

# **Supplemental Material**

*CBE—Life Sciences Education*

Pruett and Weigel

## Fieldwork experience lab materials

### Stream Biodiversity and Function

**For your week 10 prelab: Please be read the info in this packet (it will help the lab run much more smoothly), and complete the Pre-Fieldwork mapping activity**

#### Introduction

A mere 3% of the earth's water occurs as fresh water, and less than 1% is the relatively free flowing surface waters of lakes, rivers, and streams. The physical characteristics of streams or lakes, such as particle size of sediment, flow velocity and volume, temperature, oxygen content, and nutrient concentrations, combine to create more or less favorable habitat for organisms. Monitoring programs are often concerned with changes to these physical characteristics and how they affect the biodiversity of the flora and fauna. Rivers and streams offer a unique habitat to aquatic organisms because the constant flow of water provides a source of food and nutrients, a ready disposal system for waste, renewal of oxygen content, and influences the microhabitat characteristics for organisms. Streams typically contain fewer species of plants compared to terrestrial or lake ecosystems, in part because lower levels of sunlight result in less primary production and because the water flow minimizes the nutrients available within the water column for plant life. Lakes are most strongly defined by the light penetration (which can be affected by factors such as silt and phytoplankton growth), temperature differentials from the surface to greater depths, and the oxygen content (which is increased by wind and internal currents, and decreased by respiration and decomposition).

**Ecosystem ecology** focuses on the movement of energy and nutrients through organisms and their environment. Energy from the sun is fixed into carbon-based molecules in primary producers and then transferred to herbivores, carnivores, and detritivores in multiple and overlapping pathways. What are other pathways in which energy enters a biotic food web?

In terrestrial systems, much of the incoming energy is fixed by green plants. In freshwater streams, the biomass of aquatic plants is much smaller and consequently makes up a minor portion of the total energy input to the stream ecosystem. Energy inputs are from outside the stream ecosystem (called "allochthonous inputs") and can include leaf litter, woody debris, animal carcasses, and wind- or tree-fall organisms (e.g. caterpillars). This material can make up to 99% of the total energy input to woodland streams, and close to a third of this material can be leaf litter (Fisher and Likens 1973). Thus, understanding how this leaf litter and other debris are processed by stream organisms is important for ecosystem ecologists who want to quantify how energy and nutrients are moving in the stream ecosystem.

To characterize your study site, we will collect data on the primary producers and benthic invertebrates which indicate ecosystem health (**bioindicator species**), as well as the chemical composition of the site that allows for organic growth (**chemical indicators**). The combination of chemical indicators and biological indicator species will allow us to determine the 1) specific types of pollution at a snapshot in time, as well as measure the 2) overall ecosystem health and average water conditions over time. Importantly, these measurements allow for comparisons over time and between sites, which allows us to say when and where conditions are better—or not.

#### References

Fisher, S.G. and G.E. Likens. 1973. Ecological Monographs 43:421-439.  
Sparkes, T.C., C.M. Mills, L.A. Volesky, J.A. Talkington, J.S. Brooke. 2008. The American Biology Teacher, 70(2): 90-94.

## Chemical and Physical Indicators of Ecosystem Health:

### Water Pollution in the United States and the Clean Water Act

The Federal Water Pollution Control Act of 1948 was the first major law to address water pollution in the United States. Growing public concern for water quality and highly publicized events, such as the Cuyahoga River in Cleveland, Ohio catching fire, led to a restructuring of this law and in 1972 it was renamed The Clean Water Act. Under the Clean Water Act, laws were added which made it illegal for any person to discharge any pollutant from a point source into navigable waters (without permit), and also recognized the need for planning to address non-point source pollution into waterways.

### Point vs. Non-point Source Pollution

**Point source pollution** is pollution that comes from a single source, such as a factory, storm drainage pipe, or wastewater treatment plant. Basically, if you can identify one specific point where pollution enters water it can be considered a point source of pollution. Historically, point source pollution was the biggest threat to water quality in the United States. However, the Clean Water Act and laws making it illegal to discharge pollutants into water has reduced what once was our biggest threat to water quality. While this has not eliminated industrial or domestic waste from entering our waters completely, it has reduced the amount and kinds of pollutants that can be dumped directly into rivers and lakes.

**Non-point source pollution** does not have one specific source, such as a drainage pipe dumping pollutants into a river. Non-point source pollution comes from the cumulative effect of a community's residents going about their everyday activities, such as fertilizing a lawn, adding pesticides to a garden, pet wastes, and household hazardous wastes.

As a case study, consider lawn fertilizers as a non-point source pollution. Fertilizers contain nitrogen compounds called nitrates. When fertilizer is applied to a lawn or garden, and there is a rain event, some of the fertilizer washes off the lawn and enters the surface water. This surface water can directly enter a river or lake, or a storm drain system, and bring along with it the nitrates in the fertilizer. Nitrates in the water enhance aquatic plant growth, just as they were intended to enhance your grass or garden to grow. Although plants are an important part of aquatic ecosystems, too many can potentially block sunlight from reaching plants that are lower in the water column. Additionally, when plants die the associated decomposers may consume significant quantities of oxygen within the water. Thus, non-point source pollution can have effects on aquatic communities that are widespread and difficult to manage.

### Monitoring Water Quality and Water Chemistry

Water chemistry plays an important role in the health, abundance, and diversity of aquatic life in a waterbody. Excessive amounts of some chemicals such as nitrates, or the lack of others such as dissolved oxygen, can result in imbalances in water chemistry. Imbalances can degrade aquatic conditions and harm aquatic life. An imbalance in chemical measurements can also make water unsuitable for human consumption or use, and greatly increase the cost of water treatment before it can be used. The following are a few physical and chemical measurements that are commonly used to monitor water quality and overall health of aquatic ecosystems.

