Life Science: How Cell Parts and Cellular Respiration explain how yeast makes bread rise

Middle School

Ann Morris, Anna Kramer, Ramona Grove, Anne Green, and Christina Oberloh

Brighton School, Cascade Middle School (Highline Public Schools)

Anchoring phenomenon:
Two loaves of bread were baked, but only one was big and fluffy while the other was dense, hard, and didn't rise. What happened? Students review the recipe and determine that yeast was left out, and now they wonder what yeast does to make the bread rise.

Essential question about phenomenon/for unit:
What happens in yeast that makes bread rise? Why does the yeast do this?

Big Idea:
Eukaryotic cells have many parts that work together to help the cell maintain life and reproduce. The cell membrane lets in reactants that go through a chemical reaction in the mitochondria, and this happens for the purpose of obtaining useable energy used for multiple cell functions but also for reproduction. As a result waste is produced and released from the cell in order to maintain homeostasis in the cell.

Scientific explanation:
Yeast is a single-celled living organism, and in its cell are cell parts that help maintain life. Investigations give evidence that yeast is living since it exhibits characteristics of life, like made of cells (observed in a microscope), releases waste (creation of gas), and reproduces (videos/microscopes show reproduction). When yeast is combined with sugar and warm water, gas is produced and can be captured in balloons, revealing evidence that waste is produced and that the yeast responds to a stimuli (heat). When yeast is observed under a microscope, it appears that it is made of a single cell and reproduces when given water and sugar. [1-1]

Since the yeast is living and it needs food, the cell membrane allows the sugar and oxygen to enter the cell. The sugar and oxygen go to through the cytoplasm where the sugar might be dissolved and eventually to the mitochondria. The cell nucleus controls the mitochondria, so the mitochondria breaks apart the atoms that make the sugar and oxygen and those atoms are recombined to carbon dioxide and water. As a result, chemical energy in the sugar is transferred into chemical energy in ATP. The atoms that make the carbon dixoide and water are waste products so they leave the mitochondria, go through the cytoplasm and eventually leave the yeast cell through the cell membrane. Those cell parts work together to help the yeast breathe, produce and eliminate waste, obtain energy from food, all in an effort to reproduce. The result is increasing yeast cells and increasing waste, CO_2 gas, and the increased gas is released causing the particles in the bread (wheat, water, etc.) to rise as it escapes.

NGSS *Performance Expectations* addressed in this unit:

Standard	PE	DCI	CCC
MS-LS1-1	Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. (Activities 2 and 3)	LS1.A Structure and Function	Scale, Proportion, and Quantity
MS-LS1-2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. (Activities 4, 5, and 7)		Structure and Function
MS-LS1-7	Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. (Activity 6)	LS1.C Organization for Matter and Energy Flow in Organisms PS3.C Energy in Chemical Processes and Everyday Life	Energy and Matter

Summary Table of Activities in Unit

Activity	*Learning Target*	*Evidence Students Could Gain/Key Learning*	*Connection to explain part of the phenomena*
Activity 1: Initial Model	Students will propose ideas about what happens in the yeast that results in the bread rising.	Yeast is not in the ingredient list of the dense, unfluffy bread, but it is in the fluffy bread.	Yeast is important and causes the bread to rise.
Activity 2: Is Yeast Alive? LS1-1 Examine evidence through a microscope, test tube, and video that yeast is alive.	Students will observe and record evidence to determine the characteristics of life that yeast displays.	*Yeast is made of cells as seen through a microscope. *Yeast reproduces which can be seen in a video that shows yeast budding and multiplying under a microscope.	Yeast is living, so it eventually dies. The yeast uses the sugar to reproduce and to create new yeast cells. Those new yeast cells also create waste, causing the bread to expand.

