



STUDENT DRIVEN RESEARCH

A TEACHER GUIDE FOR FACILITATING SCIENTIFIC INVESTIGATIONS

About this Guide

This packet guides teachers through the Student-Driven Research process and provides a framework for facilitating student-led scientific investigations. Students take an active role in their learning by making observations, asking questions, conducting background research, developing hypotheses, and designing investigations.

As students move through the research process, they collect and analyze data, identify patterns, and use evidence to develop conclusions about their investigation. Students also have opportunities to communicate their findings and reflect on their research, building a deeper understanding of how scientific knowledge develops through questioning, investigation, and evidence.

Teachers serve as facilitators throughout the process, providing structure, guidance, and support while allowing students to take ownership of their learning and develop confidence as scientists.



NGSS STANDARDS

This Student-Driven Research process can be applied to any NGSS-aligned topic, providing a flexible framework for students to explore scientific questions and engage with the Science and Engineering Practices (SEPs) and Crosscutting Concepts across disciplines.

The process directly supports the NGSS Science and Engineering Practices by engaging students in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations, and communicating scientific findings. Throughout their investigations, students also apply Crosscutting Concepts to identify patterns, explore cause-and-effect relationships, examine systems, and make connections across scientific disciplines. By integrating these elements throughout the research process, students develop a deeper understanding of how scientists investigate, analyze evidence, and make sense of the world around them.

Educator Instructions: Leading the Process

Introduction

Student-Driven Research is a framework designed to help middle and high school students develop science skills and content knowledge through conducting their own original research. The example materials included in this packet are geared toward middle school life science, but the framework can be adapted to different subjects and grade levels by changing the content-specific components and resources. The framework provides a simple, step-by-step approach that guides students in asking their own questions, designing and conducting investigations, analyzing evidence, and communicating their findings. Students take ownership of the research process rather than relying on the teacher to provide the questions, procedures, or answers.

Student-Driven Research engages students in all eight NGSS Science and Engineering Practices (SEPs) while also supporting Crosscutting Concepts (CCCs) and relevant Disciplinary Core Ideas (DCIs). The flexible format can be implemented over consecutive days or spread across a longer period, such as one day each week.

The goal is to create a classroom where students are encouraged to be curious, creative, and independent thinkers—and where the teacher serves as a facilitator who helps students navigate the research process rather than providing all the answers.

Sample Schedule

Session 1: Question asking 50 minutes

Session 2: Project Design 50 minutes

Session 3: Field Day ~3 hours

Session 4: Data Analysis 50 minutes

Session 5: Presentation Building 40 minutes

Presentations: 10 minutes of Session 5 and subsequent classes

(If you have 90 minute blocks, combine sessions 1 & 2 as well as 4 & 5)

About Us

Headwaters Science Institute is a small non-profit organization dedicated to creating and promoting innovative science education. We are very excited to provide curriculum to as many teachers as possible and love feedback about any of our lessons. Headwaters Science Institute offers professional development workshops and works with students in their classes. You can find out more info on our website: headwatersscienceinstitute.org.

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Launching Student-Driven Research (SDR)

Authentic experiences help students connect scientific ideas to the world around them while developing critical thinking, problem-solving, evidence-based reasoning, and communication skills that support success in college and beyond. By beginning with something they can observe, relate to, or wonder about, students experience science as something they do, not simply information they learn. This approach mirrors how scientists work while building the independence and curiosity students need for future learning and careers. Use this guide and its activities to bring meaningful scientific experiences into your classroom and inspire the next generation of scientists.



SPARK CURIOSITY

Begin by introducing your students to a scientific topic or phenomenon that can spark curiosity and lead to questions. You can use a scientific reading, case study, [Headwaters' Lunch with a Scientist](#), the [Headwaters Student Journal](#), or a lesson you are already teaching to provide the initial context. The goal is to give students enough background to understand the topic while leaving room for them to determine what they want to explore.

As students engage with the topic, encourage them to make observations, discuss what they notice, and identify ideas that interest or surprise them. From these observations, guide students in developing their own research questions.



QUESTION ASKING

Begin by giving students an overview of the research project, their role as researchers, and the focal topic. Now that students have been introduced to the phenomenon and built background knowledge, they are ready to begin asking questions. In small groups, have students use the **SDR Question Formulation** activity (Page 4) to brainstorm a range of questions, then refine their ideas into questions that are specific and testable. Have groups share their strongest questions and discuss what makes a question scientifically testable given the available time, space, and resources. Students then continue through the worksheet to refine their questions, develop hypotheses, and begin planning how they will investigate their ideas.



PROJECT DESIGN

Begin by revisiting students' research questions and hypotheses, then have them design an experiment to test their question. Introduce repeatability as an important goal of scientific research: another scientist should be able to follow the same procedures and repeat the experiment. Research groups will use the **SDR Research Proposal Form** (Page 5-6) to develop and refine their hypothesis, procedures, variables, replicates, and overall project design.

As students develop their plans, have them familiarize themselves with the equipment they will use and plan how they will collect and organize their data. Instructors should work with groups to provide feedback and refine their designs. Once their plans are complete, students can finalize their sample graphs and prepare data tables for their investigation.



SDR Question Formulation

Group Members: _____

Period: _____

Research Topic(s):

Rules for Asking Questions

1. Ask as many questions as you can, even ones that aren't feasible given our time constraints and materials. It can guide us to questions that will work. Make sure to record all of the questions.
2. Change all statements into questions.
3. Do not answer any questions, but be sure to ask follow up questions or rephrase questions to help improve them.
4. Everyone should participate.

