

SCIENCE EXPERIMENTS

DAKOTA STEAM LEARNING FACILITATOR GUIDE



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

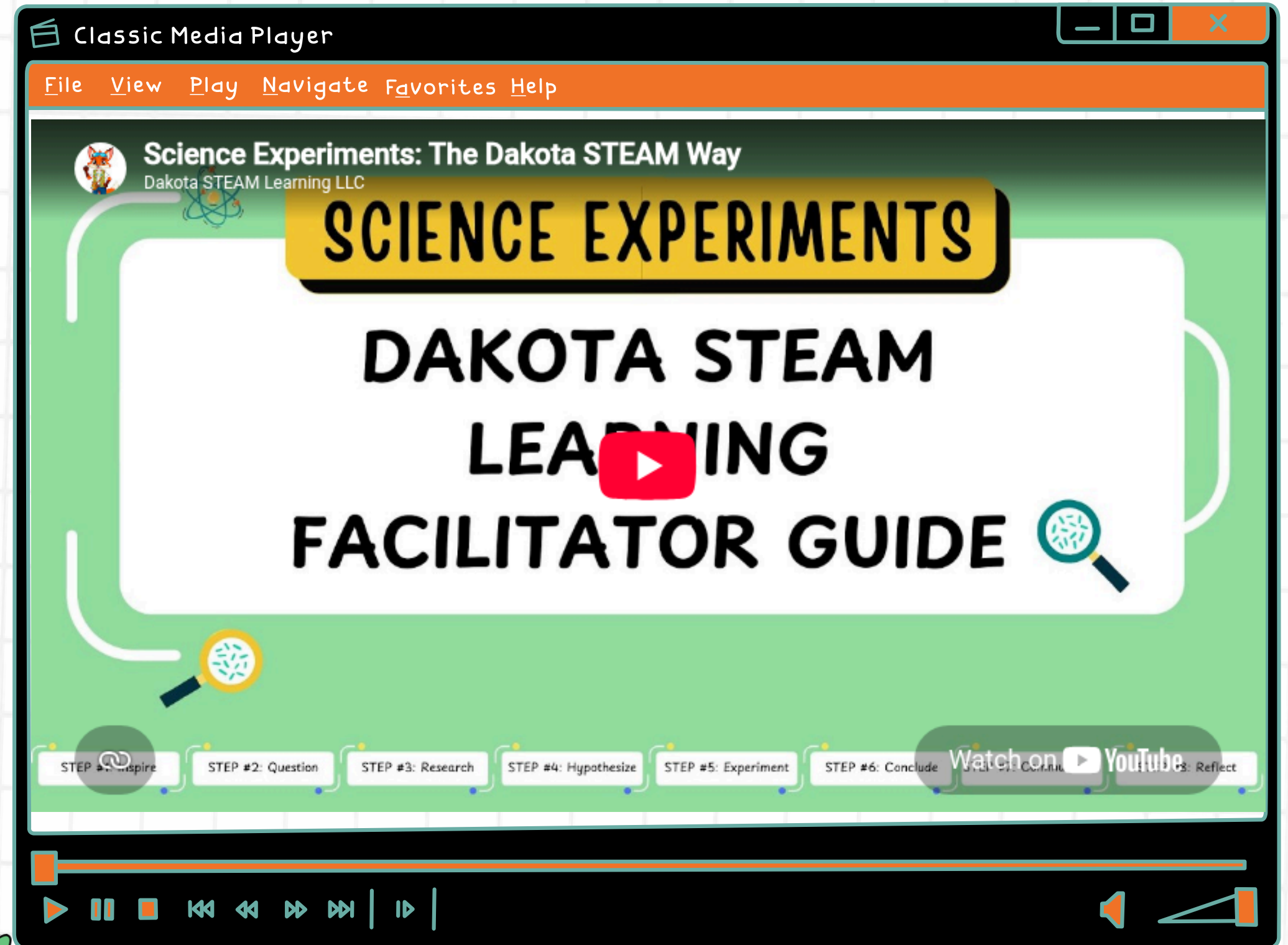
STEP #7: Communicate

STEP #8: Reflect

Science Experiment STEAM Challenge

Facilitator Guide

Our Facilitator Guides give educators the clarity, confidence, and support needed to lead engaging STEAM experiences with purpose. Organized by topic, the guides provide a diverse range of meaningful content, with a strong emphasis on science and robust engineering and art strands. They also offer intentional opportunities to connect math, technology, and other STEAM elements in ways that help students see how learning works together across disciplines. This slide guide matches our products found on our website.