Activity 3: Yeast Balloon LS1-1 Add yeast, sugar, and warm water to a test tube and put a balloon over it. Student groups will change one variable to see how that affects the amount of gas produced.	Students will use evidence to determine the characteristics of life that yeast displays as evidence that it is living.	*Yeast creates waste products. *Yeast responds to stimuli.	The yeast produces gas when it has warm water and sugar and that gas makes the balloon rise, similar to how yeast makes bread rise. The yeast is alive, so it can be killed, which it does with extreme heat in the oven.
Activity 4: BTB Lab LS1-2 Release gas in balloon in water with BTB to determine what gas is in the balloon.	Students will use evidence to infer what gas the yeast produces.	*The BTB turned from blue to yellow, because of CO_2 released from the yeast. We also blow out CO_2 causing the BTB to turn yellow. Our bodies are made of cells, like the yeast cells.	The yeast releases a gas, specifically CO_2 that causes the bread to rise.
Activity 5: Dialysis Tubing LS1-2 Set up a dialysis tubing to see what materials can transfer across, using indicators like Benedict's and BTB.	Students will simulate the transfer of materials across a cell membrane.	*CO_2 went across the dialysis tubing causing the BTB to turn yellow inside. *Sugar went across the dialysis tubing causing the Benedict's solution to turn orange when heated.	The cell membrane of the yeast allows small molecules like sugar and O_2 into the cell and allows small molecules like water and CO_2 out of the cell.
Activity 6: Chemical Reactions LS1-7 Use legos to represent atoms in molecules breaking apart and rearranging.	Students use LEGOS to model how atoms are rearranged in chemical reactions.	*Sugar is made of lots of carbon that is broken apart. *The C atoms can be rearranged to make CO_2 or used to make other molecules for the cell.	In the mitochondria, the atoms that make the oxygen and sugar are broken apart and rearranged to make the carbon dioxide and water which are released. Some of the carbon that makes the sugar can also be used to make other molecules that the cell needs for cell parts.

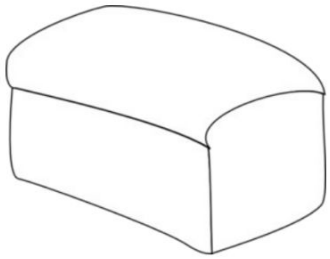
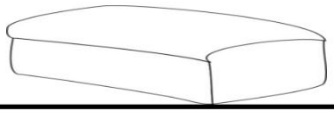
Activity 7: Cell Organelle Stations LS1-2 Read about and watch videos that review the different structure and function of a few organelles.	Students will review the function and structure of organelles to explain how they work together to help the cell.	*The nucleus controls the cell. *The membrane controls what goes into and out of the cell. *The mitochondria is the powerhouse and converts sugar into useable energy and waste products. *The cytopolasm holds the other organelles and helps transport materials throughout the cell.	The membrane lets in the sugar and oxygen which goes through the cytoplasm to the mitochondria. One the sugar and oxygen are in the mitochondria the nucleus directs it to use that sugar for energy and matter. The nucleus also regulate the amount of waste and eventually directs the cell membrane to release the extra waste.
Activity 8: Final Model and Rubric	Students will review the rubric and model template and then spend 2 days creating a final model.		

Model Template (click on picture for link)(

Name: _____ Date: _____ Period: _____

Fluffy Bread: Initial Model

Write and draw to answer the questions in the boxes below.

FLUFFY BREAD	**1.** Why **did** this bread get fluffy? *¿Por qué la barra de pan se puso esponjosa?* 	
BAD BREAD	**2.** Why **didn't** this bread get fluffy? *¿Por qué la barra de pan no se puso esponjosa?* 	

Students initial ideas after Activity 1

What is going on with the yeast? - 1

- Yeast (a living thing) needs water to “activate”, so it can sit and rise. It grows bigger. In the picture, I didn’t add water or yeast. The yeast needs energy and gets it from the water or the dough.
- Yeast needs water to consume, and it puts out “air.” The air is made of hydrogen and oxygen and it came from the water, made of hydrogen and oxygen.
- Yeast is like a bacteria, and mixed with water, it expands. The yeast expands and leaves room for air to enter the bread.The yeast soaks up the water, and the water goes into the yeast.
- Yeast is a germ and it starts to grow when it’s warm and it makes it bigger. The yeast is spreading out and it makes the bread have small holes. The air is made of oxygen and hydrogen.
- Yeast needs water to “activate” and it needs bread and heat. The air is a chemical reaction between the yeast and the water. Something new is created, like baking soda and vinegar making a gas. A gas is made too and it rises. The gas comes from the yeast.

