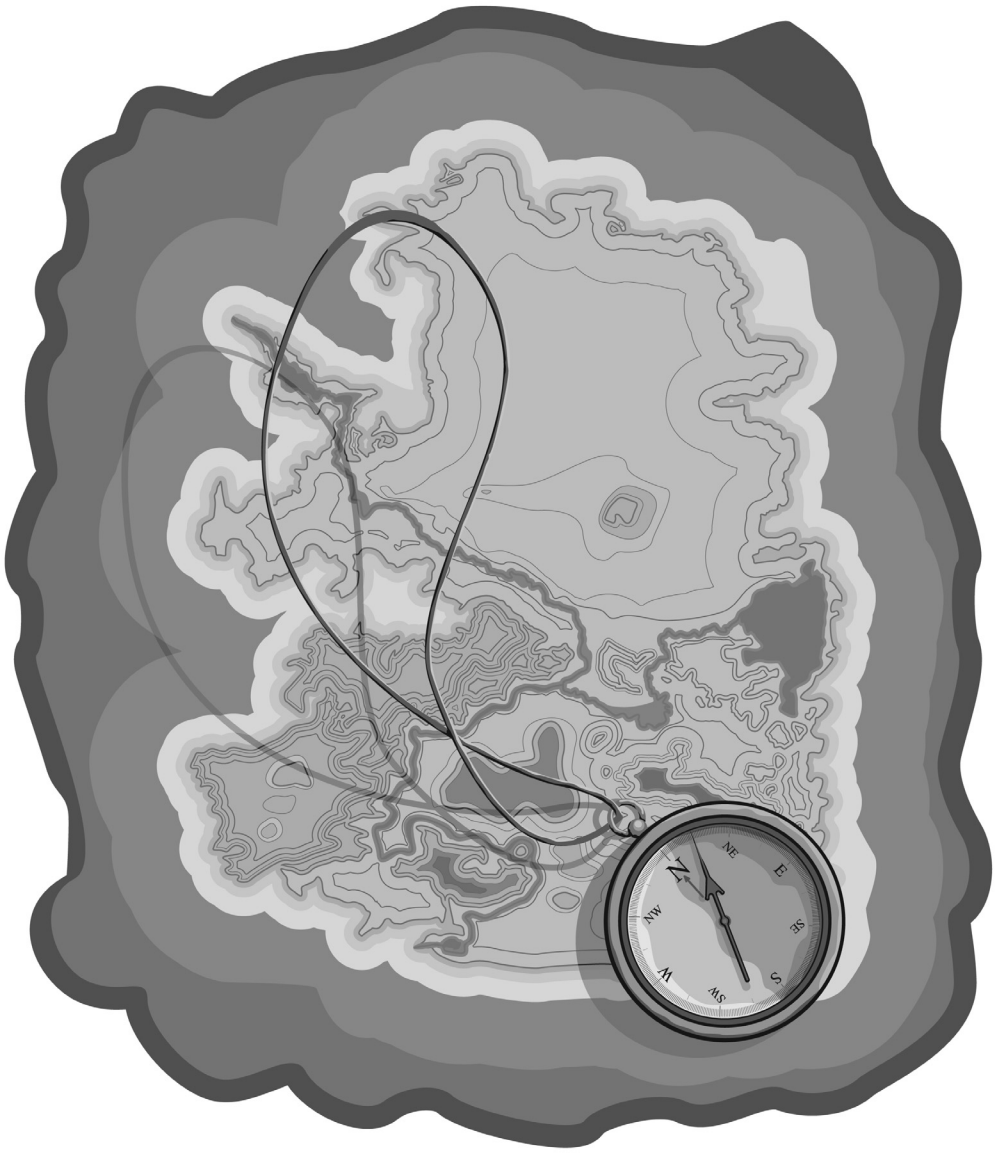
Expeditions in Your Classroom
Geometry



Nora Priest

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Introduction

We all remember a project we did in school, often with more vivid recall than we can summon for entire courses or years. And for good reason. Projects command attention. They force students to grapple with new information, skills, and technologies in ways that embed learning in memory. They contextualize education and help students truly understand why "I need to know that."

