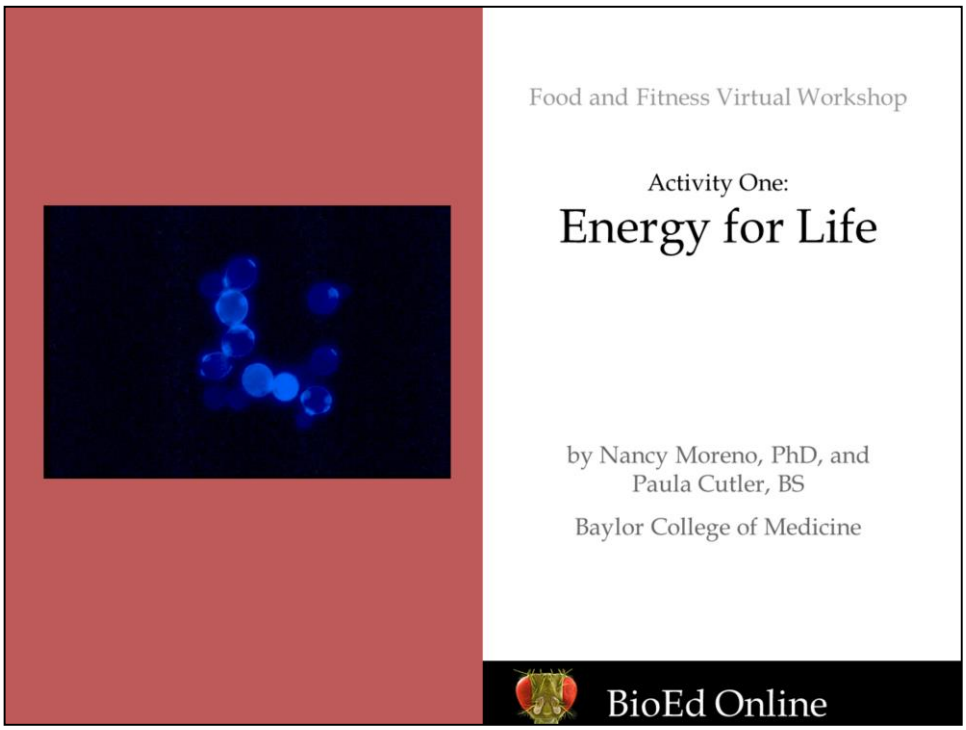


Virtual Workshop: Food and Fitness (Activity One)

Activity One: Energy for Life, of the instructional unit, Food and Fitness, helps to build students' understanding of what happens when living organisms utilize food for energy. Science concepts covered in this activity include the following.

• All organisms are composed of cells. Cells carry out functions necessary for life.

• Plants and related organisms use energy from the sun to produce food. Animals, fungi and other living things must eat plants or other organisms to obtain energy and the building blocks for life.

• Living things give off carbon dioxide and heat, among other byproducts, when they use food.

The complete Food and Fitness Activities Guide for Teachers may be downloaded as a PDF file from the Teacher Resources menu on BioEd Online.
<http://www.bioedonline.org/resources/nsbri.cfm>

Viewing this presentation fulfills part of the requirements for completing the Virtual Workshop on Energy, Food and Nutrition ("Food and Fitness"), offered for professional development contact hours on BioEd Online.

Funding for development of the Food and Fitness unit and accompanying online professional development was provided by the National Space Biomedical Research Institute (NSBRI), a consortium of leading biomedical research centers funded by the National Aeronautics and Space Administration (NASA). Visit the following sites for more information about these

organizations.