BTB Lab (Activity 4)

DIRECTIONS: What is the gas in the balloon?

1. **ALL** group members put on goggles and have their journals open.
2. Get a bin of materials from the heater.

YEAST + WATER

1. One member brings the chem plate up to Ms. Kramer to get **25 drops of "yeast + water"** added to cup 4 of the chem plate.
2. A different member adds **3 drops of BTB** to the large oval cup of the chem plate.
3. A different member adds **50 drops of water** to the large oval cup of the chem plate. Back away from it – if you breathe on it the carbon dioxide in your breath will make it change color, giving you bad data.
4. Place the chem plate on white paper. **Write** the beginning color in the oval cup in the "Before" column of your data table for "yeast + water".
5. **Cap** cup 4 with the cup cover **tightly**.
6. **Insert** the attached tubing into the BTB solution in the oval cup. You might have to hold the tubing in place.
7. After 5 min, **write** down the color in the oval cups in the "After" column of your data table.

YEAST + SUGAR WATER

1. A different member rinses out the chem plate, then comes up to Ms. Kramer to get **25 drops of "yeast + SUGAR water"** to cup 4 of the chem plate.
2. Repeat steps 4 – 9 for the "yeast + SUGAR water" mixture.
3. With your group members, discuss your results and fill in the "what this means" column.
4. When every group member has filled out their entire data table, it is time to clean up the second chem plate! **Rinse it off** really well and put it back in the bin. Your bin should look the same as it did when class began.
5. Put your bin of materials back on the heater. Take off your goggles and return them to the bucket.

Table 1: Key to Reading the Color of BTB

BTB color	**Is carbon dioxide present?**
Blue	No
Yellow-green	Yes

Trial	"Before" BTB color	"After" BTB color	What this means… (why did it change or not change?)
Air from Yeast + Water			
Ar from Yeast + Sugar Water			

Quizzes and assessments (example below, link to all) - used throughout the unit to assess student understanding

3. Which organelle controls what can go in and out of a cell? *

- Cell membrane
- Nucleus
- Mitochondria
- Cytoplasm
- Lysosome
- Vacuole

4. EXPLAIN which type of cell in your body has the most mitochondria and WHY that cell needs so many. (Hint: It's a type of cell that needs the most energy - there are a variety of acceptable answers). *

Long answer text

Explain why one bread rose and the other didn't. Explain how different organelles in the yeast cell work together to make this happen.