This book contains ten projects designed to leave a lasting mark. These projects provide students with authentic tasks involving real problems, real products, and real people, and use themes that hook young people. At the same time, they have teachers thoroughly in mind.

The high-school curriculum is packed, and, as teachers well know, a project can quickly take on a life of its own. *Expeditions in Your Classroom* 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 project management.

About Project-Based Learning

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

Authenticity
Students solve 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.

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 in defining their goals and assessing their progress. Adults around them give them ongoing and varied opportunities to demonstrate progress.

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

Introduction

Project Format and Materials

Each project contains the following materials:

Teacher Pages

- **Overview:** information on project learning goals, prior knowledge or experience needed by students, time needed for the project, and team formation information
- **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
- **NCTE/IRA Standards Connection:** a list of standards students will address through the project
- **Answer Key:** answers for Before You Go and Skill Check questions (Many answers will vary, and therefore, have been omitted from the answer keys.)

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

Project Skills Chart

Projects challenge students to flex more than one mental muscle at a time and integrate skills they often see dissected and covered in discrete math book chapters. 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	Page	Measurement	Ratio and proportion	Scale drawing	Classifying polygons	Triangle and angle measurements	Polygon measurements	Circle geometry	Three-dimensional shapes and visualization	Transformations	Coordinate systems	Calculating slope	Geometric modeling	Graph theory	Basic trigonometry
Project Putt-Putt	1	X	X	C		C	X		X	X		X			
Ripping Rooms	18	X	X	C	C	X	C	X							
Fashionistas	40	X	C	X			X		C						
At the Scene of the Crime	64	X	X	C			C				C				
Protectors of the Realm	95	X				X	X				C		C		
Superhero Challenge	113	X		X		X					X		C	C	
Thinking Outside the Box	130	X	X	X		X		X	C	X					
Director's View	151	X		X		X		C							C
This Is Air Traffic Control	168	X		X		X			X		C				C
The Great Geometry Race	195	X	X		X	X	X	X	X	X	X	X			

At the Scene of the Crime

- **scale:** the ratio between the size of something and a representation of it
- **triangulation:** a method of calculating the location of an object using known measurements of two other objects; creating a triangle from three objects and using side and angle measurements to calculate an unknown measurement

Suggested Steps

Preparation

- Gather any materials and props you may be providing for students.
- Provide administrators and colleagues with an overview of the project. Confirm any areas of the school, types of crime, and so forth that are off-limits or inappropriate.
- Write and send a note home to parents explaining the project.
- Arrange for students to have access to computers and the Internet.

Day 1

1. Form student teams, provide an overview of the project, and show students the project materials.
2. Assign students to work independently or as a team to complete Before You Go: Crime Scene Reconstruction Crash Course.
3. Provide students with computer time and Internet access to research their responses using the project web resources. Have them complete the activity for homework if needed.

Homework

Have students complete Before You Go: Crime Scene Reconstruction Crash Course as needed.

Day 2

1. Assign Before You Go: *X* Marks the Spot (Crime Scene Coordinates). Have students work in small groups to find measurements.
2. Allocate specific objects in the room, or let each group select two or three objects.
3. As an extension of the project and the math skills covered, show students how to determine paths of trajectory or calculate the angle of impact from splattered or shattered evidence. Consider using the web resources on the following page.

At the Scene of the Crime

- Criminology
  www.usoe.k12.ut.us/stc/ccc/7-8/Lessons%5C7%20Math%5CScientific%5C Criminology.htm
- Gizmos & Gadgets—Bullet Trajectory Rods
  www.csigizmos.com/products/sceneaccessories/bullettrajectory.html

4. Before the end of class, provide a preview of Activity 1: Design a Crime.
5. Discuss limits you have. Emphasize that students should strive for funny, mysterious, or baffling crimes—not scary, gory, or disgusting ones.

Days 3 and 4

1. Introduce Activity 1: Design a Crime and crime scene criteria.
2. Provide time for teams to meet to plan their crimes. Remind students that you need one legible Design a Crime Worksheet per team. Suggest that each team appoints a recorder.
3. Collect worksheets as teams finish.
4. Inform students of the day the crime scene investigations will take place. Instruct them to begin assembling materials they will need. Note that your final approval is still pending.
5. Review proposed crimes. If time allows, begin your review in class.
6. Make any notes, requests, or comments to support students' understanding. Note any calculations or math that might be unfamiliar to students or pose stumbling blocks.
7. Mark worksheets as "approved" or "needs more work."

