

Using iPads as Tools in Teaching Environmental Science Laboratory

Sheryl Shanholtzer

Georgia Perimeter College, 2101 Womack Rd., Dunwoody GA 30338 USA
(Sheryl.Shanholtzer@gpc.edu)

The iPad has many possible applications in education. We elected to use iPads as a laboratory tool. Many of our environmental science labs make use of supportive apps and require internet access, which the iPads provide. Useful apps include calculators, graphing apps, maps, conversion tools, documents, and guides for identifying organisms. We found that iPads on which the apps and bookmarks were organized for easy use, were easier to use and store than laptop computers. And, if charged while being used, do not require a special charging cabinet.

Keywords: iPads, teaching tools, environmental science

Introduction

The iPad has many possible applications in education. We, at Georgia Perimeter College, elected to use iPads as a laboratory tool. Some of our environmental science labs make use of supportive apps, which are organized for easy use, and some require internet access, which the iPads provide. We found that iPads, as compared to laptop computers, are easier to store and, if charged while being used, do not require a special charging cabinet.

An environmental science lab was being developed at the same time that iPad use was being explored at GPC. Many apps were located that would support the exercises. Some were free, others were purchased for each unit. Examples include calculators, graphing apps, maps, conversion tools, and guides for identifying organisms. These were loaded onto each iPad. For exercises requiring internet resources, URLs were

added to the home screen as icons and placed in folders for easy access. Reference documents were saved and made available using Adobe Reader App, iBooks, and iTunes U. The idea was to make technology a support for the class, without making it intrusive or requiring a big learning curve.

The first trial run assigned an iPad to each student for a semester. This worked well, but we could only accommodate one section. Next we tried keeping the iPads in the lab and distributing them before each class, which is our current model. We now have 24 iPads that support six sections, one for each student in the class.

In an effort to get student opinions of the effectiveness of the iPad use, students were surveyed at the beginning and end of Spring Semester, 2015. The mean result was 3.7 on a scale of 1, not useful, to 5, very useful. Student suggestions were mixed with equal numbers who thought it worked well, were neutral, or were not a fan of technology.

Student Outline

Portions of two exercises from our lab book, Shanholtzer and Hall, 2014, are provided in Appendix 1 and 2. These show the integration of the iPads into the exercises. These labs can be done without the iPads, but iPads simplify the process.

Notes for the Instructor

Each semester, one iPad is updated and our Instructional Technologist mirrors that one using an app called Apple Configurator. Redeemable codes were purchased for each iPad for new apps. Recently, Georgia Perimeter College purchased a Mobile Device Management system (MDM). This is a program that runs on the school's server and will allow a group of iPads to

be managed together. With this, manageable app codes can be purchased for the group.

Table 1 lists the apps we are presently using for the various exercises and their developer. Prices change, but were current June, 2015. Some of the apps we use are no longer available, or no longer free. However, many substitutes are still available. Folders with bookmarks to the web sites for each module speeds up the lab performance. Bookmarks are shown in Table 2. Figure 1 shows a screen shot of how the iPads are organized.

Table 1. Apps used in our Environmental Science course.

Module	Exercise	App	Distributor	Cost
Basic Skills				
	Sampling	Jumbo Calculator	Christopher Weems	Free
		Random #	Ronald Bell	Free
		Statistical	jaredkipe.com	4.99
	Hypothesis Testing	Calculator Pro	Apalon Apps	Free
	Mapping Techniques	Google Earth	Google, Inc.	Free
		iTopoMaps	Amphibious Technologies	7.99
	Topo Maps+	Glacier Peak Studios	Free	
Ecology				
	Site Research			
	Vegetative Analysis	LeafsnapHD	Columbia University	Free
	Animal Survey	iBird South iBird Lite and iBird Plus	Mitch Waite Group	South 6.99 Lite Free Plus 9.99
		Merlin Bird ID	Cornell Lab of Ornithology	Free
Energy				
	Energy Basics	Converter+	TranCreative Software	Free
	Energy Audit	PaperDeskLITE	Webspinner	Free
		Jumbo Calculator	Christopher Weems	Free
	Solar Energy	FoodCounter	Simon and Schuster	\$5.99