Use the resources embedded to watch a follow-along video version of this lesson.



Today We Will...

LEARNING TARGETS

Be presented with a scientific phenomena.

Make a hypothesis based on our question and test our predictions.

Draw conclusions based on the data we collected.

Be careful and follow our directions to be successful.



Science Activity



Students engage in a guided activity that allows them to experience a scientific principle.

A science activity allows students to better understand a scientific principle.

Can be shorter in time.

Science Experiment

Students are led through a science experiment following the scientific method.

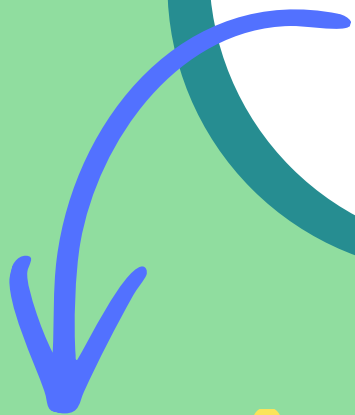
The experiment includes control variables as well as independent and dependent variables.

May be longer in time.



Progress Bar

The bottom bar serves as a valuable visual aid for your students, helping them understand their progress within the STEAM steps and allowing them to connect it with their journals.



STEP #1: Inspire

STEP #2: Activate

STEP #3: Connect

STEP #4: Create

STEP #5: Evaluate

STEP #6: Reflect

Step #1: Inspire

Observe a
scientific
phenomena

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

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STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

What scientific principle are we exploring?



STEP #1: INSPIRE
What is our scientific principle?

 **REVIEW THE PHENOMENA**

 **STEAM JOURNAL** 

Stop students
and record in
STEAM Journal

INSERT

The slide identifies the STEAM challenge science inspiration.

- Questions to ask on this slide are:
 - What do you notice about the example(s)?
 - What do you know about it?
 - What are you wondering about the inspiration?

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

What scientific principle are we exploring?



STEP #1: INSPIRE

What is our scientific principle?



REVIEW THE PRINCIPLE



STEAM JOURNAL



STEAM Slide Example

CHEMICAL REACTIONS



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

SCIENCE

Watch the video
to view the
scientific
principle.

- This page emphasizes a moment in a STEAM lesson where watching a video can enhance the research experience.
- Videos help students visualize concepts, learn more about a scientist or scientific principles, or relate them to real-world scenarios.
- We do not include a video here, as we respect teachers' discretion in determining what is best for their students and what is age-appropriate.

STEP #1: Inspire

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History of Science



- Some lessons focus on a specific scientist and their work with the scientific phenomena.
- Other lessons focus on the history of the scientific phenomena.
- Other lessons may include real-world connections.
- This info would be explained here.

History of Science

CHEMICAL REACTIONS

STEAM Slide Example

Chemical reactions have been studied for a very long time. Early scientists noticed that some materials changed into new substances when they were burned, mixed, or heated, but they did not yet understand why these changes happened. Over time, scientists began to carefully observe, measure, and test these changes, which helped them discover that chemical reactions can produce new substances with different properties. As science advanced, people learned more about atoms and molecules, and how they combine and dissociate during reactions.



STEP #1: Inspire

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STEP #5: Experiment

STEP #6: Conclude

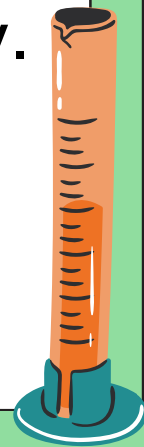
STEP #7: Communicate

STEP #8: Reflect

HISTORY OF SCIENCE

KEY SCIENTIST

Benjamin Franklin became interested in electricity after hearing about experiments in Europe, where scientists used machines to generate electric sparks. He studied static electricity by making careful observations and testing ideas, including his famous kite experiment, which helped him learn that lightning is a form of electricity. His work showed that electricity could be studied through observation, evidence, and experimentation.