Day 5

1. Return Design a Crime Worksheets to students. Highlight any important points from your review.
2. Assign which teams will swap crime scenes. Explain that each team will investigate the other team's scene.
3. Let each team know the location they will investigate or have teams meet quickly to relay this information. No other details of the crime should be discussed.

4. Review the next day's activities. State the following:
   - Two activities will take place during one class—the crime scene setup AND the scene investigation.
   - Students must be ready at the start of class, with the materials they need for both activities ready to go.

   Note: Give students at least one day of advance notice to assemble materials and props. Use the in-between time to review problem-solving strategies, any potential stumbling blocks in math that you discovered in your review of the crime scenes, and so forth. Alternatively, give students time to prepare their witness or fine-tune their setup plan.

Day 6 (Crime Day)

1. Define the tasks and time limits for students: 10 minutes to set up and 30 minutes to investigate the other team's scene.
2. Tell each team to appoint a timekeeper. Dispatch teams to set up their scenes. Teams may opt to send only one or two members.
3. After 10 minutes, announce the switch. Dispatch teams to investigate scenes.
4. Call an end to the scene investigations after 30 minutes.
5. Ask one or two members of each team to collect evidence and restore crime scene locations to their original state. Or, members of the investigating teams can do this.

Day 7

1. Review the requirements of Activity 3: Crime Scene Report and the Crime Scene Report Template.
2. Assign the due date of the report. Specify if class time will be used or if students must complete the report as homework.
3. Let teams meet to decide how they will complete assignments. Make suggestions as needed.

Report Due Date

1. Direct teams to review their partner team's report.
2. Tell reviewing teams to write their comments on the final page.
3. Discuss, debrief, and collect reports.

At the Scene of the Crime

Final Day

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

Project Management Tips and Notes

- The crime scene setup/investigation activities are best suited to an extended or block period. Alternatively, direct students to select specific crime scene locations of your choosing that can remain undisturbed from one day to the next so setup can be done in advance.
- Some students may struggle to develop crime scene sketches. Show students a floor plan example. Remind them that they can use basic shapes and symbols to represent items. Explain some of the symbols commonly used (for doors, windows, and so forth).
- To constrain the project, construct one scene of your own design for all teams to investigate. If you do, ask students to brainstorm and submit ideas for you to use.

Suggested Assessment

Use the Geometry Project Assessment Rubric or the following point system:

Team and class participation	10 points
Crime scene design	10 points
Crime scene investigation	15 points
Crime scene report	60 points
Project self-assessment	5 points

Extension Activities

- Have students present their findings as crime scene investigators testifying in court.
- Create crime scene floor plans using a computer-aided design (CAD) tool.
- Design an interdisciplinary project with science classes (physics for projectiles, biology for forensics, and so forth).

At the Scene of the Crime

Off You Go

Activity 1: Design a Crime

Goal:	To brainstorm, detail, and stage a "crime" (with your team) to be investigated by another team
Materials:	pencil, paper, ruler, measuring tape or string, "evidence" props
Tools:	Design a Crime Worksheet

Directions

1. With your team, review the crime scene criteria below and brainstorm crime ideas.

Crime Scene Criteria

- ❑ Your crime should be clever and creative. However, this is an educational adventure, not meant to be gory or to spread panic. Use common sense. Your crime should be fictitious. Obviously, you will not do anything illegal.
- ❑ Your crime must occur in school locations approved by your teacher.
- ❑ Provide at least one witness—a member of your team who is prepared to answer questions posed by the investigating team that might help them solve the crime.
- ❑ Leave a minimum of three items of evidence at the scene that relate directly to the perpetrator or perpetration of the crime.
- ❑ Evidence must be located on multiple planes (floor, wall, ceiling, and so forth) in order to challenge investigators' skills in coordinate math, measurement, and three-dimensional drawing.
- ❑ You must be able to set up your crime scene in 10 minutes or less.