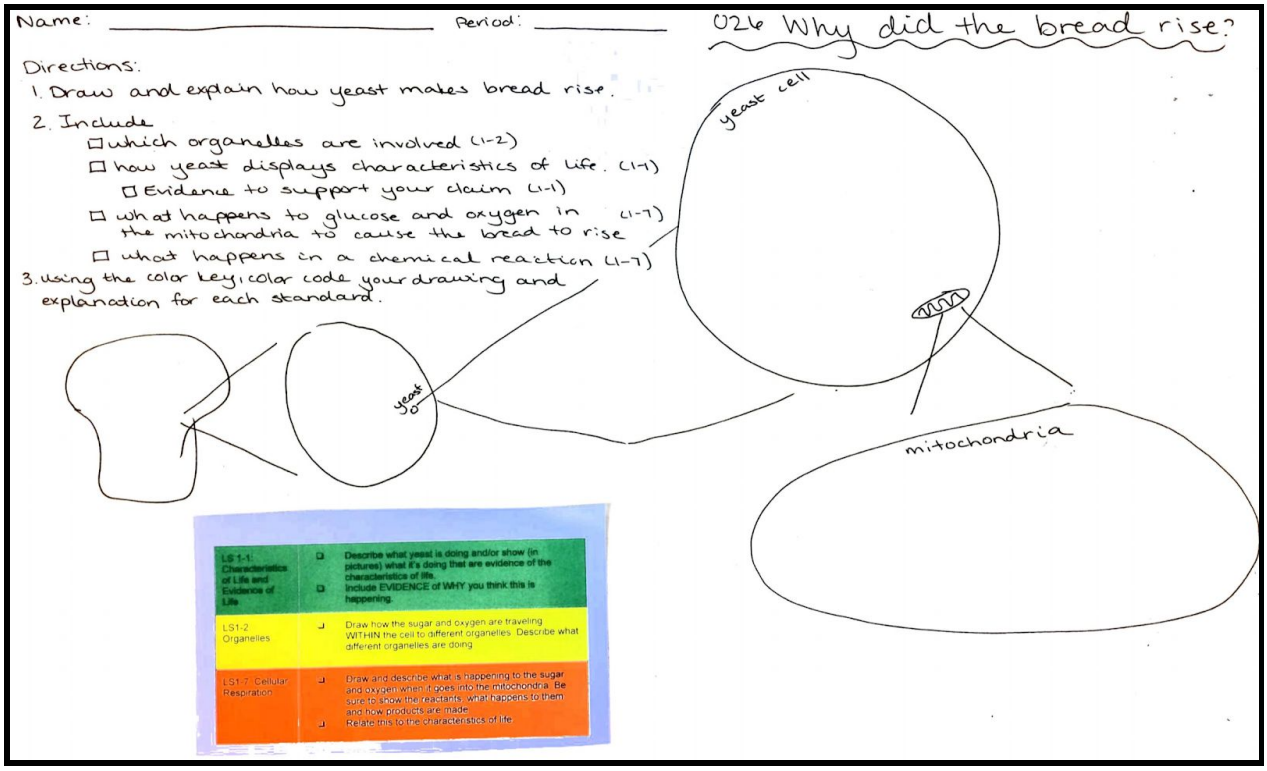
Long answer text

Additional Unit-Related Documents

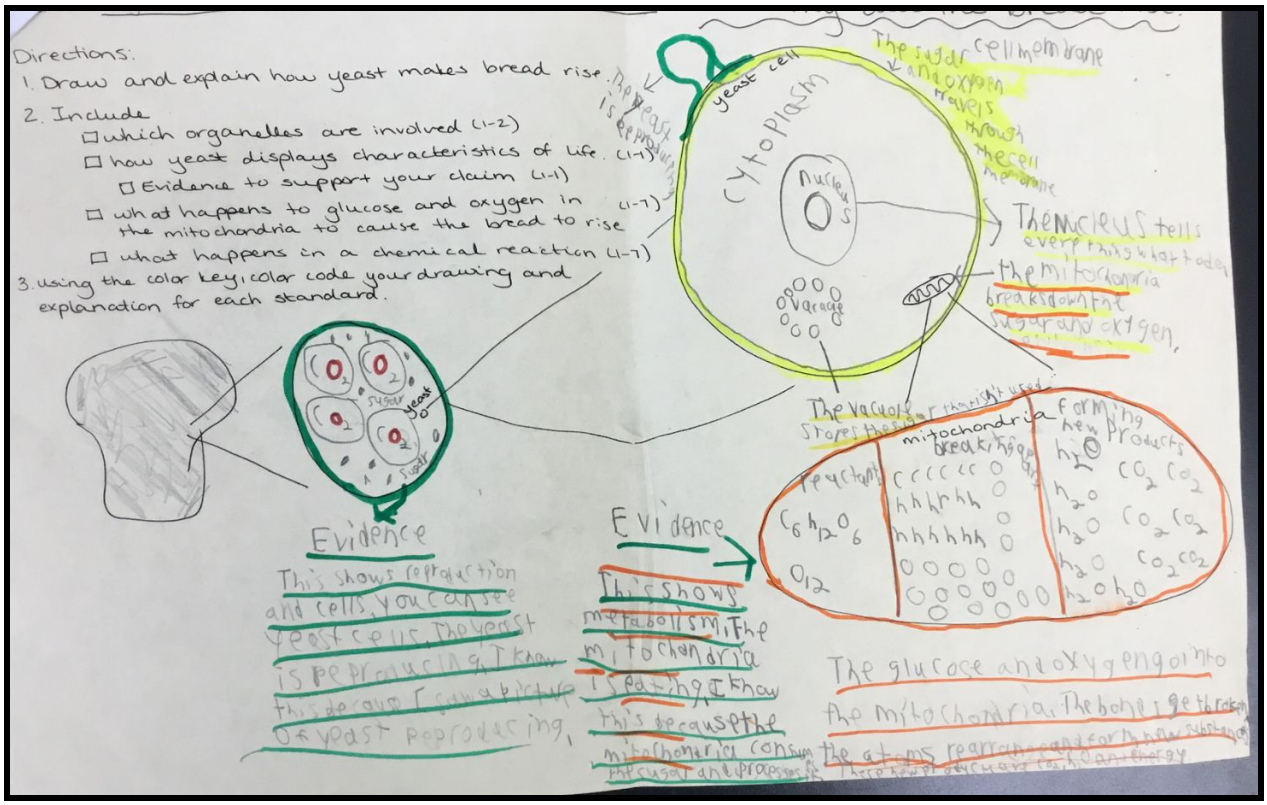
Rubric for final model

LS 1-1: Characteristics of Life and Evidence of Life	❏ Describe what yeast is doing and/or show (in pictures) what it's doing that are evidence of the characteristics of life. ❏ Include EVIDENCE of WHY you think this is happening.
