Teacher: J. Haut
Class: AP Biology
Period: 3
Assignments: Week 1

The work in this packet is due 5/8/2020. If working online, you may turn in work digitally before the deadline. I encourage you to turn work in as you complete it. If completing paper packets, attach all work to packet before turning packet in on May 8th. Make sure to have the proper heading (see pg 3) on each page to ensure that I receive all of your work. I have broken the work down into daily tasks to help you manage your time.

My office hours are 10AM-12PM, M-F. You can email me at jhaut@tusd.net, post a question in Teams, or call me at (209) 625-9540 with questions. Please continue to check your email and Teams Classroom regularly.

Day 1: AP Biology Updates: Review new information about the upcoming AP exams.

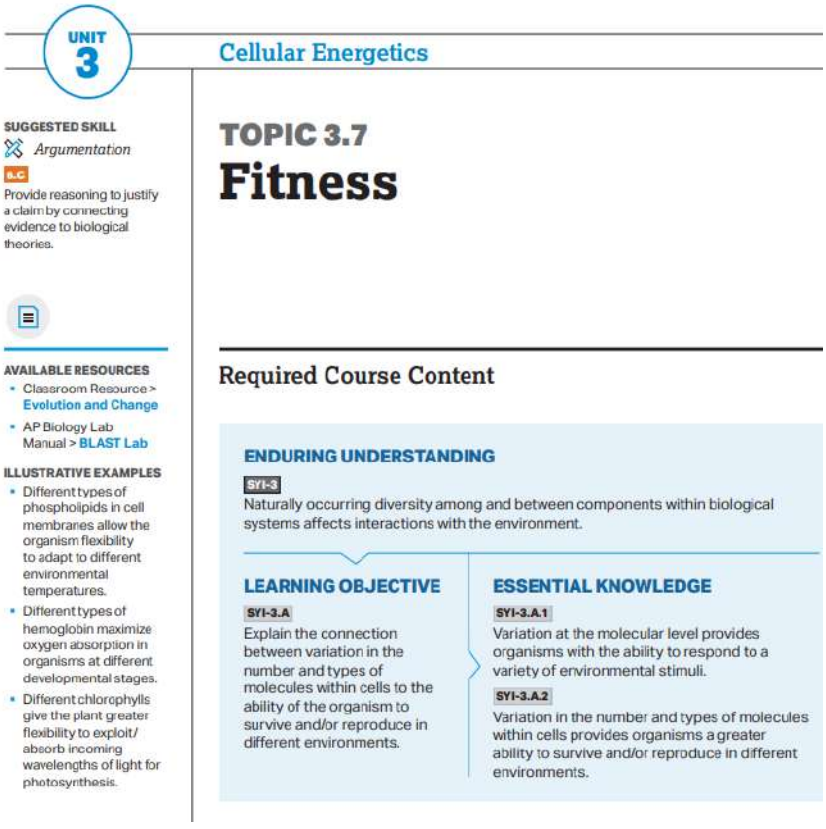
1. Go through "AP Bio Exam Updates-April 02,2020" PowerPoint slides. Take notes as needed. PowerPoint presentation available in our Teams Classroom.
2. Write 1-2 thoughtful paragraphs about what you now understand about
   a. the changes to the exam
   b. what that means for your preparation to take the exam
   c. and what new questions you have
3. Upload your response to our Teams Classroom. Click on "+Add work" and choose how you would like to upload your response, then click "Turn in". Contact me if you have questions.
4. Optional: Take the Personal Progress Checks in AP Classroom

Day 2: Topic 3.7 Fitness: Gather information about how variation at the molecular level and in the number and types of cells allows organisms to respond to environmental impacts and survive.

1. Watch and take notes on the video "Molecular Variation" from Khan Academy. https://www.khanacademy.org/science/ap-biology/cellular-energetics/molecular-fitness/v/molecular-variation

   *Pay close attention to the hemoglobin example.

2. Complete the Practice: Fitness questions at the end in Khan Academy.
3. Write 1-2 paragraphs explaining how the variation in the number and types of molecules with cells can affect the ability of an organism to survive and/or reproduce in different environments. Upload your response to our Teams Classroom.
4. Optional: After reviewing Chapters 5, 8-10, take the Personal Progress Checks in AP Classroom.


