

Living Systems

INVESTIGATIONS GUIDE



Investigation 2 – Nutrient Systems

PART 1: Yeast Nutrition

NGSS Standards:

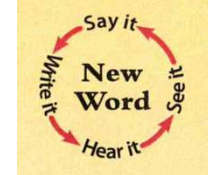
5-PS3.D

5-LS1.C

5-LS2.B

3 sessions

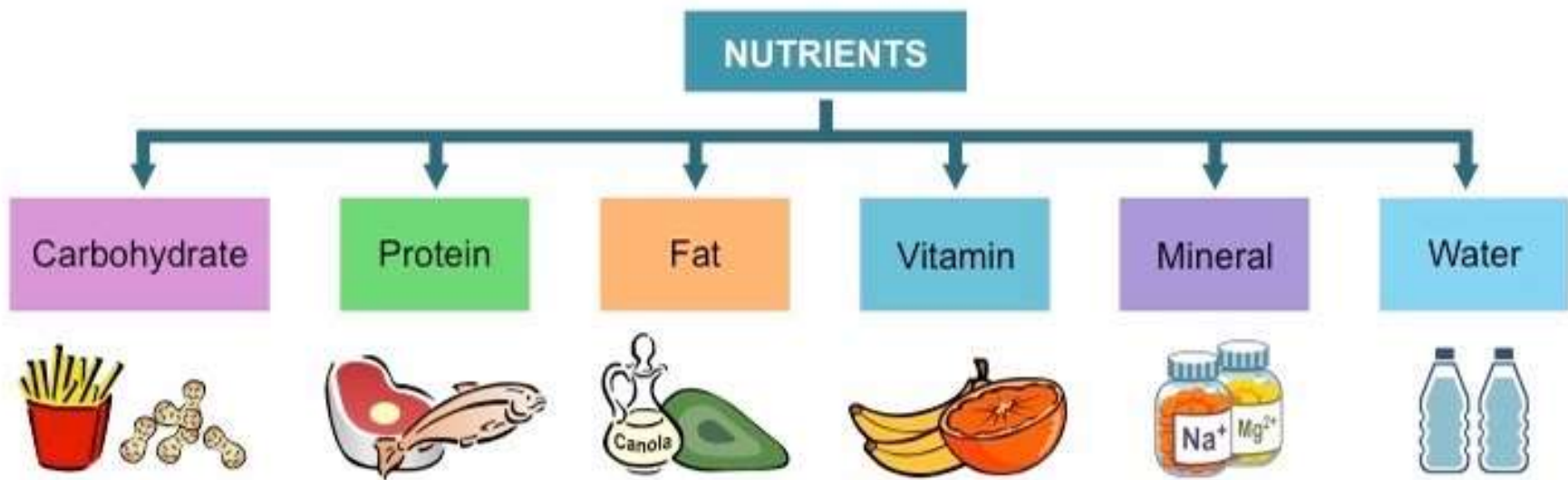
In this Investigation we are going to take a closer look at how different organisms get and use **nutrients** to survive. This lesson will focus on **food and nutrients** (substances that are essential for growth and life). **Nutrients** are chemicals found in food.



