Grade 3 Bio-fabrication Storyline

Environment and Survival

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Synopsis:

This grade 3 unit further builds basic concepts of life science with young students. It provides a series of experiences with Baker's Yeast where students experiment with yeast environments and determine how one or more conditions affect the growth of the yeast. This unit provides students with a chance to design investigations, experiment, plan for their collection of data, graph their data, communicate their results, and offer a claim backed by evidence as a scientific argument.

What Students Figure Out:

- In some habitats, organisms (like yeast) survive well, in some they survive less well, and in some they can not survive. (3-LS4-3 DCI and CC)
- We can plan and carry out fair tests in which variables are controlled and failure points are considered to identify evidence that explains cause and effect. (3-5 ETS 1-3)
- Construct an argument with evidence that in a particular habitat some organisms can survive well, and some cannot survive at all. (3 LS4-3 SEP)
- Students will transform their own data into models with mathematics. (3-5-ETS1-3)
- Students will reason abstractly and quantitatively to explain phenomena that has been observed in their experiment. (3-5-ETS1-3)

Background Knowledge (for teachers):

Yeast is classified as a single-celled fungus. Mushrooms and molds are other examples of fungi. There are over 1500 species of yeast! Baker's yeast acts as the leavening agent in bread making causing breads to rise. Chemically, baker's yeast converts sugars into carbon dioxide gas (and ethanol). Students are not introduced to single celled/microscopic organisms until middle school.

Life is defined as any organism that either moves, respirates, shows a sensitivity, grows, reproduces, excretes, or consumes nutrition. An organism is any living thing. A microorganism is 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 CO2 as a byproduct that we use to create breads.

The earliest records of yeast use in baking comes from the Ancient Egyptians. They preferred the softer and tastier bread produced when yeast was used. In the late 1800's England developed a reliable way to manufacture yeast, but it was a moist product that had a very short shelf-life. In WWII, Fleischmann's developed granulated active dry yeast. It doesn't require refrigeration and has a long shelf-life.

Active Dry Yeast is the yeast used in this unit, it lasts for over a year at room temperature and has a granular texture. Live yeast cells are inside the dry, dead cells in the grains.

Rapid Rise Yeasts are a second option for classroom use. They have smaller granules that dissolve faster and produce greater amounts of carbon dioxide. It is often marketed for use in bread machines.

LS1 From Molecules to Organisms: Structures & Processes & LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

Engaging in Argument from Evidence

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Construct an argument with evidence. (3-LS4-3)

Disciplinary Core Idea

LS4.C: Adaptation

- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)

ETS1.B: Developing Possible Solutions

- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS4-3)

Connected Math Standards-Grade 3

Solve problems involving measurement and estimation:

CCSS.MATH.CONTENT.3.MD.A.2

Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l).1 Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.2

Represent and interpret data:

CCSS.MATH.CONTENT.3.MD.B.4

Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

Additional CCSS Mathematics Opportunities

MP.2 Reason abstractly and quantitatively. (3-LS4-3), (3-5-ETS1-3)
MP.4 Model with mathematics. (3-LS4-3), (3-5-ETS1-3)
MP.5 Use appropriate tools strategically.(3-5-ETS1-3)
3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. (3-LS4-3)

Unit Phenomenon

The same recipe was used. One loaf of bread was light and rose. The other loaf of bread was dense and did not rise.

Driving Question

Why did one loaf of bread rise, while another loaf didn't rise?

Progression	Questions	Phenomena	Lesson Performance Expectation Build	Activity	What we figured out
Anchoring Phenomena	Why did one loaf of bread rise, while the other loaf did not rise?	"I made 2 loaves of bread from the same recipe. They looked very different when they were done." One loaf of bread was light and rose, while the other loaf was dense and did not rise	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (3-LS4-3)	Students view pictures of both loaves of bread or the teacher brings 2 loaves of bread that are similar to the provided pictures for students to view. Students create models of what they think is happening with the 2 loaves of bread. Students develop questions about the phenomenon they observed.	We modeled our initial thoughts of why one loaf rose and the other didn't
Establish a Driving Question Board (DQB)	Why did one loaf of bread rise, while the other loaf did not rise?	**Develop a DQB** Brainstormed and recorded any questions or wonderings that students might have about the mixture activity?		Sort or organize the questions/wonderings into categories that make sense (the ingredients/ recipe, how they were cooked/looks, appearance/ temperature, time) If questions weren't developed while modeling, brainstorm a list of questions or wonderings that students have about the phenomenon (different	We have many questions about the 2 loaves of bread and why they look different.

				bread loaves). Record these questions and share them on the classroom DQB	
Lesson 1	What does bread that rises look like?	*Observational Lab:* Looking at various breads, what do the bread have in common?		Using hand lenses, look at different kinds of bread, what structures are in all breads? How are the breads the same, how are they different? Begin SUMMARY BOARD & relationship to DQB	All breads that rise have circular structures or bubbles inside. There is bread and there are bubbles. Some breads have tiny bubbles, others have huge bubbles.
Lesson 2 **Investigating ingredients of bread**	What caused the bubbles in the bread?	Investigated some of the ingredients in bread		Work in small groups. Observe combinations of some of the main ingredients: Yeast, sugar and warm water, which are then combined in zip-lock baggies. This can be a demonstration or each small group creates their own. Bag #1 water & sugar Bag #2 water & yeast Bag #3 water, sugar, and yeast Record all observations over a few hours. Class Discussion of what they think is going on. Steer students to speak to the combination of yeast, warm water, and	The baggie with water, sugar, and yeast created many bubbles just like in the bread that had risen. 

