Grade 3: What Happened to the Bread?
Activity Sheets

Lesson 1: Connecting Yeast and Bread / What structures are in breads?

This Lesson: In this activity, breads are examined and questions about these structures are brought forward by the students. We hope to determine how bread and its interior bubbles help in the production of yeast bread.

Time Frame: 1 class period of 30 minutes for examining the structures in a variety of breads.

Materials:

- A variety of sliced breads with identifiable structures (air bubbles, crust, softer center/firmer center, whole grain and/or white bread). One small slice of 3 sample breads for each group of 2-3 students.
- Hand lenses.
- Journals or a teacher's created recording sheet for recording observations.

Teacher Science Background: Life is defined (loosely) as any organism that moves, respirates, shows a sensitivity, grows, reproduces, excretes, or consumes nutrition. An organism is any living thing. A microorganism is a subgroup of the tiniest forms of life. Yeast is in this category; it is a fungus that relies on consuming sugar to digest and produces carbon dioxide (CO_2) as a byproduct. Throughout history humans have taken advantage of this knowledge to create bread. Bakers, through time have realized how to take advantage of the ability of yeast to consume simple sugars and release bubbles in the bread by adjusting the temperatures of their initial dough mix.

Vocabulary: None

What Students Figure Out? We figure out that there are bubbles in all the bread.

Lesson Progression: This lesson provides students with a shared experience of determining the structures within all breads.

Begin a SUMMARY BOARD: Have we addressed any of our initial questions? Do we have more questions now? The use of a summary board helps you and your students cycle through what they have done, what questions they still may have, what is the plan for the day, what might we do next?

Supporting Resources:

- Fungi: Mushrooms, Toadstools, Molds, Yeasts, and Other Fungi by Judy Wearing
- From Wheat to Bread by Stacy Taus-Bolstad

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Lesson 2: Investigating the ingredients of bread

This Lesson: This lesson introduces youth to the yeast organism and the various environmental factors that affect the organism's growth and survival. It is an activity that answers the question of what caused the bubbles in the baked bread? Group the students into small groups of 2-3. Prepare 3 small Ziploc (or alternative resealable) sandwich-sized bags for each group with the following dry ingredients inside: Bag #1 - ½ tsp sugar, Bag #2 - 1 tablespoon of yeast, Bag #3 - 1 tablespoon of yeast, and ½ tsp. of sugar. Have the students add 3 tablespoons of warm water (85-90 degrees F) to each bag and secure it with the Ziplock. Students can squish the bags to mix the ingredients. Have them find a quiet spot to make observations and record any changes they see, hear, smell or feel (in a journal or a recording sheet of your preference). As time permits, it may make sense for them to leave their experiments for a short break before making their final observations. Allow students to open their bags to see and smell the ingredients for final observations. If you have access to magnifying lenses, you might encourage students to use them before the water is added and afterwards.

The baggie below had the above measured ingredients of yeast and sugar and did not become over-filled to the point of rupturing the bag. As always, you should try the experiment yourself before having your class do the activity. The images show the baggie with yeast/sugar mixture after 45 minutes and a close-up of the yeast mixture.

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Time Frame: 45 minutes for the initial yeast activity (can surround a story or recess to optimize observations. Up to an additional 30 minutes for the debriefing discussion, model revisions, and gallery walk.

Materials: Ziploc sandwich or quart-sized baggies, Active-Dry Yeast or Rapid Rise Yeast (Fleischmann's, Hodgson's, or LeSaffre are all great brands), sugar, warm water, hand lenses (optional).

Teacher Science Background: Life is defined (loosely) as any organism that moves, respirates, shows a sensitivity, grows, reproduces, excretes, or consumes nutrition. An organism is any living thing. A microorganism is a sub-group of the tiniest forms of life. Yeast is in this category; it is a fungus that relies on consuming sugar to digest and produces carbon dioxide (CO_2) as a byproduct. In the next Lesson, students will view a video that explains that yeast is a living thing. Throughout history humans have taken advantage of this knowledge to create bread. Bakers, through time have realized how to take advantage of the ability of yeast to consume simple sugars and release bubbles in the bread by adjusting the temperatures of their initial dough mix.

Vocabulary: Yeast: An ingredient in some breads

Post Activity Discussion:
Gather the whole group for a discussion and ask students to describe what they saw and what they might wonder about or have questions about with this experiment. This activity or investigative phenomenon can help generate your students' curiosity. We use the terms questions and wonderings to help open up their thinking. There are no "right answers" but instead we are looking at other connections we might be able to explore and the connection of water, sugar, and yeast to the bubbles in the bread..