UNIT 3

Cellular Energetics

SUGGESTED SKILL

Argumentation

5.C

Provide reasoning to justify a claim by connecting evidence to biological theories.

AVAILABLE RESOURCES

- Classroom Resource > Evolution and Change
- AP Biology Lab Manual > BLAST Lab

ILLUSTRATIVE EXAMPLES

- Different types of phospholipids in cell membranes allow the organism flexibility to adapt to different environmental temperatures.
- Different types of hemoglobin maximize oxygen absorption in organisms at different developmental stages.
- Different chlorophylls give the plant greater flexibility to exploit/absorb incoming wavelengths of light for photosynthesis.

TOPIC 3.7

Fitness

Required Course Content

ENDURING UNDERSTANDING

SYI-3

Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

LEARNING OBJECTIVE

SYI-3.A

Explain the connection between variation in the number and types of molecules within cells to the ability of the organism to survive and/or reproduce in different environments.

ESSENTIAL KNOWLEDGE

SYI-3.A.1

Variation at the molecular level provides organisms with the ability to respond to a variety of environmental stimuli.

SYI-3.A.2

Variation in the number and types of molecules within cells provides organisms a greater ability to survive and/or reproduce in different environments.

Day 3: Topic 3.7 Fitness: Gather information about Peter and Rosemary Grant's research.

1. Read the article in the Grant Study Worksheet and analyze the data.
2. Answer the questions at the end of the article.
    3. Write 1-2 paragraphs explaining how the variation in the number and types of molecules with cells can affect the ability of an organism to survive and/or reproduce in different environments. Upload your response to our Teams Classroom.
    4. Optional: After reviewing Chapters 5, 8-10, take the Personal Progress Checks in AP Classroom.

Day 4-5: Topic 3.7 Fitness: Answer the FRQ's. Try to answer without looking up information and limiting your time to 15-20 minutes (starting with reading the question) to answer each question. Upload your answers to Teams.

1. Scientists are investigating a population of grizzly bears living in Banff National Park. The park has been getting colder over the past couple of years. Researchers are testing the bears to assess the breakdown of the four major biological macromolecules (carbohydrates, proteins, lipids, and nucleic acids) in each bear.
    a. Which of the following statements BEST describes which bears would have a selective advantage for survival in the changing climate?
        A-Bears with higher carbohydrate concentrations.
        B-Bears with higher protein concentrations.
        C-Bears with higher lipid concentrations.
        D-Bears with higher nucleic acid concentrations.
    b. **Predict** how this will affect the grizzly population if the temperatures continue to decrease in the park.
    c. **Justify** your prediction.

2. Cellulose is a polymer made by plants from carbohydrates. In eukaryotic plants, algae, and fungi, cellulose makes up the cell wall. Certain species of bacteria also synthesize cellulose for their cell wall. *A. xylinum* is an aerobic bacterium that has been observed in soil samples and thrives on rotting fruit.

    In the process of metabolizing glucose, *A. xylinum* synthesizes cellulose. The metabolic pathway that the bacterium uses to synthesize cellulose is as follows:

    Students wanted to investigate factors that affect the amount of cellulose that *A. xylinum* can produce. The students carried out different experiments, allowing the bacteria to grow on two different surface areas with different sources of carbon and variation in temperature. The results are shown below.

    Table 1. Surface Area Investigation Results

Surface Area	Cellulose Mass (g)
Test Tube	0.076 g
Test Tube	0.189 g
Petri Dish	0.914 g
Petri Dish	0.668 g

Table 2. Carbohydrate Investigation Results ($15\ \mathrm{mL}$ carbohydrate media and $1\ \mathrm{mL}$ of *A. xylinum*)

Carbyohydrate	Cellulose Mass (g)
No glucose	0.052 g
Maltose	0.240 g
Galactose	0.058 g
Lactose	0.060 g

Table 3. Temperature Investigation Results ($15\ \mathrm{mL}$ carbohydrate media and $1\ \mathrm{mL}$ of *A. xylinum*)

Temperature (°C)	Cellulose Mass (g)
4°C	0.001 g
22°C	0.052 g
30°C	0.105 g
37°C	0.041 g

a. **Describe** the role of cellulose in the cell wall of these organisms.
b. **Analyze** the data. Under which conditions is *A. xylinum* likely to synthesize the largest quantities of cellulose?
c. In a further experiment, the students ran an experiment where the bacteria were grown under conditions where there was a smaller surface area and a temperature of 30ºC and maltose. **Predict** the effect of these conditions on the quantity of cellulose synthesized.
d. **Justify** your prediction.

