

ABSTRACT

Although Earth science students often work with maps, they have relatively little experience with the map-making process. The study of cartography provides a rich context in which students can explore the geography of a unique area of the Earth while observing the effects of construction, population, and other impacts of urbanization. *Community Cartography* utilizes a laptop computer and a variety of other technologies to develop investigation plans, gather coordinates and images, analyze data, construct maps, describe land features, and build multimedia maps. Students focus their work by determining what is geographically unique about their community.

TIES TO CURRICULUM

Community Cartography conforms to the math and science curriculum guidelines in both the *National Science Education Standards* (NSES) and the National Council of Teachers of Mathematics (NCTM) *Curriculum and Evaluation Standards for School Mathematics*. The NSES standards point to the need to develop for science as inquiry—students ask questions, plan and conduct investigations, use appropriate tools and techniques to gather data, think critically about data, and communicate results. The NCTM Standards describe how learners should apply integrated mathematical problem-solving strategies to solve real-world problems, model situations using written and graphical methods, and develop an appreciation of geometry as a means of describing the physical world. *Community Cartography* lets students make connections between real-world phenomena and mathematics, and engage in the types of activities promoted by both sets of standards.

You can integrate *Community Cartography* into a high school earth science curriculum where students learn about projections, longitude-latitude, scales, and topographical maps. The project can also be adapted to geography or mathematics courses.

LEARNING OBJECTIVES

Students will learn to

- ◆ develop and enact plans for a week-long investigation;
- ◆ collect and analyze coordinate data from hand-held GPS units;
- ◆ use digital cameras and software to gather and edit images;
- ◆ document landscape features with appropriate terminology;
- ◆ construct detailed maps using spreadsheet and graphing software;
- ◆ build multimedia presentations of maps to share with peers; and
- ◆ compare their own mapping to modern cartographic methods.

NUMBER OF LAPTOPS AND GROUP SIZE

Students work in groups of three. Ideally, each group should have a laptop. If laptops are limited, two groups can share a computer.

TIME REQUIREMENT

This lesson requires approximately eight hours of class time, and some homework assignments. The timetable describes one scenario for conducting the activity.

| Task | Time | Location |
|-----------------------------|----------|----------------|
| Introduction | 1½ hours | Classroom |
| Data collection/map-making | 2 hours | Field sites |
| Research | 2 hours | Library/home |
| Preparation of presentation | 3 hours | Classroom/home |
| Multimedia presentations | 1 hour | Classroom |

LESSON DESCRIPTION

MATERIALS

- ◆ Laptop computers
- ◆ Windows 95/98, including Microsoft Excel
- ◆ Global Positioning Systems (GPS) hand-held receiver
- ◆ Digital camera and software (one per group)
- ◆ HyperStudio multimedia software.

Introduction

Introduce students to map-making and lead a discussion on cartographic activities. Challenge students to find geographically unique locations in their neighborhoods, townships, or cities (e.g., islands, geologic formations, ecosystems, lakes, urban areas) and map and describe these areas. Familiarize students with the investigation and assessment rubric.

Instruct students on the use of hand-held GPS receivers, assign reading materials describing GPS technology, and hold simple coordinate gathering and orienteering activities around the school grounds. Demonstrate how to construct a simple map by entering data in a Microsoft Excel spreadsheet and creating a scatter-plot graph. Decide on possible locations in the community for investigation.

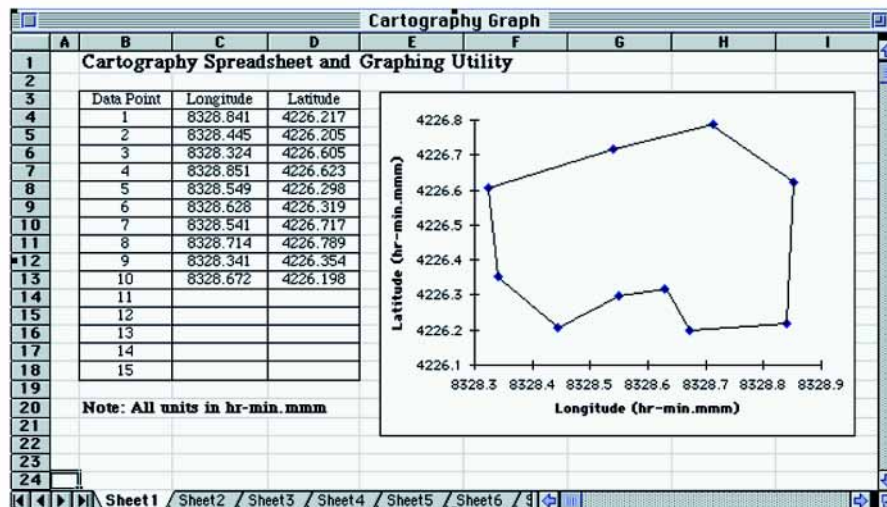
Divide the class into groups of three, and introduce each group to a community volunteer (e.g., a parent, engineer, surveyor, etc.) to work with during the investigation. Each group should develop specific plans for its investigation, agree on the location and features to document, and set up data and graph templates (see Figure 1). If possible, groups should meet at the site for a preliminary walk-through of data and image collection points. Monitor each group's progress and approve its investigation plans.