		Calorie Counter	ARAWELLA Corp.	Free
		Foodle	Pomegranate Apps	Free
Toxicology				
	Introduction			
	Blackworms and Toxicants	Statistical	Jaredkipe.com	\$4.99
	UV Hazard	DataAnalysis	Data Evaluation Systems	Free
Water				
	Where Does it Come From?	Google Earth	Google Inc.	Free
	How Do We Use It?	Aquaformia -BM: Aquaformia.com	Water Education Foundation	Free
	Where Does It Go?	iTunesU		Free
Populations				
	Measuring Changes in Population Size	Jumbo Calculator	Christopher Weems	Free
	Birth Rates	DataAnalysis	Data Evaluation Systems	Free
		Atlas for iPad Free	Appventions	Free
	Death Rates	Jumbo Calculator	Christopher Weems	Free

Table2. Bookmarks that are used in labs.

Module	Bookmark	URL
Ecology	Web Soil Survey	www.websoilsurvey.nrcs.usda.gov
	UGA Museum of Nat History	www.naturalhistory.uga.edu
Populations	International Programs	www.census.gov
	Index Mundi	www.indexmundi.com
	Population Pyramid	www.populationpyramid.net
	The World Factbook	https://www.cia.gov/library/publications/resources/the-world-factbook/
Water	Watersheds	www.water.epa.gov/type/watersheds/index.cfm

	River keeper	Ucriverkeeper.org/river-facts.php
	The Water Council	www.georgia watercouncil.org
	Water Resources	www.fultoncountyga.gov/fcwr-education/5580-water-quality
	Dekalb Co Watershed	www.dekalbwatershed.com/DrinkingWaterQualityReport.html
	Water Resources	www.gwinnettcounty.com/portal/gwinnett/Departments/PublicUtilities
	Johns Creek Environmental Campus	www.Fultonec.com
	WECalc	www.wecalc.org

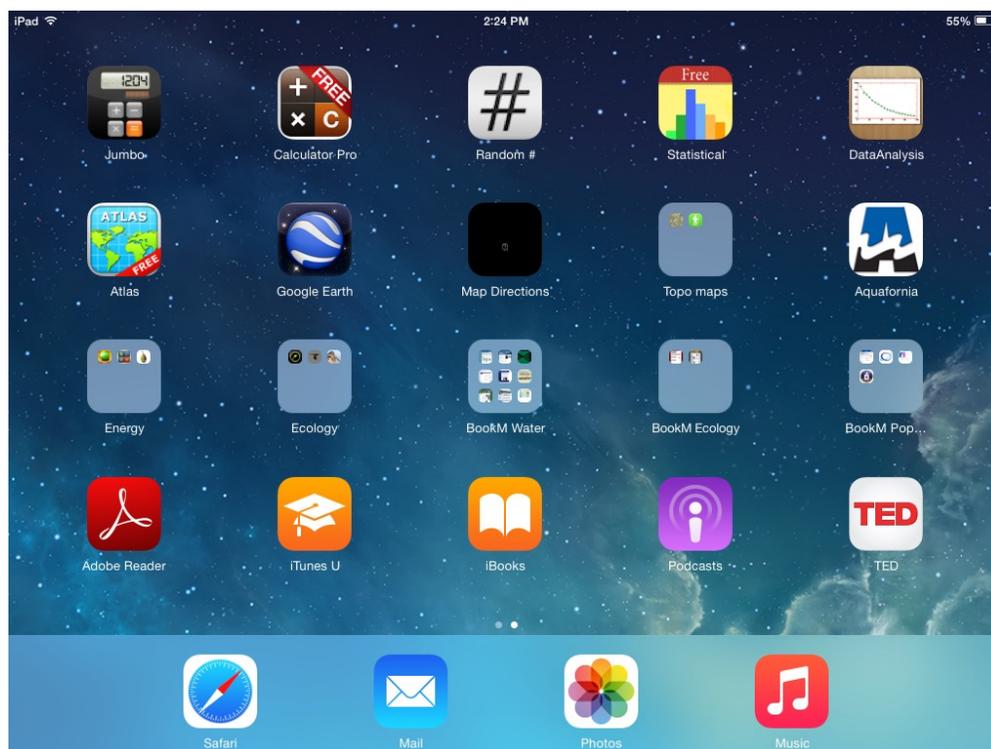


Figure 1. Screen shot of organization of iPad.

