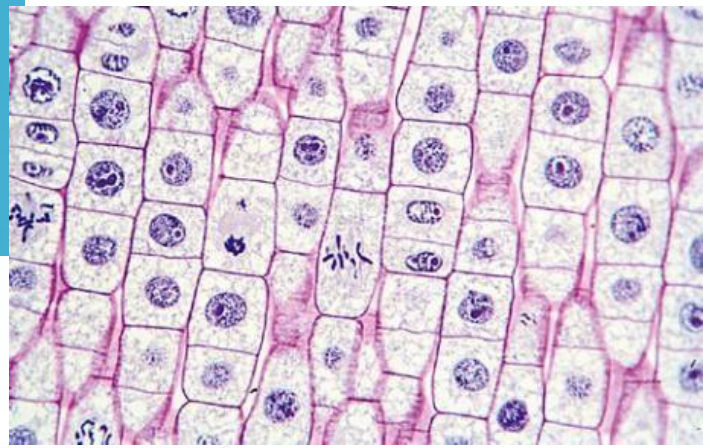


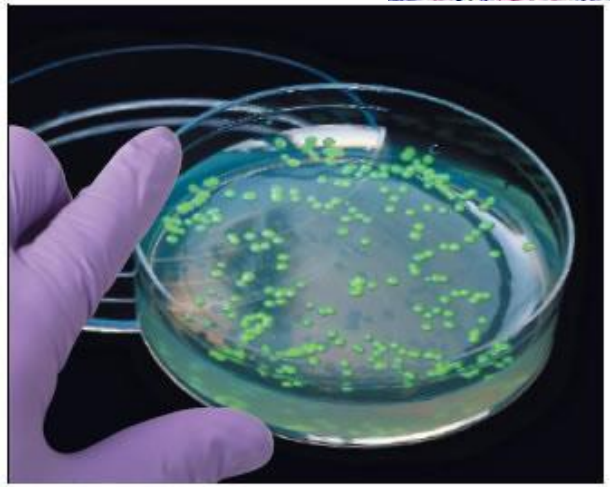
Lab Overview

Big Idea: Genetics and Information Transfer

1. Mitosis and Meiosis
2. Bacterial Transformation
3. Restriction Enzyme Analysis



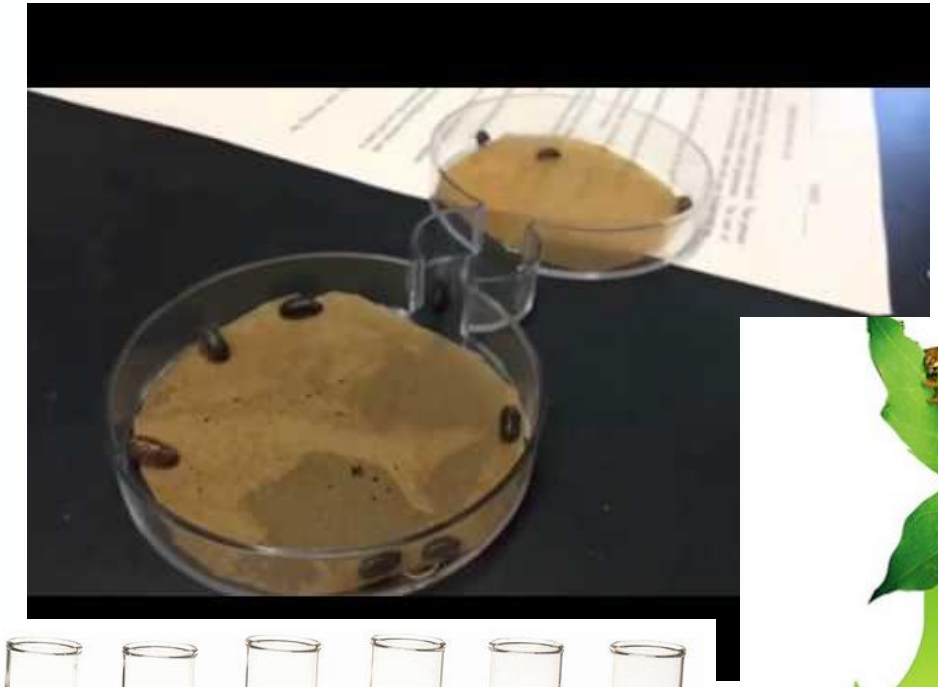


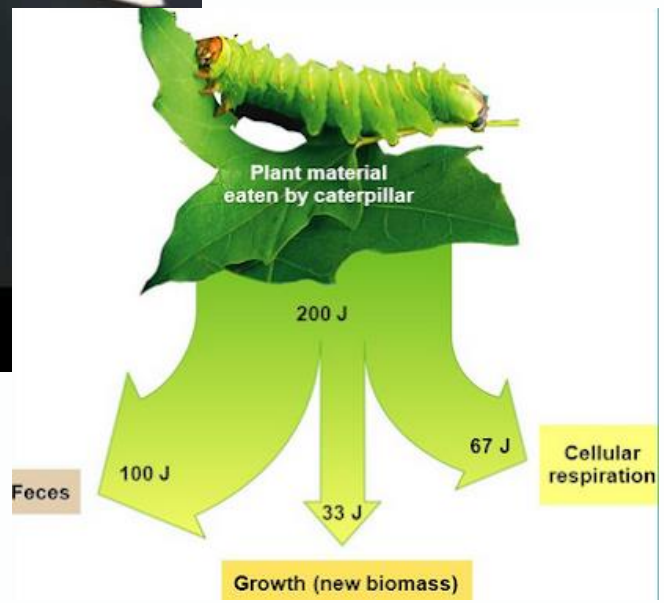


Lab Overview

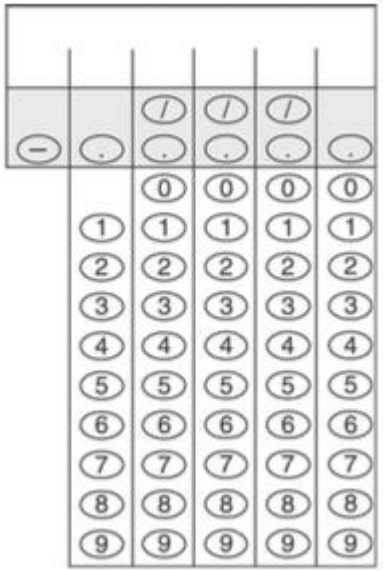
Big Idea: Interactions

1. Energy Dynamics
2. Transpiration
3. Animal Behavior
4. Enzyme Activity



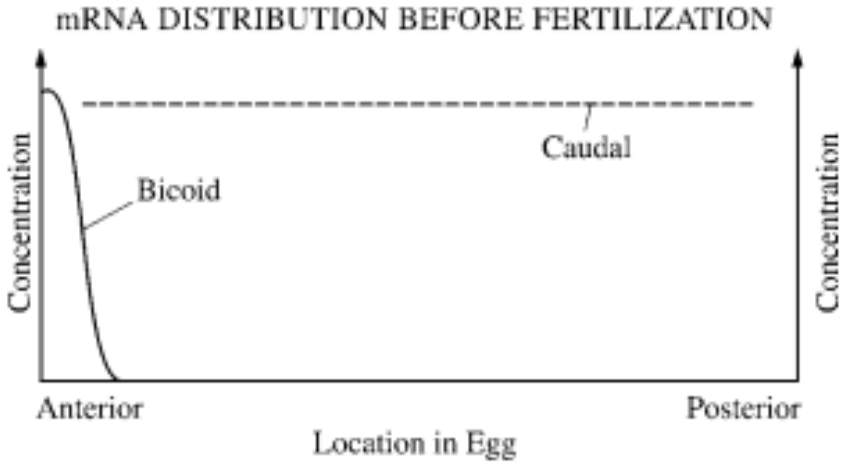


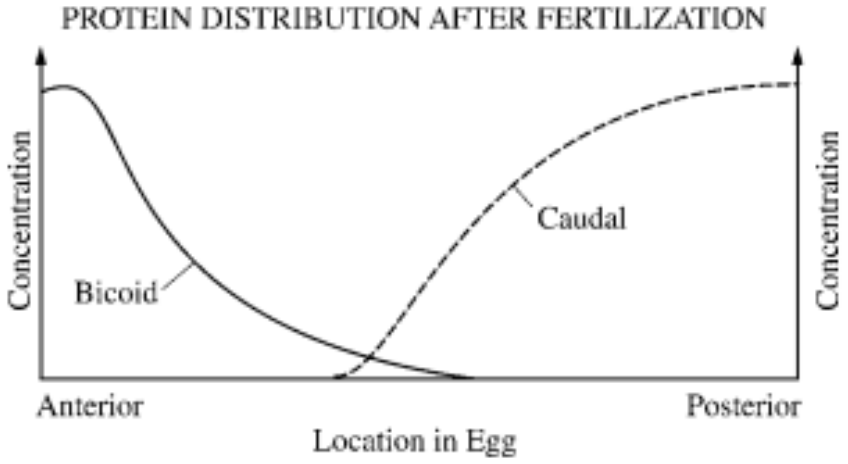
The AP Exam



Section	Question Type	Number of Questions	Scoring		Timing
I	Part A: Multiple Choice	63	50% of the final score		90 minutes
	Part B: Grid-In	6			
II	Long Free Response	2	25% of the final score	Each question will be scored on a 0–10 point scale and will contribute 12.5% of the exam's composite score. Students will have approximately 20–25 minutes to answer each question.	80 minutes + 10-minute reading period
	Short Free Response	6	25% of the final score	Each form will include three 3-point and three 4-point short free-response questions. Students will have approximately 3–10 minutes to answer each question.	

19. The first diagram below shows the levels of mRNA from two different genes (*bicoid* and *caudal*) at different positions along the anterior-posterior axis of a *Drosophila* egg immediately before fertilization. The second diagram shows the levels of the two corresponding proteins along the anterior-posterior axis shortly after fertilization.





