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Resource ID#: 151663

Primary Type: Lesson Plan

Yeast Fermentation Inquiry - Predict, Observe, Explain

Using the Predict, Observe, and Explain model, students will be able to identify the basic function of cellular respiration. Students will predict what is needed for yeast fermentation, why they do it and what gas is being released. With a teacher led debrief, students will then decide what factors allow fermentation to occur and finally explain why it's happening.

General Information

Subject(s): Science
Grade Level(s): 9, 10
Intended Audience: Educators

Instructional Time: 50 Minute(s)

Keywords: cellular respiration, fermentation

Instructional Component Type(s): **Lesson Plan,** Worksheet, Assessment, Teaching Idea, Instructional Technique
Resource Collection: FCR-STEMLearn Cell Biology 2016

Attachment

Cellular_Respiration_Debrief.pptx
Yeast_Fermentation_Inquiry_Student_Handout.docx
Teacher_Instructions_Yeast_Fermentation_Inquiry.docx
Exit_Questions_Yeast_Fermentation_Inquiry.docx

Lesson Content

Lesson Plan Template: Predict-Observe-Explain

Learning Objectives: What will students know and be able to do as a result of this lesson?

- Students will collect and measure data and draw conclusions from the results of an experiment.
- Students will be able to identify the basic function of cellular respiration.
- Students will be able to state the gas released during cellular respiration.

Prior Knowledge: What prior knowledge should students have for this lesson?

- Yeast are alive.
- Parts of an experiment (independent variable, dependent variable, controls, control group and experimental group)
- Students can make inferences based on observations.

Guiding Questions: What are the guiding questions for this lesson?

- Why do yeast ferment?

Predict: What event, related to the focus topic, that may surprise students, will the students make a prediction about?

1. Arrange students in lab groups ranging from 2-4 students.
2. Pass out the student handout, "Yeast Fermentation Inquiry." As a class, read the handout's introduction and guiding question.
3. Guiding question: Why do yeast ferment?
4. As a group, students will predict what materials are needed for yeast fermentation, why they do it, and what gas is being released? Students record their predictions on the handout.
5. Instructions for setting up the demonstration/lab (materials needed per lab group):
   - 2 packets of dry active yeast
   - 4 - 250mL flask
   - 4 Balloons
   - 80mL of sugar
   - Warm water
   - Stirring rod
   - String
   - Ruler
   - 2 timers
6. Pass out all materials. Teacher tips: Create group buckets that contain all materials. Warm water is a must for this lab. If you do not have warm tap water, then boil water up to 110°F using a hot plate. Demonstrate safety procedures on how to handle hot glass or pour water for the students.

Observe: What will the students observe and/or infer during this step of the lesson? How will students communicate their observations and inferences?

Once students have all materials, they can start their experiment by following procedures found on the "Yeast Fermentation Inquiry" handout:

Without sugar

1. Label flask 1-4. Fill flasks 1 & 2 with 100mL of warm tap water. (control group)
2. Add ½ packet of yeast to flask 1 & 2 and stir till the yeast is dissolved.
3. Place a balloon on flask 1 & 2.
4. Using the string and ruler, measure the circumference of the balloon in centimeters. Record in data table.
5. Start timer 1.
6. After 2 minutes and every 2 minutes after, rerecord the circumference.

With sugar

1. Fill flasks 3 & 4 with 100mL warm tap water. (experimental group)
2. Add ½ packet of yeast to flasks 3 & 4.
3. Add 20mL of sugar to flasks 3 & 4and stir till the yeast and sugar is dissolved.
4. Place a balloon on each flask 3 & 4.
5. Using the string and ruler, measure the circumference of the balloon in centimeters. Record in data table.
6. Start timer 2.
7. After 2 minutes and every 2 minutes after, rerecord the circumference.

Students will make observations on the circumference of the balloons. Then, students will infer what gas is being released and why. Students will record data in a data table (below):

Circumference of Balloon (cm)

Flask	Time 0	2 min	4 min	6 min	10 min
Flask 1 (no sugar)	_____cm	_____cm	_____cm	_____cm	_____cm
Flask 2 (no sugar)	_____cm	_____cm	_____cm	_____cm	_____cm
Flask 3 (with sugar)	_____cm	_____cm	_____cm	_____cm	_____cm
Flask 4 (with sugar)	_____cm	_____cm	_____cm	_____cm	_____cm

- Students need to generate an average for the control and experimental groups.
- Circulate room checking to see that Flask 1 & 2 balloons are smaller than that of Flask 3 & 4. Start asking probing questions to get students thinking. Example questions: "What's happening?" "Why do you think that is happening?" "What gas is the balloons?"
- When lab is complete have students return all lab materials and rinse/wash the flasks. Clear desks/tables for the explanation section.

Explain: How will students be encouraged to develop explanations using their observations and scientific or mathematical concepts or principles?

Each group will answer post-lab questions 1-4. Allow 10 minutes to complete. Teacher then leads debrief of questions 1-4 and shares the basic function of cellular respiration using a PowerPoint presentation. During presentation the teacher will ask questions 5-9.

Instructions for leading the closing discussion:

Clear up any misconceptions in this section. Ask for class consensus, "Does everyone in our science community (classroom) agree with this?" This opens up the discussion to other groups to share their findings.