IMPACT

The study of static charge and electricity has had a major impact on daily life by leading to the development of many useful technologies. This work helped people create lightning protection, electric generators, and many of the electrical devices used in homes, schools, and hospitals today.

EXAMPLE



Step #2: Question

Identify a question
that needs to be
answered based on the
scientific phenomena

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

KEY QUESTION

In Step #2, we'll explore our scientific question, ignite our inspiration, and dive into thoughtful reflections. Together, we'll present the key question that will guide us as we embark on this exciting experimental journey!



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

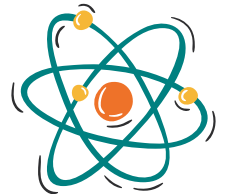
STEP #6: Conclude

STEP #7: Communicate

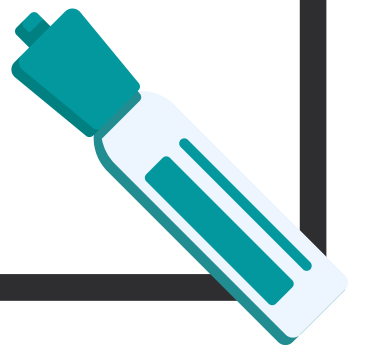
STEP #8: Reflect

KEY QUESTION

STEAM Slide Example



Can a chemical
reaction inflate a
balloon?



STEP #2: QUESTION

What question needs answering?

Draw or write what you know.

STEAM JOURNAL

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

Step #3: Research

Gather information
that could help you
make predictions and
identify procedures

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEP #3 SLIDES



Step #3 will get students thinking about the different elements of the experiment that will impact the results. We will start by activating schema and then review pertinent research before the science experiment.



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

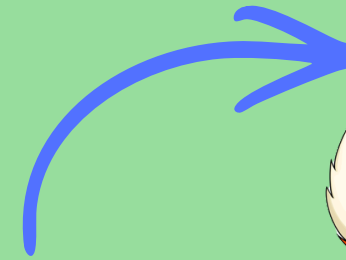
STEP #7: Communicate

STEP #8: Reflect

Activate Schema: Background Information



Questions designed to get students thinking about relevant information related to the activity are posed to initiate self-reflection.



Stop students
and record in
STEAM Journal



STEAM JOURNAL

STEP #3: RESEARCH
What do you know that could help you?

Draw or write what you know.

Which STEAM elements are involved?

☐ Science	☐ Technology	☐ Math
☐ Creativity	☐ Critical Thinking	☐ Other_____

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You would then lead students through a discussion in pairs/small groups and then a whole-group discussion if possible. We recommend using your typical discussion structure.

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect



STEP #3: RESEARCH
What do you know that could help you?

Draw or write what you know.

Which STEAM elements are involved?

☐ Science	☐ Technology	☐ Math
☐ Creativity	☐ Critical Thinking	☐ Other_____

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Activate Schema: Background Information

STEAM Slide Example



What do you
know about
Thomas Edison?



What do you
know about
chemical
reactions?



What do you
know about acids
and bases?

Science

Technology

Engineer

Art

Math

Other

Bar above will highlight the STEAM category.

Where's the STEAM?

Stop students and record in STEAM Journal



STEAM JOURNAL

STEP #3: RESEARCH
What do you know that could help you?

Draw or write what you know.