				sugar and why bubbles are produced. The combination of the 3 ingredients caused the bread to have bubbles and rise. Is yeast eating? Does that mean it's alive? Return to the models of why one loaf rose and the other didn't to revise	
Lesson 3 **What we can't see!**	What is happening that we can't see when we combine yeast, warm water, and sugar?			View this video (5:34) https://youtu.be/JlDlzr7Ljrw Discussion: Let's look back at our models. Is this similar to the student models of yeast and sugar producing gas bubbles? Revise if needed. SUMMARY BOARD/DQB	Yeast is needed for the bread to rise. Dry yeast is activated or woken up with warm water. When sugar is added the yeast eats the sugar and produces gas that creates air bubbles that inflates our bread. The yeast makes more yeast that makes more gas. Yeast is a living thing that is so small you need a microscope to see it. (*knowing this is a provided scaffold. Microscopic organisms are above grade level as elementary only speaks to visible animals and plants, but knowing yeast is alive as mentioned in this video helps with the*

					understanding of habitats and survival in this unit).
Lesson 4 **Discussion prior to the experiment** **(this discussion could be done at the end of Lesson 3 if time allows)**	Yeast is a living thing. What could have caused the yeast not to eat the sugar in one bread so it could produce bubbles/gas?			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? Let's investigate.	Maybe the temperature of the water affected the yeast.
Lesson 5 **Experimental Design**	Can we create a FAIR experiment that can help us determine the best environmental conditions (in this case temperature) for yeast to grow? How does measurement aid our understanding of results? How can we use data to help us understand exactly what we saw?	Plan and carry out an experiment that will help us understand how water temperatures affect yeast growth.	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or a prototype that can be improved. (3-5 ETS 1-3) Measuring liquid volumes using standard units of measurement. (CCSS.MATH.CONTEN.3.MD.A.2) Generating measurement data by measuring lengths using rulers with halves and fourths of an inch. Make a line	Students work in small groups (optimal is 3) to plan and carry out experiments with yeast growing (same amounts of yeast and sugar for all, various temperatures of water). • How can we plan a fair test? • How do we uniformly measure our results? • How can we compare our results and generate a class graph? SUMMARY BOARD/DQB	Planning a fair test or experiment can be tricky in a class. Students would need to agree on many conditions or variables before beginning to test how yeast grows in different temperatures. Some of the considerations include: How yeast growth would be measured? Which variables should be controlled? How much yeast, water, sugar and flour should be used? Who will test the various temperatures of water? How will the temperature be maintained? Etc.

			plot.(CCSS.MATH.CONTEN.3.MD.B.4)		
Lesson 6 **Evaluating Results**	How can we evaluate our results?	Whole Class Discussion: Which results are chance, which are real differences? How do we know? How big of a difference would we consider as significant or important? Does one trial give us reliable results? How can we know if the experiment was done uniformly? What conditions or variables are changed and which are we trying to keep constant? Does the timing of the measurements matter?	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (3-LS4-3) • Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or a prototype that can be improved. (3-5 ETS 1-3) Generating measurement data by measuring lengths using rulers with halves and fourths of an inch. Make a line plot.(CCSS.MATH.CONTEN.3.MD.B.4)	Using our class graph, statistically discuss our results. Look for the following: • outliers • the ability to compare our results • questionable results SUMMARY BOARD/DQB *Do we need to redefine variables and then test once more? If so, do that and re-develop a class graph.*	• We know how to plan and carry out fair tests • We made and compared multiple solutions to a problem • We know the temperature of the water can change how the yeast works. Too hot, the yeast dies. Too cold the yeast doesn't wake up.
Lesson 7 **Problematizing**	What might happen to the bread if only some of the yeast died, were woken up or were not	Revisited the student models		Discuss this third scenario.	Some yeast can survive in certain temperatures while others do not

	given enough time to produce lots of gas?			Add a third scenario to your model to explain if the bread partially rises Students do a gallery walk. Come together to make a consensus model	
Lesson 8 **Coming to Conclusions**	How does the environment affect the survival of living things?	Class Discussion: How did the environment affect the survival of yeast? Assessment #1: Writing a concluding statement about temperature and survival of yeast. Include answers to how you might improve your experimental design, are there other things that you now see as important to control?	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (3 LS4-3)	Ask the class to consider how vulnerable yeast is. Review one environmental condition that must be met in order for yeast to survive and grow (temperature of water). SUMMARY BOARD/DQB	In order for any organism to survive, they have to be in an environment or habitat that supports them. For yeast: too hot of water kills the yeast cells, too cold does not activate the yeast enough. Is there an optimal temperature for yeast to thrive?
Lesson 9 **Extension Assessment**	Do other organisms do better in certain habitats? Why? (temperature, amount of food or water available)	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?	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. (3 LS4-3)	Give background information on an organism. Pose a question about the organism (not yeast) and why in certain habitats it does well, in other habitats it does not do as well and in others the organism cannot survive.	Example Answer: The arctic fox would not survive in a desert because it is too hot in the desert. The arctic fox survives in a cold habitat. The arctic fox has small ears and thick fur to keep in heat so the arctic fox would get too hot in the desert. In our

				(temperature, amount of food or water available)	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.
Lesson 10 **Bread Baking**	Culminating Experience – baking your own bread.	Students use the results of their investigations to optimize conditions and bake the best basic dinner rolls.		With help from another adult or two, students mix small batches of dough, let rise, punch down, knead, let rise, form rolls, let rise, and bake rolls.	We can use yeast and bake some small breads or rolls.