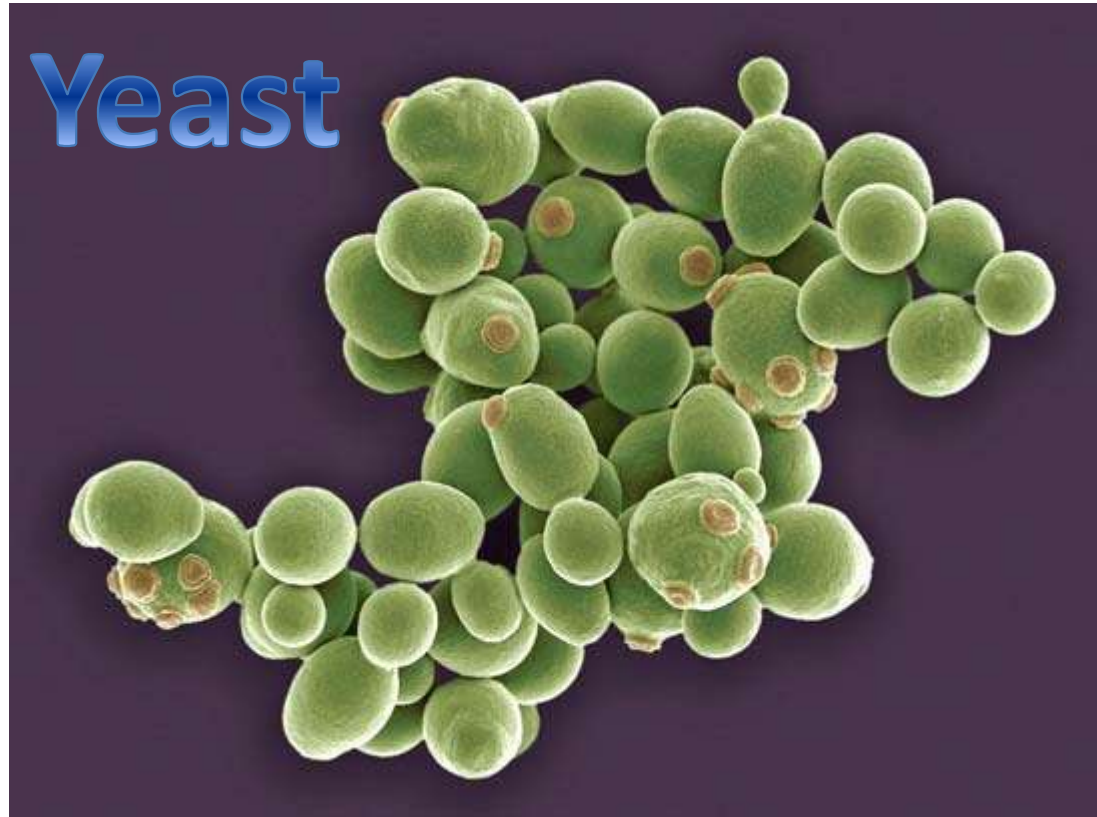
The guiding questions for this Investigation will be.....

What is food, where does it come from, how do organisms use it?

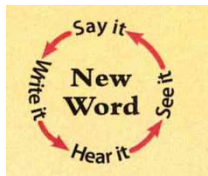
These are the 6 essential nutrients that you need as a human being to survive:



We are going to start our investigation with a very SMALL microorganism called.....

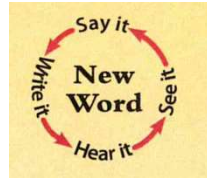


*Other examples
of "dormancy"*



dormant: inactive, a resting state.

What is **yeast**?



1 : a single-celled fungus that ferments (breaks down) sugar to produce **carbon dioxide**- a waste gas produced by cell respiration.

2 : living **yeast** cells are used in baking to make dough rise.

Fermentation is the process in which a substance breaks down into a simpler substance. Microorganisms like yeast and bacteria usually play a role in the **fermentation** process, creating beer, wine, bread, kimchi, yogurt and other foods.



What does **yeast** need to break its dormancy?

