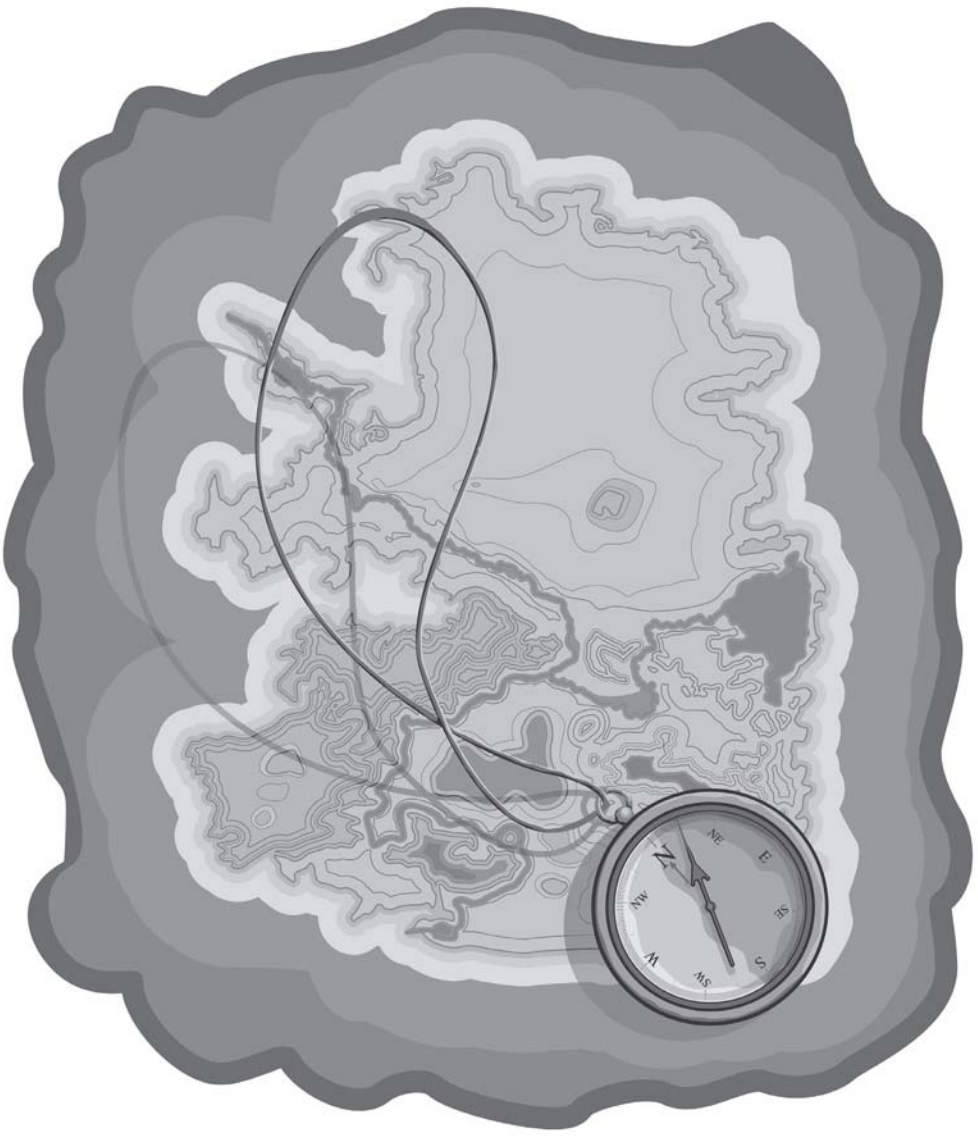
Expeditions in Your Classroom
Middle School Science



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Contents

Introduction

Students learn effectively when they have an opportunity to apply their knowledge to real-life problems. This book contains ten expeditions that engage students in real learning. Expeditions typically have greater scope and complexity than the usual classroom project. They are bigger, more ambitious undertakings which, in turn, offer opportunities for greater student engagement and more profound learning. Each project links students to a bigger issue in their community. The expeditions illustrate how education has relevance in students' lives today and in the future. Each one strives to give students new skills that can help them both inside and outside the science classroom. Many projects reach out to other content areas within a student's grade level, allowing students to tap into knowledge from English language arts, mathematics, social studies, or art.

You may choose to use some or all of the expeditions, and to use them in the given order or in any order that suits your students' needs. For example, you might wish to start off the school year with the Prescription for Health expedition so that students can track their progress toward a healthy lifestyle throughout the year.