Activity

Students and the volunteers collect data at the sites. Each group member should adopt a specific role: GPS data gatherer, data entry/organizer, and image collector/recorder. Groups can follow this rough procedure:

1. Collect a set of longitude and latitude coordinates for one location at the site.
2. Enter coordinates (DEG-MIN.MMM) into the Microsoft Excel spreadsheet.
3. View scatter-plot graph.
4. Gather and load digital image of feature or terrain (image is saved on a floppy disk).
5. View, edit, or retake image using graphics software.
6. Type a detailed description of landscape features into Excel.
7. Repeat process for more locations at the site.
8. Work a large perimeter—a quarter mile at minimum—to gather data from many areas.
9. While collecting subsequent data points, analyze the automatic updating of coordinates on the scatter-plot to determine if the map matches the actual terrain and direction of travel.
10. Repeat (or average) GPS measurements for more accurate results.

Figure 1: Microsoft Excel data and graph template



SUGGESTIONS

- ◆ Foster student engagement by providing introductory activities such as videos, magazine articles, guest speakers, and displays of previous students work. Invest time working through the entire project beforehand to determine and solve trouble spots.
- ◆ If laptop computers are limited, divide the class in half for different activities. Half the class (in groups of three) will conduct the investigation, while the remaining groups will work on other activities (e.g., topographical maps, globes, scaling). Reverse roles after a week.
- ◆ Enlist help from other departments: take advantage of expertise in computer applications, graphic arts, and mathematics.
- ◆ Using community volunteers is critical to the project's success. Adults can transport students to neighborhood locations and supervise data collection activities outside the classroom.

During the third session, groups continue to collect data and analyze the progression of the map. Groups can collect more data to help build a better representation of the map and to highlight unique areas. Also, groups might attempt to properly identify terrain features using classroom or other resources.

HyperStudio Presentation

Back at school, demonstrate how to use HyperStudio software, and let groups start work on their multimedia presentation. Students can copy and paste text into HyperStudio, and import images from previously saved files. Enhance maps with street names, colors, patterns, legends, and other information. Students can also import recorded sounds, graphics, and short movies generated with the digital camera. For homework, students research modern cartographic methods on the Internet and integrate research into their HyperStudio stack. HyperStudio offers exciting graphical capabilities, but students should focus more on the content of their presentations than their appearance.

Groups trade laptops to view and critique their classmates' HyperStudio-based presentations. Students should write three positive aspects about the contents of each presentation and one suggestion for improvement, then give the presentation a score on a scale from 1–10. The goal of this sharing activity is to have students observe the planning and analysis techniques of others, learn about an unfamiliar location in their community, and gather ideas on areas for improvement. Follow-up with a class discussion about student map-making experiences, modern cartographic methods, and careers in surveying, land use development, and cartography.

ASSESSMENT

Teachers may want to hand out the following assessment tool to the class before beginning the activity, to serve as a rubric for meeting project objectives.

| Possible Points | Points Earned | Description |
|-----------------|---------------|--|
| 10 | _____ | Developed and enacted productive investigation plans. |
| 10 | _____ | Collected and analyzed at least 10 accurate data points. |
| 10 | _____ | Collected and described at least 10 quality landscape images. |
| 10 | _____ | Used a spreadsheet and graphing program to construct a coordinate map. |
| 30 | _____ | Built an integrated HyperStudio multimedia stack illustrating the map. |
| 10 | _____ | Researched modern cartographic techniques |
| 10 | _____ | Worked collaboratively with team members. |
| 10 | _____ | Average score from peer review of HyperStudio presentation. |
| 100 | _____ | TOTAL |

This rubric contains a broad array of strategies to assess individual aspects of student learning—project planning, data collection skills, analysis techniques, technology usage, researching capabilities, content understandings, and presentation quality. The construction of the final multimedia presentation and peer review enhances both the authenticity of the project and provides feedback. In addition, the final presentation provides a view of how students integrated various components of the project (e.g., data, analysis, comprehension). The teacher plays the most important role in assessment of this investigation, providing constant support and feedback to students as they work through various stages in the project.

REFERENCES

Books

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Web sites

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