Projects to Develop Career-Ready Skills

UNBOXED PREPARED PARENTS

What is *Learn*?

Learn is a monthly project modeled on a research-based approach to learning called Project-Based Learning (PBL). PBL offers real-world, personally meaningful activities to challenge our thinking and inspire action. We believe that when kids pursue their passions, practice the Habits of Success, and develop strong cognitive skills they will be successful and fulfilled.

Each month, ***Learn*** offers a new project that marries kids' desire to change the world with the best learning science and the most important Habits of Success.

The **Appendix** provides additional guidance about how the project relates to skills and additional learning resources.

How does it work?

Each month, we provide ~20–25 days of learning activities to help kids develop an **Impact Project.** Through the project, they'll strengthen their college-ready skills and deepen their knowledge across subjects.

Projects are broken up into *challenges* to help kids think, read, write, experiment, and even build solutions to real problems.

- To start, there is one **essential question** for kids to explore. (Don't worry, we'll explain that term in a moment.)
- Next, we ask kids to **"find their why"**—this allows kids to make projects more personal and meaningful.
- And then kids dive into the **project** where they research, experiment, solve problems, and ultimately produce a final project they can proudly share.

You are not alone!

"Learning Support Tools" and "Coaching Moments" provide additional support along the way.

Make sure you check out the **Learning Support Tool**, which has extra resources for kids and parents. We all learn differently!

LEARNING SUPPORT *tools*

Project Overview

This is the essential question we'll think about:

How can the scientific process help us learn by experimenting?

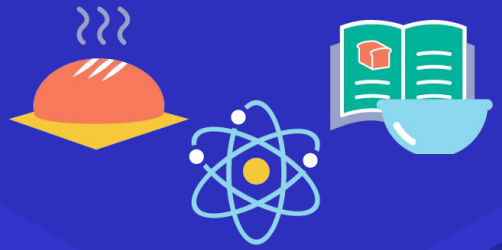
Essential questions are questions with no one, right answer. These are questions that never get old. And the answers you find will evolve over your lifetime. Each month we'll share an essential question that ties the skills you are learning to the impact you are making in the world. This will help you reflect in meaningful ways on your academic work, and also be a better global citizen.

Explore the Essential Question

LEARNING SUPPORT *tools*

This month's project is...

The Science of Bread



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Your project culminates in a final product you create and share.

In this project, you will learn **how to approach problems scientifically** through the process of baking bread. You'll practice baking a basic loaf of bread to serve as a baseline for your experiment. Then, using the science of bread-making and a scientific investigation process, you'll modify your basic recipe to see how small changes affect the final result.

You'll complete 3 challenges.

1. Select a first recipe and bake your first loaf of bread.
2. Learn about the science that turns flour, water, salt, and yeast into a loaf of bread, and learn how to design an experiment.
3. Plan, conduct, and document an experiment to improve your bread recipe!

You'll create a recipe documenting the procedure and results from your best bake. Your recipe will include these components:

Don't worry, we will teach you how to do this!

- Ingredients
- List of steps with explanations of what they do to the final product
- Photos of the process
- Suggestions for other changes to the recipe

This project is broken into 3 challenges to complete over the month.

Produce Your First Loaf

1

What are the basic steps to bread-making?

- 4 hours -

Explore the Science of Bread-Making

2

What can we learn about bread-making that will help us design an experiment?

- 5 hours -

Investigate Changes to Your Recipe

3

How do changes to your bread recipe impact the end product?

- 4 hours -

This calendar shows you how the steps fit into a month of learning and exploration.

