



Earth Exploration Toolbox—Advice to Authors

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Chapters in the Earth Exploration Toolbox (EET or Toolbox) are similar to recipes in a cookbook—each chapter walks the user through gathering the necessary ingredients and putting them together in a specific way to produce a map, image, graph, or other data product.

This document presents guidelines and advice for creating an effective chapter that will be consistent with the rest of the EET. Throughout the document, we've used recipes and cookbooks as analogies for chapters in the Toolbox. Even if you don't know your way around a kitchen, we hope the comparisons will help clarify our goals for EET chapters.

Why would you write an EET Chapter?

- Do you know of data or a data analysis tool that can illuminate a fundamental or advanced concept in Earth system science in an especially elegant way?
- Do you have a practical demonstration of a data analysis technique that could explain some Earth system research to a novice data user?
- Is there a classic Earth system science lesson that you can bring to life by accessing and analyzing data?

These are examples of procedures that could serve as core activities for chapters in the EET. By writing an EET chapter, you can share data use skills with teachers and students, helping them to become comfortable users of data and data analysis tools.

Defining your chapter

Begin by identifying a clear example of some data or tool's power, or with an important concept that can be illustrated through data analysis. Brainstorm at least a couple approaches to the topic. Confirm that your idea is possible and reasonably practical by working through the procedures yourself.

Take into account the fact that teachers have a high value for lessons that address classic science concepts. These concepts appear with predictable regularity on college course syllabi, and show up in the National Science Education Standards (NSES) for K-12 students. You can access the NSES standards at

<http://pals.sri.com/pals/standards/nses5-8text.html>

<http://pals.sri.com/pals/standards/nses9-12text.html>

The current national trend of requiring students to pass high-stakes tests for high school graduation has forced K-12 teachers to focus on covering the enumerated standards, leaving little time for more peripheral concepts. Thus, the chapters that

would be most attractive to these teachers are the ones that demonstrate good alignment with science teaching standards.

Also, give careful consideration to other methods that are commonly used to teach the concept you've identified. Assess if using data truly is a better, cheaper, faster, or more effective way to teach that content for some part of the population or in some circumstances.

Compelling case studies

In EET chapters, we strive to show the use of data and tools within a compelling case study. An interesting and scientifically valid storyline can provide motivation for students and teachers to perform data manipulations and analysis procedures. Without an interesting story behind the steps, some users might just as well perform the procedures outlined in a software manual.

Examples to admire

Every day, NASA's Earth Observatory (<http://earthobservatory.nasa.gov/>) posts a dandy example of a data-supported story that could serve as the case study of an EET chapter. EO's daily feature presents a data image and a brief story about someone's interpretation of the data. A yearly compilation of these professionally written data-supported stories is available in NASA's DAAC yearbooks:

(<http://nasadaacs.eos.nasa.gov/newsfeatures.html>)

We're not suggesting that EET chapters must have a professional-quality article for their case studies—we're pointing these out as good examples of what the scientifically minded public apparently values, stories showing how data analysis can illustrate or illuminate issues that affect human lives.

Often, data providers and tool builders can build up some situational background around their favorite demonstrations to develop a case study. Building a story around a demonstration might also be accomplished by focusing on data from an interesting place or a noteworthy event. Comparing data from two or more locations or looking at the difference between average data and data from a specific time period is another technique that might provide a storyline. The goal of the case study is to give users an appreciation for what the data analysis means for humans.

Scaling your chapter appropriately

Consciously or unconsciously, potential users of EET chapters will do a cost-benefit analysis as they scan each chapter, comparing the number and complexity of steps they must perform with the value of the product they will produce. If the potential product is so large and wonderful that it seems unattainable, few people will make the attempt. Conversely, if someone is going to go to a lot of trouble to make something, the product should have some obvious value.

Consider the cookbook analogy again...

Envision a moderately experienced cook browsing through recipes, searching for something interesting to prepare and serve at a dinner party. The cook might look for something new and unique, but they would probably steer clear of dishes that were so complex that the risk of failure was large.

Settle on an attainable yet worthy product for your chapter. If your project is very large, you can always reduce its scale and write a sequel to your first chapter later. A more limited chapter will be more successful in persuading folks to take the first step of working with the data.

Also, though you may be an expert with a particular set of data and/or tools, it's important not to overwhelm novice users with more information than they need. Limit the background information and new science content in your chapter to the topic at hand.

Another consideration in defining the scope of your chapter is the specific data-using skills that teachers and students need to develop. The following recommendations for developers are from the Using Data in the Undergraduate Classroom Report.

Within data-rich educational modules, students need to be able to:

- Find and access data relevant to the topic they are investigating
- Evaluate the quality of this data
- Manipulate data to answer questions
- Combine data sets to solve a central problem
- Generate visualizations and representations that communicate interpretations and conclusions
- Contribute student data to larger data sets
- View individual student data in the context of larger data sets

It's not likely that a single chapter would cover all of these items, but the list does provide some guidelines for the kinds of skills chapters should address.

Finally, keep in mind that instructors at all levels like to adapt resources to fit their own specific situations. Within reason, build in the flexibility for users to access similar data for a different location or time within your chapter. The data you feature in your chapter may end up serving as a model or demonstration set, essentially teaching users to perform similar analyses on other datasets.