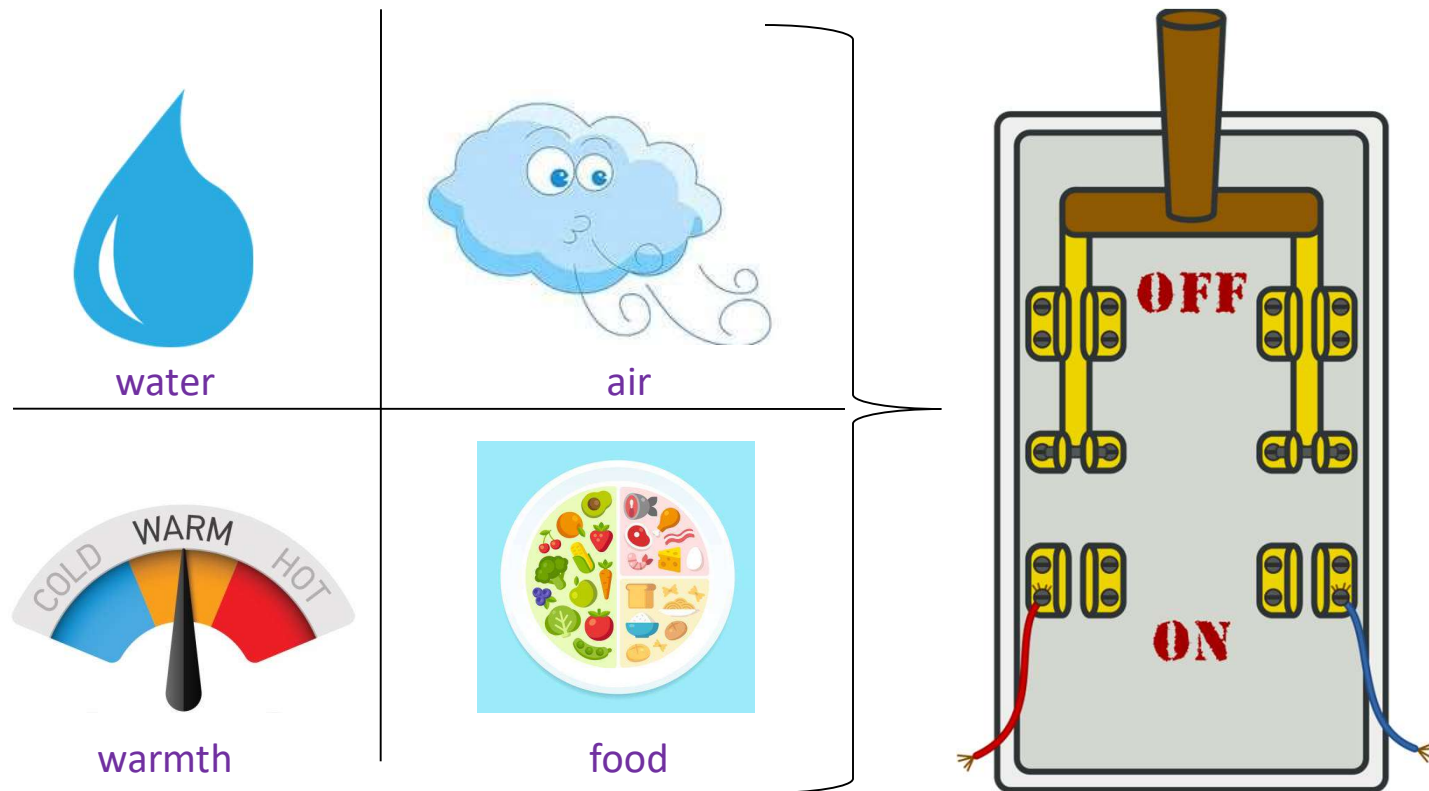




What does yeast need to break its dormancy?

Turn & Talk: How can yeast be “activated”, that is to break out of its dormant state?

Remember, yeast is a living organism and has the same requirements as all other living organisms.

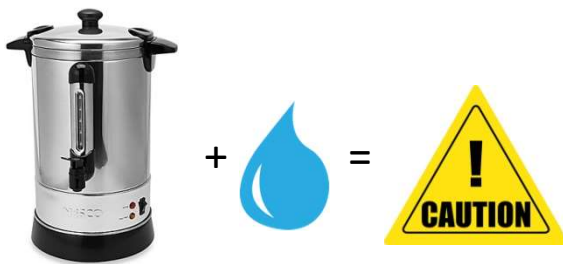




Today, in your groups you will develop an investigation to **activate yeast**.

You will need...

