



Teacher EarthCache™ Site Development

As indicated in the Introduction, EarthCaching has many interdisciplinary applications and is an excellent way to get students hooked into Earth science, geography, mathematics and language arts. Assuming you have now decided to try using EarthCaching with your students, developing an EarthCache™ site to meet your classroom needs can be an exciting endeavor. The goal of this section is to simplify the process of turning an idea into an EarthCache™ site. This is accomplished by outlining steps to create an EarthCache™ for the classroom and providing the steps that were taken in creating an EarthCache™ site for Dinosaur Ridge in Morrison, Colorado.

How to Develop an EarthCache™ Site for Use in Your Classroom

Identify an Objective

The first step in creating an EarthCache™ site, as in any lesson or unit, is to identify the objectives. What do you want the student to learn from this EarthCaching experience? In the physical geography class, an objective that relates to the interaction of humans with the environment might be appropriate.

Examples:

1. To develop in students an understanding of Earth/geographic systems and concepts.
2. To develop in students a deeper understanding of technology and how it can be applied to geography (GPS, GIS, databases, etc.)

If the EarthCache™ site were being developed for the science classroom, objectives that relate to scientific inquiry and Earth science concepts would be needed.

Examples:

1. To develop in students an understanding that Earth as we know it today has developed over long periods of time, through the continual process of change.
2. To develop in students an understanding of how scientists derive hypotheses, collect and analyze data, and draw conclusions about a given location or condition.

If the EarthCache™ site is being developed for the mathematics classroom, objectives that relate to research and measurement can be developed.

Examples:

1. Students will be able to interpret and develop scale drawings such as those based on maps of EarthCache™ locations to solve real-world problems.
2. Students will be able to select appropriate units of measurement and determine/apply them in a real-world context when researching an actual EarthCache™ location.

If the EarthCache™ site is being developed for the language arts classroom, objectives that relate to effectively communicating ideas and non-fiction information might be suitable.

Examples:

1. Students will be able to select and use an appropriate format for writing according to the intended audience and purpose.
2. Students will be able to write notes, comments, and observations that demonstrate a working knowledge and comprehension of the EarthCache™ location.

Develop Goals Based on Education Standards/Learning Expectations

Once the objectives for the unit have been determined, specific goals must be developed in order to choose the type of EarthCache™ site to be created. Within each class, state and/or national standards should be consulted in determining specific goals for the EarthCache™ site unit.

Because EarthCaching is interdisciplinary, standards in a number of disciplines can be addressed. Included in Appendix E are the relevant national and state standards. A link to state standards is also located at www.geosociety.org/educate/standards.htm. Reviewing your state standards can help you determine how best to develop your EarthCache™ site to ensure that it is appropriate for your teaching curriculum.

Depending on your purpose or disciplinary focus, you can develop goals that emphasize certain aspects of the cache location.

- If you are planning the EarthCaching unit within an Earth science class, knowledge of the local geology will be needed to set the goals for the EarthCache™ site you will develop.

Examples:

1. Students will be able to observe the differences between sedimentary and metamorphic rock outcrops.
2. Students will observe and describe an unconformity.
3. Students will describe the effects of glaciers on the land surface.

Within a physical geography class, a goal that ties in local geology with changes due to human interaction might be appropriate.

Examples:

1. Students will be able to identify the interaction between people and the physical environment (e.g. at a man-made reservoir).
2. Students will be able to develop an original question regarding the interconnectedness of the geology of the site and the human use of the site.

If the EarthCache™ site is being developed for the mathematics classroom, goals that relate to research and measurement might be appropriate.

Examples:

1. Students will be able to produce scale drawings of artifacts or items of interest found at the EarthCaching location.
2. Students will be able to correctly use the metric system on-site when collecting empirical data at the EarthCache™ location.

Within a language arts class, a goal for describing the local geology might be appropriate.

Examples:

1. Students will be able to properly complete a data collection field form.
2. Students will be able to accurately describe rock formations and topography found at the EarthCache™ location.

Identify an Actual Location

Once your learning goals and objectives have been developed, the next step to creating an EarthCache™ site is selecting a location that will enable the goals to be met. Though there are numerous educationally significant locations, finding a site that guides the students to

accomplish desired educational goals is key. Checking the EarthCaching Web page for possible EarthCache™ sites in your area that already address your objectives and goals is a logical place to start. Sources that will assist in identifying an appropriate location are all around you.

