Microorganism Multiplication

Indicators (Lesson Objectives)

1. Research and report on a microorganism's requirements (i.e., food, water, air, waste disposal, temperature of environment, reproduction).
2. Examine and illustrate size, shape, and structure of microorganisms found in an environment.

Materials

Activity 1: Yeast Blowup
3 - 125 ml Erlenmeyer flasks
water
hot plate or thermos
1/2 teaspoon flour
1/2 teaspoon sugar
1/2 teaspoon yeast
3 or more balloons

Activity 2: Spore Drop
large mature mushrooms with visible, dark gills
pencils
ruler
plastic or glass domes (bowls, glasses, bottoms of plastic bottles, cups) large enough to cover mushrooms
knife
white 12" x 12" paper towels or 8-1/2" x 11" sheets of paper
hair spray
hand-lenses or microscope
optional clear, self-adhesive contact paper

Activity 3: Reporting
Poster Paper (optional)

Background

Fungi - Yeast

Yeasts are small, single-cell organisms. They are members of the family *fungi* (singular, fungus), that also include mushrooms.

Time: Two or three 50-minute class periods.

Utah Core Science Standard V: Students will understand that microorganisms range from simple to complex, are found almost everywhere, and are both helpful and harmful.

Objective 1: Observe and summarize information about microorganisms.

Intended Learning Outcome: Make observations and comparisons between different organisms; make classification comparison; make illustrations; formulate simple research questions; predict results, use data to construct reasonable conclusions; record data; explain and report observations with pictures.

Fungi differ from plants in that they have no chlorophyll. Thus they have been useful to humans for centuries in the production of certain foods and beverages. They are responsible for the rising of bread dough and the fermentation of wine, whiskey, brandy, and beer. They also play the initial role in the production of vinegar. Most yeasts can live only on sugars and starches. From these they produce carbon dioxide gas and alcohol. Yeasts reproduce by a method called *budding.* A small knob or bud forms on the parent cell, grows and finally separates to become a new yeast cell. Although this is the most common method of reproduction, yeasts also multiply by the formation of spores.

Yeast used in bread production are an example of a fungus that causes fermentation. Yeast consume the sugars present in bread dough to use the energy from the sugar for growth and reproduction. When the yeast consume sugar, it is broken down into carbon dioxide gas and alcohol. Little bubbles of carbon dioxide released from the yeast fill the dough and cause it to expand or "rise." A slice of bread can be examined with the naked eye or with a magnifying glass to see the many small spaces made by the carbon dioxide.

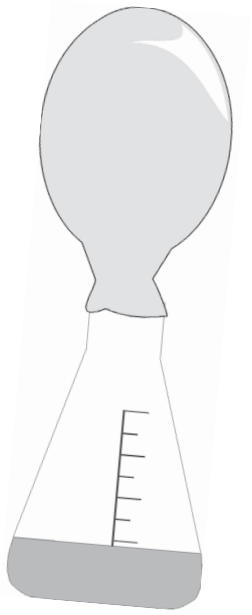
Some yeasts are *psychrophilic* i.e. they can grow at relatively low temperatures. In fact, the fermentation of wines and beer is often carried out at temperatures near 4°C (40° F). Some psychrophiles, can create a spoilage problem in meat coolers and other refrigerated storage areas.

Because yeasts can grow under conditions of high salt or sugar content, they can cause the spoilage of certain foods in which bacteria would not grow. Examples are honey, jellies, maple syrup, and sweetened condensed milk. Foods produced by the bacterial fermentation process, such as pickles and sauerkraut, can also be spoiled by yeasts which interfere with the normal fermentative process. Certain yeasts are pathogenic. However, yeast infections are much less common than are bacterial infections.

Club Fungi: Mushrooms, Rusts and Smuts

Mushrooms, toadstools, bracket fungi, shelf fungi, puffballs and other various parasites such as rust and smuts are club fungi. Club fungi reproduce by spores. The mushroom is the fruiting body. The "roots" which are really the mycelium grow in very fertile soil or other plant and/or animal organic matter. The mycelium may live for years, slowly growing underground. Only when the conditions are favorable do mushrooms (the fruiting body) grow up above the surface. The spores are formed in the gills located within the "cap." Under close examination the spores are produced in an area of the gills that are shaped like "clubs." Rusts are club fungi that produce rust-colored spores during one

phase of their life cycle. Rusts are parasites on wheat, barley, oats, and other crops. Each year they cause millions of dollars of damage to crops. Smuts are similar to rusts. Their name refers to the black dusty-looking mass of spores they form within the tissues of the host plant. Smuts attack corn, wheat, oats, barley, and rye.