Expeditions in Your Classroom: Middle School Science is designed for grades 5–9. It provides activities and materials that scaffold student tasks, set clear criteria for final products, and offer assessment tools and a detailed outline of project steps so that teachers can focus energy on instruction rather than on project management. Teachers will need to spend time with these materials in order to get a sense of each expedition and all of its components. Each expedition addresses national standards and provides accessible routes to understanding for a broad audience of students.

Given the scope of each expedition, advance preparation is critical to successful implementation. As you prepare materials for each expedition, consider the needs of your classroom. You may wish to print out the student pages as a packet to give in its entirety to students, rather than hand them out in the suggested order. This will streamline your preparation time, as well as allow students who complete activities ahead of time to move on to the next phase as expeditions allow.

About Project-Based Learning

In *Real Learning, Real Work*[1], Adria Steinberg describes the qualities of powerful projects: the six *A*'s.

Authenticity

Students work problems and questions that are meaningful and real. People outside school walls tackle the same challenges. What students create and do has value beyond school.

Academic Rigor

Students encounter challenging material and learn critical skills, knowledge, and habits of mind essential for success in one or more disciplines.

Applied Learning

Students put their knowledge and skills to work in hands-on ways and learn how to organize and manage themselves along the way.

[1]Steinberg, Adria. *Real Learning, Real Work (Transforming Teaching).* New York, NY: Routledge, 1998.

Introduction

Active Exploration
Students go into the field. They investigate and communicate their discoveries.

Adult Relationships
Students connect with adults with relevant expertise. They observe them, work with them, and get support and feedback.

Assessment
Students play an active role defining their goals and assessing their progress. Adults around them give them ongoing and varied opportunities to demonstrate progress.

Project Format and Materials

Each project contains the following materials:

Teacher Pages

- **Introduction:** includes an overview of information on project learning goals, plus information on prior knowledge or experience needed by students, time and materials needed for the project, key vocabulary, suggested point assessment, and team formation
- **Suggested Steps:** a day-by-day view of how to deliver project activities
- **Project Management Tips and Notes:** suggestions for how to handle possible issues or information on project options and variations
- **Extension Activities:** suggested activities for extending the project or exploring related areas
- **National Science Education Standards (NSES) Connection:** a list of standards your students will meet through the project
- **Answer Key:** answers for Skill Check questions

Student Pages

- **Expedition Overview:** a description of the project challenge, learning objectives, key vocabulary terms, materials needed, and Web resources students use for project activities
- **Before You Go:** lead-in activities designed to review fundamental skills or knowledge needed for the project
- **Off You Go:** activities that support the core project, including guidelines and instructions for final products or presentations
- **Expedition Tools:** handouts and worksheets associated with project activities
- **Check Yourself:** two assessment tools that students use to check skill development (practice problems or questions) and evaluate their project performance overall

A Science Project Assessment Rubric is also included and can be used with any project.

Project Skills Chart

Projects always challenge students to flex more than one mental muscle at a time and integrate skills they often see dissected and covered in discrete units of study. Each project in this book has a core skill focus but also gives students an opportunity to practice other skills. Use this chart as a reference to help you find the best project for your needs.

C = Core skill
X = Other skills covered (sometimes optional)

Project	*Structure of Earth systems*	*Populations and ecosystems*	*Diversity and adaptations of organisms*	*Structure and function of living systems*	*Motion and forces*	*Properties of matter*	*Transfer of energy*	*Populations, resources, and environment*	*Nature of science*	*Inquiry skills*	*History of science*	*Personal health*	*Risks and benefits*	*Technology design*
Climate Change in Your Neighborhood	C							X	X	X				
Best Soils for Planting	C							X		X				
BioBlitz		C	C					X		X				
Tracing Family Health				C						X	X			
Prescription for Health	C											C		
Bike Routes to School					C					X		X		
Household Hazardous Waste						C				X			X	
Sound Around				C			C			X		X		
Solar Energy Planning	C						C			C				
Oil Spill						C							X	X