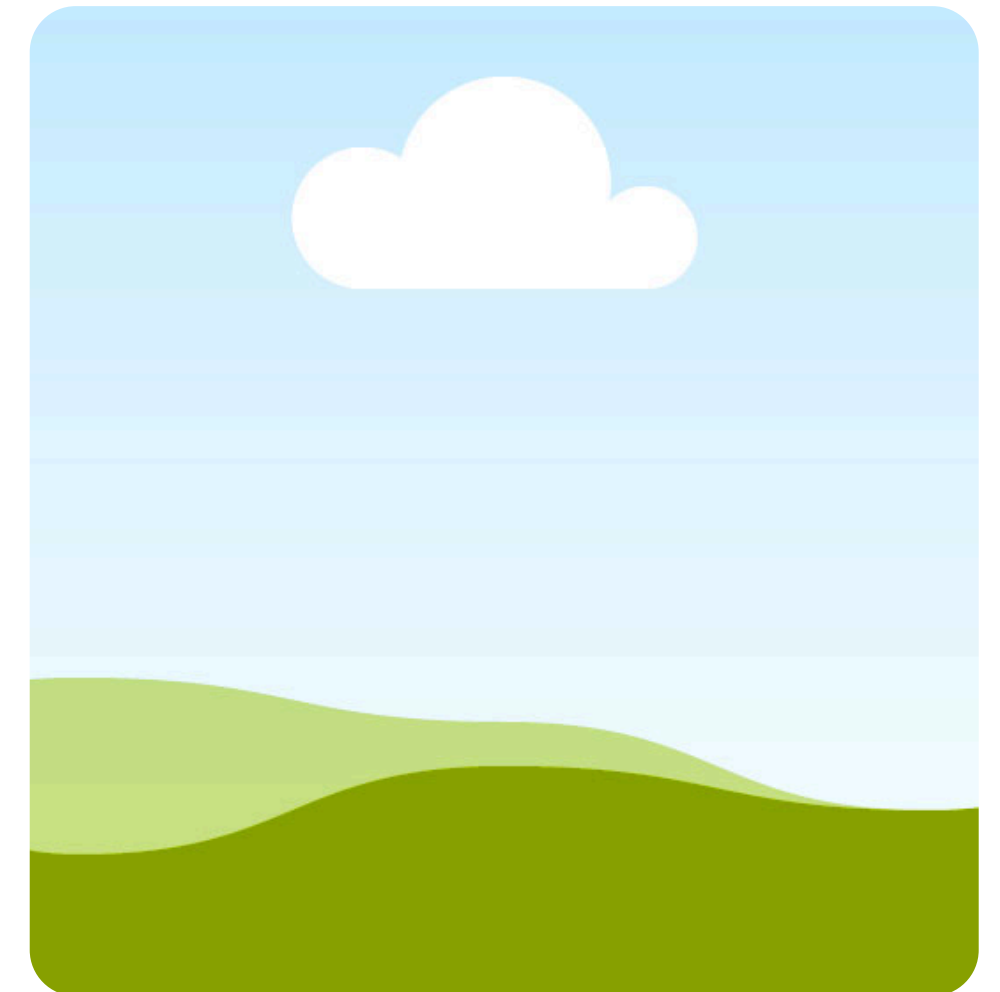
Which STEAM elements are involved?

☐ Science	☐ Technology	☐ Math
☐ Creativity	☐ Critical Thinking	☐ Other _____

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- Information and images specific to this STEAM category are explained here on these slides.
- Students can do their own research to supplement this section.

SCIENCE



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect



STEAM RESEARCH :

Chemical Reactions

Chemical reactions happen when 2 or more substances are mixed together and create a new material.

STEAM Slide Example



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEAM RESEARCH

Optional:
Find a video to
learn more
about (research
topic).

- This page emphasizes a moment in a STEAM lesson where watching a video can enhance the research experience.
- Videos help students visualize concepts, learn more about a scientist or scientific principles, or relate them to real-world scenarios.
- We do not include a video here, as we respect teachers' discretion in determining what is best for their students and what is age-appropriate.

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

Stop students
and record in
STEAM Journal

Time to Journal



STEP #3: RESEARCH
What do you know that could help you?



Draw or write what you know.

Which STEAM elements are involved?