Here are some of the questions and wonderings students might have:

- What happened to the sugar/yeast?
- Why doesn't sugar and water make bubbles?
- I think my baggie got cold. Why did it get cold?
- I saw bubbles. Which substance produces bubbles?
- The one with yeast smelled before we started but now it really smells!
- Which substance causes the smell?
- What would happen if we made the water cold or really hot?
- What if we added more sugar?
- Would the same thing happen if we added fake sugar or honey?

Additional questions can be added to the Driving Question Board (DQB). These might include questions about temperature, amounts or volumes, bubbles and odors, or the

liquid used. For example, ideas about the warmth of the water or coldness of the results could be grouped under, “How does the temperature change the bubbles made?” Another category could be the ingredients: “What if there were no liquid, or if different liquids were used, what would happen?” You might also find questions about how long it took (timing), or if light has anything to do with the reaction? These are all great ideas that can invite students to learn by practicing science. Your next activity might be to ask students to revise their initial models based on what they figured out.

Revising Models:

Return to the students’ initial models of the risen and not risen breads. Have them revise their models to include the bubbles created by the water, sugar, and yeast in the risen bread. The bread that did not rise also had water, sugar, and yeast, but no bubbles. What do they think might have happened? Have them share or participate in a gallery walk to support students going public with their thinking.

What Students Figure Out? The baggie with the water, sugar, and yeast made many bubbles just like in the risen bread.

Lesson Progression:

1. Whole group: show bread ingredients including yeast, sugar, and water. Explain the procedure with the 3 bags and different combinations.
2. Small group: send each group off with 3 Ziplock bags filled as directed above. Students make observations (see, feel, hear) and record their observations on a data sheet (see resources or teacher created).
3. Whole group: class discussion, sharing observations and formulating more questions about the observations they have made. Consensus discussion of what was figured out.
4. Small group or individuals: Return to their bread models to revise.

Supporting Resources:

Data Sheet: Observations

STEM From the Start Videos

https://unh.box.com/s/4r3g5ktk3w740r98004pz35cywbk9y1m

https://unh.box.com/s/cuj1iuudll9li792lzeidqtt2b04wfa4

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Lesson 3: What we can't see in the making of bread?

This Lesson: Students watch a short, age appropriate video on breadmaking and the role of yeast (see resources). They are told in the video that yeast is a living thing that consumes sugar and produces gas (CO_2). This is also an opportunity to incorporate non-fiction books on bread making and fungus. Students are asked to examine and revise their models of the process of yeast producing gas bubbles in bread to expand and chemically change the flavor and consistency of the dough and what happens to the loaf that does not rise.

Time Frame: 1 meeting period of 30-45 minutes to share the books and/or the interview with a baker.

Materials:

- Teacher choice
    - Whiteboards for model making and markers.
    - Paper and markers
    - Ability to take pictures of student models to digitally archive to view later

Science Background: (From Lesson 2)

Vocabulary:

- **Alive**: Life is defined (loosely) as any organism that moves, respirates, shows a sensitivity, grows, reproduces, excretes, or consumes nutrition.
- **Organism**: any living thing.
- **Yeast:** A living organism

What Students Figure Out? Students learn how and why yeast is used in breadmaking. They determine that the bubbles in bread help us understand how yeast (a living organism) can digest simple sugars and then produce CO_2. This digestion aids the baker in their quest to chemically and physically alter bread dough to produce something we bake and eat regularly. They also figure out that sometimes the yeast "does not wake up" and produce gas.

Lesson Progression: This lesson provides a time for research (non-fiction book, interview) and then time for students to develop a model to explain the role of yeast in

bread making. (Consider remote and asynchronous classrooms for more independent research by students or teams of students.

Summary board work/DQB: What have we figured out? Have we addressed more of our initial questions? Do we have more questions now?

Supporting Resources:

- Fungi: Mushrooms, Toadstools, Molds, Yeasts, and Other Fungi by Judy Wearing
- From Wheat to Bread by Stacy Taus-Bolstad
- **View this YouTube video** (5:34) https:// youtu.be/JlDlzr7Ljrw
- Additional Videos
    - Baker's Yeast Under a Microscope - observation from eye up to 1500x https://www.youtube.com/watch?v=iyWtp_L0Kzc
    - Yeast Fermentation Under the Microscope – recommend no sound https://www.youtube.com/watch?v=7SQWnWwZM1E

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Lesson 4: A discussion

This Lesson: From the previous lesson, students know that yeast is a living thing. The question is, “What could have caused the yeast not to eat the sugar and produce bubbles/gas?” This lesson is a class discussion on that question. **Discussion:** Steer the discussion to the environmental conditions; Temperature. What happens when you are too hot or too cold? Can living things get too hot or too cold? What could happen if their environment isn’t what they need? Let’s investigate.