Project Assessment Rubric

	% of grade	4 (Excellent)	3 (Good)	2 (Fair)	1 (Poor)
Knowledge and skills specific to project		Defines all key science terms with examples. Actively uses terms, methods, and skills and transfers them to other situations and contexts.	Defines majority of terms, with examples. Majority of skills are applied correctly. Sometimes transfers them to other situations or contexts.	Definitions and explanations are confusing or incorrect. Some skills used correctly.	No evidence of knowledge or skill development. Few correct methods, few correct answers.
Science knowledge		Work shows high-quality understanding of science concepts. Applications of knowledge are sophisticated and used consistently to support problem solving.	Work reflects solid science knowledge. Applications are used to solve problems.	There is little evidence of science understanding. Application of understanding is inconsistent.	There is no evidence of science understanding.
Inquiry skills		Excellent use of inquiry skills. Understanding of inquiry process clearly demonstrated.	Uses inquiry skills competently. Collection and analysis of data is accurate and consistent.	Inconsistent use of inquiry skills. Some inaccuracies in data collection and analysis.	There is no demonstration of inquiry skills. There are many errors in data collection and analysis.
Reasoning		Reasoning is sophisticated, logical, and well supported. Evidence clearly supports explanations.	Reasoning is logical and well supported. Application of problem-solving skills is good. Link between evidence and explanation is consistent.	Reasoning is weak and lacks supporting evidence. Understanding of link between evidence and explanation is inconsistent.	Reasoning is unclear. No understanding between evidence and explanation apparent.
Final product		Meets all criteria. Organization and information exceed expectations. Reflects excellent understanding of project content.	Meets all criteria. Organization and information presented clearly. Reflects good understanding of project content.	Meets most criteria. Some elements or components are missing.	Did not contribute; did not submit, or missing major components.
Presentation		Completed within specific time. Evidence of preparation is obvious. Emphasizes most important information.	Almost completed within time. Preparation evident. Covers majority of main points.	Almost completed within time. Little preparation evident. Misses a number of important points.	Did not participate, no preparation, way under or over time, or information is confusing and disjointed.
Teamwork		Workload divided and shared equally by all members.	Most members, including student, contributed fair share.	Workloads varied considerably. Student did not contribute fair share.	Few members contributed. Student made little to no contribution.
Class participation		Contributed substantially.	Contributed fair share.	Contributed some.	Contributed very little.

Climate Change in Your Neighborhood

Overview

Students examine weather records. They compare the weather from the past 10 years to the climate patterns of the past 100 years and examine predictions about the future climate. If desired, students can create posters for their town council showing the impacts of climate change on their community.

Time

Total time: 6 to 7 hours

- **Before You Go—Weather Patterns:** one class, pp. 10–11
- **Activity 1—Climate Discovery:** one class and 40 minutes of homework, pp. 12–16
- **Activity 2—Changes:** one class and 40 minutes of homework, pp. 17–19
- **Activity 3—Climate Change Report:** one class and 90 minutes of homework, p. 20
- **Check Yourself! Skill Check** and **Self-Assessment and Reflection** worksheets, 30 minutes of class time or homework, pp. 21–22

Materials

- notebook
- newspapers, magazines, or Internet news articles
- chart paper
- graph paper
- markers
- clear tape
- colored pencils

Skill Focus

- evidence and explanation

Prior Knowledge

Previous instruction in weather and climate will allow students to apply their understanding in this Expedition.

Team Formation

Students work in pairs, as individuals, and as a whole class.

Climate Change in Your Neighborhood

Homework
Students should complete **Section 2: Patterns of Weather** (p. 11) by describing the annual patterns of temperature and precipitation. Students will write a summary of an article on climate change found in the news media.

Day 2

1. Discuss student ideas on the annual patterns of temperature and precipitation.
2. In pairs, students share their summaries of the articles they read.
3. Distribute **Activity 1: Climate Discovery** (pp. 12–13) and **Expedition Tool: 100 Years of Weather** (pp. 14–16).
4. Have students graph local temperature and precipitation data for the previous year and compare the data with their predictions.
5. Students should graph the climate data for their area and identify three areas where the graphs are similar and three where they are different.

Homework
Have students write why they think the weather data varied from the climate data. Students should write a question they could answer by examining additional years of data.

Day 3

1. Have students discuss their homework responses and questions in pairs.
2. As a whole class, discuss students' ideas. Review some student questions, revising them so students can answer them by analyzing 10 years of data.
3. Have students work in pairs and select either precipitation or temperature to investigate. Students should revise a question to investigate using the additional data.
4. Distribute **Activity 2: Changes** (p. 17) and **Expedition Tool: Is Your Climate Changing?** (pp. 18–19).
5. Students can work in pairs to graph the average monthly measurement for each of the past 10 years using different colors.
6. Students analyze the data by comparing it with the climate data and applying it to their question.
7. Students should list key findings from their analysis.

