GUIDED PRACTICE

Class: Cellular respiration (Previous lesson was fermentation)
Date assigned: tba
Date due: tba
Time estimate to complete this assignment: 2 hrs

Overview/Introduction

All living things need to break down molecules and use them for energy. We have already looked at one common way of doing this: fermentation. While many organisms are very successful using only fermentation, Eukaryotes like ourselves get most of our energy from cellular respiration. This lesson covers the fundamental process of cellular respiration in preparation for our next lecture.

Learning Objectives

Basic objectives

List 3-5 learning objectives that you expect students to be able to master on their own before class.

- State where in the cell/mitochondria each step of cellular respiration occurs.
- Describe the steps of aerobic respiration
- Explain the relationship between fermentation and cellular respiration
- Explain the relationship between terminal electron receptor, electronegativity, and how much energy is released in metabolism.
- Explain how oxygen availability determines pyruvate's path to fermentation or respiration.

Advanced objectives

List 3-4 learning objectives that you expect students to need help mastering.

- Explain why cellular respiration, using a proton gradient to power chemiosmosis and ATP synthesis, extracts more energy per glucose molecule than fermentation.
- Compare and contrast aerobic respiration and anaerobic respiration
- Relate the processes of fermentation, anaerobic respiration, and aerobic respiration to adaptations and habitat of example organisms.
- Determine the consequences for cellular and bodily function of blocking different stages of cellular respiration.

Commented [VB1]: This is a bit too long for a prep work, imo. You may not get as good compliance as you want.

Commented [VB2]: Do you mean "list in order and give the major outcome of each step"?

Commented [VB3]: Is there an actual relationship? Or do you mean "distinguish between"? (Sorry, I forget my basic bio!)

Commented [VB4]: I think you need a different word than explain… Explain is actually fairly problematic because depending upon the amount of knowledge and different knowledge you're drawing upon, it could be very low level or very high level. What do you mean by "explain" in this context?

Commented [VB5]: Here too. Maybe a good goal for this is "Based on oxygen availability, predict whether pyruvate would enter the fermentation path or the respiration path."

Commented [VB6]: Advanced objectives are a great place to think about "so what" and "now what". Your 3rd bullet here gets at that in the most explicit way.

Preparatory Activities and Resources:

1. Give detailed, action-oriented instructions for completing the Guided Practice assignment. Keep in mind that the activities should be minimal, simple, engaging, productive, and failure tolerant (see Talbert, 2017, pg. 135)

Review the pages in this module on cellular respiration. (*I will build these.*)

Download the "Aerobic Cellular Respiration Roadmap" worksheet in this module. For each of the numbers in the diagram (*This will be a cartoon of a mitochondrion in a cell, illustrating the locations for major steps in cellular respiration*.), describe in 1-3 complete sentences what happens during that stage of aerobic cellular respiration. The items are numbered in order of when they happen in the process of respiration.

Bring a printout of your completed roadmap worksheet to class. We will be using them during lecture.

Take the module quiz. You may retake the quiz as many times as you want, until the due date.

2. Give a "playlist" of resources such as readings, videos, audio, or other content delivery methods that provide students the content to work with.
   - Relevant sections from the textbook, Raven 12th ed.
   - ATP and respiration (Crash Course Biology #7) (13:25): https://www.youtube.com/watch?v=00jbG_cfGuQ&feature=youtu.be
   - Cellular Respiration (Kahn Academy) (14:18): https://www.youtube.com/watch?v=2f7YwCtHcgk&feature=youtu.be

Exercises: Please complete by *_Midnight before lecture____*.

- Give a method for students to submit their work online BEFORE the face to face class meeting. Google forms, Surveymonkey, and tools in your LMS will all work. Alternatively, give them instruction on what completed work to bring to class as an entry ticket.
- The submitted work should demonstrate students' mastery of the basic learning objectives.

See #1 of preparatory activities and resources?

Questions?

Give a way for students to get help.

- Open discussion board in Canvas
- Message me via Canvas

ADVANCED PRACTICE

This is given for students to complete after the class meeting in which they work together.

Class: Cellular respiration
Date assigned: day of lecture
Date due: Midnight before next class
Time estimate to complete this assignment: 3 hrs

Learning Objectives

Advanced objectives

- Explain why cellular respiration, using a proton gradient to power chemiosmosis and ATP synthesis, extracts more energy per glucose molecule than fermentation.
- Compare and contrast aerobic respiration and anaerobic respiration
- Relate the processes of fermentation, anaerobic respiration, and aerobic respiration to adaptations and habitat of example organisms.
- Determine the consequences of blocking cellular respiration at different stages.

Activities & deliverables

Complete the quiz for this week. Content from the cellular respiration lecture will be included on the quiz.

Read the page in the Cellular Respiration module on Canvas, which is based on a real poisoning case. (*This will describe the circumstances of a cyanide poisoning and the mechanism by which cyanide acts*.)

Complete the assignment in Canvas based on the case study (counts as an assignment, but set up as a quiz in Canvas to facilitate grading).

- *This assignment has students identify what stage in cellular respiration the poison directly disrupts (using the same graphic organizer they used for lecture)*
- *Determine what occurs to the subsequent steps, once the poison acts.*
- *In the presence of cyanide, are human cells able to make ATP? Yes, they can still undergo fermentation, but this is insufficient to maintain cellular function in the long term.*
- *Determine why certain tissues were affected faster than others (e.g. – ones that are more actively using energy, like brain and heart, run out of ATP faster*)

All assignments are due by midnight before the next lecture.

