



LESSON PLAN: CROSSROADS

Title: Aerobic vs. Anaerobic Respiration

Grade: 9-12

Subject: Science

Unit: Comparing Aerobic vs. Anaerobic Respiration

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Lesson Duration: 3 - 4 hours

Sample Results:



OVERVIEW:

Fermentation is a minor but an alternative pathway for all living cells on earth to derive energy. Fermentation (anaerobic respiration) generates energy without the use or help of the oxygen molecule. The main way that most cells derive energy on earth is by utilizing the oxygen molecule also called aerobic respiration. In fermentation or anaerobic respiration, the oxygen molecule is not utilized. Most cells on earth utilize both processes. Human beings use fermentation or anaerobic respiration to generate energy during emergencies only. We use fermentation when the body's requirement for energy exceeds what aerobic respiration can

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provide. The body then switches to generate extra energy via fermentation which is the minor and inferior pathway. The byproducts of human fermentation or anaerobic respiration are very painful and in the long run not good for the human body. A typical example is an athlete who begins to have thigh and leg pain when fatigue sets in. What causes the muscle pain is lactic acid, a major product of fermentation. After we have been jogging a while and breathing in deeply, the body begins to demand more energy and uses anaerobic respiration or fermentation to generate extra energy.

In bacterial and vegetable kingdoms anaerobic respiration or fermentation plays a bigger role in generating energy in order to live. Yeast for example uses anaerobic respiration predominantly to make energy. We as humans use the byproducts of this process for our good. We drink alcohol which is a byproduct of fermentation in yeast as compared to lactic acid in humans. We also use the carbon dioxide which yeast produces during fermentation to raise our bread.

We teach our students fermentation in order for them to understand the continuous relationship between all the kingdoms on earth and how they generate energy.

OBJECTIVE:

Students will compare and contrast aerobic respiration and anaerobic respiration (fermentation) and discuss the connection regarding this process between humans and plants. Students explain how each process occurs.

MATERIALS:

Magazines (for students to cut out photos)
Art Supplies (Markers, pencils, erasers, glue, etc.)
Article - *Foods That Give Us Energy*
Charts/Visual Aids
Food Web Chart

TEACHER PREPARATION:

Students need to know Academic and Content Vocabulary(below) before reading the article and before the lesson.

Academic Vocabulary

Energy
Photosynthesis
Aerobic Respiration
Anaerobic Respiration
Fermentation
Lactic Acid
Cytoplasm
Mitochondria

Content Vocabulary

Autotrophs (food chain/article)
Heterotrophy (food chain/article)

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PROCEDURE:

I. Introduction of Topic:

Discuss and make connections between art, science and literature. Discuss Dionysus, scientist involved in making the fabric out of wine as well as art.

II. Introduction of Lesson: (5 minutes)

- [Whole Group] - **What is Energy?** The capacity for a physical system to do work
- [Whole Group] - **What gives us energy?** Food
- [Whole Group] - **Why do certain types of foods give us energy yet others drain energy?** Answers will vary

III. Development: (30 minutes)

- [Shared Reading] - **Article** - *Foods That Give Us Energy*
- [Whole Group] - Discuss Article
- How do plants get their energy? Photosynthesis - where plant absorbs light to produce sugars and carbohydrates and stores that energy in the root system. Plants store excess sugars in the roots in order to have back up energy on cloudy days. Many plants store this excess sugar in the form of a vegetable.
- Why do certain types of food give us energy yet others drain energy? Discuss food web.
- Discuss the difference between Aerobic and Anaerobic Respiration - Use Chart

	Aerobic Respiration	Anaerobic Respiration
Oxygen Required	Yes	No
Where chemical Reaction Takes place:	Cytoplasm and Mitochondria	Cytoplasm
Process:	Oxygen is used to generate the small energy molecule ATP	ATP is synthesized using the electron transport chain, with inorganic molecules other than oxygen
Production of ATP	38 mol ATP per 1 mol glucose	2 mol ATP per 1 mol glucose
Ability to be sustained:	Indefinitely	Short Term

- Give examples:

	Aerobic	Anaerobic
Humans	<ul style="list-style-type: none"> • Oxygen is used to produce energy. • Moderate intensity for longer duration. • Example: Cycling, Jumping Rope 	<ul style="list-style-type: none"> • Body is forced to work without oxygen. • Short Durations • Example: Weight Lifting, Pull ups, Push ups
Plants	<ul style="list-style-type: none"> • Photosynthesis is used to produce sugars and 	<ul style="list-style-type: none"> • Plants store excess sugar in the form of vegetables.

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	carbohydrates and stores energy in the root system. <ul style="list-style-type: none"> • Example: Sunny Days 	<ul style="list-style-type: none"> • Example: Cloudy Day
Other	<ul style="list-style-type: none"> • Microbe Fermented Fabric (uses acetobacter – rod shaped bacteria + wine) to produce fabric 	<ul style="list-style-type: none"> • Fermentation of yeast, wine, etc. • Conversion of a carbohydrate such as sugar into an acid or alcohol. • This dates back to as far as 7000 BCE in parts of the Middle East.

IV. Closure: (5 minutes)

Why do you think we teach students the fermentation process? We teach students fermentation in order for them to understand the continuous relationship between all the kingdoms on earth and how they generate energy.

V. Assessment:

- You can take photographs to represent aerobic vs. anaerobic respiration and write a paragraph describing the difference.
- You can draw pictures to represent aerobic vs. anaerobic respiration and write a paragraph describing the difference.
- You can create mood board/collage to represent aerobic vs. anaerobic respiration and write a paragraph describing the difference.
- Any other artistic representation of aerobic vs. anaerobic respiration and write a paragraph describing the difference.

NATIONAL STANDARDS

- SC.912.L.18.7: Identify the reactants, products, and basic functions of photosynthesis.
- SC.912.L.18.8: Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.
- SC.912.L.18.9: Explain the interrelated nature of photosynthesis and cellular respiration.
- SC.912.L.18.10: Connect the role of adenosine triphosphate (ATP) to energy transfers within a cell.

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