LS1-2: Organelles	❏ Draw how the sugar and oxygen are traveling WITHIN the cell to different organelles. Describe what different organelles are doing.
LS1-7: Cellular Respiration	❏ Draw and describe what is happening to the sugar and oxygen when it goes into the mitochondria. Be sure to show the reactants, what happens to them and how products are made. ❏ Relate this to the characteristics of life.

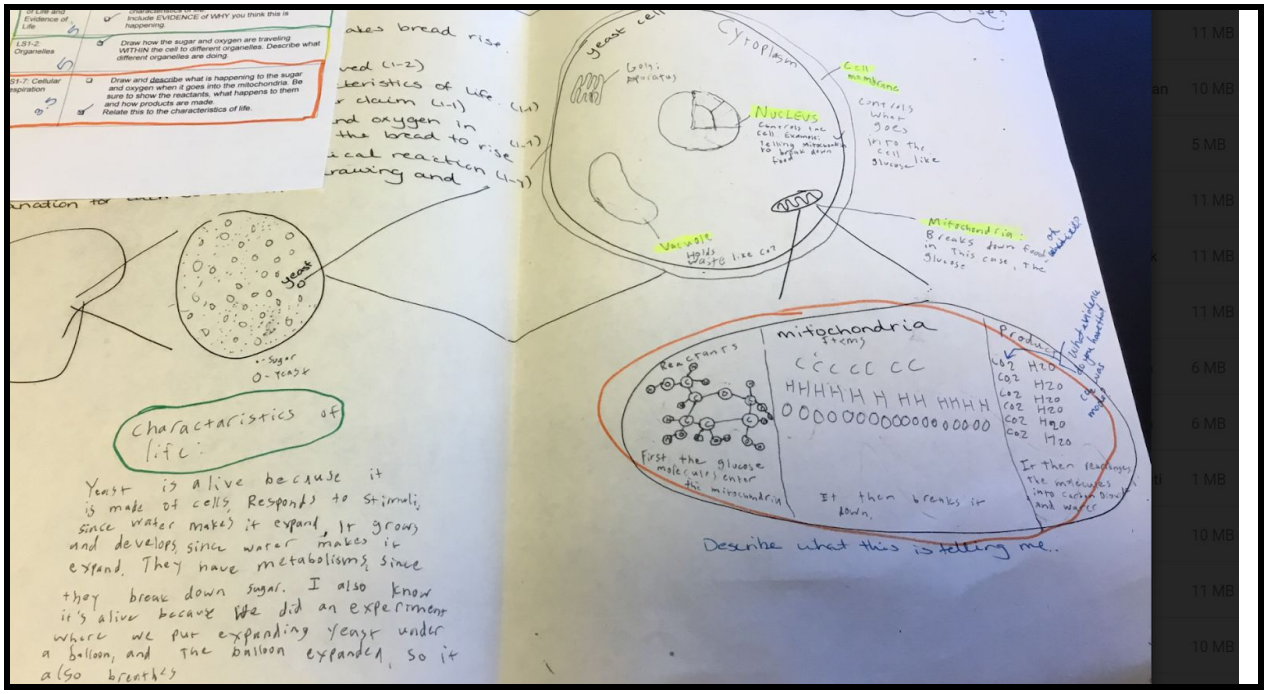
Final model (click on picture for link)