- Warm water (caution)
- Cookie (*do not eat*)
- Zip bags
- 50 mL syringes
- Thermometers
- Containers (1 L)



In your groups, design a procedure for finding out what yeast needs to break its dormancy.

How will you design an investigation to observe what is needed to activate yeast?

Think-About-It:

If your group decided to combine all of the materials at once (warm water, yeast, food, space) – **how would you know if yeast needs all three to activate?** How can you know if only food, or only water, or only warmth will activate yeast?

TASK: Share out ideas and agree on an investigation procedure.





All living organisms need **water**. So “active” yeast will need water.



All living organisms need **food**.

The investigation question then becomes, **does yeast need water AND food to become active?**

We need to test for this!

A. Each group will get two 1 L zip bags. Label one bag “food” . Leave the other bag unlabeled.

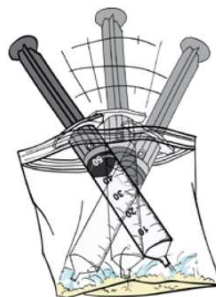
B. Put two level 5 mL spoons of dry (dormant) yeast into each zip bag.

C. Use a syringe to draw up 50 mL of warm water. Squirt the water into one of the bags with the yeast, spraying back and forth to wet all the yeast. Do the same with the other bag.

D. Put two animal crackers in the “food” bag. Let the cookies soak for a moment and then crush them a bit by squeezing them through the bag.

*E. Seal the bags most of the way across. Lay them flat on the table, holding the open corner up slightly, and carefully press most of the air out of the bags. **Seal the bags tightly.***

*F. Put the sealed bags into a warm-water bath (the 1 L container half filled with warm water) for **10 minutes**.*



Warm-Water Bath



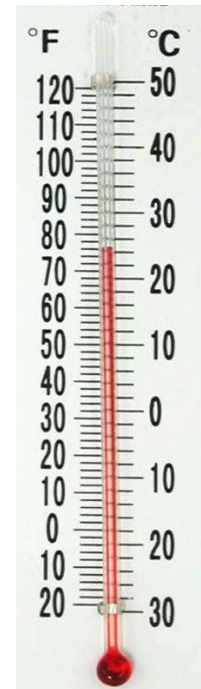
Your team needs to maintain the warm-water bath at a temperature between 40° C and 50°C for 10 minutes.



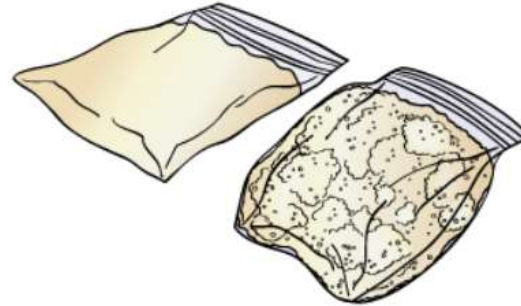
If the temperature drops below 40°C – you will need to add more warm water.

The yeast will die off if the temperature goes above 50°C.

During the 10-minutes, **take active notes in your notebook.**



Results



What changes do you see?

Share-out and write observations in your notebooks.

The bubbles and gas in the bag with the cookie provide evidence that the yeast is using ENERGY. The yeast in the “food” bag is getting the nutrients it needs to conduct its life functions. Yeast in plain water is not active, it is not using energy. The cookie is a source of energy for the yeast.



Something in the cookie is food for the yeast!

Can you think of a way to find out what cookie ingredient is food for yeast?
Is one of the ingredients the food that the yeast is using for energy?

End session

Review What We Have Learned:



- Yeast is a microorganism found in many products. Like all living organisms, yeast needs warmth, water, and nutrients (food) to become active. When yeast is not active it is dormant.
- Our investigation proved that yeast became active when presented with water and food.
- One ingredient in the cookie provided the yeast with energy.
- Today we will review the ingredients to determine what was in the cookie that the yeast responded to.



What does yeast need to break its dormancy?



