

Building an Ecosystem with a Semester–Long Lab Writing Project

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Introduction

One goal of our freshman ecology and evolution course is that students learn how external forces and inter-specific interactions form and shape ecosystems. Unfortunately, students may focus so much on understanding individual elements that they lose sight of ecosystems as a whole. Another goal of our course is to introduce students to the experimental methods and literature of ecology. The laboratory portion of the course includes three inquiry labs in which they design their own experiments, and summarize their results in short formal reports modeled on scientific papers. However, many of our students had never read primary literature before starting their first formal report. Without that experience many students struggle as they try to imitate the technical writing style, and to locate and incorporate appropriate references.

We addressed these problems simultaneously with a simple semester–long exercise in which students identify and write about interconnections between organisms within a single ecosystem. The exercise reinforces that ecosystems contain many interacting species, and are shaped by multiple forces. Students learn to use online databases (Biological Abstracts, Zoological Record, Web of Science, etc.) and the library, as well as gain more frequent experience reading primary literature. The exercise also provides instructors an opportunity to critique students' technical writing skills before they complete their first formal lab report. Although it was not one of our original objectives, we have found this exercise also encourages students to reassess their earlier ideas and revise them in light of new information.

Overview of the Exercise

The objectives and guidelines for the exercise are explained to students during the first lab meeting. Their first summary is due at the beginning of the next lab meeting, and subsequent reports

are turned in weekly thereafter. Students write an overall summary of their ecosystem in the final week.

The First Assignment

Each student selects one species about which they wish to know more, and writes a 1-page summary of its natural history. While not required, we encourage them to choose an organism from a familiar habitat, or a habitat that interests them. Their summary should include information about that species' habitat, movements, range, interesting physical features and habits, interactions with other species, main source of food or energy, and reproductive strategy. They must cite primary literature sources for all of the information in their summary. Whenever possible, they should include an image of the organism, with a source citation for the image.

Subsequent Assignments

Each week for the following 8–10 weeks, students must expand their ecosystem by describing another species in it. As they summarize the natural history of each new species, they also must explain how it is related to one or more of their previous subjects. The relationship may take many forms, e.g., predator and prey, parasite and host, competitors for a particular resource, one species that succeeds another, or mutualism. As before, students must cite primary references for all their information. Some of our lab instructors also require students to summarize the relationships in a continually expanding schematic diagram (see Appendix for details).

Final Assignment

At the end of the semester, each student creates a final summary of the interactions among all the organisms in their ecosystem. We expect them to briefly describe external abiotic forces that affect these interactions, such as geography, rainfall, etc. It is important for students to understand that their final project will not contain every piece of information from their earlier assignments. Rather, they should pull out individual elements to make a coherent story. Final summaries can be in any number of formats. It is up to individual instructors to decide which is best for their particular group and situation. We suggest one of the following.

- **Summary Article.** As with earlier assignments, it should be limited to one page, excluding the images and list of literature citations.
- **Oral Presentation.** These are more time consuming, but other students get to learn more about ecosystems besides the one they chose. It also gives instructors an opportunity to discuss larger interconnections between ecosystems.
- **Concept Diagrams and Electronic Posters.** Students can draw and revise concept diagrams on paper, but it is more convenient to use a computer program to create flow charts. Instructions for using Microsoft Powerpoint to make diagrams and electronic posters is in the Appendix. They can be photocopied and given to students.

Discussion

Suggestions When Grading the Weekly Summaries

Instructor's comments on weekly papers should reflect the goals of this exercise, which are to build thinking and writing skills through frequent feedback. Limit comments on the natural historical facts for individual organisms. Instead, focus on correcting mechanical errors. Point out

why certain references are particularly good or poor choices. If a student's rationale for connecting two species is flawed, explain why.

To help us monitor students' progress, we make photocopies of graded papers before returning them to the students. The record also helps us identify and reward a student who struggles initially but improves dramatically over the semester.

Common Problems

Students invariably start with "charismatic megafauna," and unless instructed otherwise, their chosen organisms may consist entirely of vertebrate consumers. To prevent them from forming a skewed view of the ecosystem, we require students to include links to invertebrates and plants. Some instructors also require at least one summary description for the primary producer in the ecosystem. A second common problem is students jumping between 2 habitats that are distinct but near each other. For example, a student may try to link an aquatic organism in a stream to a species on the stream bank. Although they are not strictly the same habitat, we allow students to make these connections as long as they can explain them satisfactorily. The students also must be able to relate the two areas (such as stream bed and bank) in their final overall summary. Finally, students will neglect to cite their references a second time in their final summary paper; remind them beforehand to include all references, not just new ones. A few students fall into an anthropocentric trap. They assume that by using humans they can link any organisms they wish together, but this will not build one coherent ecosystem. The simplest solution is to tell students in advance that they cannot humans as the ecosystem's central axis.