☐ Science	☐ Technology	☐ Math
☐ Creativity	☐ Critical Thinking	☐ Other_____

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Add to your
STEAM Journal

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

Step #4: Hypothesize

Identify what you
expect to happen
when testing our
question

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEP #4 SLIDES

Step #4 will generate their scientific hypothesis. We include key information and guiding questions about a hypothesis as well as options for students to choose from. These “Possible Predictions” can help students succeed. You can have them brainstorm a hypothesis before revealing the “possible predictions” to students, if appropriate for their level.



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEAM Slide Example

HYPOTHESIZE

HYPOTHESIS

Based on all we have already seen, make an educated prediction of what will happen!

HYPOTHESIS

What do you think will happen when we test our experiment?

STEAM JOURNAL

123

STEP #4: HYPOTHESIZE
What do you predict will happen?

Hypothesize

☐ ☐ ☐ Other:

Stop students and record in STEAM Journal

POSSIBLE PREDICTIONS

I think the chemical reaction can inflate a balloon.

I don't think a chemical reaction can inflate a balloon.

Record another prediction or state your "why".



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

HYPOTHESIS

Based on everything we've observed so far, what do you expect will happen during our upcoming test?



I think the sweet candy will cause a chemical reaction when it comes into contact with a base.



I think the sour candy will cause a chemical reaction when it comes into contact with a base.

I believe this because_____



STEAM JOURNAL



STEP #4: HYPOTHESIZE

What do you predict will happen?

Choose a hypothesis or write your own.

☐☐☐☐

Other:

Stop students
and record in
STEAM Journal

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Step #5: Experiment

Gather data while we follow a procedure to test our hypothesis

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEP #5 SLIDES

In step #5, students will learn about independent, dependent, and control variables.

STEAM materials will be presented; it will be a great time to discuss expectations with each one.



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

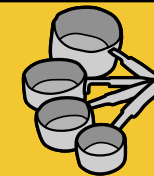
**Remember
Tools, Not Toys!
Be Safe, Have Fun!**



STEAM MATERIALS



**Water
Cups**



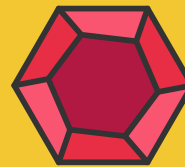
**Measuring
Cup**



**Measuring
Spoon**



**Plastic
Spoon**



**Fake
Gems**



**Salt, Sugar, &
Baking Soda**



Pencil



Labels



**Safety
Goggles**

**STEAM Slide
Example**

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

VARIABLE TYPES

Students can
attempt to
identify for this
experiment.

INDEPENDENT VARIABLE

Independent Variables are the ONE thing you change during the experiment. Important to have just one change per experiment.

DEPENDENT VARIABLE

Dependent Variables are the change that happens because of the independent variable. Dependent Variables is the data you are gathering.

CONTROL VARIABLE

Control Variables are the things you keep consistent within the experiment. Control Variables usually have several aspects in an experiment.

INDEPENDENT VARIABLE

INDEPENDENT VARIABLE

The ONE thing you change during the experiment.

Important to have just one change per experiment.

EXAMPLE

The type of liquid being given.



DEPENDENT VARIABLE

DEPENDENT VARIABLES

The change that happens because of the independent variable.

The data you are gathering.

EXAMPLE

The height of the plant.



CONTROL VARIABLE

CONTROL VARIABLES

Everything you keep consistent within the experiment.

Control Variables usually have several aspects per experiment.

EXAMPLE

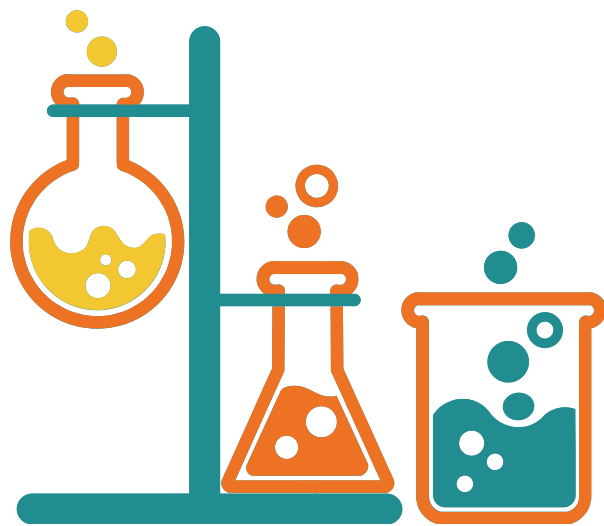
soil type
sunlight amounts
liquid amounts
other aspects



SCIENCE REMINDERS

REMEMBER

We must all follow the same procedure for our data to be valid.