Animal Crackers

Nutrition Facts	
Serving size	1 Pouch (29g)
Amount per serving	
Calories	120
% Daily Value*	
Total Fat 3.5g	4%
Saturated Fat 1g	5%
Trans Fat 0g	
Polyunsaturated Fat 1.5g	
Monounsaturated Fat 1g	
Cholesterol 0mg	0%
Sodium 115mg	5%
Total Carbohydrate 22g	8%
Dietary Fiber 2g	6%
Total Sugars 8g	
Includes 8g Added Sugars	16%
Protein 2g	
Vitamin D 0mcg 0%	Calcium 0mg 0%
Iron 0.8mg 0%	50mg 0%

Ingredients: Whole wheat flour, sugar, enriched flour (wheat flour, niacin, reduced iron, vitamin B₁ [thiamin mononitrate], vitamin B₂ [riboflavin], folic acid), soybean and palm oil. Contains 2% or less of salt, baking soda, soy lecithin, natural flavor, rosemary extract for freshness. **CONTAINS WHEAT AND SOY INGREDIENTS.**

Something in the cookie is food for the yeast!

Can you think of a way to find out what cookie ingredient is food for yeast?

Is one of the ingredients the food that the yeast is using for energy?



Flour or Sugar?

How can we design an investigation to compare flour and sugar as potential energy nutrients for the yeast?



Flour or Sugar?



- A. Each group will get one 1 L zip bag.
- B. Put two level 5 mL spoons of dry (dormant) yeast into the zip bag.
- C. Use a syringe to draw up 50 mL of warm water. Squirt the water into the bag with the yeast, spraying back and forth to wet all the yeast.
- D. Seal the bags most of the way across. Lay them flat on the table, holding the open corner up slightly, and carefully press most of the air out of the bag. **Seal the bag tightly**.
- F. Put the sealed bag into a warm-water bath (the 1 L container half filled with warm water) for **10 minutes**.

****Half of the groups will add 1 level spoon of flour to the yeast. Mark your bags with an "F".**

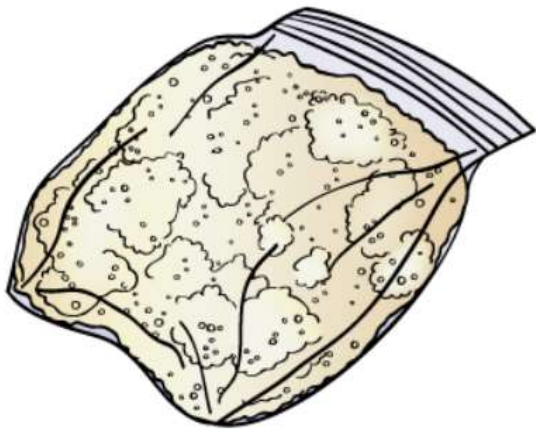
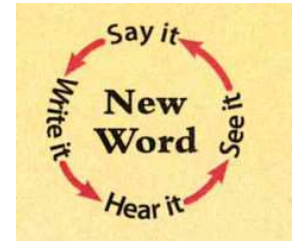
****Half of the groups will add 1 level spoon of sugar to the yeast. Mark your bags with an "S".**

Carbon dioxide



The gas produced in the cookie bag by the yeast is **carbon dioxide** (CO_2), a waste gas our cells produce when they are active.

When an organism uses nutrients for energy and produces waste products, the organism is **metabolizing**. The process is called **metabolism**.