Other Applications

This type of exercise is not restricted to exploring ecosystems. The same general format could be used to help students understand a variety of complex systems. Attendees at the 2004 ABLE mini-symposium presentation suggested that students could connect the individual organelles within a particular cell type to one another. Another idea was to link the tissues and organs within a multicellular organism.

Appendix: Creating Posters with Microsoft Powerpoint

Setting Up a Basic Layout Page

The default page size used for slides can be increased to standard letter size or larger. Simple schematic diagrams showing the early stages and basic links of an ecosystem fit on 1 standard letter page that can be printed and handed in. If students are creating a poster summary for the entire semester, it is better to use a larger layout page, and view the poster electronically rather than print it.

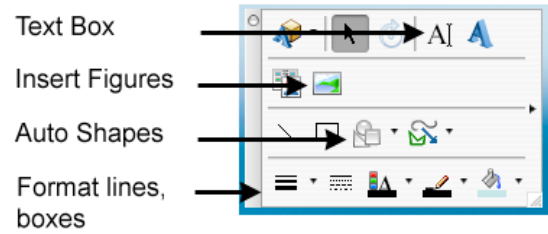
The instructions below apply to both PC and Mac format.

- Under the "File" menu, go to "Page Setup."
- In the dialogue box, change the "Slides Sized For" option. You can choose a standard paper size and orientation (portrait vs. landscape), or "Custom", which allows paper sizes up to 56 x 56 inches. Once you have chosen the page size, click "OK."
- The program may report that you are outside of the printing area for your printer. If so, DO NOT let it fix the margins for you. Instead, select "Continue."
- You will return to the main composition page, which should now be the size and orientation you selected.

Using the Flow Chart and Drawing Tools

Once you have a basic template page, you can use the Drawing tools to quickly create, annotate, and update flow charts and diagrams. Depending on Powerpoint’s default settings, a Drawing menu will appear that resembles the Figure to the right.

Drawing Menu

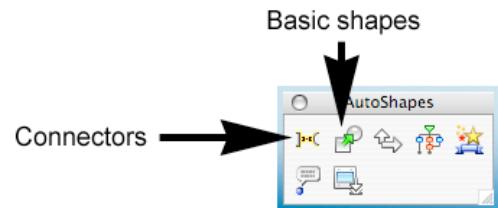


There are several tools that you will use routinely.

- The “Insert Text” command can be used two ways. If you choose it, then click and drag on a blank area of the page, you create a new empty text box in which to type information. If you choose “Insert Text” then click on a pre-existing box, oval, or other shape, text will be placed inside that shape.
- The “Insert Figure” command places a picture onto the page. Once a picture is placed, it can be dragged to any location, resized, etc.
- The remaining options on the last line of the Drawing menu let you control weight and color of the text, shapes, and lines that you draw.

“Auto Shapes” is not a single command, but a submenu that lets you access two more essential tools. Click on it to get a submenu similar to that shown to the right. “Basic shapes” are squares, ovals, stars, etc., that you can use instead of a simple text box to place information on the page. “Connectors” are the most important tools you have. They are used to link shapes together to make flow charts. They are anchored to the sides of shapes, so when a text box or shape is moved, they adjust automatically.

Auto Shapes Submenu



The figure below shows a simple ecosystem diagram being constructed. On the left side are the submenus for the connectors and shapes. On the right, connectors (heavy arrows) already link the frog to rotifers, and rotifers to the dragonfly naiad. Explanations have been placed over each link using text boxes. A new connector (thin arrow) is being added that links the naiad to the adjacent text box.

To place a new connector, click on a style (with/out arrowhead, straight, curled) in the menu. Move the cursor near a text box or figure. All potential anchor points on the box or figure will be highlighted. Click AND HOLD on an anchor point to set one end of the connector. Move the cursor to the destination box or figure; available anchor points will be highlighted again. Release the mouse button over an anchor point to set the other end of the connector. If you accidentally choose the wrong anchor point or need to revise a connection, click on the connector to make it active, then drag either end to a new anchor point. Finally, use the tools at the bottom of the main Drawing menu to change the format of the connector lines, boxes, or text.