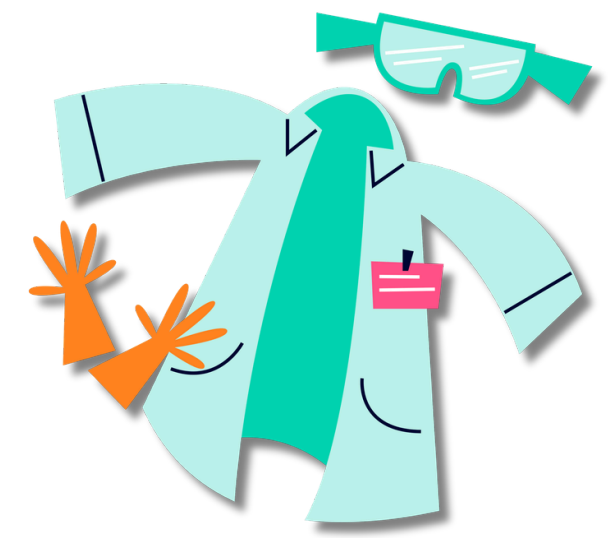
REMEMBER

Our procedure must test the question we are answering.



REMEMBER

Our procedure must be a safe learning environment!



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

This exercise is designed to encourage students to think critically about how scientific procedures are developed. They rarely correctly predict the procedure. This elicits a good conversation about why the procedure is sequenced in a very specific way. They typically struggle with making sure the variables are being measured correctly.



How could we design our experiment procedure?



Identify a procedure that tests our question.

Make sure your procedure gathers data about the dependent variable.



Everyone must follow the same procedure for our data to be valid.



The procedure must test the question we are answering.

Procedure Ideas

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

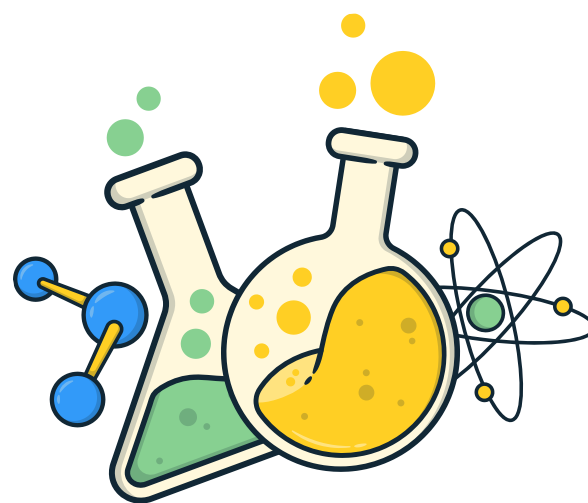
STEP #8: Reflect

FINAL PROCEDURE

See if your procedure prediction matches our experiment procedure.



Experiment Time!



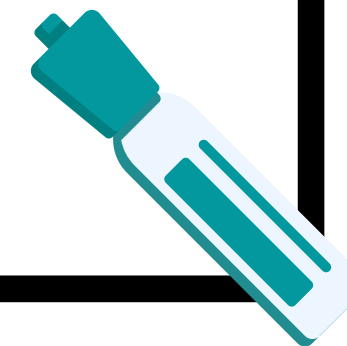
STEP #5: EXPERIMENT
Follow the process to complete the science experiment.

Experiment Steps		
1	2	3
4	5	6

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Stop students and record in STEAM Journal



STEAM JOURNAL

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

Create Step #1

Create Step #2

Create Step #3

Create Step #4

Create Step #5

Create Step #6

Create Step #7

Create Step #8

CREATE #1

Create Steps are embedded
into Step #5 to have a guided
science experiment.