Here is a list of sources that you can access:

1. poll colleagues,
2. contact state or university geological departments,
3. personal experience/knowledge,
4. local library,
5. historical/preservation societies,
6. state/local visitor centers,
7. points of interest around campus (in compliance with state/local law), and
8. survey markers and Benchmarks.

From this point on, using the EarthCache™ site template available in Appendix A will help you gather all of the information you need to develop the EarthCache™ location.

Thinking About Geography

Geographers look at the world from a spatial perspective. Everything and every place can be looked at geographically. The following guidelines suggest a way for teachers and students to think about the world around them (used with permission from the Florida Geographic Alliance and Dr. Ed Fernald).

Model for Studying Place

When selecting a place or learning about a place for the first time, it is good to think about what you already know and what you would like your students to learn about the EarthCache™ location. Some potential questions are listed below.

1. Location and Physical Characteristics:
 - a. Where is the EarthCache™ site you want your class to study?
 - b. What is it a part of?
 - c. What are the physical characteristics of the place (rocky, sandy, hot, cold, humid, dry)?
 - d. What is the quality of the water, soil, and air (good or bad)?
2. Population and Culture:
 - a. Is there evidence of human activity at this location?
 - b. Do people live close to or far from the EarthCache™ location?
 - c. How have people used the EarthCache™ site in the past?
 - d. How have humans changed the landscape around the EarthCache™ location?
3. Economic and Land Use:
 - a. What types of resources are located near the EarthCache™ site (reservoir, power plant, dams, highways, airports, landfills)?
 - b. Is it near or in a recreational area?
4. History:

- a. What past human activity took place at your EarthCache™ location? (Sometimes the character of a place is so heavily influenced by people that one must look at what has happened in the past to make decisions for the future.)
 - b. What natural events have occurred (hurricanes, floods, earthquakes, droughts, tornadoes)?
5. Problems and Prospects:
- a. What are some positive qualities regarding people and nature at the EarthCache™ location?
 - b. What are some negative qualities regarding people and nature at the EarthCache™ location?

Ways to Sharpen Senses and Observation Powers


1. What is the reason you chose this place for an EarthCache™ location?
2. What do you see (vegetation, neighborhoods, bodies of water, footprints, animal tracks/scat, garbage, feathers, anthills, or prairie dog towns)?
3. What do you hear (machines, cars, kids, birds, water, wind in trees, planes)?
4. What do you smell (mowed grass, garbage, food, stagnant water, flowers, salt water)?
5. What do items found at the EarthCache™ site feel like (soft, slippery, coarse, wet, dry)?

Generally, observations are described in words. Sometimes, however, it is good to sketch what you see. It is your impression of what you are observing and it may provide a deeper appreciation for the site you have selected. Even if you are taking digital photos, try sketching your EarthCache™ location and relate it to what you saw, heard, smelled, and felt.

Ensure Access and/or Get Permission

EarthCache™ sites will always be on land owned by someone. For this reason, EarthCache™ sites developed on private and public land **must** have prior approval of the landowners before submission. EarthCaches™ developed in National Parks, National Forests, or other public lands are encouraged. These must have verbal or written approval from the appropriate land-managing agency. The name and contact details of the person from whom you received approval **MUST** be provided on your EarthCache™ Site Submittal Form.

Develop a Content Explanation of EarthCache™ Site

Once your site has been chosen, you will need to develop the educational content for the EarthCache™ site based on the directions in the Submittal Guidelines section at  www.earthcache.org (see Appendix A, guidelines). The first guideline indicates:

EarthCache™ sites must provide Earth science lessons. They take people to sites that can help explain the formation of landscapes or to sites of interesting phenomena such as folds, faults, intrusions, or reveal how scientists understand our Earth (such as fossil sites, etc.).

As the developer of the site, you must create the educational notes for the EarthCache™, keeping in mind your site will be used by the general public as well as educators and students. Your sources for finding the site, listed above, may also be useful in gathering information

for writing these notes. Online searches might also yield information as well as visits to local libraries or visitor centers. **EarthCache™ sites must be educational**, providing accurate, but simple explanations of what visitors will experience at the site. The educational notes must be written to a reading age of an upper middle school (14-year-old) student. Please read Appendix A for additional guidelines and instructions for the creation of an EarthCache™ site.