Literature Cited

Shanholtzer, S., C. Hall, ed.. 2014. Environmental Science 1401 Lab Manual, *Exploring the Environment*, Hayden McNeil, 224pp.

About the Author

Sheryl Shanholtzer is a graduate of: Columbia College, SC with a BA in biology, Florida State University with a MS in biology, and the University of Georgia with a Ph.D. in zoology. Her graduate work involved vertebrate biology and salt marsh ecological studies. She has been a Professor of Biology at Georgia Perimeter College since 1982, where she teaches Principles of Biology for majors, Anatomy and Physiology and Environmental Science. She is very interested in the lab experience and is author of the in-

house laboratory manual for the introductory biology major's course and an environmental science laboratory

manual for which she is an editor and author. Sheryl has been an active member of ABLE - since 1988.

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Appendix A

Selected Energy Exercise from *Exploring the Environment* (Shanholtzer and Hall, 2014)

Uses Food Counter, Calculator and Converter Apps

At this point in the lab, students have looked at energy basics and have done an energy audit of a building. They are somewhat familiar with units of energy, especially kwatt-hrs.

Activity 2—What Does It Take to Run a Human?

Plants convert energy carried by light into energy stored in organic molecules. The energy stored by the plants is called the net primary production and is what is available to other non-photosynthetic organisms as food. Organisms that eat plants are called primary consumers, those that eat primary consumers are called secondary consumers, and those that eat secondary consumers are called tertiary consumers. Each of these levels is called a trophic level and indicates how many steps away their food is from the energy of the sun.

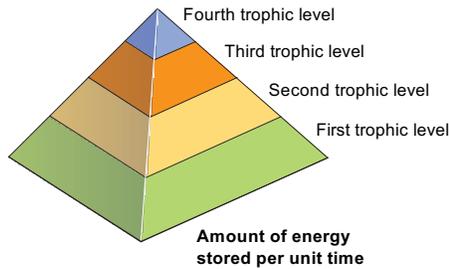
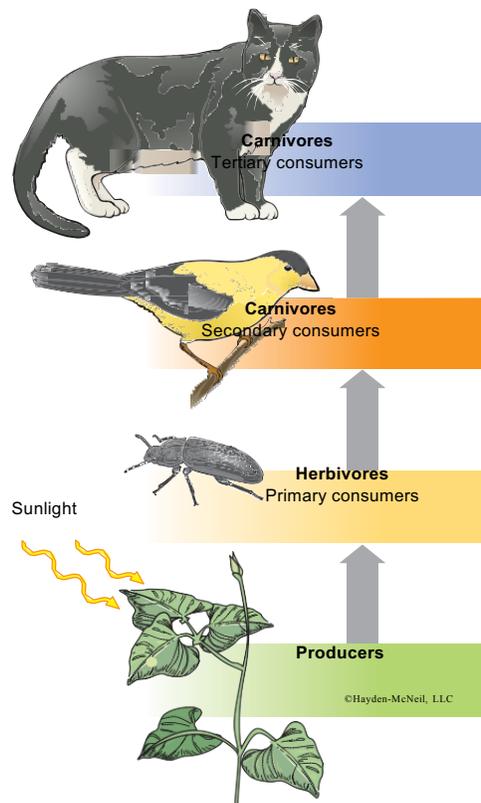


Figure 3-1. Energy transfer through trophic levels.

MODULE C: ENERGY—WITHOUT IT NOTHING WOULD HAPPEN

Each kcal of a primary consumer (beef or chicken) required 10 times that amount of energy in plant material to produce it. Secondary consumers (fish mostly) require 100 times that amount in plant energy.