If completing work via paper packet, all handouts are included in this packet. You can answer questions on additional paper and attach to packet before turning the packet in on 5/8/2020. Please make sure to put the following heading on every page you attach to ensure that I receive it.

From student:

Student Name
Teacher Name
Name of Class
Period#
Assignment Week

AP Biology

2020 National Exam
Monday, May 18 @ 11:00AM PST

New Testing Schedule

New Test Format will be ...

- 25 min FRQ
- 5 min submit answer
- 15 min FRQ
- 5 min sumit answer

45 Minutes Total

What Technology may I use?

Phone
iPad
Tablet
Laptop
Desktop

If you know of students who have a need for technology or connectivity in order to take their AP Exam, please contact Mrs. Rotondi ASAP
College Board has to know before April 24.

Two Options

1. Type your answers on your electronic device
2. Handwrite your answers, take a photo with your phone, and submit using your electronic device

25 Minute FRQ

Worth 65% of score

Free-response question 1: Interpreting and Evaluating Experimental Results is an 8 to 10-point question that presents students with an authentic scenario accompanied by data in a table and/or graph.

This question assesses student ability to do the following in four question parts:

- Part A (1 to 2 points): **Describe** and **explain** biological concepts, processes, or models.
- Part B (3 to 4 points): **Identify** experimental design procedures.
- Part C (1 to 3 points): **Analyze** data.
- Part D (2 to 4 points): **Make** and **justify** predictions.

Task Verbs in this FRQ 1, part A

- **Describe:** Provide relevant characteristics of a specified topic.
- **Explain:** Provide information about how or why a relationship, process, pattern, position, situation, or outcome occurs, using evidence and/or reasoning to support or qualfiy a claim. Explain "how" typically requires analyzing the relationship, process, pattern, position, situation, or outcome; whereas, explain "why" typically requires analysis of motivations or reasons for the relationship, process, pattern, position, situation, or outcome.

Task Verbs in this FRQ 1, part B, C, and D

- **Identify:** Indicate or provide information about a specified topic, without elaboration or explanation.
  - Here with procedures–DON"T FORGET TO IDENTIFY CONTROL!
- **Analyze data:** Interpret data sets or statements made based on evidence in order to reach a conclusion. Identify relationship data shows between variables, pattern, situation, or outcome seen in data
- **Make and Justify Predictions:** State your predictions and provide evidence to support, qualify, or defend a claim, and/or provide reasoning to explain how that evidence supports or qualifies the claim.

15 Minute Question

Worth 35% of score

Free-response question 4: Conceptual Analysis is a 4-point question that presents students with an authentic scenario describing a biological phenomenon with a disruption.

This question assesses students' ability to do the following in four question parts:

- Part A (1 point): **Describe** biological concepts or processes.
- Part B (1 point): **Explain** biological concepts or processes.
- Part C (1 point): **Predict** the causes or effects of a change in a biological system.
- Part D (1 point): **Justify** predictions.

Task Verbs in this FRQ 2, part A and B

- **Describe:** Provide relevant characteristics of a specified topic.
- **Explain:** Provide information about how or why a relationship, process, pattern, position, situation, or outcome occurs, using evidence and/or reasoning to support or qualify a claim. Explain "how" typically requires analyzing the relationship, process, pattern, position, situation, or outcome; whereas, explain "why" typically requires analysis of motivations or reasons for the relationship, process, pattern, position, situation, or outcome.

Task Verbs in this FRQ 1, part C and D

- **Predict/Make a prediction:** Predict the causes or effects of a change in, or disruption to, one or more components in a relationship, pattern, process, or system.
- **Justify:** Provide evidence to support, qualify, or defend a claim, and/or provide reasoning to explain how that evidence supports or qualifies the claim.