Resources:

- Relevant sections from the textbook, Raven 12th ed.
- Link to poison control center page on cyanide

Questions?

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- Message me via Canvas

Commented [VB1]: Again, this is pretty long!

I'm not sure if what's described below will actually take 3 hours. And I'm pretty sure that if it really does take 3 hr, you will get people cheating because this is a lot of time.

I know that you SHOULD be able to count on 6 hr outside of class for a 3 unit course but that's the very very high end and it's better to back off a bit.

Commented [VB2]: I wonder about asking them to find a new example as well. Or, can they identify principles? I'm concerned about them memorizing facts about cyanide poisoning and not being able to deal with a novel situation in an exam or something, and feeling "tricked."

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Flipped IN-CLASS Lesson Plan Template

Topic or concept: Cellular respiration (Previous lesson was fermentation)

Basic objectives for preparatory work:	Advanced objectives for classwork & after class work:

• State where in the cell/mitochondria each step of cellular respiration occurs.
• Describe the steps of aerobic respiration
  ○ Label in sentences for each number; together, ends up being a narrative
  ○ Print out and swap in class
• Explain the relationship between fermentation and cellular respiration
• Explain the relationship between terminal electron receptor, electronegativity, and how much energy is released in metabolism.
• Explain how oxygen availability determines pyruvate's path to fermentation or respiration.
	• Explain why cellular respiration, using a proton gradient to power chemiosmosis and ATP synthesis, extracts more energy per glucose molecule than fermentation.
	• Compare and contrast aerobic respiration and anaerobic respiration
	• Relate the processes of fermentation, anaerobic respiration, and aerobic respiration to adaptations and habitat of example organisms.
	• Determine the consequences for cellular and bodily function of blocking different stages of cellular respiration.

	Time planned	Activity and rationale	Resources needed
Beginning of class period	5 mins	Set up framing device for the day's activity. *In order to do things that require more energy, organisms need to be more efficient about extracting energy from molecules (glucose). How do organisms accomplish this?*	Lecture prep/slides with information about some different organisms with varying energetic needs (one with fermentation, one with anaerobic cellular respiration, and one with aerobic cellular respiration)
Beginning of class period	15 mins	Student activity: Swap print outs of graphic organizer (from guided practice) with a neighbor and give feedback; Do they match? Were there parts that one or both of you were not sure about? Teacher activity: Walk around and listen in on student	Print out of pre-lecture activity (each student brings their copy to class) Pen/pencil

Commented [VB1]: This is a good idea! May want to reduce the time the first time, it might take a couple of tries to see how long this really takes. Having it be too long will be worse than having it be too short.

	Time planned	Activity and rationale	Resources needed
		conversations to identify points of confusion or areas of understanding	
Middle of period	15 mins	(Start mini lecture by summarizing what you heard in student conversations—what you heard that was on target/ showed good comprehension, and anything that was commonly misunderstood) Mini-lecture based on Q&A from preparatory activities. Clarify misconceptions and offer new info. Review electronegativity tower and anaerobic vs. aerobic respiration Clarify evolutionary context- *Why is fermentation still useful for certain organisms or under certain conditions? Why would organisms evolve to use processes that require oxygen? Under what conditions are anaerobic respiration favorable?*	Lecture prep/slides (include a simple, "correct" version of the graphic organizer / worksheet)
Middle of period (use if needed)	30 mins	Mini-jigsaw with groups of 3 Each group gets information sheets about 3 organisms, one each that uses fermentation, anaerobic respiration, or aerobic respiration Students review their own example for 5-10 minutes Work together for 15 minutes- 5 minutes each to present/discuss their example 7-10 minutes to complete a worksheet. - Figure out which organism uses which type of metabolism. - What about the organism's natural history makes that type of metabolism favorable or the other types of metabolism unfavorable?	Worksheet for each group, to be handed in at the end of class On the worksheet: - Electronegativity tower - 3-column table comparing and contrasting fermentation, aerobic resp. and anaerobic respiration

Commented [VB2]: Resist the temptation to make this longer! ☺

Commented [VB3]: I don't quite get what's happening here. If they have all the information at their fingertips, what's to figure out? I'd be concerned that people would be able to race through this and not need to work in groups at all.

	Time planned	Activity and rationale	Resources needed
End of period	10 mins	Review final compare / contrast together so everyone goes home with a "correct" version to study from Briefly introduce applied activity- What happens when something disrupts an essential process? Will have a case study on poisoning as post-lecture follow-up.	Slide with questions from the worksheet ~~Slide with information about the follow-up activity.~~

Commented [VB4]: Will they be responsible for other organisms too? I would be concerned about people memorizing their three, but not elucidating the **principles** so they could apply them to novel organisms.

Flipped AFTER CLASS Work Plan Template

Advanced learning objective	Activity and rationale	Instructions to students
1. Explain why cellular respiration, using a proton gradient to power chemiosmosis and ATP synthesis, extracts more energy per glucose molecule than fermentation. 2. Compare and contrast aerobic respiration and anaerobic respiration 3. Relate the processes of fermentation, anaerobic respiration, and aerobic respiration to adaptations and habitat of example organisms. 4. Determine the consequences of blocking cellular respiration at different stages.	Quiz in Canvas for ALOs 1-3 Case study for poisoning with a molecule that interferes with mitochondrial function.	Take the weekly quiz as usual; content from this lecture will be included. Read the page in the Cellular Respiration module on Canvas, which is based on a real poisoning case. Complete the assignment in Canvas based on the case study.

Commented [VB5]: Hm, interesting!! Not sure what's in here but case studies are usually good; minor mystery to solve.