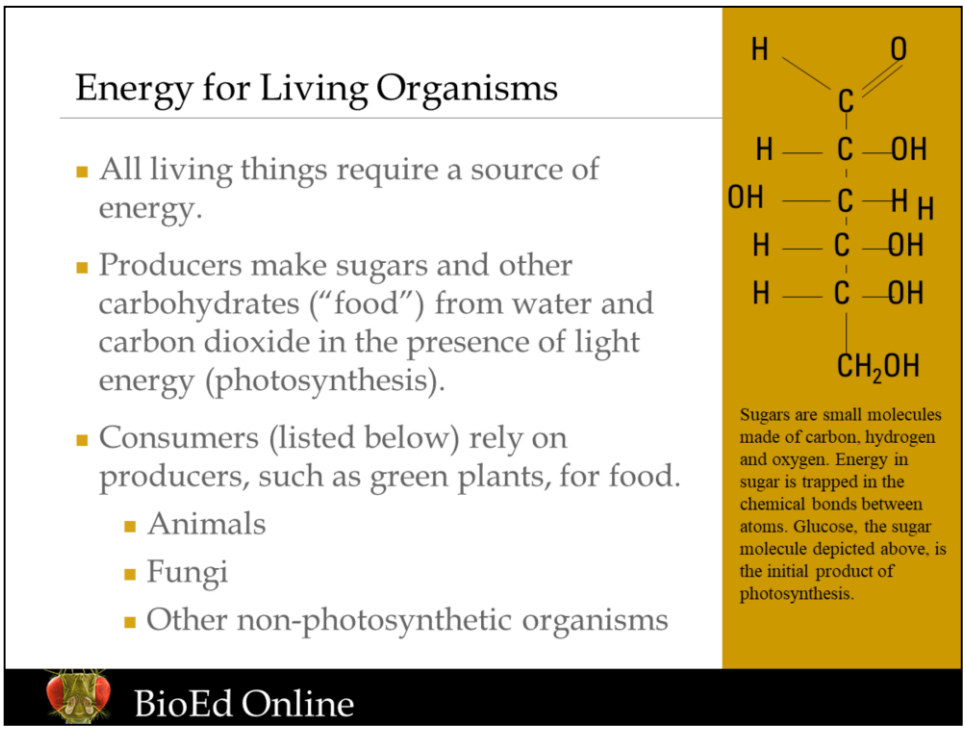
Center for Educational Outreach, Baylor College of Medicine: <http://www.ccit.bcm.tmc.edu/ceo/>

National Space Biomedical Research Institute: <www.nsbri.org>

National Aeronautics and Space Administration: <http://www.nasa.gov>

Image Reference:

Saccharomyces Genome Database (Carsten Kettner). *Saccharomyces cerevisiae* Wildtype YCC588 cells stained with Calcofluor White [fluorescent micrograph, 1000X]. Retrieved 6-28-2004 from http://www.yeastgenome.org/yeast_images.shtml



Energy for Living Organisms

All living things on Earth require energy to maintain themselves, move, grow and reproduce. Plants, green algae and other photosynthetic organisms are able to build all of the materials they need from very simple chemicals. Using energy from light, these organisms, known as producers, are able to manufacture carbohydrates from water and carbon dioxide. All other organisms, considered consumers, ultimately rely on food from producers.