Basically... Claim-Evidence-Reasoning

AP Biology Testing Dates

Monday, May 18, 2020 @ 11:00 AM
From your home on your device

Makeup Date
Wednesday, June 03, 2020 @ 1:00 PM
ONLY if you have a conflict with May 18
Must be validated by your school

Exams will be returned to teachers no later than May 26!

We Have Six Weeks

- Review the key concepts we have studied
- Focus on the science practices that will support the two questions on the national exam
- Take advantage of the Personal Progress Checks in AP Classroom
- Utilize multiple practice exams that mimic the current exam structure over the next six weeks

Fitness: Molecular Variation
Transcript from Khan Academy

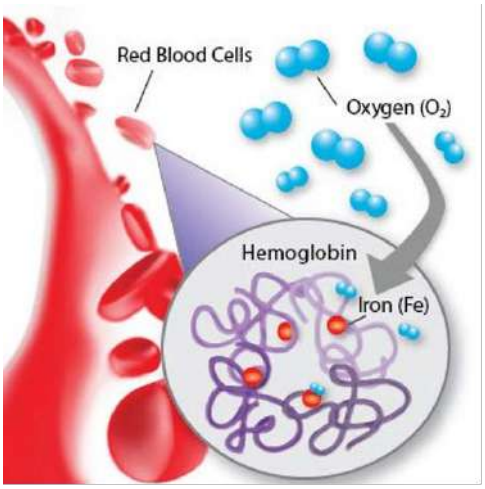
https://www.khanacademy.org/science/ap-biology/cellular-energetics/molecular-fitness/v/molecular-variation

We are now going to discuss molecular variation in cells. You are probably familiar with the idea that you have a variation of genetic makeups in a population. But even within an organism you have variation in the types of molecules that an organism can produce and when they produce them.

So, for example, we know that we all have DNA, all organisms, living organisms that we know about, they have DNA. I'll just do this as a quick drawing of DNA. We know that we have genes in our DNA that code eventually, they go from DNA to messenger RNA, and then they go to the ribosomes to be translated into proteins. And these proteins are a major way of expressing what is encoded in our DNA.

Now, it turns out that our DNA will encode for not only multiple proteins but multiple types of the same protein, and it can encode for some of these proteins more under certain circumstances and other proteins more in other circumstances based on environmental factors. Those environmental factors might influence what part of the DNA is being transcribed into mRNA, which then is translated into proteins at different times. And there's several very interesting examples of this.

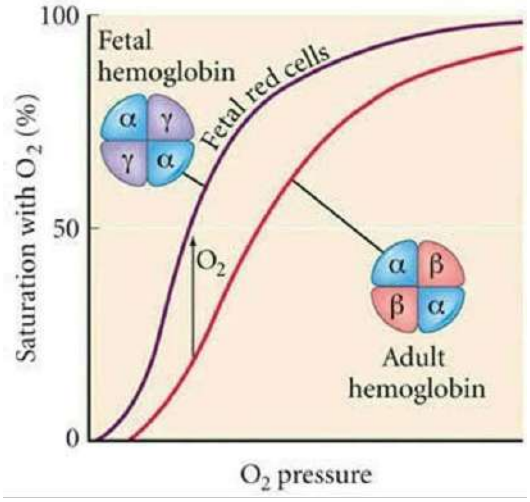
It turns out that hemoglobin, which you might recognize as the protein complex that binds to oxygen in our red blood cells, that the type of predominant hemoglobin changes from when we are inside our mothers' wombs to when we become independent beings. So, this right over here is a picture of a hemoglobin molecule.



https://www.medicinenet.com/hemoglobin/article.htm

You see here four heme groups that each bind two oxygen, and when you're a fetus the primary type of hemoglobin is hemoglobin F, and then once we come out of our mothers' wombs the hemoglobin F stops getting produced and we go to hemoglobin A.