Climate Change in Your Neighborhood

Lingo to Learn—Terms to Know

- **climate:** the long-term pattern of changes in temperature, precipitation, relative humidity, wind, and air pressure, usually averaged over 100 years
- **mean:** the average of a set of measurements that is computed by adding all the values and dividing by the number of values in the set
- **nature of science:** the process of investigating science to develop understanding of the world around us
- **trend:** the general direction of change in a set of data
- **weather:** the day-to-day changes in temperature, precipitation, relative humidity, wind, and air pressure

Suggested Steps

Preparation

- Review all the materials and activities for the expedition. Note printables that you'll need to copy.
- If desired, contact the town council, your local or state parks department, and conservation organizations to invite them to class in support of the student expedition.
- Access weather data and prepare data tables of monthly average temperatures and monthly total precipitation for the past year for students. A good Web site for this information is www.weatherbase.com.
- Access weather data and prepare data tables of monthly average temperatures and monthly total precipitation for the past 10 years for students. A good Web site for this information is www.weather.gov/organization.php.
- Access regional climate data and prepare a table with the monthly average temperatures and monthly total precipitation for your region.
- It might be beneficial to have a mathematics teacher to support analysis of data and a social studies teacher to discuss geography, climate, and influence on civilizations.

Day 1

1. Have students complete a quickwrite, a short 5-minute written response to the following question: How has the climate changed in your area over your lifetime or over your parents' lifetime?
2. Have students discuss responses in pairs and as a whole class.
3. Clarify definitions of *climate* and *weather.*
4. Distribute **Before You Go: Weather Patterns** (p. 10).
5. Have students complete **Section 1: Cycles of Weather** (p. 10) and discuss responses to the questions.

Climate Change in Your Neighborhood

Homework
Students should complete **Section 2: Patterns of Weather** (p. 11) by describing the annual patterns of temperature and precipitation. Students will write a summary of an article on climate change found in the news media.

Day 2

1. Discuss student ideas on the annual patterns of temperature and precipitation.
2. In pairs, students share their summaries of the articles they read.
3. Distribute **Activity 1: Climate Discovery** (pp. 12–13) and **Expedition Tool: 100 Years of Weather** (pp. 14–16).
4. Have students graph local temperature and precipitation data for the previous year and compare the data with their predictions.
5. Students should graph the climate data for their area and identify three areas where the graphs are similar and three where they are different.

Homework
Have students write why they think the weather data varied from the climate data. Students should write a question they could answer by examining additional years of data.

Day 3

1. Have students discuss their homework responses and questions in pairs.
2. As a whole class, discuss students' ideas. Review some student questions, revising them so students can answer them by analyzing 10 years of data.
3. Have students work in pairs and select either precipitation or temperature to investigate. Students should revise a question to investigate using the additional data.
4. Distribute **Activity 2: Changes** (p. 17) and **Expedition Tool: Is Your Climate Changing?** (pp. 18–19).
5. Students can work in pairs to graph the average monthly measurement for each of the past 10 years using different colors.
6. Students analyze the data by comparing it with the climate data and applying it to their question.
7. Students should list key findings from their analysis.

Climate Change in Your Neighborhood

Homework
Have students write their responses to the question they investigated using the evidence supplied by the data. Students should prepare a poster summary of their ideas for classmates.

Day 4

1. Have students form small groups of six. Pairs of students can present their questions and posters to the group.
2. Have students use their newfound knowledge to revise their answers to the following: How has the climate changed in your area over your lifetime or over your parents' lifetime?
3. Distribute **Activity 3: Climate Change Report** (p. 20).
4. Have students work in pairs to plan their research report and poster presentation on their question about climate change. Both students will research what is known about climate change in their region.
5. One student should write a report of the investigation. The other student should write a summary of what scientists already know about that aspect of climate change in their region.

Homework
Students should complete their report on climate change and prepare a poster that illustrates their findings.

Day 5

1. If desired, invite town representatives to hear the student poster sessions.
2. Have pairs of students present their poster sessions to the whole class or to new smaller groups.
3. You might wish to have students present written materials from their reports to town representatives.

Final Day

1. Have students complete the **Check Yourself! Skill Check** problems (p. 21).
2. Check and review answers.
3. Have students complete the **Check Yourself! Self-Assessment and Reflection** worksheet (p. 22) and submit it (optional).

Project Management Tips and Notes

- Some students might have difficulty predicting weather trends throughout the year. It might help if these students think about when they have experienced heavy rains or snows, or exceedingly cold or hot temperatures.
- Pairing of students provides support for students who might need help interpreting graphs.
- The topic of climate change provides a good example of how science develops. It has been very controversial. Scientists and policy-makers have debated findings over decades. The science was finally agreed upon when numerous researchers were corroborating findings that were supported by a common hypothesis. The process of investigating science to develop understanding of the world around us is the nature of science and is important for students to understand.
- Be sure students know how to cite information for their reports and how to judge the reliability of Web sites.