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
Explore the Essential Question & Project Overview	**Challenge 1** **Step a:** Find a recipe and prepare to bake	**Challenge 1** **Step b:** Bake your first loaf	**Challenge 1** **Step c:** Reflect on your first bake	**Challenge 2** **Step a:** The science of bread-making
DAY 6	**DAY 7**	**DAY 8**	**DAY 9**	**DAY 10**
Challenge 2 **Step b:** Designing an experiment	**Challenge 3** **Step a:** Write a testable question	**Challenge 3** **Step b:** Modify your original recipe	**Challenge 3** **Step c:** Bake using your new recipe	**Challenge 3** **Step d:** Reflect on the results of your bake

Plan Your Project Milestones

LEARNING SUPPORT *tools*

INSPIRATION

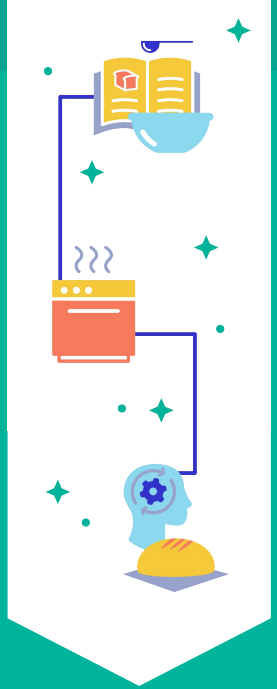
Baking in the real world!

Let's see how someone else turned to baking during the current pandemic:

Beth's Story

Beth Nguyen is a novelist who wrote about her experience baking cakes as the COVID-19 pandemic impacted our day-to-day routines. "In times of waiting and worry, it feels useful to gather ingredients and turn them into something that might bring sweetness to someone's day. Baking is so much more than following directions; it's about understanding process....Whatever the result, I know I'll be a little more ready for whatever comes next."

Read this article about Beth Nguyen's connection with baking.



CHALLENGE 1

Produce Your First Loaf

40% to complete

CHALLENGE 1:

Produce Your First Loaf

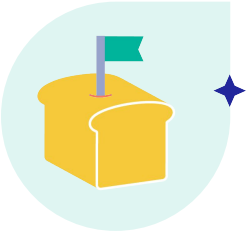
1

- 4 hours -

The first challenge is to **use a simple recipe to learn the basics of bread-making.** This recipe will be what you modify later in the project.

KEY TERM

A **recipe** is a list of ingredients presented with instructions for cooking or baking something to eat.



How do these steps help you?

Objectives: Find a recipe, prepare your ingredients, and bake your first loaf of bread.

a

Find a recipe and prepare to bake

You'll collect the ingredients you'll need and make sure you understand the steps needed to make bread.

What will you have at the end of this step?
A plan for how to bake a loaf of bread.

- 30–60 minutes -

b

Bake your first loaf

You'll make a loaf of basic bread from a simple recipe.

What will you have at the end of this step?
Experience making bread (and some delicious bread too!)

- 3 hours prep, 1 hour baking -

c

Reflect on your first bake

You'll think about how your baking went and record some data about how your bread turned out.

What will you have at the end of this step?
An idea of what you might want to change for future baking.

- 30–60 minutes -

Baking is very personal, but it is also universal.

Beth Nguyen, like many others, found joy and comfort in baking with her family during the Covid-19 pandemic. Experimenting with new recipes led to growth and satisfaction. “Not every item has turned out, but every effort has made me feel more capable,” she said.

Baking—particularly baking bread—is an activity thousands of years old, which extends across cultures. It is also an activity closely connected to experimentation and the scientific process—even if bakers don’t realize it!

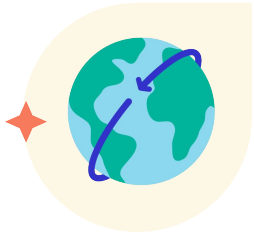
For example:

Imagine **Erika**, an 8th grader who lives in Atlanta, Georgia.

We’ll follow Erika through the entire project, as she learns how to bake bread from scratch.

Look for Erika’s examples at each step!

Select a basic bread recipe for your first loaf.



Bread is a staple of almost every culture in the world, so selecting a basic recipe can be a personal decision. Think carefully about the type of bread you'd like to make. Does your family have a traditional bread you can try making?

There are many basic recipes to choose from. If you don't have a specific type of bread in mind, flour companies often provide basic recipes on their websites or packaging, like the two options we have linked to the right.

In any case, look for a basic recipe that calls for few ingredients and uses kitchen tools you have access to.

No-Knead Crusty White Bread
from the King Arthur Baking Company

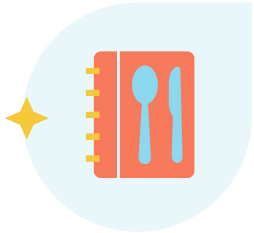
Gluten Free No-Knead Bread
from Bob's Red Mill

Let's prepare to bake.