Stop students
and record in
STEAM Journal

STEP #4: HYPOTHEZIZE
What do you predict will happen?

Hypothesize

DATA COLLECTION
Follow the process and collect your own data.

VARIABLE	VARIABLE	NOTES

OBSERVATIONS/CONCLUSIONS

STEP #5: EXPERIMENT
Do the experiment.

DATA COLLECTION
Follow the process and collect your own data.

VARIABLE	VARIABLE	NOTES

OBSERVATIONS/CONCLUSIONS

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STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

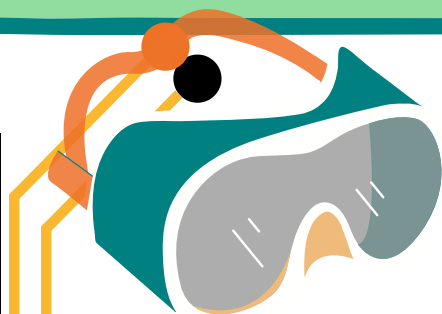
STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

CREATE #1



Using your data collection sheet:

- Identify each candy you will be using and record the candy's physical properties.
- Once finished, you may taste-test each candy and record if it is sweet or sour.
- **Note: You should NEVER taste test science materials unless explicitly told to do so, and it is necessary for the experiment.**



Length



Color



Texture



Odor



Density



Mass



Shape



Volume

DATA COLLECTION			
Follow the process and collect your own data.			
Independent Variable	Category	Dependent Variable	Notes
Physical Properties Identify 3-5 Per Candy	Circle Sweet or Sour	Circle Any Present Signs of a Chemical Reaction	Notes
Candy #1:	Sweet Sour	COLOR CHANGE RELEASE OF LIGHT CHANGE IN ODOR BUBBLE FORMATION SOLID FORMATION TEMPERATURE CHANGE	
Candy #2:	Sweet Sour	COLOR CHANGE RELEASE OF LIGHT CHANGE IN ODOR BUBBLE FORMATION SOLID FORMATION TEMPERATURE CHANGE	
Candy #3:	Sweet Sour	COLOR CHANGE RELEASE OF LIGHT CHANGE IN ODOR BUBBLE FORMATION SOLID FORMATION TEMPERATURE CHANGE	
Candy #4:	Sweet Sour	COLOR CHANGE RELEASE OF LIGHT CHANGE IN ODOR BUBBLE FORMATION SOLID FORMATION TEMPERATURE CHANGE	
Candy #5:	Sweet Sour	COLOR CHANGE RELEASE OF LIGHT CHANGE IN ODOR BUBBLE FORMATION SOLID FORMATION TEMPERATURE CHANGE	

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STEAM Slide Example

STEP #6: Conclude

Look at the
data and draw
conclusions based on
our gatherings

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEP #6 SLIDES

In Step #6, students will work on drawing conclusions from their experiment results.

Slides may include results for students to choose from to become familiar with science experiment results.

Slides may also include “In case you missed it!” slides to further explain the scientific phenomena for students in relation to the experiment.



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

FINDINGS

- What conclusions can you draw based on our data?
- Was your hypothesis correct?
 - Why?
 - Why Not?



STEP #6: CONCLUDE
What conclusions can you make based on the data?

☐ ☐ ☐ Other: _____

**Stop students
and record in STEAM
Journal**

What helped you come to these conclusions? _____

✓ **STEAM JOURNAL** ✓

Conclusions

What do we conclude?

- A chemical reaction can inflate a balloon.
- A chemical reaction cannot inflate a balloon.
- Other conclusion based on scientific data.

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

CONCLUSIONS

STEAM Slide Example

What conclusions can you draw based on our data?

Was your hypothesis correct?

Why?
Why Not?

STEAM JOURNAL

STEP #6: CONCLUDE

What conclusions can you make based on the data?

☐ ☐ ☐ Other:

What helped you come to these conclusions?

CHOOSE A CONCLUSION



Sweet candy caused a chemical reaction when it came into contact with a base.



Sour candy caused a chemical reaction when it came into contact with a base.



