Microbes as Consumers

Summary

Have students design experiments as a class to determine if yeast are autotrophic or heterotrophic. Students will utilize a set of materials to address the above question by growing yeast cultures under conditions containing food, light, both and neither.

Time Frame

2 class periods of 45 minutes each

Group Size

Small Groups

Life Skills

Thinking & Reasoning, Systems Thinking

Materials

- 2 clear plastic bottles with wide mouth opening per group or 2 clear plastic bottles with small opening and funnels to pour yeast
- 2 dark coverings (ie. black construction paper or dark cloth or dark storage area) per group of students which are testing amount of light per group.
- one 8" to 9" round balloons per bottle
- 5 mL sugar and 5 mL of yeast per bottle

Background for Teachers

Yeast are heterotrohpic organisms (they need food for energy). When placed in an aqueous environment (water) with simple sugars (honey) they ferment (eat) the sugar into ethanol and C0 2 (this is why bread rises). The CO 2 is released in a gaseous state and can be seen bubbling in the bottle as well as when it passes through and airlock or fills a balloon. In order to successfully grow yeast they need to be in room temperature water and have food. Under these conditions a robust fermentation will usually occur within 24 hours. If these conditions aren't met the yeast will not feed and no bubbling will occur.

Student Prior Knowledge

Students need to be taught Concept of what separates living things from nonliving things. Undergone general introduction to microorganisms and the scientific method.

Intended Learning Outcomes

1. Use Science Process and Thinking Skills
   - a. Observe simple objects, patterns, and events, and report their observations.
   - f. Plan and conduct simple experiments.
   - g. Formulate simple research questions.
   - i. Use data to construct a reasonable conclusion.
   - 3. Understand Science Concepts and Principles
   - c. Solve problems appropriate to grade level by applying science principles and procedures.
   - 4. Communicate Effectively Using Science Language and Reasoning
   - b. Describe or explain observations carefully and report with pictures, sentences, and models.

Instructional Procedures

What factors will make yeast grow best? Have students write down their hypothesis.
Introduce students to bottles (yeast houses) and add water until 2/3s full in each.
Show them the sugar and explain how this is used as food for organisms.
Demonstrate to students how to properly cover their bottle to prevent light and explain or demonstrate how they can block light (prevent photosynthesis).
Explain how balloons work and how we can visualize gas release.
Have students design 4 different yeast habitats to answer proposed question. (light, no light, temperature, amount of sugar, control.) Note: amount of sugar is relative to amount of liquid. 5mL of sugar per 5mL yeast per 235mL of water. Students can alter the amount of sugar as a variable.
Add yeast and place bottles which are testing light near window (light source) and maintain at room temperature.
Robust fermentation should begin within 24-48 hours. During which times students can visualize bubbles coming out or airlocks and currents within and record their observations.
Have students share their observations and state their conclusions concerning which habitats were bubbling and whether yeast are autotrophic or heterotrophic.

Extensions

Hydrometers can be used to measure the density of honey solutions before and after fermentation. The resulting change in density can be used to calculate the amount of CO 2 released and the ethanol percentage of the fermented solution.
If sugar is added at a rate of more than 3 grams per 4L the yeast are incapable of completely fermenting the solution because they can not continue to grow in ethanol concentrations above 15%. This could be used to teach students about the impacts and definition of pollution.

Authors

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