Fill in Table 3-3 with calories from each trophic level. Multiply the calories by the ecological efficiency to find out how much energy must have been stored by plants to produce your food.

Table 3-3. Ecological efficiency of food sources.

Trophic Level	Consumed Calories	Ecological Efficiency	Calories from Producers
Plants		× 1	
Primary consumers		× 10	
Secondary consumers		× 100	
Total calories from producers			

- 1) What was your energy footprint for that day in kcal? _____
 - 2) How many people are there on Earth? _____ If each one ate what you did for the day, how much energy is necessary to “run” all humans for one day?
- ☉ Convert kcals to electrical units. Kcal _____ in kWatt-hours _____

The **Converter+ App** or the following link (<http://www.unit-conversion.info/power.html>) can be used to convert units of energy.

Of course this does not include the energy used to till the land, produce the fertilizer, make and apply pesticides, and maintain and transport the food.

Appendix B

Selected Portion of Population Exercise from *Exploring the Environment* (Shanholtzer and Hall, 2014)

Uses Bookmarks to Web Sites and Calculator

At this point in the lab, we have looked at biological attributes that cause birth rate and biological reproductive potential to vary among populations of various animals. We begin here to look for differences in birth rates among human populations. Are there differences? Are they caused by differences in reproductive potential, or sociological differences?

Activity 2—Now let's look at the birth rate for humans in different parts of the world.

Birth rates are usually given per year. While they can be expressed as absolute numbers for a population, they are most often expressed as a number per individual in the population. In human populations it is not likely that there will be as many births as there are individuals, so the number per individual is less than one. To make these easier to understand they are often multiplied by 100 and expressed as births per 100, or multiplied by 1,000 and called crude birth rates.

Use the **BookM Populations folder on the iPad and select International...** or (<http://www.census.gov/population/international/data/idb/country.php>). Choose “Demographic Overview” for each of the countries listed in Table 2-6 and a date (2012 for this exercise) and submit. After submitting, you will see a column labeled Demographic Indicators for each country. Fill in Table 2-6 with the birth rates/1,000 (crude birth rate) and fertility rates (most done for you here). You may use the **Bookmark, Index Mundi** (<http://www.indexmundi.com/g/g.aspx?v=26&c=mx&l=en>) to find the same data.

Indicate in Table 2-6, and locate and circle on the map (Figure 2-1), the **four** countries with the highest and lowest birth rates. Is there a pattern to their location? Use the **Atlas App** to help you locate countries.

Could any of the following biological differences vary between countries and cause the differences you see in birth rates from one country to another?

- a. Difference in number of young/reproductive event
- b. Difference in time required between reproductive events
- c. Difference in age at maturity or first reproductive event
- d. Difference in sex ratios

Activity 3 - Fertility Rate

The fertility rate is defined as the average number of offspring a female produces in her lifetime. All of the biological factors plus reproductive lifespan determine this. In nonhuman populations, fertility rate is often close to the biological maximum. In human populations, biological and social factors adjust the fertility rate.

Go back to Table 2-6 and look at the fertility rates. Compare birth rates and fertility rates for the same countries.

1. Which country has the highest fertility rate?
2. Which has the lowest?
3. Do fertility rates and birth rates match?
4. What else might limit fertility rates (how many children a women has in her life time)?

EXERCISE 2—BIRTH RATES

Table 2-6. Birth rates, fertility rates, and literacy rates of various countries.

Country	Crude Birth Rate	Fertility Rate	Female Literacy	Other
U.S.A.	13	2.0		
Mexico	19	2.3		
Guatemala	26	3.2		
Columbia	17	2.1		
Afghanistan				
North Korea	15	2.0		
India	21	2.6		
Japan	8	1.4		
China				
Ethiopia	38	5.4		
Egypt	24	2.9		
Chad	39	4.9		
Austria	9	1.4		
Germany	8	1.4		
France				
Brazil	15	1.8		
Iran	19	1.9		
Somalia	42	6.3		
Canada	10	1.6		
Zambia	43	5.9		