### *Water Temperature*

Water temperature directly affects most of the physical, chemical and biological characteristics of bodies of water. For example, **temperature directly affects the amount of dissolved oxygen in water; in general, colder water can hold more dissolved oxygen than warmer water.** So simply adding warm water, which is not regulated the same as adding other pollutants, can deplete dissolved oxygen levels in water and kill aquatic organisms. Similarly, the metabolic (respiration and digestion) rates of organisms, such as fish, aquatic insects and aerobic bacteria, increases with higher temperatures, meaning they need more oxygen to survive. Additionally, although water temperatures will fluctuate naturally throughout the year, humans can also increase water temperature by altering the plant coverage (shade) along waterbodies and by adding warmer water from industrialized areas to bodies of water. Thus, water temperature changes happen and can have large effects on ecosystems.

### *pH (Parts Hydrogen)*

Water (H<sub>2</sub>O) contains both H<sup>+</sup> (Hydrogen ions) and OH<sup>-</sup> (hydroxyl ions). “pH” is an abbreviation for the French expression, “Pouvoir Hydrogene,” meaning “the power of Hydrogen.” It measures the H<sup>+</sup> ion concentration of substances and gives results on a scale from 0 to 14. Water that contains equal numbers of H<sup>+</sup> and OH<sup>-</sup> ions is considered neutral and will have a pH 7 (e.g., distilled drinking water). If a solution has more H<sup>+</sup> than OH<sup>-</sup> ions, it is considered acidic and has a pH less than 7. If a solution contains more OH<sup>-</sup> ions than H<sup>+</sup> ions, it is considered basic with a pH greater than 7. The pH scale is logarithmic, which means that every one-unit change on the pH scale is a ten-fold change of the sample.

In the United States, the pH of rivers is usually between 6.5 and 9.0, and because rain water is naturally acidic (pH~ 5.6), rain can turn rivers and lakes slightly acidic, but usually within tolerable ranges. However, **acid rain**, produced from byproducts of either natural geological formations or industrial processes, can have a pH ranging from 4.5 to as low as 2.0. Because most organisms have adapted to life in water of a specific pH, slight pH changes can harm the organisms and occasionally lead to death, but at extremely high or low pH values (12.0 or 3.5), water becomes lethal to most organisms.

### *Nitrates*

Nitrogen is an essential nutrient required by all living plants and animals for building proteins. Excess amounts of nitrogen compounds in rivers and lakes can result in unusually large populations of aquatic plants and/or organisms that feed on plants. For instance, some algal blooms are a result of excess nitrogen entering the waterbody. For this reason, excess nitrogen can be considered a chemical pollutant. We will be measuring the levels of nitrates (NO<sub>3</sub>) as an indication of nitrogen-based pollution entering the river, and as a measure of increased rates of decomposition within the river. Decomposition is a natural process and healthy process in aquatic ecosystems, but recording nitrates in higher levels than expected or in different areas of the same water body can be an indication of an unbalanced ecosystem.

### *Phosphorus*

Phosphorus is also an essential plant nutrient and is most readily available to aquatic plants in the form of phosphate (PO<sub>4</sub>). In many instances, phosphate can be the nutrient that limits or prevents plant growth, although in nature, phosphate it is generally present in very low levels measured in tenths or hundredths of a mg/L. So, even small increases in the amount of

phosphorus entering a stream can have a large impact on plant growth. If point source or nonpoint sources of pollution are high in phosphate, they can over-stimulate the growth of all types of aquatic plants. Increased plant growth due to excess phosphorus can lead to higher decomposition rates and ultimately higher levels of nitrogen in the water, and such growth can also cover water surfaces and physically block sunlight from reaching plants that are lower in the water column. Without sunlight, these plants no longer conduct photosynthesis or produce dissolved oxygen in the water.

### *Turbidity*

Turbidity is the measure of relative clarity of a liquid, measured as the amount of light that is scattered by material in the water when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity. Light scatters due to the material, or particulates, found in water, such as clay, silt, inorganic and organic matter, algae, soluble colored organic compounds, and microscopic organisms. High particulate concentrations affect light penetration, and thereby the productivity and habitat quality of an area, and are also known to provide attachment places for other pollutants, notably metals and bacteria. For this reason, turbidity readings can be used as an indicator of potential pollution in a water body.

### *Conductivity*

Specific conductance (shorthand ‘conductivity’) is a commonly-measured water quality parameter that can indicate change in water systems. Most bodies of water maintain a fairly constant conductivity that can be used in comparisons between sampling sites or through time. Differences, whether due to natural flooding, evaporation or man-made pollution, can be very detrimental to water quality and are best detected early using conductivity.

### *Available Light*

Photosynthesis provides the primary production necessary to sustain ecosystems. However, photosynthetic reactions (and the organisms reliant on them) can only function with adequate light. Photosynthetic Active Radiation (PAR) is measured to quantify the amount and potential effects of available light on ecosystems. This information is highly-depth specific, as light penetration through water decreases with depth, but even shallow areas can have low light availability due to contaminants in the water and canopy coverage—both of which may change over time.

### Sanitary Sewers and Storm Sewer Systems

Many people incorrectly believe waste that is dumped into the storm sewer is treated at a wastewater treatment plant. In fact, many metropolitan and suburban areas have separate storm and sanitary sewer systems. Sanitary sewers collect wastewater from dorms, academic buildings and residential homes and treat it before discharging it back into waterways. Storm sewers, on the other hand, are a direct connection to the city's waterways. Issues can arise when heavy rains flood an area overloading these systems.