Now you might say, well, why do we have this variation in the type of hemoglobin? And the answer is, that those are two different environments. When a fetus is in the mother's womb, it's not directly breathing. It's getting its oxygen from the mother's blood. The mother's blood does not mix directly with the baby's blood, but there's a boundary where you have the mother's blood here, and I'll say this is the baby's blood right over here, and you have the gas exchange of the oxygen going through that boundary, and then of course the release of the carbon dioxide going the other way. And this environment where the baby's red blood cells have to bind to the oxygen is a relatively low oxygen environment compared to, say, our lungs, because it has oxygenated and deoxygenated blood mixing in that same place, and it does not have direct access to, say, the lungs. And so, in this low oxygen environment, the hemoglobin molecules have to be really good at binding to oxygen.



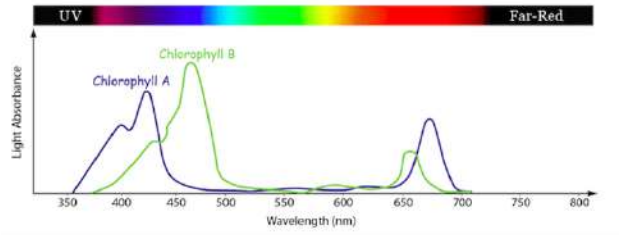
https://brainly.in/question/6203446

And we can see that from this diagram right over here, where the horizontal axis is the partial pressure of oxygen, and the vertical axis is how saturated with oxygen these different hemoglobin molecules can become. And you can see that the fetal hemoglobin, which is

depicted by this blue curve, it gets 50% saturated at a lower partial pressure of oxygen than the adult hemoglobin.

So, one way to think about it, it is stickier, it binds with that oxygen. It can pull that oxygen out of the blood far better, which makes sense for the environment that the fetus is in. But once it comes out of the mother's womb, it doesn't need that stickiness and there're some drawbacks of that stickiness as well because it makes it hard for that oxygen to go into as many of the body's tissues, and so that's why you have this transition from hemoglobin F to hemoglobin A.

It's not just hemoglobin where we see this molecular variation. Plants and other organisms that conduct photosynthesis contain multiple types of chlorophyll. Remember chlorophyll is a very important molecule in capturing light energy which can then be used to help synthesize carbohydrates in things like plants. And here we see how two different chlorophyll molecules, both that would be found in plants, and how well they absorb light of different frequencies.



http://www.ledgrowlightshq.co.uk/chlorophyll-plant-pigments/

So, you can see chlorophyll a is really good at absorbing the violet bordering on blue light, while chlorophyll b is better at the blue-green type of light. And then you have another peak here where chlorophyll b is better at absorbing an orangish red, while chlorophyll a is better at absorbing, I guess you could say, a red bordering on infrared wavelength.

And the reason why it is valuable is that the light that the plant gets, especially at different times of day, at different times of year, is going to have different wavelengths, and so this just lets the plant capture more energy that it can use in photosynthesis.

And these were just two examples of molecular variation. In our cellular membranes, there's multiple types of phospholipids that are forming the phospholipid bilayer, and those multiple types are, they have different levels of how fluid they are at different temperatures.

And there're animal studies that show that the variations change depending on the conditions. For example, a cold-blooded animal might have more of the fluid phospholipids when it is very cold so that the membranes don't become overly rigid.

But I will leave you there. This is just to appreciate this idea that we have all sorts of molecular variation inside organism cells, and it allows those organisms to better adapt to their environment or different stages of their development.

Natural Selection in Real Time

"When we made the comparison between the size of the offspring generation and the population before selection, we found a measured, evolutionary response had taken place and it was almost identical to what we had predicted."
-Peter Grant