Time Frame: One science block or at the end of Lesson 3 (20-30 minutes)

Materials:
Space for a group discussion/scientist circle

Vocabulary:
Environment: The surroundings or conditions that an organism (living thing) needs to survive.

What Students Figure Out?: Maybe the temperature of the water affected the yeast. We need to investigate.

Lesson Progression:

- Students understand that yeast is a living thing that eats and produces gas. Students are trying to figure out why in the case of the bread that did not rise, why the yeast did not produce gas.
- This discussion is needed to introduce the experiment students will engage in during the next lesson.

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Lesson 5: Can we create a fair experiment that can help us determine the best environment (in this case temperature) for yeast to grow?

This Lesson: Students are asked to design and carry out an experiment that would help us determine the optimal yeast growing temperature (conditions). Depending upon your comfort level with experimental design and having your student teams work on different things, you can expand this activity to include other parameters such as different:

- Liquids: water, milk, vinegar, etc.
- Amounts of sugar or substances like honey, Stevia, etc.
- Types of yeast: cake, dried, powdered vs granules
- Containers: plastic, glass, metal, etc.

Time Frame: 3 class periods of 30 minutes (one: plan, two: experiment, three: creation of graphs and other tools to communicate findings).

Materials:

- Active Dry yeast or Rapid Rise yeast
- Sugar
- Water at variable temperatures
- Optional: If multiple variables are used extra supplies will be needed (see items above)

Science Background: Planning a fair test or an experimental design that tests some parameters is exciting to many students, and at the same time can be either exciting or concerning for some teachers. Experiments are great learning experiences. Results can be quantified in order to develop/use graphs. Using graphs will help us determine the optimal conditions for our initial question about the best growth conditions for yeast and to help communicate our results to a diversified audience. Measurements should be accurately and uniformly taken for the greatest precision. This ties in mathematics as well as data science which is extremely valuable today.
This is an exciting and essential time in a science classroom where student ideas and voices are heard. Allowing students time to become familiar with the materials also gives insight to procedural issues that could influence results. For example, if the containers are made of different materials, the temperature could be affected. Remember that visual records (images) that students share with each other can motivate questions about better designs for experiments. These opportunities to offer

feedback in positive ways builds students' collaboration, communication, creativity, and critical thinking skills. All highly valuable college and career ready skills.

Vocabulary: Variables, Controls, Measurement, Graph (please use the vocabulary from your math curriculum that would help to connect this unit)

What Students Figure Out? Kids determine how to plan fair tests where variables are controlled and held constant, and failure points considered for improvement and growth in understanding. Students are asked to provide evidence that the water at temperatures hotter than 90 degrees or colder than 80 degrees created environments that impede the yeasts' ability to survive.

Lesson Progression: Students are asked to determine which water temperature will provide optimal results for yeast.

Activity/Class 1: The first lesson is devoted to planning the experiment to answer our question (what is the optimal temperature for yeast?). The kids (along with their willing teacher) will need to design how the experiment will proceed. If we are only going to switch the temperature of the water...how do we begin?

Things to consider: do we all need to use exactly the same amounts of yeast, sugar and water? What sort of a container should we use? How can we measure our results? How will we assure that our results reflect the truth? Which type of graph will help us see our results clearly and perhaps make some conclusions?

It is critically important that the class discusses how they will measure their results and come to a consensus on their method (in order to create results that can be compared). It's great to take your time through these lessons. It reflects the hard work scientists must go through.

Activity/Class 2: All students will get their supplies and begin to experiment using a variety of water temperatures, yet the same amounts of water and identical amounts of yeast (1 Tbs.) and sugar (½ tsp.). They need to try to determine the best temperature for the yeast to digest the sugars and create the most CO_2. Students should be able to test more than 1 water temperature and record their results.