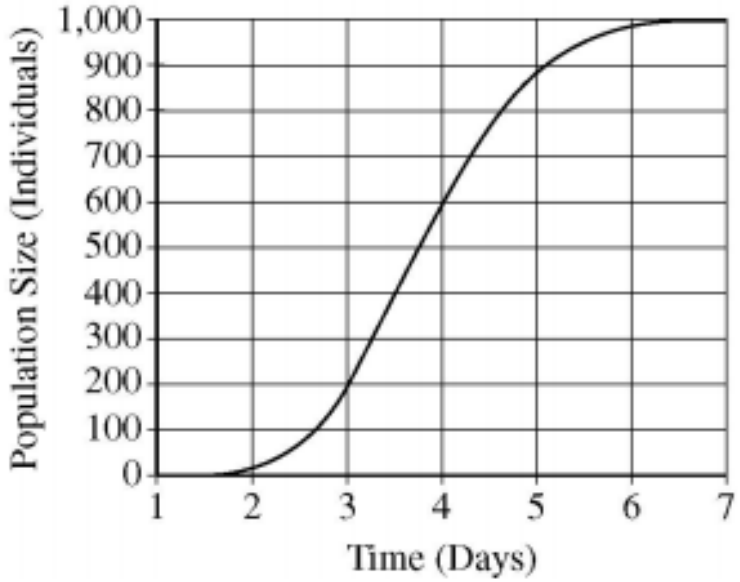
Which of the following conclusions is best supported by the data?

(A) Bicoid protein inhibits translation of *caudal* mRNA.

(B) Bicoid protein stabilizes *caudal* mRNA.

(C) Translation of *bicoid* mRNA produces caudal protein.

(D) Caudal protein stimulates development of anterior structures.



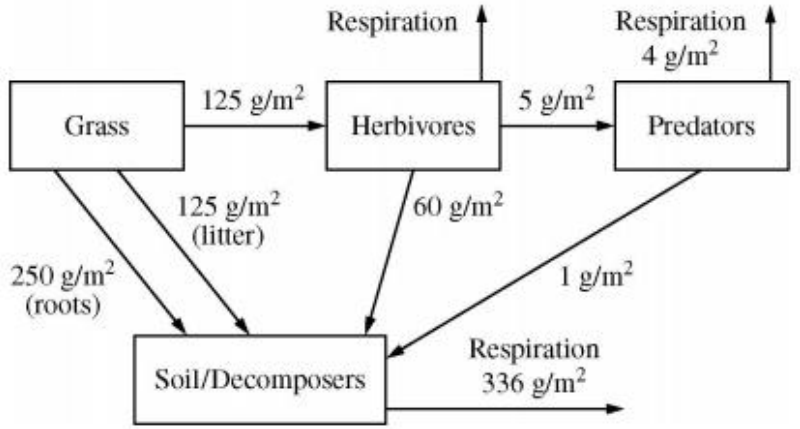
1. Use the graph above to calculate the mean rate of population growth (individuals per day) between day 3 and day 5. Give your answer to the nearest whole number.

2. In a certain species of flowering plant, the purple allele *P* is dominant to the yellow allele *p*.

A student performed a cross between a purple-flowered plant and a yellow-flowered plant. When planted, the 146 seeds that were produced from the cross matured into 87 plants with purple flowers and 59 plants with yellow flowers.

Calculate the chi-squared value for the null hypothesis that the purple-flowered parent was heterozygous for the flower-color gene. Give your answer to the nearest tenth.

CARBON FLOW IN A GRASSLAND ECOSYSTEM



3. How much carbon (in g/m^2) is released into the atmosphere as a result of the metabolic activity of herbivores? Give your answer to the nearest whole number.

The AP Biology Exam is challenging

2018 Data

Sciences

Exam	5	4	3	2	1
Biology	7.2%	21.6%	32.8%	28.3%	10.2%
Chemistry	13.4%	17.6%	24.9%	23.5%	20.6%
Environmental Science	8.8%	23.9%	15%	25.8%	26.5%
Physics 1	5.7%	15.3%	19.6%	28.6%	30.8%
Physics 2	13.1%	15.6%	34.4%	29.2%	7.75%
Physics C: Electricity and Magnetism	37.4%	22.5%	13.5%	16.3%	10.3%
Physics C: Mechanics	30.2%	27.3%	19.7%	12.7%	10%

Biology	2017	6.2%	20.9%	36.7%	27.8%	8.4%
Biology	2016	6.3%	20.6%	33.6%	29.2%	10.3%
Biology	2015	6.2%	22.0%	35.9%	27.6%	8.3%
Biology	2014	6.5%	22.2%	35.1%	27.4%	8.8%

Final Thoughts

The skills and processes approach to AP Biology is excellent preparation for:

- College courses, particularly STEM courses,
- The MISA,
- Any course or career that requires effective communication and analytic skills.

Questions?

Index Card:

please include your contact info

Online form:

Type the link in your browser or scan the QR code

bit.ly/SciNight19

For more information on enrolling your student in this course, please contact the Counselor and/or the Science Department Resource Teacher at your high school.