## A Short History on Proctor Creek and The Emerald Corridor of Atlanta

Proctor Creek, which starts in West Atlanta near I-20 and winds its way to the Chattahoochee, was historically a place of importance for locals. It has gone from a fishing and swimming hole where local churches baptized generations of families, to a polluted and largely neglected urban creek. The health of the surrounding community has followed this decay.

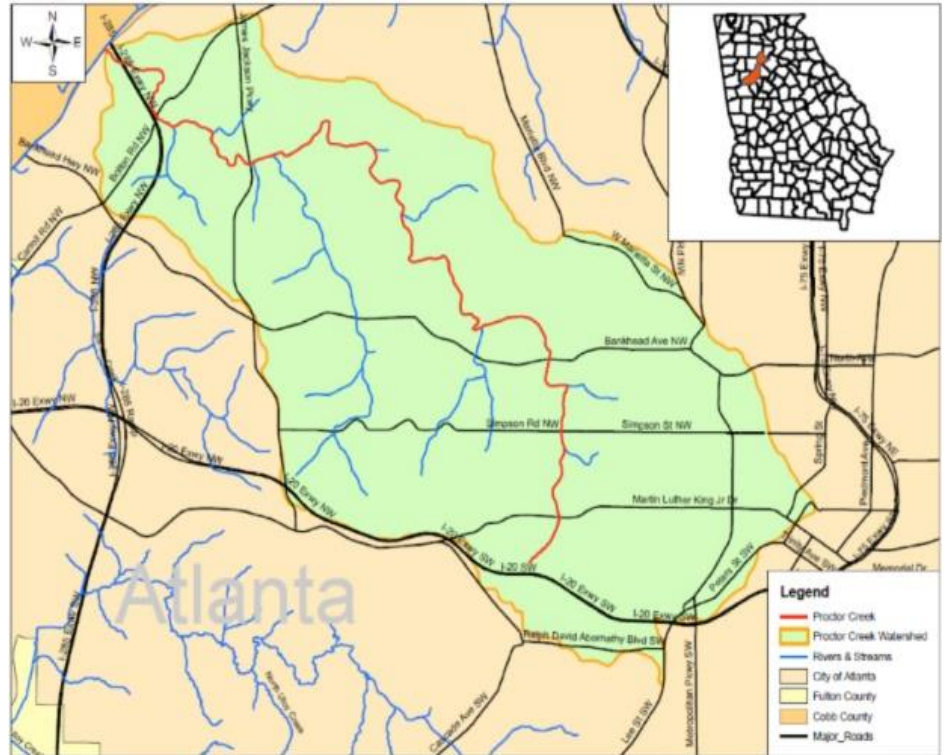
During the construction of many of the nearby sports arenas, the natural water table was disrupted. This caused massive flooding in the surrounding area through water diverted into overflowing sanitary and sewage systems. Combined with litter dumping, these overflows have damaged the ecological health of the streams, which is only now recovering.

Recent efforts have begun to revitalize the creek and community. Volunteers and members of the Chattahoochee Riverkeeper and West Atlanta Watershed Alliance, as well as USFW, USDA, and the EPA, have been working together to monitor Proctor Creek and assess its health. The nonprofit Emerald Corridor Foundation has also begun plans on Proctor Park, a 9.2-acre greenspace including a natural wetland to help to control and buffer the creek to pollution.

In 2013, the Urban Waters Federal Partnership designated Proctor Creek to be a priority Urban Waters location. Through this program, there is increased coordination and focus among federal agencies and partners on problems in the watershed. Solving these problems will lead to economic, social, and ecological revitalization in the area; ***your data through the ecological experiments we conduct in this course will contribute to these efforts.***

*For more information on the creek and surrounding watershed, see here:*

- <http://www.atlantawatershed.org/inside-dwm/offices/watershed-protection/atlantas-watersheds/the-proctor-creek-watershed/>
- <http://www.proctorcreek.org/creek-data.html>



## **Data to Collect in Lab**

You will visit two sites (Site A: Bankhead Station and Site B: Pet Heaven Cemetery) over the next two week of lab. Each week, you will be recording a bit about these sites to understand more about Proctor Creek's Ecology

1. Create a sketch of your sites. Your sketch should include at least a 10-yard section of the creek, with each of your sites as the center of the sketch. You should also include 15-yards into the riparian zone (rivers edge stretching from shore back onto land) on both sides of the water. Include and label the following items in your sketch: Direction of river flow, Presence and location of all vegetation (trees, bushes, grasses, downed trees, etc.), Presence of buildings and structures (bridges, buildings, sidewalks, roads, parking lots, etc.), Potential Point Source pollution sites (storm drainage pipes emptying directly into the river), Potential Non-Point Source pollution sites. Comment or draw arrows to any areas with high canopy coverage, unstable banks, and barriers that might trap/block organismal movement in the water (e.g. fallen trees, tires, etc.).

Site A:

Site B:

2. Conduct tests for chemical and physical characteristics of each site. Follow the directions in each kit closely as this will influence your results. Record results below. Additional space is provided below, should you wish to use the sensors or other equipment in your investigations of ecosystem health.