EET's Target User

EET chapters are designed for a generally computer literate audience. To encourage consistency across chapters, consider this profile of our fictitious target user:

- a high school science teacher
- studied science in college, but did not have a graduate school/research experience
- is a relatively early adopter of new technologies
- routinely uses email, Web browsers, and word processing applications plus some record keeping program for student grades
- is familiar with spreadsheet functionalities but has rarely built their own spreadsheet or database files
- understands general computer functions such as opening, saving, and renaming files, and navigating to different folders or directories to access specific information

- is not especially knowledgeable about file types and extensions (needs to be told which files require special handling such as decompression or conversion, or which must be opened from within a specific application)

Getting ready to write

Examining a completed EET chapter is the best way to get an overview of the chapter structure and understand the purpose of each section. Go to <http://serc.carleton.edu/eet/chapters.html> and peruse any of the available chapters to get a feel for the chapter format. You'll notice that the main substance of the chapter is in the Case Study and the Step-by-Step Instructions. Other pages such as Teaching Notes and About the Tool and Data contain useful information, but don't require the same level of planning and development.

Developing the instructions

Once you've settled on the topic for your case study, make an outline of the major tasks it will take to perform the data analysis from beginning to end. You'll expand on this outline to three levels: the major tasks become the **Parts** of the chapter, the actions it takes to complete each part are called **Steps**, and the particulars of each step are referred to as **Details**.

Note: Developers usually begin chapter development in a word processing document or on paper. Flexibility is important and multiple changes are the rule rather than the exception. Once the outline is fairly well developed, but before you begin the actual writing of instruction text, consult the EET Template Description document (in production), which describes the text fields you will complete to build your chapter.

Step-by-step Instructions page

The Step-by-Step Instructions page actually provides an overview of what it'll take to complete the entire project. Some examples of these large-scale, multi-step tasks are

- Access or download an analysis tool
- Obtain data for a specific time or place
- Manipulate the tool to perform some analysis procedure
- Interpret the results of your analysis

These tasks will be the main **Parts** of your chapter, listed on the Step-by-Step Instructions page. Chapters usually have from 3 and 5 parts, but can contain up to 6. Each Part should have an obvious outcome, ending at a natural break in the action.

In our food preparation analogy, the Step-by-Step Instructions page is analogous to the outline for preparing a multi-step dish—a listing of the main components of a dish that must be prepared separately and then combined.

For example, here are the **Parts** you might see for a recipe to make a special fruit salad.

1. Make lemon sauce
2. Prepare whipped topping
3. Peel and cut fruit
4. Combine and serve

Each of the tasks requires further instructions, but the outline helps organize the cook's efforts by chunking the job into discreet parts.

Part pages

Each Part of the chapter requires the user to complete a sequence of **Steps** to complete the Part's major task. Steps should be described with enough detail so that users who are familiar with the application or tool can perform the action without further help. All necessary information such as links to follow, paths to navigate, or dialog box settings to use should be evident in the Step description.

In addition to describing the Steps, Parts pages deliver the science content of the chapter. Content should appear in fairly brief text blocks that inform the user about science concepts related to the technology instructions and data manipulations they are performing. Content comments can precede or follow the technology instructions, depending upon if the text explains what the user is about to do, or if it focuses on helping the user interpret the result of an action they just completed.

Steps are analogous to the directions for preparing separate components of a dish. For example, the **Steps** for Part 1, Make lemon sauce, in the special fruit salad recipe from above might be

1. Melt 1/4 c. butter in saucepan
2. Add 1/2 c. granulated sugar
3. Add 1 c. water
4. Add 1 tsp. corn starch
5. Bring to slow boil
6. Boil until thickened then remove from heat
7. Add 1/4 c. lemon juice
8. Add zest of one lemon

Developers often identify some number of Steps for a Part, then find they need to increase that number because they want to split out some smaller tasks from the original steps. When describing a sequence of procedures in writing, even the very slightest steps must be made explicit, so the number of steps tends to increase during development (this is one of the best reasons to get chapters fairly well developed in a word processing document before entering them into the EET page templates).

To keep users moving through a chapter, no Part should have more than 8-10 Steps. If you find yourself needing that many steps, consider splitting the Part into more than one task, or lumping some of the closely related steps together.

Science content comments interspersed among the Steps in a chapter are similar to the "About..." sections that provide background information about specific ingredients in one of our favorite cookbooks, *The Joy of Cooking*. For instance, the lemon sauce recipe above might have a sidebar comment telling cooks how to keep the sauce free of lumps and reminding them to cook the sauce thoroughly enough to avoid any raw taste from the corn starch. A cook could prepare the recipe without this information, but their knowledge (and their sauces!) can be enhanced when they use this information.

Delivering your chapter content

Most authors will submit their chapters as Word document along with a well-labeled set of images. TERC staff will put the content into the EET website.

Details

Some users prefer to have every single step of a new technology process spelled out for them—this kind of user wants to walk through the chapter in a lockstep fashion, mentally checking off each procedure as it is completed. EET chapters offer this level of detail without cluttering the instructions for more confident users. **Details** are provided as hidden text immediately following the Step they clarify.

Recall that each Step provides enough information for the competent user to perform the Step. In the Details however, you'll spell out a fairly complete sequence of the actions that users should follow. You'll also provide screenshots that highlight the buttons, controls, or fields to complete so users have a visual to check their own progress. In developing the Detailed instructions, expert data users often omit small steps that they perform without thinking about them. Watching a novice data user struggle when the details are not complete will help you see how explicit your details must be.

Details are similar to cookbook sections that provide information on a specific preparation technique. In the lemon sauce recipe, such a section might describe how to recognize when the sauce had thickened sufficiently, including a photograph to illustrate the text. Again, a cook could thicken the sauce without this information, but a beginner would find it useful.