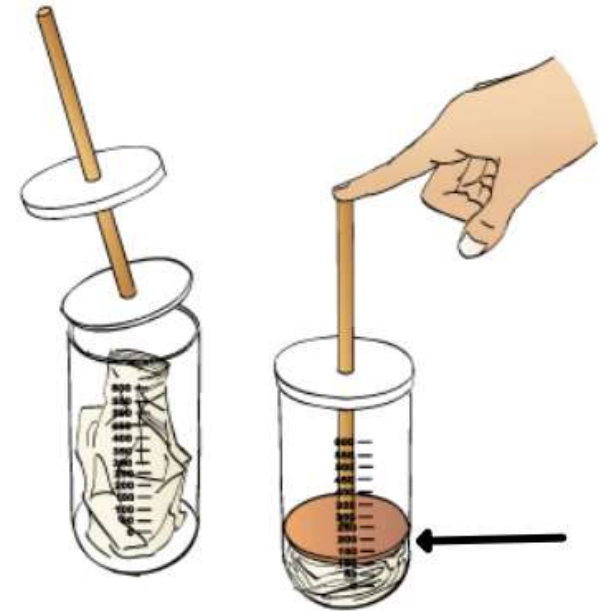


The “food” bag puffed up because the yeast produced a waste gas when it became active. The gas produced by the yeast was carbon dioxide.

Volume Tubes

A volume tube is used to measure the volume of carbon dioxide produced by the yeast.

1. After the 10 minutes is up, put the bag in the cylinder.
2. Insert the piston on the top of the bag and place the lid on the cylinder.
3. Press down on the stick with one finger (don't press too hard).
4. Look at the point on the tube where the piston crosses the number lone. Read the volume of carbon dioxide in the bag in millimeters.
5. Read and record the volume in your notebook.



Sugar

Group	Volume of CO ₂ (ml)

Flour

Group	Volume of CO ₂ (ml)

Review:

- Which of the ingredients produced the most carbon dioxide?
- What does this data tell us about the energy nutrient for yeast?
- What is the evidence that yeast uses sugar for food energy?
- Why can we call the bag with sugar, water, and yeast a system?



WHY?

So why did we use yeast in the first place?

CLASS READ ALOUD:

Yeast is not a plant, nor is it an animal. Yeast is a fungus. Yeast is a good organism for us to start our inquiry into nutrients and metabolism because it is a single cell.

All living organisms are made of cells. **Cells are the basic units of life.** Yeast is a single-cell fungus. Humans, like you, are organisms made of trillions of cells. Yeast organisms are single, individual cells. Each yeast cell is an organism. Yeast cells don't have mouths. So how do they get their nutrients to keep them alive. They absorb the nutrients through their membranes. The same way your trillions of cells do. That is why we started out simple.

End session

TIME TO READ



There's Yeast in My Bread!

If you ever watched someone make bread, you might have noticed that they added a light brown material called yeast to the dough. What is yeast, and why add it to the dough?

Yeast is a kind of fungus. You might have heard of some other kinds of fungus. Mildew is a kind of fungus that grows on organic materials like paper and leather. Mushrooms are the visible part of fungi that live on organic matter in the soil. These fungi are distant relatives of the yeast used to make bread.

One baker's yeast organism is a single **cell**. A single yeast cell is way too small to be seen with unaided eyes. With a microscope, you can see that one yeast organism is a tiny round object.



Yeast



Investigation 2 – Part 1

Wrap-up Questions



1. What kind of organism is baker's yeast?

A single-celled fungus.

2. How do yeast organisms get their nutrients?

They absorb them through their cell membrane.