You've selected your recipe, and tomorrow (or one day soon) you'll bake! But before you bake your first loaf, you'll need to prepare.

1. **Read** the entire recipe from start to finish.
2. Gather all of the **ingredients** you need.
3. Make sure you have all of the **equipment** you need.
4. Carefully review the steps of the recipe and plan your schedule. If the recipe calls for dough to rise, be sure to **plan** for that time.

Use the ***Learning Support Tool*** to list your ingredients and plan your procedure.



TIP

- Ask an adult to help with this step and any step where you use the oven!
- You may need help getting ingredients and finding equipment.
- You'll also need to plan around others who might be using the kitchen at the same time you're baking.

It's time to make your first loaf of bread!

If it's your first time baking, there are some important things to keep in mind:

- Make sure you **wash your hands** before and after handling the dough. (And don't eat raw flour!)
- Try to keep your workspace **clean** as you're working. You'll have less clean-up to do later, and you'll have a safer workspace!
- If you use a microwave to warm your water, **be careful!** Water that is heated in the microwave can get really hot. Make sure you have a heat-proof oven mitt or towel to protect yourself.

Remember!

When it's time to bake, make sure you have appropriate supervision before you start to use the oven!

While your bread is rising...

Every baker—and scientist!—makes mistakes. It's part of exploration and learning, and often mistakes lead to new discoveries.

Try to keep a **growth mindset** as you're working through these challenges. Baking is something that can take a really long time to master, but each careful attempt will help you learn, and you'll be more prepared for success the next time you bake!

If you get frustrated while making this dough, or if your bread doesn't work out this time, don't worry! The important thing is you learn from those challenges.

COACHING *moments*

Growth Mindset

When we keep a **growth mindset**, we remember that any ability can be improved through hard work and practice, and we let that knowledge guide our actions.

Congrats! You just made your first loaf of bread!

Even if it didn't come out as you thought it might, you still did something new.

You're going to build on this loaf of bread later on, so it's important to reflect on how this went.

1. **What went well?**
2. **What didn't go well?**
3. **How can you change the recipe to make it better the next time?**

Jot down some thoughts on how the bread tastes. Ask your friends and family to share their thoughts too!

Use the ***Learning Support Tool*** to record your reflection!

Reflect on Your Bake

LEARNING SUPPORT tools

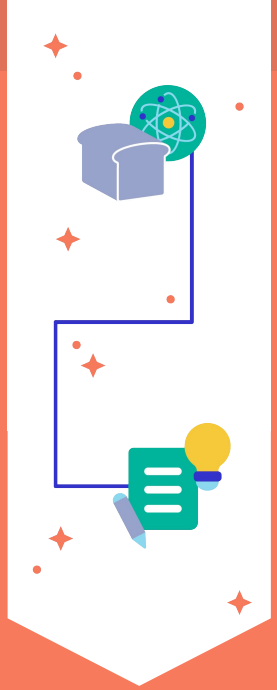
What did Erika learn from her bake?

What went well and didn't go well?	What she'll do next time?
It was hard to keep ingredients organized and to remember how much of each she needed.	Next time, she'll measure ingredients into smaller containers before mixing them together.
The bread dough was sticky, and it was frustrating to mix.	Next time, she'll ask someone to help put more flour on her hands so the dough doesn't stick when she's shaping it.
The dough took longer to rise than expected.	Next time, she'll start making the dough earlier so it has more time to rise.

CHALLENGE 1:

You just finished your first challenge!

Nicely done!



CHALLENGE 2

Explore the Science of Bread-Making

65% to complete

CHALLENGE 2:

Explore the Science of Bread-Making

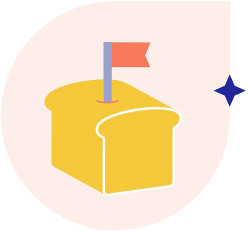
2

- 5 hours -

This challenge helps you better **understand the processes** that turn basic ingredients into bread. You'll learn important terms and encounter questions that will help you **plan your scientific investigation.**

KEY TERM

A **variable** in a scientific experiment is something that changes.