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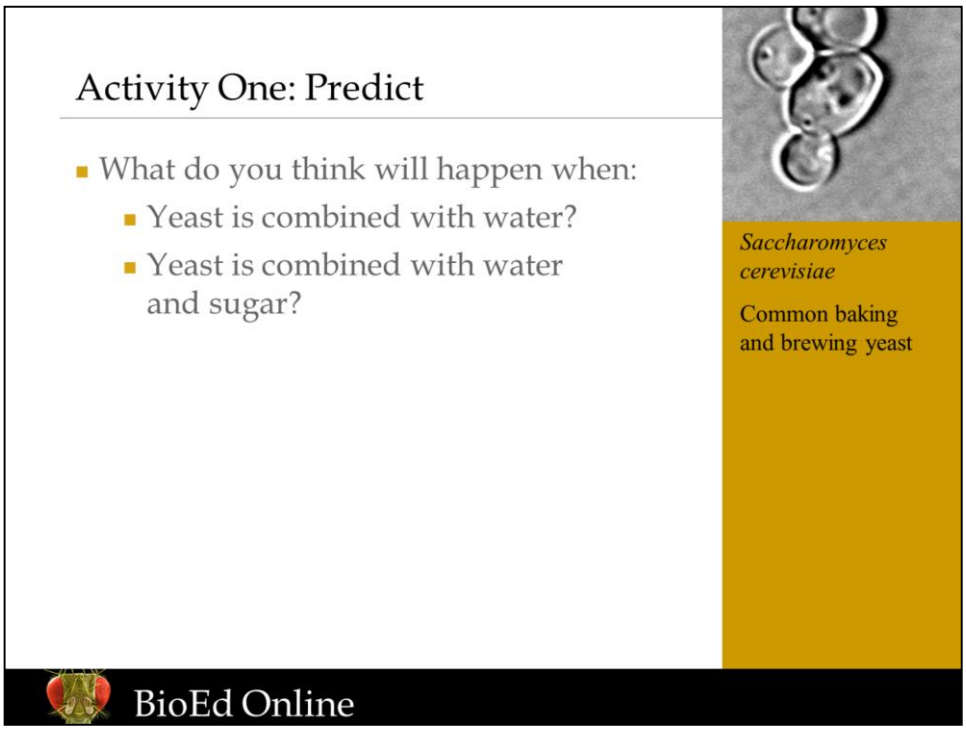

Predict

Yeast are living organisms that belong to the Kingdom Fungi. Species of the yeast genus *Saccharomyces* are used in baking and brewing. These yeasts metabolize sugars and produce carbon dioxide as a waste product. In fresh bread dough, the accumulated carbon dioxide makes the bread rise and become spongy. When yeast break down sugar in an environment without oxygen, ethyl alcohol also is produced as a waste product.

This activity begins by asking students to predict what might happen when yeast are "fed" table sugar (sucrose, $C_{12}H_{22}O_{11}$). Sucrose consists of two smaller sugar molecules (monosaccharides): glucose and fructose.

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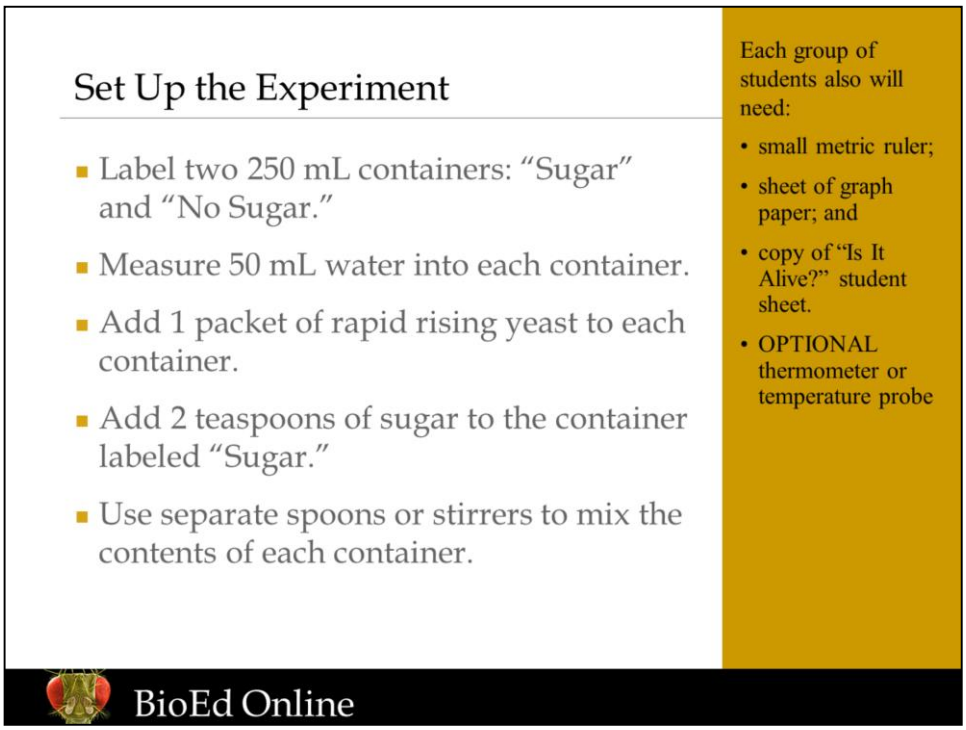
Reference:

Alcamo, I.E. (2003). *Microbes and Society: An Introduction to Microbiology*. Boston: Jones and Bartlett Publishers.

Image Reference:

Saccharomyces Genome Database (Peter Hollenhorst and Catherine Fox). *Saccharomyces cerevisiae*, Wildtype cells W303 derivative cells stained [light micrograph]. Retrieved 6-28-2004 from http://www.yeastgenome.org/yeast_images.shtml



Set up the Experiment

Students should work in groups of 2-4 to set up yeast cultures consisting of 50 mL of room temperature water and one packet of rapid rising yeast. Two teaspoons of sugar should be added to one culture only (the other culture is left alone as a control). Separate spoons or stirrers should be used to stir each mixture.

Within a few minutes, bubbles will begin to appear near the surface of the mixture with sugar.

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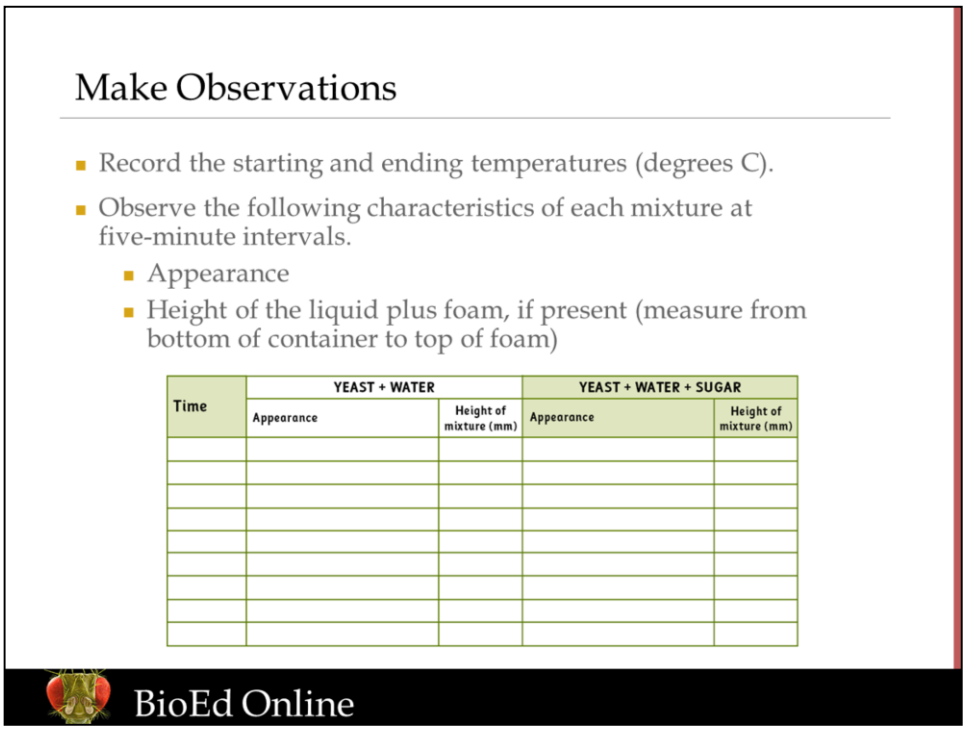

Make Observations

Students should observe each of the yeast mixtures at five-minute intervals. Have students record the total height of the mixtures (liquid plus foam) after each observation. Also, have students record the starting and ending temperatures (degrees C) of the mixtures.