Develop Logging Requirements

Every EarthCache™ site needs a way to test that the visitors have learned something by going to the site. The visitors' experiences are what they record in their log. Just saying they have been to the EarthCache™ site, or even posting a photograph, is not enough. We suggest the following ways to have people log their visit:

1. Have them provide an answer to a question about the site, such as the estimated size of some object (like the size of a boulder, crystal, waterfall, etc.).
2. Have them provide the answer to a question that they can find on some preexisting signage.
3. Have them provide a hypothesis for why a feature exists at that location (e.g. Why do you think the waterfall has two drops rather than one drop at this location?).
4. Have them compare and contrast this site with another EarthCache™ site that you have developed. If you do this, visitors must be informed in your text that they must have visited both sites in order to log their visit(s).

Geocaching members log any cache they have visited online. They must open the cache they have visited, where there is a link in the top right corner that reads, "Log your visit". Simply click on the link, type in the information required for the log as indicated in the cache text, and submit. An email will be sent directly to the cache owner. If a visitor does not correctly submit the log requirements, the owner will contact the visitor via email.

Submit Your EarthCache™ Site for Approval

Now that you have developed your EarthCache™ site in accordance with the EarthCache™ Site Guidelines, the process is easily completed by following the steps for submittal set forth on the EarthCache™ Web site.

Develop Student Activities

Once your EarthCache™ site is online, you may wish to develop specific activities for your students to complete during their visit. The activities should guide your students toward completion of the educational goals you have identified.

Possible Student Activities Utilizing Teacher-Developed EarthCache™ Sites

1. **Latitude/Longitude Refresher Exercise**
 - a. In the classroom:
 - i. give students latitude and longitude coordinates of the EarthCache™ site you plan to visit,
 - ii. provide students a paper topographic map of the area containing the EarthCache™ location and have them physically plot the coordinates on the map,

- iii. compare student work to the actual coordinates you (the teacher) have determined, and
- iv. after the coordinates exercise, have students study the topographic map and brainstorm reasons why they will be visiting this particular EarthCache™ site.

2. Predicting Change Over Time

- a. At an EarthCache™ site:
 - i. after students have achieved the goal of your EarthCache™ site lesson, have students discuss what kinds of factors might cause change in the area (climate, seismic activity, human/environment interaction, movement of human or animal populations, etc.).
 - ii. using what they have learned or already knew about the area, have students predict how this area might change over various ranges of time.
 - 1. 50 years
 - 2. 100 years
 - 3. 1,000 years
 - 4. 10,000 years
 - 5. 1,000,000 + years

3. Geography and Local History

- a. After students have studied the events of a famous battle, for example, create an EarthCache™ of the site (e.g. Gettysburg) addressing what Earth-based phenomena were contributing factors to the outcome of the battle.
 - i. In groups, have students write about different areas of the battlefield and explain how the lay of the land (rivers, valleys, hills, outcrops), weather, climate, and timing (day or night time) influenced the progress of the battle in that particular area.

4. Extractable Resources

- a. Create an EarthCache™ site where resources are being mined, grown and harvested, or caught.
 - i. Have students survey the site and predict the sustainability of the site and/or resource.
 - ii. Have students explain how the extraction of this resource influences the quality of local human life.
 - iii. If the site is not being sustained, but has the potential for sustainability, direct students to construct a written sustainability plan.

5. Natural Disaster

- a. Create an EarthCache™ site where a natural disaster has taken place.
- b. Students will analyze the nature of the disaster.
 - i. What Earth related conditions needed to be present for this disaster to occur?
 - ii. Why did it occur when it did?
 - iii. What immediate effect did it have on who or what?
 - iv. If the event occurred a long time ago, what have been the lasting effects?
 - v. Were there any beneficial effects of this event?
 - vi. What is the potential for this kind of event to occur again at this site? What are the

implications of a similar disaster?

6. Physical Observations of the Site

In Florida school districts, students complete the following activity when visiting an EarthCache™ location (from the Florida Geographic Alliance):

Observation Data Collection Sheet

- a. Date of Visit: _____
- b. Observer's/Group Name: _____
- c. Weather Conditions: Sunny_____ Cloudy_____ Rainy_____
- Hot_____ Cold_____ Humid_____
- d. Location and Comments: Absolute Location_____
- Relative Location_____
- e. General Topography: _____
- f. Land Use:
1. Human Alterations: _____
 2. Nearby Uses: _____
 3. Disturbances: _____
- g. Vegetation/Comments: _____
- h. Water/Comments: _____
- i. Birds/Comments: _____
- j. Insects/Comments:_____
- k. On the page below, please sketch what you see, hear, smell, and feel at the EarthCache™ location you are visiting (if appropriate).