How do these steps help you?

Objectives: To better understand how the ingredients and recipes steps turn dough into delicious bread and design a scientific experiment to see what happens when you change the recipe.

a

The science of bread-making

You'll learn what is happening in the dough as it rises, when you knead it, and as it bakes, and you'll encounter different variables in bread-making.

What will you have at the end of this step?
New information that can help you design an experiment.

- 30–60 minutes -

b

Designing an experiment

You'll learn how to design a simple experiment to make your next loaf of bread even better!

What will you have at the end of this step?
A list of variables you could change in your recipe.

- 30–60 minutes -

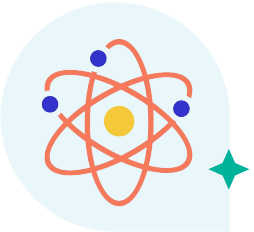
There's science in your bread!

When you took your basic ingredients and mixed them together to make your bread, you actually were using a ton of science, but you probably didn't even realize it!

When it comes to making bread, there are three major processes that determine how it turns out:

1. **Rising**
2. **Kneading**
3. **Baking**

In this challenge, you're going to explore how these processes affect the end result of your bread.



TIP

This video from HowStuffWorks gives a good overview of what's happening when you make bread.

Does it sound complicated? Fear not! **Even the world's best bakers were brand-new at one point.** Through learning and practice they grew their baking knowledge and skills. You can too!

Let's explore the first process—rising.

The bread recipe you used may have called for yeast to make the bread rise. This process is also called **leavening**. The type of leavening you use might be one **variable** in your experiment.

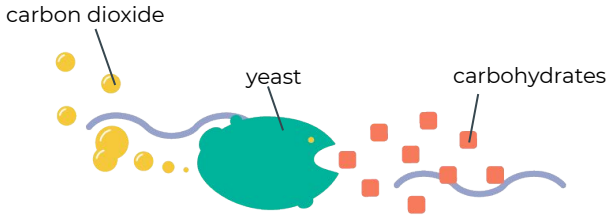
Yeast is a **biological leaven**. In other words, it's a fungus. That's right. **It's alive!**

Yeast eats carbohydrates (sugars and starches) and produces carbon dioxide gas—the same gas that makes the bubbles in your favorite soda!

Flour contains a lot of these carbohydrates, so when you mix the yeast into the flour, they start eating up the carbohydrates and making lots of tiny bubbles. Over time, these bubbles are what makes your bread rise!

This video provides more information about types of yeast and how they work.

Other recipes call for **chemical leavening,** using baking powder or baking soda. These recipes use a chemical reaction to create the carbon dioxide bubbles.



TIP

Some breads are **unleavened**, which means there is no rising agent added to the dough. They're generally flat breads.

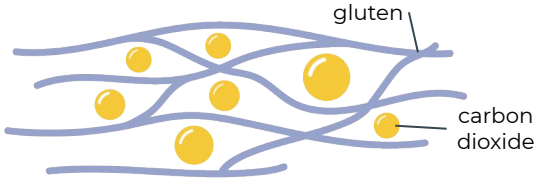
How does your dough trap all of those bubbles?

For your bread to rise, that gas made by the yeast needs to be trapped. That's where gluten comes in!

Gluten is a name for a group of proteins commonly found in wheat flour. When these proteins mix with water, they form a stretchy, elastic network in the dough that traps all of the gas from the yeast. Like tiny balloons, they fill with carbon dioxide. This makes the bread rise!

Kneading—that is, pressing, folding, and stretching the dough—can make the gluten network in the bread stronger, making for a more chewy texture, and potentially, bigger bubbles in the bread. One **variable** in a bread-making experiment could be the amount of time spent kneading.

Take a look at **this video from "America's Test Kitchen**" for a nice demonstration of how gluten works. Look for the **variable** in this video's experiment.