Question List

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Read through all your questions and ★ your top 3.



SDR Research Proposal Form

Question and Hypothesis

Improve your top 3 questions: Make your questions more specific; adjust them to the study site and equipment available.

1. _____

2. _____

3. _____

Final Research Question: Choose one of your questions and revise it to make it as specific and testable as possible.

List your independent and dependent variables.

Independent

Dependent

Claim: What do you think will be the answer to your question?	Evidence: What evidence will you need to collect to test your claim?	Reason: Give a reason why you think your claim will be true.

Develop a hypothesis for your research question. Based on your background research and observations, use your independent and dependent variables to predict what you think will happen during your investigation:



SDR Research Proposal Form

Tools and Methods

List the equipment your group will need to collect your evidence.

How many times will you collect each type of evidence? Good scientists collect the same type of evidence multiple times to account for natural variability in their data and increase the reliability of their results.

How will your group collect the evidence to test your claim? Write step-by-step instructions. Be specific about the number of trials and replicates you will conduct.

1. -----

2. -----

3. -----

4. -----

5. -----

6. -----

7. -----

8. -----

9. -----

10. -----

Collect, Analyze, Discover

Collecting and analyzing data helps students turn observations into evidence while developing critical thinking, problem-solving, and evidence-based reasoning skills that support success in college and beyond. By gathering data, identifying patterns, and interpreting results, students learn how scientists use evidence to answer questions and develop conclusions. This process helps students build confidence in working with data and understanding how scientific knowledge is supported by evidence.

Use this guide and its activities to help students collect, analyze, and communicate meaningful data while strengthening the skills needed to think and work like scientists.

DATA COLLECTION



Begin the field research day by organizing students into their groups. Have research groups revisit their question, hypothesis, and methods while instructors introduce equipment, help refine plans, and establish clear geographic and behavioral boundaries. Before collecting data, give groups time to test and adjust their methods. Students can then begin data collection while instructors support accurate equipment use, minimize bias, and troubleshoot challenges. If a group needs to change its question or hypothesis, students should document the change, ensure it aligns with program learning goals, and confirm they can collect enough data to graph and analyze.

COLLECTING MEANINGFUL DATA



Remind students to collect sufficient and consistent data, including equal amounts of data across treatments. A minimum of three replicates per treatment is recommended, although more data will generally produce more informative results. As data collection comes to an end, have students reflect on their findings by considering whether their data answered their research question, what patterns or unexpected results they observed, and how their results might differ across locations or times of year. Before leaving the field site, instructors should review student data sheets to ensure the information is complete, legible, and organized for analysis.

DATA ANALYSIS



Begin by revisiting students' research questions and introducing strategies for analyzing their data. Emphasize the importance of looking at patterns across multiple data points rather than drawing conclusions from individual observations. Have students sketch a draft of the graph they will use to represent their findings. Demonstrate graphing and data analysis techniques, then have research groups create their graphs and begin interpreting their results. Instructors should work with groups to check their graphs, identify patterns or unexpected results, and discuss what the data can, and cannot, tell them. Students then begin organizing their findings into the project presentation, using instructor feedback to refine their graphs, analysis, and conclusions.

Supplemental Tools for Data Analysis: Use these tools to help students organize, input, and analyze their data after collection.

[Sample Data Entry Sheet](#)

[Middle School Data Analysis and project building](#)

[High School data analysis and presentation building](#)

[Middle School stats walk through](#)

[High School stats walk through](#)



SDR Data Collection Sheet

Group Members: _____ Period: _____

Question: _____

Now it's time to collect and record your data! Carefully follow the investigation steps and make sure you measure each variable consistently. Record your observations and measurements in the chart below as you go. Be as accurate and detailed as possible. Your data will help you identify patterns and draw conclusions about what happened during your investigation.

Dependent Variable(s) → Independent Variable(s) ↓				

Communicating Scientific Findings

Science communication and presentation skills help students turn their scientific findings into clear, compelling stories while developing communication, creativity, and critical-thinking skills that support success in college and beyond. By organizing information, creating visuals, and presenting evidence-based conclusions, students learn how scientists communicate their discoveries to different audiences. This process helps students build confidence in explaining complex ideas, using visuals effectively, and communicating scientific information clearly. Use this guide and its activities to help students organize their research, build effective presentations, and communicate their scientific findings while strengthening the skills needed to think, work, and communicate like scientists.



PRESENTATIONS

Begin the science communication day by reminding students of their focal question and helping them connect their research findings back to that question. Introduce the presentation evaluation criteria and review what makes an effective scientific discussion, including how to use evidence to support conclusions. Give student groups time to finish building their presentations while instructors move between groups to provide feedback, answer questions, and help students strengthen their scientific explanations and visuals.

Groups that finish early can practice presenting to one another and provide peer feedback. Select 1–2 groups to present to the class as examples, allowing approximately 5 minutes for each presentation followed by 3 minutes for questions.

Before the first presentation, remind students what makes a strong scientific question and encourage the class to listen for how the presenting group connects its question, evidence, and conclusions. Continue presentations during subsequent class time until all groups have had an opportunity to share their research.

Presentation Templates:

[Middle School Project Template](#)

[High School project template](#)

Bring Student-Driven Research to Your School

Want to take your students' research to the next level? Headwaters Science Institute offers in-person, Headwaters led programs that guide students through our Student Driven Research process, from developing a research question and designing a study to collecting and analyzing data and presenting their findings

Interested in bringing a Headwaters program to your school? Contact us to learn more about our programs and how we can partner with your school to give students an authentic, hands-on science research experience.

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