Evaluation Tools

The process of creating your EarthCache™ site for the classroom is nearly complete. It is now time to assess your students' mastery of the educational goals upon which your EarthCache™ site is based.


There are numerous ways to assess students and evaluate whether or not they have mastered educational goals using EarthCaching. The assessments that you develop will vary depending upon the lesson's objectives, educational goals, and student activities. In each case, expectations should be clear and a rubric or other scoring guide provided (see Appendix C).

Examples:

- a. Journal Entry
- b. Reflection Questions
- c. Traditional Written Test
- d. Laboratory
- e. Field Manuals and Assignments
- f. Mathematical Computation and Measurements
- g. Assessment in which the students are required to use the skills they have learned during their EarthCaching experience to navigate a scenario-based exercise

Pre-existing EarthCache™ sites may already have attached lesson plans that educators have developed for the site. Check the EarthCache™ Web page for educators for additional ideas and evaluations.

Submit Your EarthCache™ Site Lesson Plan

Once your lesson plan and evaluations for students are complete, you can submit them to the EarthCaching site for use by other teachers. At the  www.earthcache.org

Web site, open the “EarthCache™ for Teachers” page. There you will find directions for submitting your lesson plans for your specific EarthCache™ site. You may also do this when you submit your EarthCache™ site for approval.

Sample Procedure for Teacher-Developed EarthCache™ Site

Developing the Dinosaur Ridge EarthCache™ Site

The following is an example of an actual EarthCache™ site in Colorado and the development process that led a teacher to develop it for her Earth science class.

(Site:  www.geocaching.com/seek/cache_details.aspx?wp=gcmqgg)

1. Identify Objectives

- a. The objectives for the Earth science class for which EarthCaching will be used are:
 - i. Students know and understand longitude and latitude, maps, GPS technology, and computer/Web site use.

- b. To develop in students an understanding that Earth as we know it today has developed over long periods of time, through the continual process of change.
- c. An understanding of how life has evolved over time in a record preserved in sedimentary rocks.

2. Identify Educational Standards/Learning Expectations

- a. Colorado State Science Standards:
 - i. Standard 4.1: Students know and understand the composition of Earth, its history, and the natural processes that shape it. Benchmarks (5–8): explaining how fossils are formed and used as evidence to indicate that life has changed through time; modeling natural processes that shape Earth’s surface (for example, weathering, erosion, mountain building, volcanic activity);
 - ii. Standard 5: Students know and understand interrelationships among science, technology, and human activity and how they can affect the world. Benchmark (5–8): describing how people use science and technology in their professions (scientists can use GPS to pinpoint locations of phenomenon).
- b. Colorado State Geography Standards:
 - i. Standard 1.1: Students know how to use maps, globes, and other geographic tools to acquire, process, and report information from a spatial perspective. Benchmark (5–8): explaining the characteristics and purposes of and explaining differences among maps, globes...; interpreting and constructing maps...
 - ii. Standard 1.2 Students develop knowledge of Earth to locate people, places, and environments. Benchmark (5–8): locating places using latitude and longitude.
 - iii. Standard 3.1: Students know the physical processes that shape Earth’s surface patterns. Benchmark (5–8): describing the consequences of physical processes on Earth’s surface.

3. Identify Goals

- a. The goals for this visit will be:
 - i. to understand maps and use latitude and longitude to locate significant outcrops displaying Earth processes.
 - ii. to understand how sedimentary rocks form in horizontal layers with youngest on top, oldest on bottom (Law of Superposition) and how tectonics or erosion may cause these layers to be exposed. Students have already studied this and will use the opportunity to observe this law in the field.
 - iii. to observe how fossils are preserved in sedimentary layers and how the ages of these fossils can be estimated relative to one another.

4. Select a Location:

- a. Site was chosen based on previous knowledge from a field trip to the Dinosaur Ridge Visitor’s Center and a GSA field trip to the area. Materials from the Friends of Dinosaur Ridge (A Field Guide to Dinosaur Ridge by Martin Lockley) and from a 2002 GSA Annual Meeting Field Trip “Geological Reconnaissance of Dinosaur Ridge and Vicinity” field book were used to make the EarthCache™ site and student activity.
- b. Ensure access and/or get permission
 - i. Site has public access, but traffic can be dangerous. Enlist additional adults to

supervise students during the trip, warn them about the narrowness of the road.