TIP

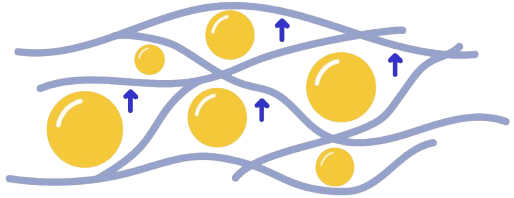
In gluten-free breads, other ingredients are added to create a similar structure. This video shows how "America's Test Kitchen" altered pizza crust to make it gluten-free. Take note of all of the different variables they experimented with.

Finally, what is happening to the bread in the oven?

When your dough is baking, a lot is happening. The heat of the oven makes the gas bubbles in the dough expand, which makes the dough puff up even more. This video from "NBC News Learn," shows what is happening to the yeast as bread is baking in the oven.

There are other chemical reactions taking place while your bread is baking as well, causing the dough to set and brown.

Think back to your first loaf. What temperature was the oven? The oven temperature is another variable you can change. This interesting video from the cooking website "Mashed" explains some of the effects that high and low temperatures have on our baking—and some of the history behind ovens themselves!



As a treat, check out this **TEDEd video,** which explains what's happening in the oven when cookies bake. It's not bread of course, but some of the principles are the same. And who doesn't love cookies?

Let’s learn about experimental design.

In the last step, you learned about the science of bread-making and discovered some of the variables that affect how bread bakes.

In this step you’ll learn how scientists design experiments, so that you can design your own in the next challenge.

- You’ll learn the different types of **variables** you should have in an experiment.
- You’ll learn what a **control group** is, and why it’s important.
- Finally, you’ll **brainstorm variables** you can change in your recipe.

TIP

Learning experimental design might seem scary, but remember with practice, **this is a skill you can build!** In fact, that’s one of the most important goals of this project—helping you approach problems scientifically!

How do scientists design experiments?

Scientists design experiments by **changing one thing** at a time and **observing the effect** of that change.

All experiments have two types of variables: **independent variables** and **dependent variables.**

1. **INDEPENDENT**— the thing the scientist (that's you!) modifies because they think it will affect the results.
2. **DEPENDENT** — the thing that changes **because** of modifications to your independent variable. This is usually what you measure.

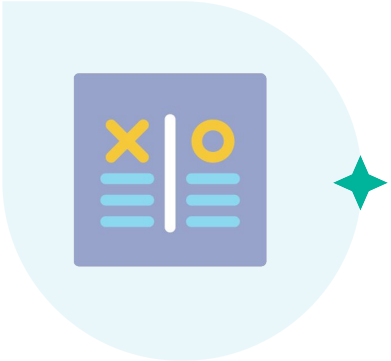
The table below provides a few examples of variables in a baking experiment.

INDEPENDENT VARIABLES	DEPENDENT VARIABLES
The type of flour you use	The taste of the bread
How long you let the bread dough rise	The size of the bubbles in the bread
How much yeast you use	The color of the crust
How long you bake the bread	The texture of the bread

What else do scientists need in an experiment?

In addition to variables, scientists need to have a **control group** in an experiment.

- A control group is like a **baseline.**
- Scientists compare the results of the experiment to the control group to see if there is a change to the dependent variable.
- For this project, your control group is the loaf you made in Challenge 1.



One more thing about experiments...

When designing an experiment, it is important to **keep everything the same except** for the changes you make to **the independent variable.**

For example, if you want to test how different flour types affect your bread, then you should only change the flour type in each loaf and keep the rest of the recipe the same.

If you don't keep the other variables constant, you won't be able to tell which change you made to the recipe caused which effect.

Baking bread is great for experimentation.

The different steps and ingredients in baking provide lots of ways to approach an experiment. In a moment, you'll make a list of possible independent variables to use in your experiment. First, look at what Erika came up with.

Variable	How could I change it?	How might my bread be different if I change this?
Amount of yeast	Increase it	Maybe the yeast make more bubbles and the bread is fluffier
Amount of rising time	Decrease it	Maybe there will be fewer bubbles, so the bread will be denser
Amount of kneading	I could knead the bread dough next time.	Maybe kneading will make the gluten stronger, so the bread is chewier

Let’s brainstorm your recipe variables!

Now that you know what rising, kneading, and baking do in the baking process, and how **variables** help you design a scientific investigation, think about the variables you could change in your recipe.