Site A:

Measurement	Replicate 1	Replicate 2	Replicate 3	Average
Temperature (C°)				
pH				
Nitrates (NO <sub>3</sub> <sup>-</sup> ) ppm (mg/L)				
Light (μmol s <sup>-1</sup> m <sup>-2</sup> )				
Conductivity				
Turbidity (AU)*				
Phosphates (PO <sub>4</sub> <sup>-3</sup> ) ppm (mg/L)*				

Site B:

Measurement	Replicate 1	Replicate 2	Replicate 3	Average
Temperature (C°)				
pH				
Nitrates (NO <sub>3</sub> <sup>-</sup> ) ppm (mg/L)				
Light (μmol s <sup>-1</sup> m <sup>-2</sup> )				
Conductivity				
Turbidity (AU)*				
Phosphates (PO <sub>4</sub> <sup>-3</sup> ) ppm (mg/L)*				

\*Note: These tests require bringing back at least a 50mL a sample of water to the lab.

Other Notes:



**Biological Indicators of Ecosystem Health:**

Calculating the Biotic Index of River Health (BI)

Because macroinvertebrates have different sensitivities, or tolerances, for growth and development in the presence of different forms of pollution, these **bioindicators** can be used by ecologists to assess and compare ecosystem health through time and space.

Each macroinvertebrate has a tolerance value (**a**) that indicates level of pollution tolerance. The tolerance scale is on a 0-10 ranking system, where 0 means the organism does not tolerate pollution at all and a 10 is given to an organism that can survive in very polluted waters. Thus, a macroinvertebrate with a **low** tolerance value is **not tolerant** to pollution, and a macroinvertebrate with a **high** tolerance value **can tolerate** pollution. The higher your overall Biotic Index, the more polluted the system.

*This is how to calculate a General Biotic Index using macroinvertebrates:*

- a. You counted 24 Mayflies in your sample (n)
- b. Mayflies have a Tolerance Value of 4 (a)
- c. Multiply n (24) X a (4) = 96 (*see the top row of the table below*)
- d. Repeat for each Macroinvertebrate in the entire sample
- e. Add the values in the n\*a column and divide by the total number of organisms

Calculate the Historic Biotic Index for Proctor Creek (below). Suggested completion before lab

Site: **Proctor Creek**

Date: October 17, 1963

Macroinvertebrate Taxa	Number (n)	Tolerance Value (a)	n*a
Ephemeroptera (mayflies)	24	4	96
Plecoptera (stoneflies)	35	1	
Trichoptera (caddisflies)	46	4	
Odonata (dragonflies)	18	3	
Coleoptera (beetles)	52	5	
Megaloptera (dobsonflies)	2	3	
Chironomidae (flies)	25	7	
Amphipoda (scuds)	39	4	
Isopoda (sowbug)	12	7	
	Sum n:		Sum:

Sum (n\*a): \_\_\_\_\_ / Total n: \_\_\_\_\_ = Biotic Index (BI) \_\_\_\_\_

The Biotic Index (BI) generated is then compared to a range of values that correspond to overall Water Quality and Pollution Estimates (below).

BI	Water Quality	Pollution Estimate
<3.75	Excellent	No pollution
3.75-5.0	Good	Low pollution input
5.01-6.5	Fair	Moderate pollution input
>6.5	Poor	Heavy pollution input

From your BI, what are the water quality and pollution estimates of the area historically?

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**Data to Collect in Lab**

1. Use dichotomous keys and other resources to identify the macroinvertebrates found at your site. Collect your invertebrate sample in each focal habitat using D-nets and other tools to sample the benthic community. Continue analysis by identifying macroinvertebrate organisms (take pictures for later identification/confirmation, if necessary).
2. Calculate the Biotic Index for your sample. Record your data in the blank table below. Use the above table & online references as sources for tolerance values.

Site A: \_\_\_\_\_

Date: \_\_\_\_\_

Macroinvertebrate Taxa	Number (n)	Tolerance Value (a)	n*a
	Sum n:		Sum:

Sum (n\*a): \_\_\_\_\_ / Total n: \_\_\_\_\_ = Biotic Index (BI) \_\_\_\_\_

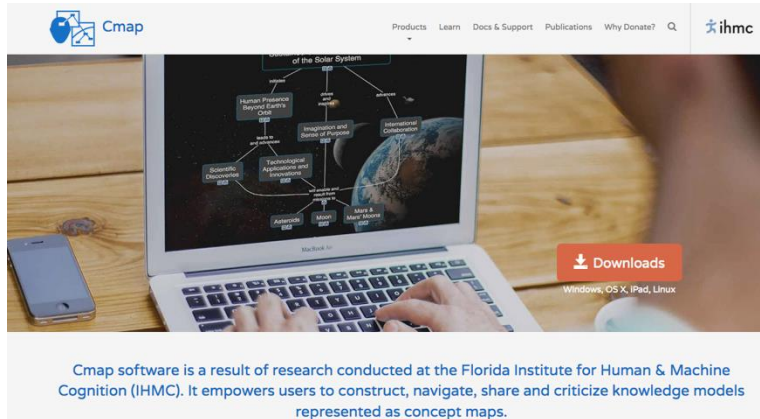




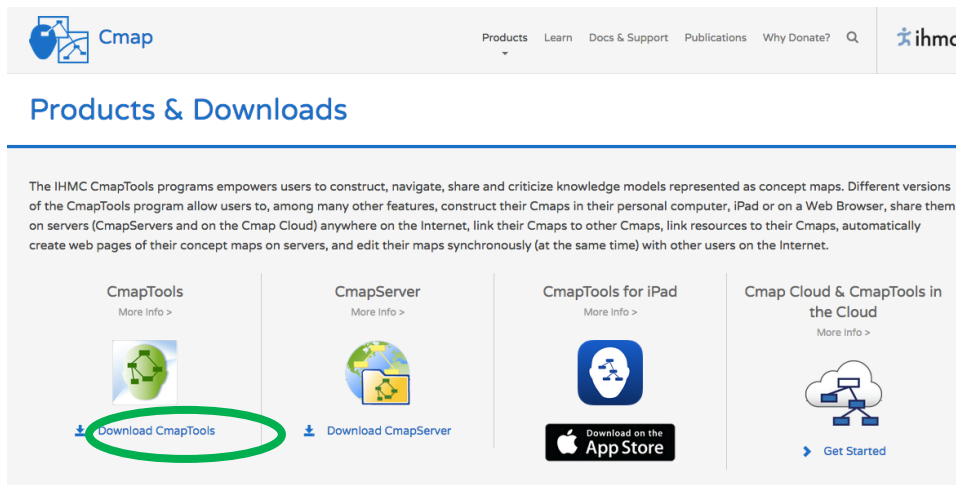
## Concept map online instructions and resources

### HOW TO DOWNLOAD CmapTools

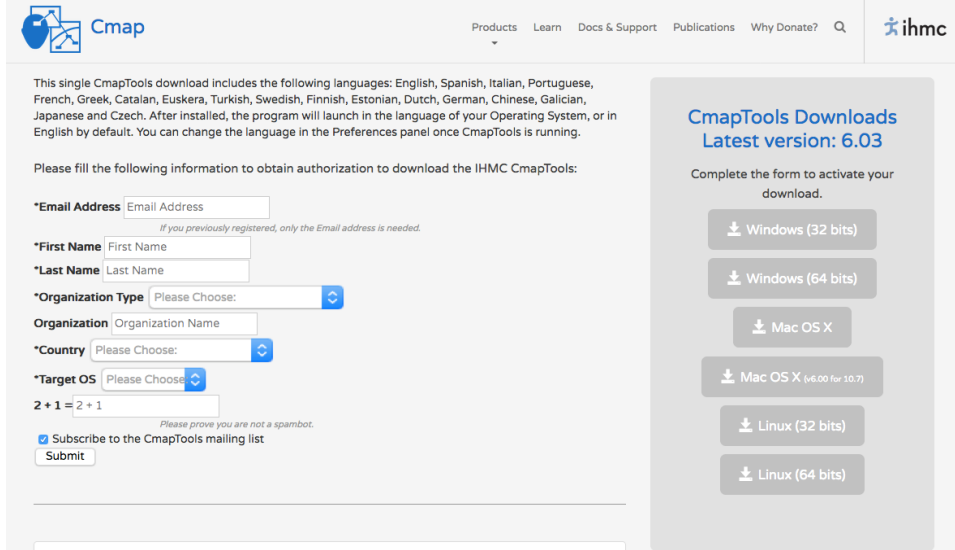
1. Go to the Florida Institute for Human and Machine Cognition website: <http://cmap.ihmc.us/>



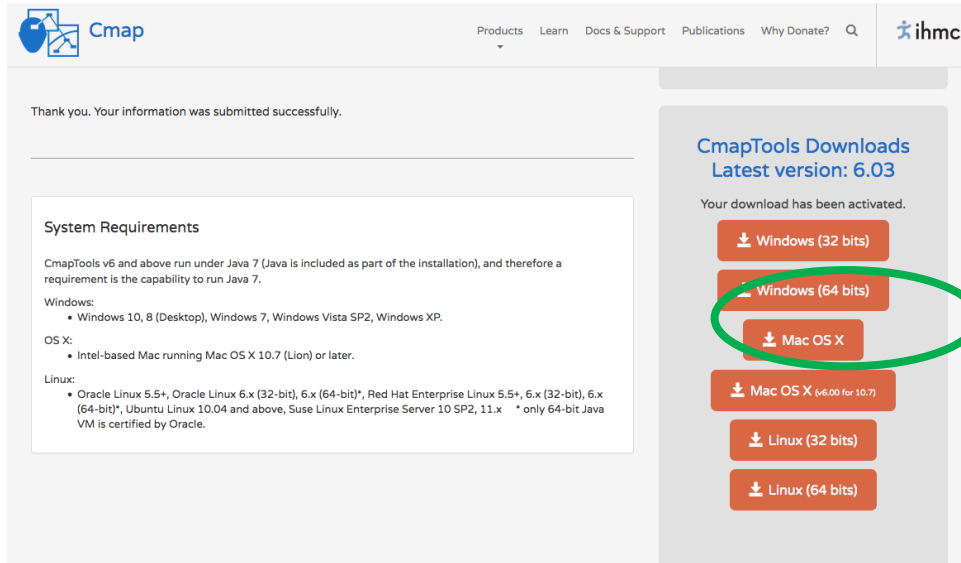
2. Click on “Downloads” and then “Download CmapTools”



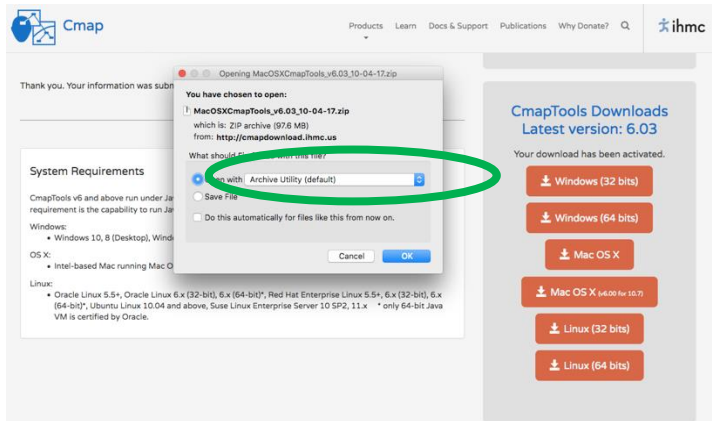
3. Scroll down and fill out the form. Provide required information: your Georgia Tech email address, first name, last name, organization type (i.e., higher education), country, and target operating system.