3. Where does carbon dioxide gas come from?

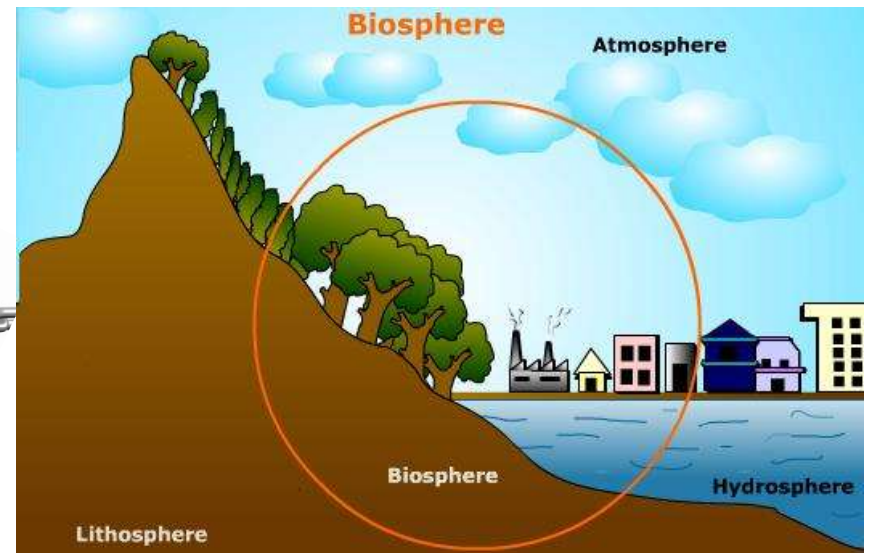
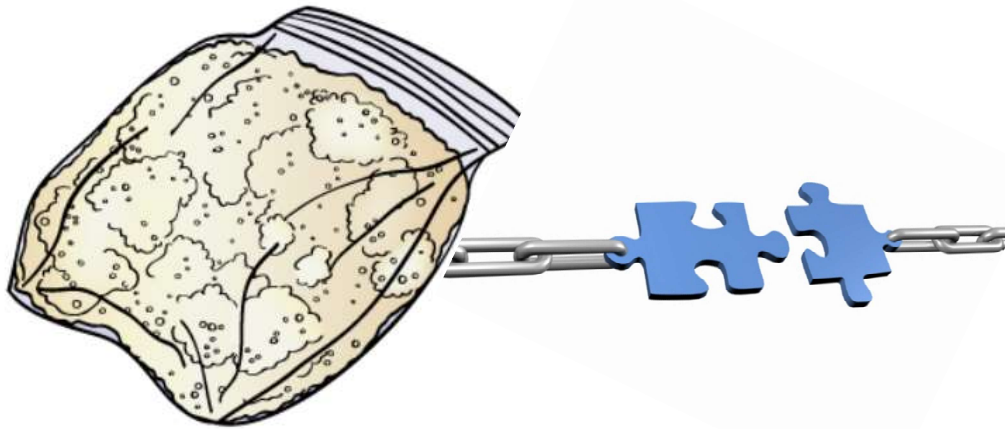
When yeast break sugar down for energy, the gas is given off as waste.

Written Reflection:

(in your notebooks)

Turn & Talk:

How can we make a connection between **yeast and carbon dioxide** with **the biosphere and the atmosphere**?



dormant – inactive, a resting state.

yeast - a single-celled fungus that
ferments (breaks down) sugar to
produce carbon dioxide.

nutrient – a chemical in food that helps to keep an organism alive and active.

sugar – a nutrient that cells use for energy.

carbon dioxide – a waste gas
produced during cellular respiration.

metabolism – the process of using
nutrients for energy.

fungus– an organism that lacks chlorophyll and gets nutrients from dead or living organisms.

cell – the basic unit of life.



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Yeast

Why put fungus in your bread dough? Yeast eats **sugar**. When a yeast cell takes in a molecule of sugar, it breaks it down to use it for energy. The yeast breaks several carbon atoms off the sugar molecule. The carbon atoms combine with **oxygen**, forming carbon dioxide (CO_2) gas. The carbon dioxide produced by the yeast creates thousands of tiny bubbles in the dough. The dough rises as it fills with gas bubbles. The bubbles make the bread light and soft.

Where does the sugar that feeds the yeast come from? Some bread recipes call for a little sugar, but extra sugar is not necessary. Wheat flour contains a lot of starch and a small amount of a chemical called an enzyme. The enzyme breaks down the starch molecules into simpler molecules. Some of these molecules are sugar. The sugar that the yeast eats is from the starch in the flour. It takes time for the enzyme to act on the starch. So it can take several hours for bread to rise.

Next time you have a slice of bread, look closely at its texture. It is all full of holes, like a sponge. The holes were carbon dioxide bubbles. And remember, when you are eating a piece of bread, you are eating millions of baked yeast cells. Yum!



The holes in bread are the result of carbon dioxide bubbles.