2. Choose your best idea and formulate a detailed, step-by-step plan and story line for your crime. What crime occurred and how?
3. Record the details of your plan on the Design a Crime Worksheet.
4. Prepare your witness or witnesses.
5. Following your teacher's instructions, stage your crime at the location you selected.

At the Scene of the Crime

Expedition Tool

Design a Crime Worksheet

Your team name: _____

Your crime scene location: _____

1. What will the crime scene location look like? Attach a detailed sketch that shows important features and objects (walls, doors, windows, furniture, and so forth) and their dimensions. Include accurate labels and measurement information. Your drawing does not need to be done to scale.
2. What is the crime and how will it happen? Write a step-by-step description of how the crime will occur.

   _____

   _____

   _____

   _____

   _____

3. Make a list of the evidence perpetrators will leave behind. What, if anything, about the location will change as a result of the crime? You can provide location information relative to a baseline, another object in the room, or another piece of evidence.

   Mark the location of evidence on your crime scene sketch.

Item	Description	Location	Measurements

(*continued*)

At the Scene of the Crime

Expedition Tool

4. Is there anything else important to know about the scene (for example, lighting conditions or angle of lighting, security, time of day, used or vacant, and so forth)?

   _____

   _____

   _____

5. What will your witness(es) see and when? Invent a story for each witness and mark the location or vantage point of each on your crime scene sketch.

   - Who is the witness?
   - When was he or she at the scene of the crime?
   - Why was he or she at the scene of the crime?
   - What are his or her physical characteristics?
   - What was his or her vantage point or field of view?
   - What did/could the witness see? What didn't the witness see and why?
   - What else does the witness know or not know about the crime scene?

6. List any materials or props will you need to stage your crime.

   _____ _____

   _____ _____

   _____ _____

   _____ _____

At the Scene of the Crime

Off You Go

Activity 2: Investigate the Scene

Goal:	To investigate and document another team's crime scene
Materials:	notebook, sketch paper, pencils, digital camera, ruler, measuring tape or string, compass, protractor
Tools:	Crime Scene Checklist, Evidence Inventory, Witness Statement

Directions

1. Organize your team and assemble the materials you need to document the scene. All team members should take notes. Assign specific roles and duties to each person; for example, there should be a lead investigator, a sketch artist, a photographer, an evidence recorder, a witness interviewer, and so forth. You may need to play more than one role.

2. Go to the scene of the crime. As a team, determine your approach.

   - What are your initial impressions? Do you have any hunches or theories?
   - What are the boundaries of the crime scene?
   - How will you do your walk-through?
   - How will you get the measurements you need?

3. Use the Crime Scene Checklist and the Witness Statement tools to help you conduct your search, collect data, and document the scene. Remember, according to the FBI, physical evidence cannot be overdocumented!

4. Interview witnesses at any stage of your crime scene search. Witnesses may be interviewed once, and for no more than five minutes. You may interview only one witness at a time.

5. When your investigation is complete, compare notes as a team and do a final survey of the scene.

At the Scene of the Crime

Expedition Tool

Crime Scene Checklist

Use this checklist to help you collect the information you need during your crime scene search.

- ❑ Investigator names
- ❑ Type of crime
- ❑ Crime scene location
- ❑ Date and time arrived at scene
- ❑ Scene conditions
- ❑ Search approach and methods used
- ❑ Description of the crime scene and search findings
- ❑ Measurements (scene area and boundaries; location and size of evidence; other relevant measurements such as victim's height, shoe size, size of windows and doors, and so forth)
- ❑ List of sketches (overview and side-view shots required; others optional as needed)
- ❑ List of photos (optional)
- ❑ List of witnesses interviewed/witness statements
- ❑ Evidence inventory

At the Scene of the Crime

Expedition Tool

Evidence Inventory

List key items of evidence discovered at the scene.

Item	Description	Location	Measurements

At the Scene of the Crime

Expedition Tool

Witness Statement

Witness name: _____

Interviewed by: _____

Relationship to victim or other witnesses: _____

Profile (age, occupation, relevant physical characteristics, and so forth):

_____

_____

_____

_____

_____

Statement:

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