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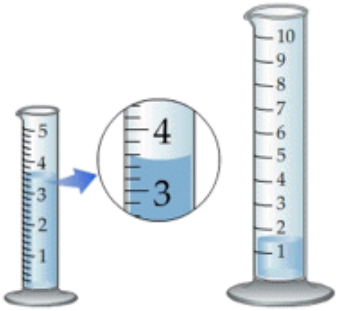
One testing set-up and progression (a possibility, but just one of many):



The results above could be further quantified by measuring with a ruler the active yeast bubble formation. If available, graduated cylinders could be used which have graduated volume measurements right on the cylinder. Students should construct a simple table to organize and keep track of their data. These are valuable executive functioning skills for students to learn. A properly constructed table includes headings and measurement units such as inches, millimeters, or milliliters depending upon the measurement tools. Visual observations can also be included. Student critiques of different tables again provides opportunities for students to base their ideas on evidence and not on the people who made the suggestions.

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Activity/Class 3: (Data Science development) Developing a graph of the results will help us to visualize which temperature is best for the development and growth of yeast. Teachers can coach students to do this by letting the students discuss the best type of graph to communicate their data, or they can construct the graph and have kids add in their data. The former strategy develops far greater scientific practices than the latter. You are developing a graph that represents all the student data; the teacher could do this by first drawing an x and y axis, and then asking the class to design the graph. What should the axes be (consult the chart used to record the data), what are the units of measurement (should they be included?), should the graph be a line or bar chart (is the data continuous or discrete?)? What should the title be ("The Effect of _____ on the _____)?

Summary board work: Have we addressed more of our initial questions?

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Lesson 6: How can we evaluate or analyze our results and communicate our findings to others?

This Lesson: In this lesson, the students discuss and analyze their results. The opportunity to identify what was learned (summary board), to ask further questions about the process or confidence of our results, to further test or improve the experimental design, and how to best communicate our findings are all important scientific practices.

Time Frame: 1 class period of 30 minutes

Materials: class graph from the previous experiment

Science Background: Yeast has a specific temperature range in which it will activate and thrive. The graph should clearly give an acceptable temperature range.

Vocabulary:

- Outliers
- Questionable results
- Confidence levels
- Chance results
- Variables

What Students Figure Out? Yeast (an organism) requires certain temperature conditions to grow, digest, and produce gas (CO_2) to make bubbles in the bread. If the temperature is too cool, the yeast will not activate (wake up). If the temperature is too hot, the yeast does not survive. As scientists, students can decide if their results are trustworthy or if the design needs improvement. Students can also determine additional questions raised to make suggestions for further experimentation.

Lesson Progression: Begin by pulling out the class graph and prompt the discussion by asking leading questions, such as listed in the Storyline. Class discussion of the results will help students engage in arguments based on evidence. It also provides students the chance to reflect critically on results-determining if they are reliable.

Summary board work: Have we addressed more of our initial questions? Do we have more questions now?

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Supporting Resources:

From *The Inquisitive Cook*, by Anne Gardiner and Sue Wilson with the Exploratorium (Henry Holt and Co., 1998).

300° F–400° F (150° C–205° C): Surface temperature of a browning crust.

200° F (100° C): Interior temperature of a loaf of just-baked bread.

130° F–140° F (55° C–60° C): Yeast cells die (thermal death point).

120° F–130° F (49° C–55° C): Water temperature for activating yeast designed to be mixed with the dry ingredients in a recipe.

105° F–115° F (41° C–46° C): Temperature of water for dry yeast reconstituted with water and sugar.

100° F (38° C) or lower: When yeast is mixed with water at too low a temperature, an amino acid called *glutathione* leaks from the cell walls, making doughs sticky and hard to handle.

95° F (35° C): Temperature for liquids used to dissolve compressed yeasts.

80° F–90° F (27° C–32° C): Optimum temperature range for yeast to grow and reproduce at dough fermentation stage.

70° F–80° F (21° C–27°C): Recommended water temperature for bread machines.

40° F (4° C): Recommended refrigerator temperature. Used directly from the fridge, yeast is too cold to work properly.

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Lesson 7: Problematizing

This Lesson: Have students revisit their models and add new information they have gained from their experiment and analysis. Bring the students together to create a Consensus Model (a class copy of the model where items similar in the student models are agreed upon and added). Once the Consensus Model is complete, allow students to think deeper about the original phenomenon and have them try to explain a situation where the bread rises some, but not as much as it should. The bread is not flat, but it has not fully risen. *How can we explain partially risen bread given what we know about environmental conditions and organisms (living things)*? What might have happened with the yeast? (Possible student ideas: The bread needed more time to rise. Some yeast might have woken up and survived and others didn't because of the temperature of the water. The room was too cool.). How can we show that on our models? You could have students add this 3rd scenario to their own models or add the new situation to the Class Consensus Model. Their final revisions whether 2 scenarios or all 3 on their models could be a summative assessment of their model explaining the phenomenon.