Suggested Assessment

Use the Project Assessment Rubric or the following point system:

Team and class participation	10 points
Before You Go	15 points
Activity 1	15 points
Activity 2	15 points
Activity 3	40 points
Self-Assessment and Reflection	5 points

Climate Change in Your Neighborhood

Extension Activities

- Students can take weather measurements and compare them with the closest national weather station.
- Students can keep regular track of daily weather and compare monthly averages to climatic averages.
- Students can analyze rainfall data in more depth to discover whether storms are becoming more violent, with intense rainfall.

National Science Education Standards Connection

Structure of Earth Systems

- Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.
- Clouds, formed by the condensation of water vapor, affect weather and climate.
- Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.

Nature of Science

- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.
- In areas where active research is being pursued and in which there is not a great deal of experimental or observational evidence and understanding, it is normal for scientists to differ with one another about the interpretation of the evidence or theory being considered. Different scientists might publish conflicting experimental results or might draw different conclusions from the same data. Ideally, scientists acknowledge such conflict and work toward finding evidence that will resolve their disagreement.

Inquiry Skills

- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.

Answer Key

Check Yourself! Skill Check

1. Weather is made up of the day-to-day changes in temperature, precipitation, relative humidity, wind, and air pressure.
2. Climate is the long-term pattern of changes in temperature, precipitation, relative humidity, wind, and air pressure, usually averaged over 100 years.
3. A mean is the average of a set of measurements that is computed by adding all the values and dividing by the number of values in the set.
4. A trend is the general direction of change in a set of data.
5. Scientific explanations are developed by thorough research. A hypothesis is proposed that identifies how a researcher thinks an event occurs. The researcher then develops a method to test the idea that includes gathering and analyzing data. The data either supports or refutes the hypothesis, and the researcher proceeds to propose another line of inquiry to explore the idea. Many researchers propose opposing ideas. Through this process, which is based on using evidence from data collected to support an idea, science evolves a true understanding of the world around us.

Climate Change in Your Neighborhood

Expedition Overview

Challenge

Are you ready to investigate the weather and climate in your area? You will compare current temperature and precipitation data with climate trends, and learn about climate change. You will create a presentation on the impacts of climate change on your community.

Objectives

- To learn how temperature and precipitation vary over the year
- To learn about the climate of your area
- To compare current weather with climate trends to determine if the climate is changing
- To learn about how the climate is changing around the world
- To communicate possible impacts of climate change on your community

Project Activities

Before You Go

- Weather Patterns

Off You Go

- Activity 1: Climate Discovery
- Activity 2: Changes
- Activity 3: Climate Change Report

Expedition Tools

- 100 Years of Weather
- Is Your Climate Changing?

Other Materials Needed

- notebook
- newspapers, magazines, or Internet news articles
- chart paper
- graph paper
- markers
- clear tape
- colored pencils

Climate Change in Your Neighborhood

Before You Go

Weather Patterns

Goal:	To learn how temperature and precipitation vary during a year
Materials:	notebook, graph paper

Directions

Section 1: Cycles of Weather

1. Predict the amount of precipitation (rain or snow) that falls in your area each month. Write your predictions in the table below.
2. Predict the average daily high temperature in your area each month. Write your predictions in the table below.

Month	Total precipitation per month	Average high temperature per month
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

3. On a sheet of graph paper, graph your predictions. Remember to properly label your graph and title it.

(*continued*)

Climate Change in Your Neighborhood

Before You Go

Section 2: Patterns of Weather

Weather and climate are closely related, but they are not the same. Weather is what happens in the atmosphere around us every day. Climate is the pattern of weather over longer periods such as 100 years, and over broader areas, such as a region or the globe.

Examine your predictions for precipitation and temperatures for your area. Precipitation and temperature are the two key measurements analyzed over 100 years to determine climate. Then answer the following questions.

4. What season of the year do you predict receives the most precipitation in your area—spring (March, April, May); summer (June, July, August); fall (September, October, November); or winter (December, January, February)? Remember that 10 inches of snow is equal to approximately 1 inch of rain.

5. Look at the graphs of your predictions. Describe the two lines, noting any possible relationship between precipitation and temperature.

6. Find an article on climate change in the newspaper, on the Internet, or in a magazine. Print or cut out the article to bring to class. On another sheet of paper, write a three-paragraph summary of the article to share with your class. The summary should identify the key points made in the article. Be sure to record the name of the publication, its date, and/or the Web site.

Climate Change in Your Neighborhood

Expedition Tool

100 Years of Weather

My Predictions versus Weather Data

Similarities	Differences