Other conclusion based on scientific data.

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEAM RECAP

In case you missed it!

- This page emphasizes a moment in a STEAM lesson where watching a video can enhance the research experience.
- Videos help students visualize concepts, learn more about a scientist or principle, or relate them to real-world scenarios. This area would be great for finding a video on a STEAM career, a scientist, or a scientific principle.
- We do not include a video here, as we respect teachers' discretion in determining what is best for their students and what is age-appropriate.

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEP #7: Communicate

Share your conclusions
and
prove your findings

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEP #7 SLIDES



In Step #7, students will work on presenting their findings by explaining and expanding.



STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

PRESENTATIONS FOR THIS EXPERIMENT

RESULTS

RESULTS

Explain the data you collected.

What candies reacted with the base?



CONCLUDE

CONCLUDE

Explain your conclusions and justify how you came to them.

Sweet versus Sour candy. Why do you think one reacted?



NEXT STEPS

NEXT STEPS

Share how you could expand upon your findings and test related questions.

What other types of candy could you test? Can you predict what they would do?



STEAM JOURNAL

What information do you want to share with others?



STEP #7: COMMUNICATE
What information do you want to share with others?
Draw or write what you want to share.

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEP #8: Reflect

Reflect on your
experience
exploring the
scientific principle

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

STEP #8 SLIDES



In Step #8, students will reflect on their experiment, and they will review STEAM careers related to the scientific phenomena. You may also find a video to highlight a career or other real-world connections.

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

STEP #7: Communicate

STEP #8: Reflect

REFLECTIONS

Stop students
and record in STEAM Journal



STEP #8: REFLECT
Think about this science activity and the results.

Results What surprised you about the activity?	
Reflect What would you like to do differently next time?	
Career Would you be interested in being a scientist?	

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STEAM JOURNAL

Reflect

What surprised you about this experiment?
Was our procedure effective?
Why or Why Not?

Reflect

Is this a scientific field you would like to explore more?



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STEAM CAREER

STEAM Slide
Example

CHEMIST

A chemist is a scientist who studies substances and how they change. Chemists learn about the tiny parts that make up matter and observe how different materials can combine or react.



WHAT THEY DO

Chemists investigate materials, test their properties, and look for patterns in how substances behave. They may create new products, improve medicines, or help solve problems by carefully studying chemical reactions.



WHY THEY MATTER

Chemists matter because they help people understand the world at a very small scale. Their work supports medicine, clean water, safe products, and many everyday materials that people use.

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STEAM CAREER

STEAM Career
Title

Classic Media Player

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This page highlights a moment in a STEAM lesson in which watching a video can enhance the STEAM career slide.

We do not include a video here, as we respect teachers' discretion in determining what is best for their students and what is age-appropriate.

STEP #1: Inspire

STEP #2: Question

STEP #3: Research

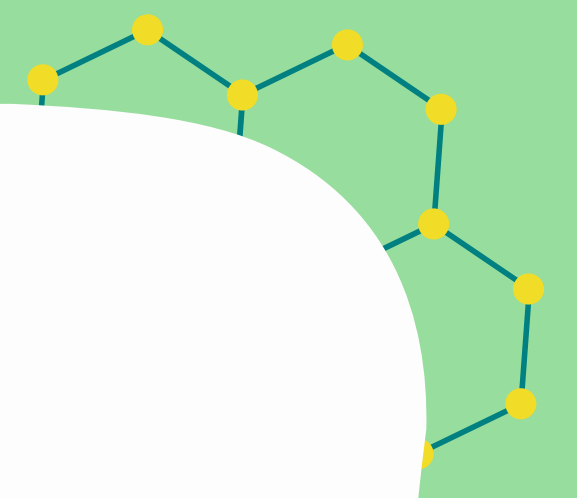
STEP #4: Hypothesize

STEP #5: Experiment

STEP #6: Conclude

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STEP #8: Reflect



Thank you for creating
with us today!

This concludes today's
activity!



Dakota STEAM Learning LLC

Find More STEAM At



STEP #1: Inspire

STEP #2: Question

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