Consider the different ingredients and steps in your first bake. Make a list of these variables, and for each one, ask yourself:

- How could I change it?
- How might my bread be different if I change this?

The ***Learning Support Tool*** will help you structure your thinking. In the next challenge you’ll use **one** of these variables to design a **scientific investigation** to see what happens when you change the recipe.

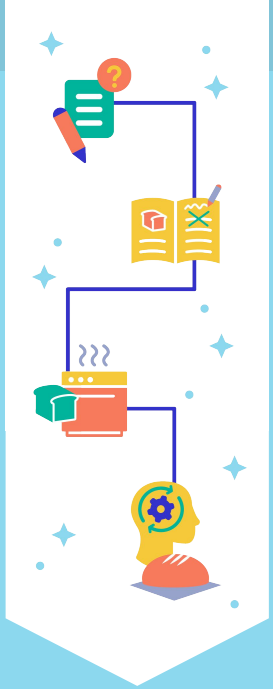
Brainstorm Baking Variables

LEARNING SUPPORT *tools*

CHALLENGE 2:

You just finished your second challenge!

Nicely done!



CHALLENGE 3

Investigate Changes to Your Recipe

100% to complete

CHALLENGE 3:

Investigate Changes to Your Recipe

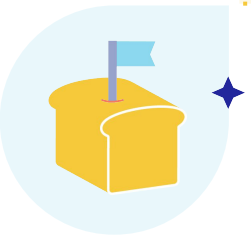
3

- 4 hours -

As you complete this challenge, you will be using what you've learned about the science of bread to **try to improve the original recipe** through a controlled experiment.

KEY TERM

A **controlled experiment** is an experiment that changes one independent variable and keeps everything else the same.



How do these steps help you?

Objectives: To make a plan to revise your original recipe and test your new recipe with another round of baking

a

Write a testable question

You'll use what you learned in Challenge 2 to write a testable question and hypothesis.

What will you have at the end of this step?
A testable question and hypothesis.

- 20–40 minutes -

b

Modify your original recipe

You'll decide how you are going to modify the original recipe to try to answer your question.

What will you have at the end of this step?
A new recipe you'll use to make a new loaf of bread.

- 20–40 minutes -

c

Bake using your new recipe

You'll use your new recipe to bake some more bread!

What will you have at the end of this step?
Fresh bread, and an answer to your testable question!

- 3 hours prep, 1 hour baking-

d

Reflect on the results of your bake

You'll look back at how your bread came out and come up with new improvements you could make to the recipe.

What will you have at the end of this step?
A recipe for your best loaf of bread.

- 20–40 minutes -

Every experiment needs a testable question and a hypothesis.

To conduct an experiment, you need to know specifically what you're testing for. **A testable question** is often asked like this:

"How does [independent variable] affect [dependent variable]?"

"If I change [this about my recipe], then [this will happen to my bread] because [this reason]."

In addition, scientists will make a hypothesis. **A hypothesis** is a prediction of what the scientist thinks the answer to their scientific question will be, based on what they know already. A hypothesis is often written as an "if...then...because..." statement, like this:

Erika also identified a testable question and a hypothesis.

Erika noticed that the dough she made the first time took a long time to rise, so she wanted to see how the rising time affects the size of the bubbles in her bread.

Her testable question:

"How does the dough's rising time affect the size of the bubbles in the finished bread?"

Her hypothesis:

"If I let the dough rise for longer, then the bubbles in the bread will be bigger because the yeast will have more time to make gas."

Let's identify your testable question and hypothesis

Step 1:

Using your brainstorm from the previous step, choose one independent variable and one dependent variable to form your question.

Remember, the only thing you'll change in the recipe is your independent variable. You'll keep everything else the same.

"How does [independent variable] affect [dependent variable]?"

Step 2:

Using what you've learned about the science of bread, make a hypothesis that answers your testable scientific question.

"If I change [this about my recipe], then [this will happen to my bread] because [this reason]."

TIP

Keep in mind, you might make a hypothesis that ends up not being correct at the end. **This is completely okay!** You'll still have learned something. For now, just make your best prediction.

Write a Testable Question and Hypothesis

LEARNING SUPPORT tools

How can you test your hypothesis?