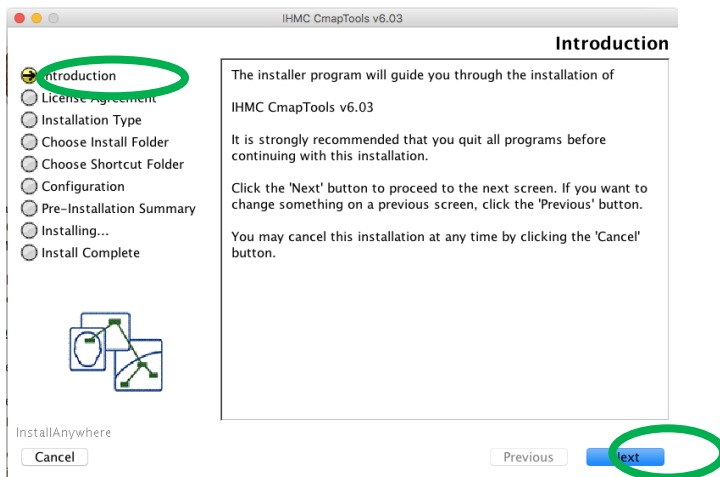
4. Select the appropriate download application for your computer. The IHMC Cmap “Windows (64 bits)” or “Mac OS X” downloads are appropriate for most personal computers. You do not need to make a donation to download CmapTools.



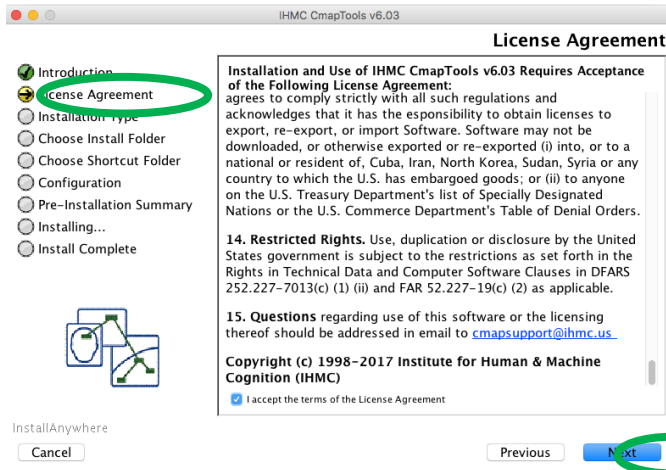
5. A box entitled “Opening Win64CmapTools\_v6.03\_10-04-17.exe“ or “Opening MacOSXCmapTools\_v6.03\_10-04-17.zip” (depending on operating system) should appear. Click on “Save File.”



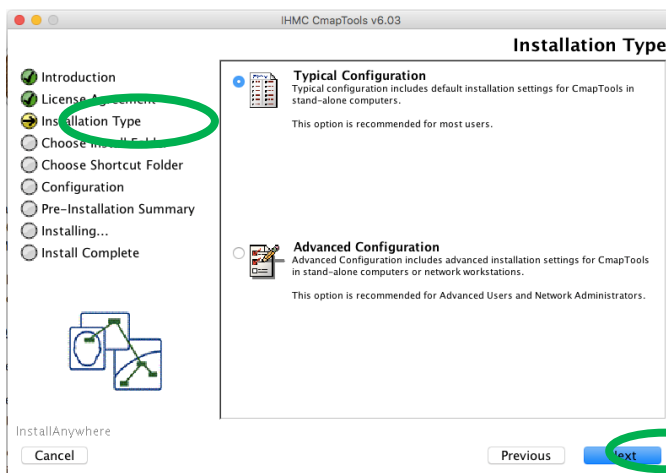
6. If you have a Windows operating system, open the executable CmapTools file from your Downloads folder or other specified directory, and then click “Run.” If you have a Mac operating system, double-click the zip file from your Downloads folder or other specified directory, and then open the newly created CmapTools\_v6.03\_10-04-17 application.
7. The download of the CmapTools installation program will begin.
8. A dialogue box entitled “IHMC CmapTools v6.03” should appear. You should start on the “Introduction” tab. Click “Next.”



9. You should now be on the “License Agreement” tab. Click “I accept the terms of the License Agreement” and then click “Next.”