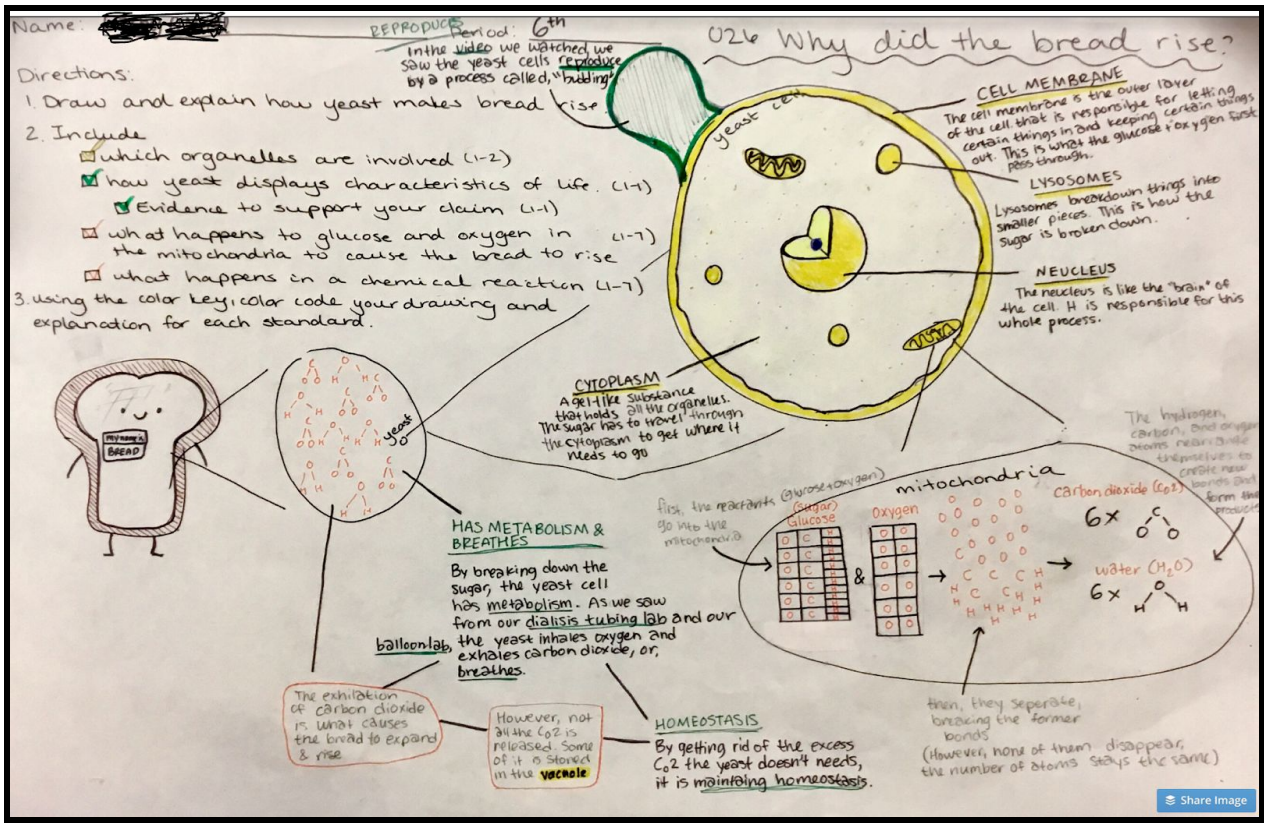
Student Example #1



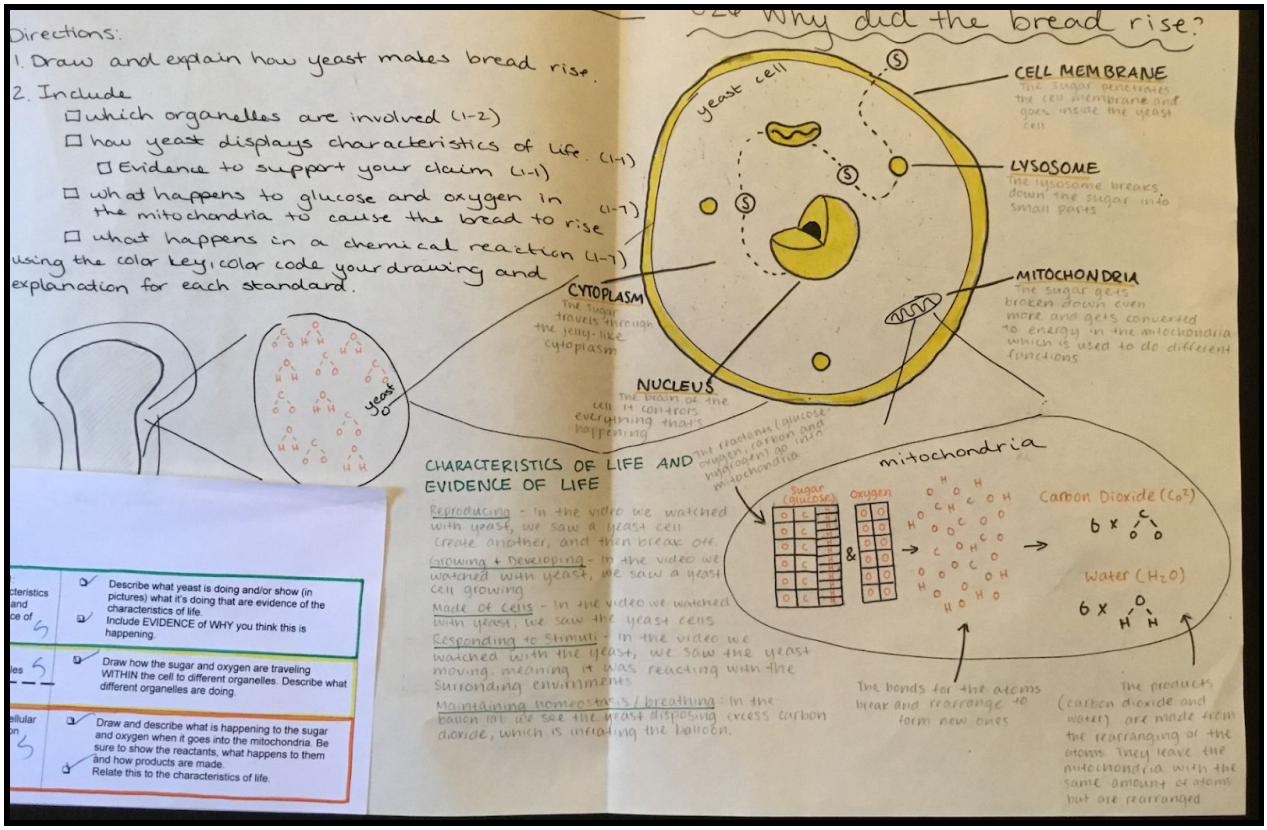
Student Example #2



Student Example #3



Student Example #4



Student Example #5