Answers to Post-lab questions

1. What was the independent and dependent variables? *IV: sugar DV: circumference of balloon*
2. List three controls. *Amount of water, flask size, type/size of balloon, temperature of water, amount and type of yeast*
3. Which flasks were your experimental group and which flasks were the control group? Experimental Group: Flasks 2 & 3 Control group: Flasks 1 & 2
4. How was the circumference of the balloon from the control groups' different form the experimental groups? *Experimental groups' balloon circumference was larger, while the control groups was smaller.*

Teacher Debrief/Presentations questions – to be used after cellular respiration explanation

1. In the experiment what was the yeast's food? *sugar*
2. What was the waste product? *gas*
3. What type of gas waste was being released? (Hint: what do we release?) *carbon dioxide*
4. *Why do yeast ferment? To gain energy*
5. How is this experiment similar to what we do as humans? *Humans eat, mainly carbohydrates (sugars), in order to obtain energy. We then exhale carbon dioxide as a waste product.*

Common errors/misconceptions to anticipate and how to respond:

- Gas released isn't oxygen, but rather carbon dioxide. Probe them to understand that yeast are alive and are metabolizing the sugar.
- When class discussion is complete, pass out exit slip to each student. This is an individual assignment.

Summative Assessment

1. Answering post lab questions as a class. The answers are contained in the **Yeast Fermentation Inquiry Teacher Instructions** document.
2. Students will also complete individually a set of **Exit Questions**.

Answers to Exit Questions (10pts)

1. What gas was being released when the yeast fermented? Carbon dioxide (5pts)
2. Yeast fermentation is a type of cellular respiration. Why were the yeast fermenting? to obtain/release energy (5pts)

Formative Assessment

Circulate room checking each group's whiteboards and asking probing questions to get students thinking. Example questions:

- **"What's happening?"** Possible student response: Two balloons are blowing up, while the other two are still deflated.
- **"Which ones(balloons)?"** Possible student response: Two balloons with sugar are blowing up.
- **"Why do you think that is happening?"** Possible student response: Something with the sugar or the yeast is breaking down sugar and releasing a gas.
- **"What gas is released into the balloons?"** Possible student response: carbon dioxide, oxygen, methane... If they state the wrong gas, then remind them that yeast are alive. Relate them to us, what gas do we release? Possible student response: carbon dioxide "**Why?"** Possible student response: waste product

Feedback to Students

- Remind students that yeast are alive. Relate their daily functions to those of humans, i.e. eating to obtain energy.

Accommodations & Recommendations

Accommodations:

- Read procedures together as a class.

Extensions:

- Instead of using sugar, use other macromolecules. Carbohydrates, proteins and lipids can be tested to observe which releases more carbon dioxide/energy.

Special Materials Needed:

- Yeast Fermentation Inquiry Student Handout
- Lab materials
- Exit Questions
- Cellular Respiration PowerPoint

Further Recommendations:

- Demonstrate how to use string and ruler to measure circumference.

Additional Information/Instructions

By Author/Submitter

Review Teacher Instructions handout found in the attachments section.

Source and Access Information

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Aligned Standards

Name	Description
SC.912.L.18.8:	Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.
SC.912.N.1.1:	Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following: 1. **Pose questions about the natural world,** (Articulate the purpose of the investigation and identify the relevant scientific concepts). 2. **Conduct systematic observations,** (Write procedures that are clear and replicable. Identify observables and examine relationships between test (independent) variable and outcome (dependent) variable. Employ appropriate methods for accurate and consistent observations; conduct and record measurements at appropriate levels of precision. Follow safety guidelines). 3. **Examine books and other sources of information to see what is already known,** 4. **Review what is known in light of empirical evidence,** (Examine whether available empirical evidence can be interpreted in terms of existing knowledge and models, and if not, modify or develop new models). 5. **Plan investigations,** (Design and evaluate a scientific investigation). 6. **Use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs),** (Collect data or evidence in an organized way. Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration, technique, maintenance, and storage). 7. **Pose answers, explanations, or descriptions of events,** 8. **Generate explanations that explicate or describe natural phenomena (inferences),** 9. **Use appropriate evidence and reasoning to justify these explanations to others,** 10. **Communicate results of scientific investigations, and** 11. **Evaluate the merits of the explanations produced by others.** **Clarifications:** Florida Standards Connections for 6-12 Literacy in Science For Students in Grades 9-10 LAFS.910.RST.1.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. LAFS.910.RST.1.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text. LAFS.910.RST.3.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. LAFS.910.WHST.1.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. LAFS.910.WHST.3.9 Draw evidence from informational texts to support analysis, reflection, and research. For Students in Grades 11-12 LAFS.1112.RST.1.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. LAFS.1112.RST.1.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. LAFS.1112.RST.3.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. LAFS.1112.WHST.1.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. LAFS.1112.WHST.3.9 Draw evidence from informational texts to support analysis, reflection, and research. Florida Standards Connections for Mathematical Practices MAFS.K12.MP.1: Make sense of problems and persevere in solving them. MAFS.K12.MP.2: Reason abstractly and quantitatively. MAFS.K12.MP.3: Construct viable arguments and critique the reasoning of others. [Viable arguments include evidence.] MAFS.K12.MP.4: Model with mathematics. MAFS.K12.MP.5: Use appropriate tools strategically. MAFS.K12.MP.6: Attend to precision. MAFS.K12.MP.7: Look for and make use of structure. MAFS.K12.MP.8: Look for and express regularity in repeated reasoning.
	Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied. **Clarifications:**

SC.912.N.1.6:	Collect data/evidence and use tables/graphs to draw conclusions and make inferences based on patterns or trends in the data. Florida Standards Connections: MAFS.K12.MP.1: Make sense of problems and persevere in solving them.