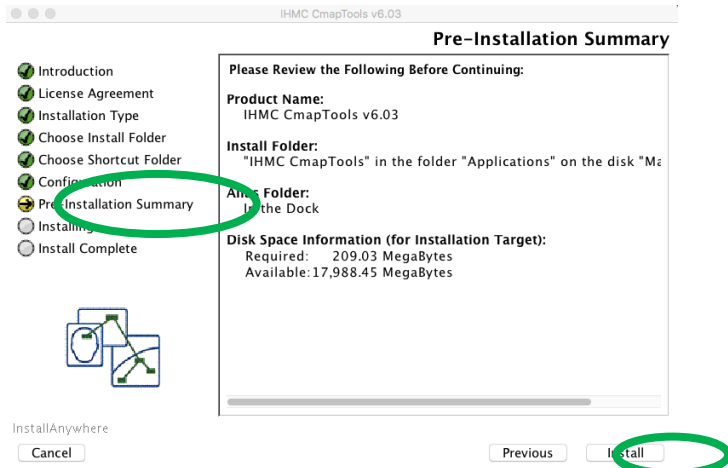


10. You should now be on the “Installation Type” tab. Click on “Typical Configuration” and then click on “Next.”

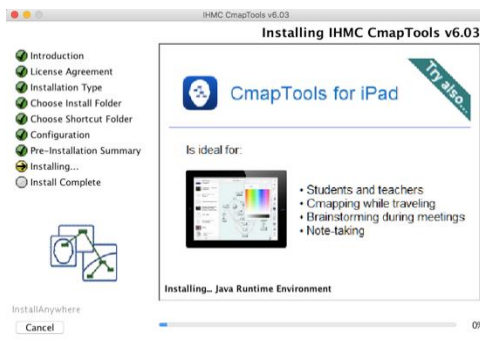


11. The installation software should automatically complete the “Choose Install Folder,” “Choose Shortcut Folder,” and “Configuration” stages and should now be on the “Pre-Installation Summary” tab. Click “Install.”

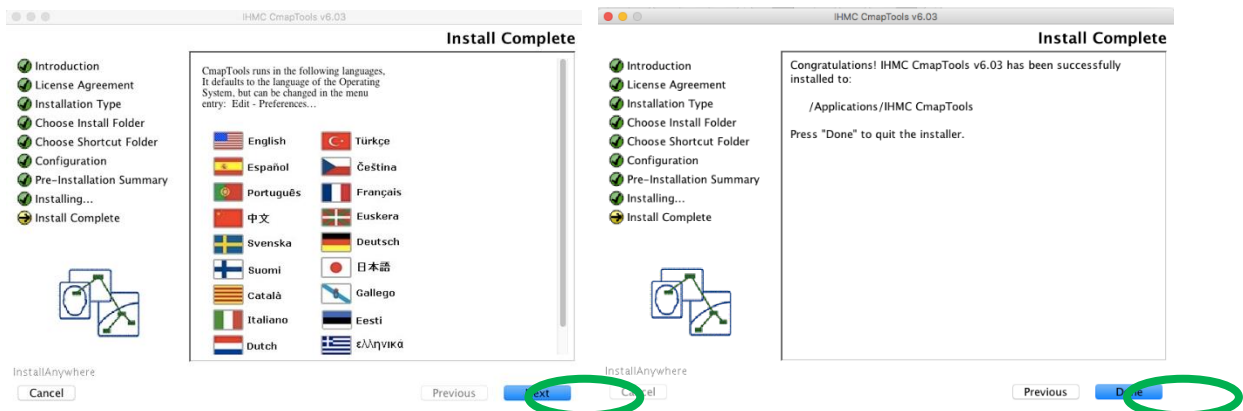




12. Installation of CmapTools should begin.



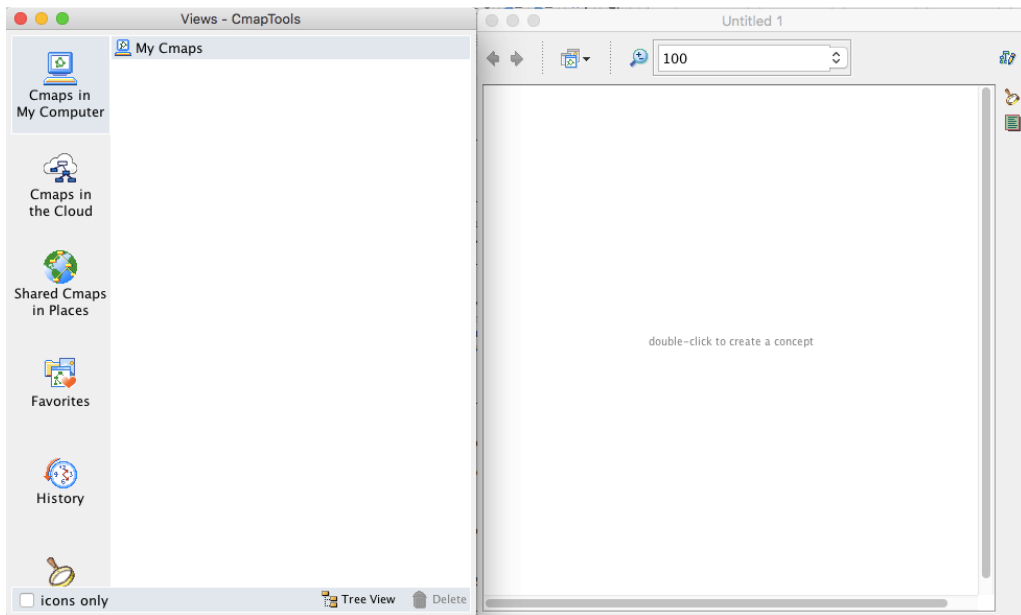
13. Once the installation is complete, click “Next” and then “Done.”