You've written a testable question and made a hypothesis that you think answers the question. Next, you'll figure out an experiment to test your hypothesis!

Your experiment will use your recipe from the first challenge as a starting point, and you'll **modify the recipe** to answer your question and test your hypothesis.

In your experiment, make sure you **only change one variable** in your recipe—that's your independent variable.

How did Erika modify her recipe?

Erika decided to make some changes to how long she let the dough rise. Her original recipe had the dough rise for 2 hours.

For her experiment she decided that she would make two loaves:

- One would rise for 2 hours 30 minutes.
- One would rise for 2 hours 45 minutes.

Everything else in her new recipe would stay the same as in the original.

Let's modify your recipe!

Step 1 Take a good look at your original recipe. Look for the step or steps in the recipe where your independent variable shows up.

Step 2 Rewrite (using the Learning Support Tool) or carefully annotate these steps to record your modification.

Careful documentation creates a record of your experiment, which is especially important if you want to conduct the experiment multiple times with different changes to your independent variable.

TIP

You can do this step more than once. Each time you test a change to your independent variable, you'll learn something and get closer to the perfect loaf!

With careful planning, you can test multiple versions of your independent variable at the same time, like Erika did in the example. Remember, your first loaf serves as your control group.

Modify Your Original Recipe

LEARNING SUPPORT *tools*

COACHING *moments*

You might be wondering...

“What if my new recipe doesn’t work?”

One of the most important parts of being a scientist is recognizing that failure is always an option, and that’s okay!

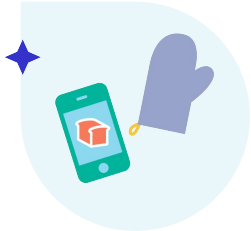
Science teaches us to try and try again, so it is okay to make mistakes! Some of the biggest scientific discoveries are the result of someone making a mistake and then learning from it.

Even if your bread doesn’t turn out like you thought—or your hypothesis is proven false—don’t feel bad! You will learn something with each attempt, whether you succeed or fail.

Time to bake!

Gather your ingredients and ask for the help you need. It's time to test your hypothesis using your new recipe—that is, the experiment you designed! Remember:

- **Follow the recipe carefully** so you can keep the other variables constant.
- **Take some pictures** (or have someone take them for you) so you can include them as documentation in your reflection or on your recipe.



TIP

Make sure you're safe! Ask an adult for help using the oven or heating up the water for the yeast.

Don't forget to wash your hands before and after handling the dough (and don't eat raw flour!)

How did your new recipe turn out?

Congratulations on making another batch of bread! Take some time to reflect on how it went. Think about the following questions:

- What went well?
- What didn't go well?
- **Was your hypothesis correct?** How did the changes to the recipe affect the final product?
- How was the bread different this time compared to last time?
- How can you change the recipe to make it better the next time?

The ***Learning Support Tool*** can help structure your reflection.

Reflect on Your Experiment

LEARNING SUPPORT tools

Putting it all together

Now that you've made changes to the recipe, it's time to write up a recipe card you can use again and share with others!

- Make sure you **include a note** citing the original recipe and a brief description of how you changed the recipe from the original version.
- Consider including **pictures** of how you baked your bread so you can remember the steps you took.

And remember, if your bread didn't turn out the way you hoped it would, don't worry! Every baker has had unsuccessful bakes—you're in good company!

TIP

You're not done until you want to be! The process you used to identify a question, make a hypothesis, and test your result can happen over and over again, until you've decided that your recipe is perfect! Feel free to repeat these steps until you're satisfied.

Document everything so you can remember what worked and what didn't!

My Final Recipe

LEARNING SUPPORT tools

You did it!

All 3 challenges complete.
Time to *Celebrate*!

Produce Your First Loaf

1

Explore the Science of Bread-Making

2

Investigate Changes to Your Recipe

3

Celebration of Learning Reminder!

Remember, a **celebration of learning** is an opportunity for you to showcase your work, feel pride in your accomplishments, and expand your comfort zone to present to family, friends, and the community.

The celebration is a terrific opportunity to share your final product and everything you've learned in making it. So, let's celebrate! Everyone is excited to see what you've learned.