5. Develop a Content Explanation of EarthCache™ site

- a. Visit actual field site and record the latitude and longitude waypoints at each of the important locations. Based on text and previous knowledge, it was determined that the EarthCache™ site would include waypoints for the following geologic phenomena: Dinosaur bone fossils at type section; Brontosaurus bulges in sandstone; white ash layer; spherical concretion (although this is not significant to the objectives); ripple marks; and dinosaur tracks. These points were all logged, and the EarthCache™ site was submitted with text explaining the geology based on the information found concerning the site.


6. Develop Logging Requirements

- a. Logging requirements should involve making sure the visitor is receiving some education at the site. The logging requirements at this site involve submitting a picture and answering three questions related to the site: “To LOG this site, please submit a picture in front of one of the features and submit answers to the following questions:
 - i. About how far apart are the Brontosaurus’ (Apatosaurus) footprints (on average)?
 - ii. How old is the white ash layer, according to the explanatory text in front of it?
 - iii. Are the dinosaur bones at stop 2 older or younger than answer 2? (Think about the layers and their position relative to each other).”

7. Submit EarthCache™ site for Approval

- a. The Dinosaur Ridge EarthCache™ site was submitted in accordance with the EarthCache™ site guidelines ( www.earthcache.org). The process was easily completed by following the steps set forth in the introduction section of this text and at  www.earthcache.org. Approval of the EarthCache™ site was received and the site immediately went ‘live’ and was used in the classroom.

8. Assessment/Evaluation

Students completed activities on mapping using latitude and longitude. They visited the  www.earthcache.org site to see the Dinosaur Ridge EarthCache™ site they would be visiting.

- a. Mapping the Trek (Thinking Spatially)
 - i. In class, conduct a few classes on freehand mapping.
 - ii. Review and require map elements:
 1. Title
 2. Orientation
 3. Date
 4. Author
 5. Legend
 6. Scale
 7. Index
 - iii. As practice, students will create a detailed map of a (small) area familiar to them using all the elements listed above.
 - iv. Before navigating to Dinosaur Ridge, give each student a piece of blank grid-paper (2x2 cm squares).
 - v. As students begin navigating their way to the site, instruct them to draw a detailed map of the route using GPS waypoints and personal observation. They must use all map elements listed above. Also, using the elevation feature on their GPSr to create

contour lines, if possible.

- vi. To assess, compare students' maps to a published 1:24,000 scale map of the area to see how accurate their rendering is. If map is not available, reference www.terraserver-usa.com and enter coordinates provided in decimal minutes. TerraServer will provide aerial and topographic maps at this site. Also, check for detail with students' use of map symbols.

b. Create a Side-Profile Map of Dinosaur Ridge

- i. Locate a 1:24,000 scale topographic map of the Dinosaur Ride area.
- ii. Create a line graph only with the "Y" values filled in. The values for "Y" coincide with the elevation values on the topographic map from lowest to highest.
- iii. Place the line graph below the map, trace light vertical lines from the elevation contour to its corresponding value line on the map and then draw a dot at that point on your graph.
- iv. After you have "connected" the contours to the values, you will have a series of dots that you can then connect, which will in turn give you a side-profile drawing of Dinosaur Ridge.
- v. For detailed instructions on creating side profile maps, go to the excellent site www.interactive2.usgs.gov/learningweb/teachers/volcanoes_download.htm, and see lesson 2 on volcanoes. This is a great visual instruction for drawing side-profile map. Another good site is: www.geology.isu.edu/geostac/Field_Exercise/topomaps/topo_profiles.htm.
- vi. After the map is drawn, direct students to place markers on their maps, indicating where (1) the major rock layers are located and (2) where the major features are located; for example, where the dinosaur bones, Brontosaurus Bulges, the ash layer, the large concretion, the ripple marks, and the large collection of dinosaur footprints tracks are located. Have them label or key the symbols on their maps. An excellent resource for this activity is a stratigraphic column of the area showing the relationship between the various rock layers.

c. Compare Ages of Features – Wrap Up and Understanding

- i. After the first two activities are completed, have students compare the relative ages of the features seen at the site.
- ii. Have them write a short history of the area concerning only the features mentioned (i.e. dinosaurs died and bones quickly covered to form fossils; then much later an Apatosaurus walked on wet sand, leaving large depressions in the sediment that were preserved, etc...).