Activity 1: Yeast Blowup

1. In three 125 ml Erlenmeyer flasks place 1/2 teaspoon of flour, 1/2 teaspoon sugar, 1/2 teaspoon yeast.
2. In the one flask add cold tap water to the 100 ml mark (15°C, 60°F). In the second flask add warm water to the 100 ml mark (38°C, 100°F). In the third flask add boiling water to the 100 ml mark (100°C, 212°F). Swirl the flasks.
3. Place a balloon over each flask (three different colors help for identification).

Observations:

a. What do you observe in the first 5 minutes?
b. What do you observe in 20 minutes?
c. What do you observe in 60 minutes?
d. What is blowing up the balloons? (carbon dioxide from yeast respiration)
e. What was the best temperature? Why?
f. What do you think would happen if twice the sugar was added? How about half as much?
g. Yeast is added to bread dough. Why does the bread rise?
h. Will temperature affect how quickly bread will rise?
i. Can you see evidence of carbon dioxide bubbles in bread?
j. If you add more yeast to bread will it rise faster?

Activity 2: Spore Drop

Cut off mushroom stems just below the cap. Select an area where the "Spore Drop" experiment can be left undisturbed for 24 hours. Provide each individual or small group with a mushroom cap, sheet of paper and dome.

1. Place mushroom cap, gill side down, on white sheet of paper or paper towel.
2. Cover the cap with a dome, leave undisturbed for approximately 24 hours.
3. Carefully remove dome and mushroom cap.
4. Observe spores with a hand-lens. To preserve the spore pattern, spray it with hair spray or cover with clear, self-adhesive contact paper. *Note: Do not spray the pattern if you plan to*

Questions for Investigation or Assessment

1. Is yeast alive?
2. What does yeast need to live?
3. How does yeast help bread rise?
4. How does/do _____ affect yeast?

   sugar (quantity)
   water
   kind of sugar (honey vs. sucrose)
   artificial sweetener
   temperature
   light (infrared, ultraviolet)
   salt
   air/oxygen/carbon dioxide
   microwaves
   preservatives

5. What causes bread to rise?
6. Can you see where yeast has respired in bread?
7. Why would a baker need to understand the needs of yeast?

observe the spores under a microscope. Observe spores through a microscope, *if desired.* Discuss the spore pattern art. Are all patterns the same? Can you see each spore?

Activity 3: Reporting

1. After completion of the microbe observation activities in this and the previous lesson plan, ask students to work in pairs and to select a microorganism.
2. Ask students to research that organism to determine its needs and how it reproduces. (Use library and Internet resources including those mentioned in the Resource section of this and the previous lesson plan.
2. Ask each group to present their findings by creating a poster or other media (i.e. transparencies).

Questions for Investigation or Assessment

1. How are mushrooms grown commercially? (www.mushroomcouncil.com)
2. Why would mushroom growers need to understand mushroom reproduction? (to ensure mushroom production for sale)
3. Are mushrooms grown in Utah? (yes, in Fillmore)

Extensions, Adaptations, Integration

Activity 1a: Variations

Vary the amount of sugar, substitute whole wheat flour, use no flour, no sugar, add hot or cold water to the flask, test instant yeast versus standard yeast, etc.

Activity 2a: Fungi Fun Math

Did you know a mature mushroom can produce 2 billion spores in 4 days? How many hours does it take for a mushroom to produce 2 billion spores? *(96 hours)* How many spores can a mushroom produce in a day (24 hours)? *(500 million)* How long would it take to produce 1 billion spores? *(2 days or 48 hours)* What is the diameter of your mushroom cap? *(Hint: The diameter is the length of a straight line passing through the center of a circle or sphere, from one side to the other side).* What is the radius of your mushroom cap? *(Hint: The radius is the length of a straight line extending from the center to the outside or periphery of a circle or sphere.)*

Resources

Mushroom Information, www.mushroomcouncil.com

Materials adapted from materials provided by Utah State University Extension and Utah Agriculture in the Classroom, www.agclassroom.org/ut.