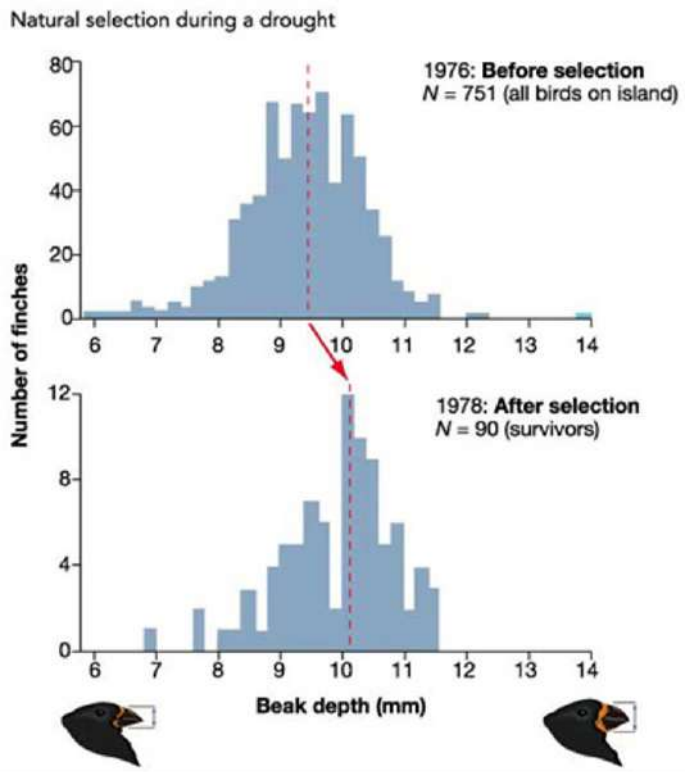
Darwin thought that evolution took place over hundreds or thousands of years and was impossible to witness in a human lifetime. Peter and Rosemary Grant have seen evolution happen over the course of just two years.

The Grants study the evolution of Darwin's finches on the Galapagos Islands. The birds have been named for Darwin, in part, because he later theorized that the 13 distinct species were all descendants of a common ancestor. Each species eats a different type of food and has unique characteristics developed through evolution. For example, the cactus finch has a long beak that reaches into blossoms, the ground finch has a short beak adapted for eating seeds buried under the soil, and the tree finch has a parrot-shaped beak suited for stripping bark to find insects.

The Grants have focused their research on the medium ground finch, *Geospiza fortis,* on the small island of Daphne Major. Daphne Major serves as an ideal site for research because the finches have few predators or competitors. (The only other finch on the island is the cactus finch.) The major factor influencing survival of the medium ground finch is the weather, and thus the availability of food. The medium ground finch has a stubby beak and eats mostly seeds. Medium ground finches are variable in size and shape, which makes them a good subject for a study of evolution.

The first event that the Grants saw affect the food supply was a drought that occurred in 1977. For 551 days the islands received no rain. Plants withered and finches grew hungry. The tiny seeds the medium ground finches were accustomed to eating grew scarce. Medium ground finches with larger beaks could take advantage of alternate food sources because they could crack open larger seeds. The smaller-beaked birds couldn't do this, so they died of starvation.

In 1978 the Grants returned to Daphne Major to document the effect of the drought on the next



http://fig.cox.miami.edu/~cmallery/150/unity/sf38x1b.jpg

generation of medium ground finches. They measured the offspring and compared their beak size to that of the previous (pre-drought) generations. They found the offsprings' beaks to be 3 to 4% larger than their grandparents'. The Grants had documented natural selection in action.

While beak size is clearly related to feeding strategies, it is also related to reproduction. Female finches tend to mate with males that have the same size beaks. These factors together can add to the development of new species.

The Grants return each year to Daphne Major to observe and measure finches. They have been collecting data on the finches for over 25 years and have witnessed natural selection operating in different ways under different circumstances.

PBS. (n.d.). Natural selection in real time. Retrieved 4/4/2020 from https://www.pbs.org/wgbh/evolution/educators/course/session4/elaborate_b_pop1.html.

Questions: Answer the following questions using complete sentences.

1. Analyze the data provided. What does it indicate about the finches on the Galapagos Islands?
2. Based on the data from the Grant's study, what was the difference in average beak size of all adult finches before the drought in 1977 and the average beak size of adult finches that survived the drought?
3. Explain how the average beak size of finches changed from before the drought in 1977 to after the drought in 1978, once the population had recovered and started to breed again.
4. Explain how variation at the molecular level provided the finches with the ability to survive in response to the change in environmental conditions is response to the drought.

It is important to realize from this study that the genetic variation that underlies the differences in beak size was already present in the population. Because of natural selection, the allele frequency of those birds that expressed the larger beak size increased in the population and the allele frequency of those birds that expressed the smaller beak size declined and may eventually be lost from the population.

From this example, you can see how dramatic changes can occur in a population as a result of natural selection. You can also see how careful observation by the Grants over consecutive years allowed them to capture empirical evidence of natural selection in real time.