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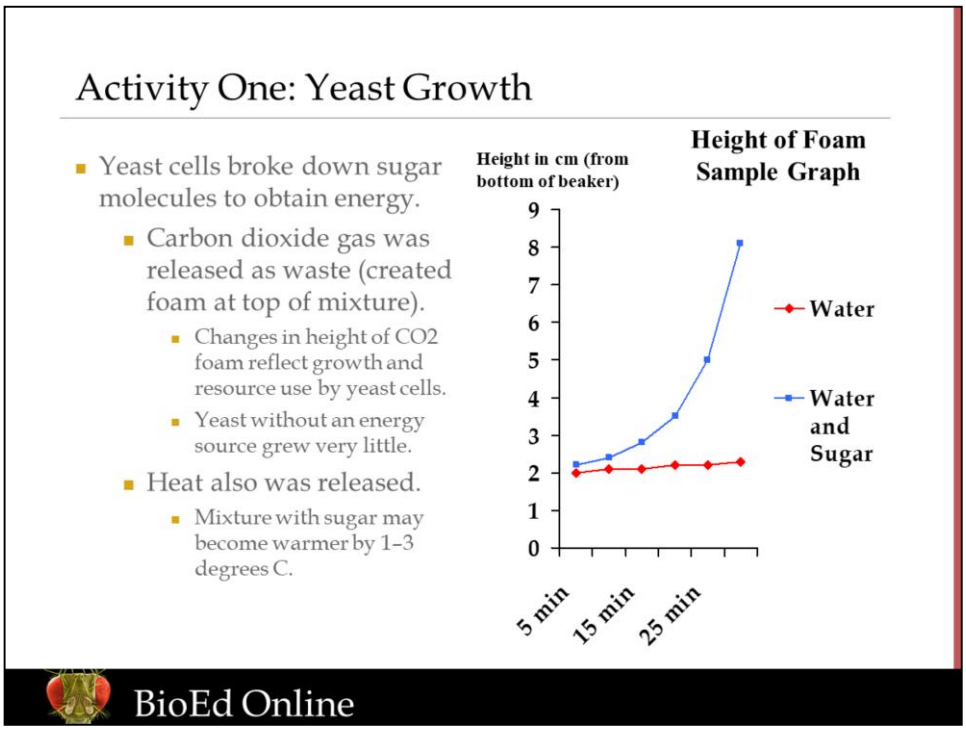

Yeast Growth

This activity provides two different kinds of evidence that yeast were metabolizing sugar for energy. First, in the container with sugar, the yeast produced CO_2 gas, which was observable as bubbles and foam at the top of the mixture. Second, the temperature of the yeast and sugar mixture rose. (Depending on room temperature, sensitivity of the thermometer and other variables, a temperature change may not always be observable.)

The growth of the layer of bubbles or "foam" at the top of the mixture of yeast and sugar appears as a curve, instead of a straight line. The curve may reflect the gradual activation of the cells' metabolism, or it may be related to actual yeast growth.

When metabolized, table sugar quickly is broken into its component monosaccharides, glucose and fructose. The breakdown of glucose, called glycolosis, converts glucose molecules into smaller molecules and, finally, into the three-carbon puruvic acid. This process takes place in the cytoplasm of microorganisms and does not require oxygen. Each step of the process is catalyzed by an enzyme. In most plant and animal cells, glycolysis is the precursor to the final breakdown of food molecules in the mitochondria. However, for many anaerobic organisms, such as yeast, which do not use molecular oxygen, glycolysis is the cell's principal source of energy. In these organisms, the pyruvate is converted into products, such as ethanol and CO_2, which are excreted from the cell.

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<http://www.bioedonline.org/resources/nsbri.cfm>

Reference:

Alberts, B., Bray, D., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (1998). *Essential Cell Biology*. New York: Garland Publishing.

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