Time Frame: 1-2 class of 30 minutes

Materials:

- Student models to refer to create a revised version
- An area for a class discussion and sharing student models
- Whiteboard or large sheet of paper taped up to the board or on an easel for the Consensus Model
- Markers

Science Background: This discussion needs to be deeper than eliciting a few responses and moving on. Ask students to explain their reasoning or ask them why they think a certain way. Encourage others to add to others' initial comments

Vocabulary: yeast, organism, environment

What Students Figure Out? What they have learned in this unit can be applied to similar situations. Yeast is a living thing (organism). Possibly some of the yeast did wake up and survive, but not enough to make enough gas bubbles for the bread to fully rise.

Supporting Resources:

Science Talk Primer
Talk Moves Checklist
Science Talk Norms

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Lesson 8: Coming to Conclusions

This Lesson: Return to basic understanding that YEAST is alive and discuss some of the attributes of living things and the environment different organisms need to survive. Then bring the discussion back to the survival of the yeast in our experiment and what that has to do with the bread rising or not. The students should be able to explain the unit phenomenon using science concepts they now understand.
Why did one loaf of bread rise, while another loaf didn't rise? Each child is to individually answer that question.

Time Frame: 1 class of 30 minutes

Materials: a teacher designed rubric to determine their success

Vocabulary: yeast, organism, environment

What Students Figure Out? Yeast is a living thing (organism). Based on evidence from class, temperature plays an important part in yeast's ability to live, thrive, and survive. Without the yeast waking up, surviving, eating, and producing gas, the bread will not have bubbles that make it rise.
Lesson Progression:

- Class discussion-how did the environment affect the survival of yeast and the outcome of the bread?
- Assessment-writing a conclusions statement about temperature and survival of yeast and the impact of that survival on the bread.
- Optional Assessment-writing OR discussion-how might you have improved your experimental design?
- Optional Assessment-writing OR discussion-how did math help us determine our conclusions?

Final visit to the summary board before the written assessment. Have we addressed all of our questions? Do we still have more?

Your group may be more than ready to repeat lessons 5 and 6 to test other variables that may relate to the survival of yeast. This could be an extension activity, if time allows.

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Lesson 9 Title: Extension Assessment

This Lesson: An authentic assessment of student understanding is to have students use science concepts they have learned and apply them to a new situation/phenomenon. In this assessment, students read articles about two different types of foxes. They construct an argument with evidence (from their understandings of the survival of yeast) that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (3 LS4-3).

Question for Assessment #2: Would an arctic fox survive in the desert where it is hot? or Would a desert fox survive in the arctic where it is cold?

Time Frame: 2 classes of 30 minutes. One class to read, annotate, and discuss the articles. One class for students to draft their explanations.

Possible Student Response:

Example Answer #1: The arctic fox would not survive in a desert because their body is made to survive in an area that is cold. the desert. The arctic fox has small ears and thick fur to keep in heat so the arctic fox would get too hot in the desert. They have fur on the pads of their feet that helps them in the snow. In our yeast experiment, we found out that the yeast does better in water that was not too hot or cold. The temperature was important to the yeast living. This is the same for other animals like the arctic fox. It does better in a habitat that is colder than a desert. The desert is too hot for the arctic fox to survive.

Example Answer #2: The desert fox would not survive in the arctic because their body is made to survive in an area that is hot. The desert fox has large ears and fur that insulates them from the sun to keep them cool during the day, and warm during the cold night. The desert fox would give off too much heat through its ears and get too cold in an arctic habitat. In our yeast experiment, we found out that the yeast does better in water that was not too hot or cold. The temperature was important to the yeast living. This is the same for other animals like the desert fox. It does better in a habitat that is hot. The arctic is too cold for the desert fox to survive.

Students also might use other info from the articles such as diet or protection from predators in their habitats. They might also use the analogy of how humans dress according to the weather.

Supporting Resources:

Desert Fox Article - National Geographic Kids
Arctic Fox Article - National Geographic Kids

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Lesson 10 Title: Bread Baking

This Lesson: Can be inserted at any point in the unit but could also be a culmination of all things learned. In this lesson, students bake basic bread to be consumed in class. The teacher is free to determine how this can be done, what type of bread and whether parent volunteers may help. The more basic type of bread, the better.

Suggested: each child makes their own dinner roll.

Time Frame: 1 class of 30 minutes

Materials:

- **Flour**
- **Yeast**
- **Salt**
- **Sugar**
- **Water**
- **Butter**