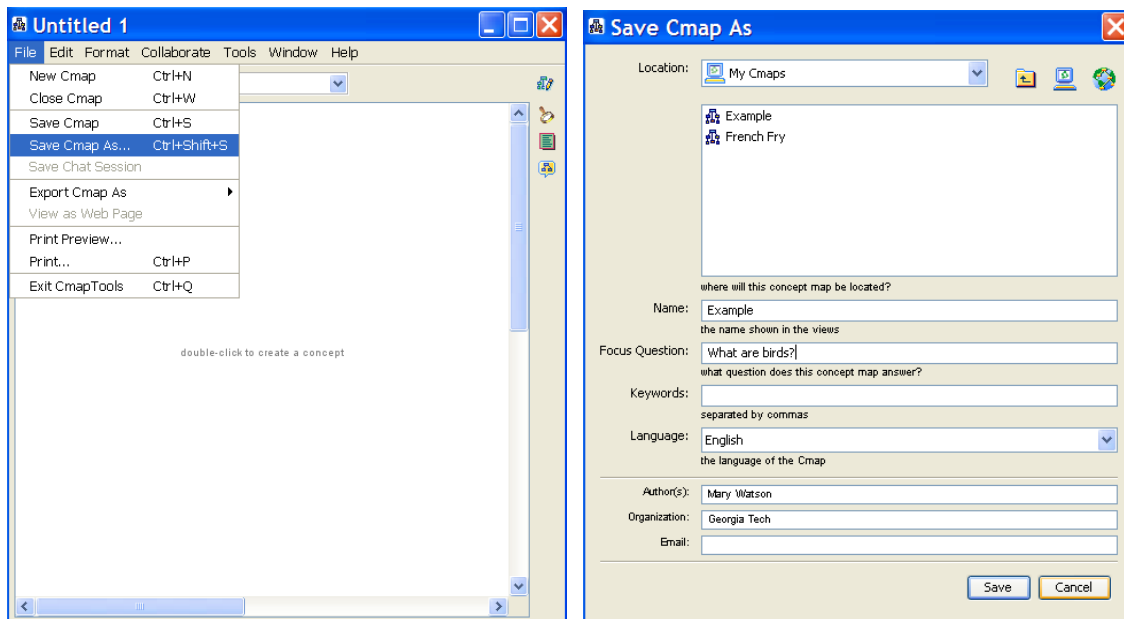
14. CmapTools is now installed on your computer.

## HOW TO USE CmapTools

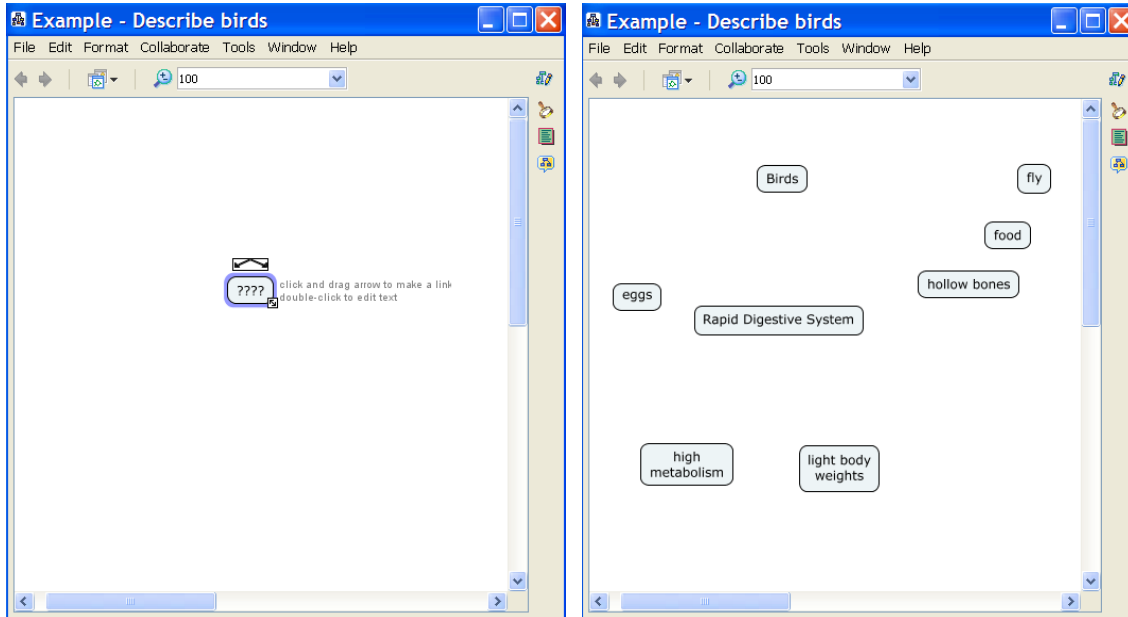
1. Open CmapTools. Two windows should appear: “Views” and “Untitled 1.” Close the “Views” window.



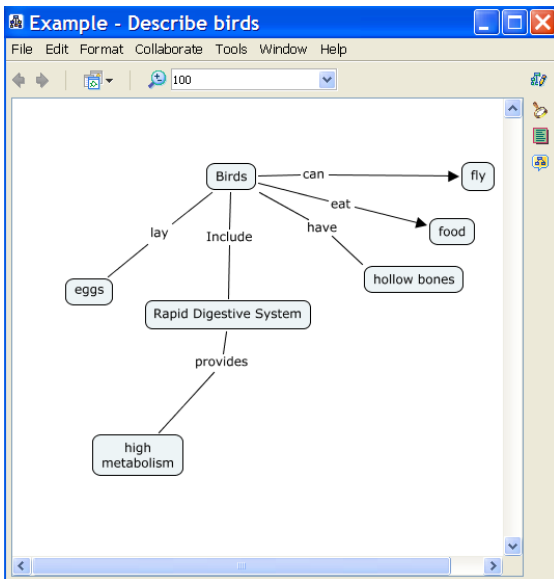
2. On the CmapTools top toolbar, select “File” and then “Save Cmap As.” On the “Save Cmap As” dialogue box, provide a file “Name” and the “Focus Question” that your concept map will address. For this demonstration, the file name is “Example” and the focus question is “Describe how birds fly.”



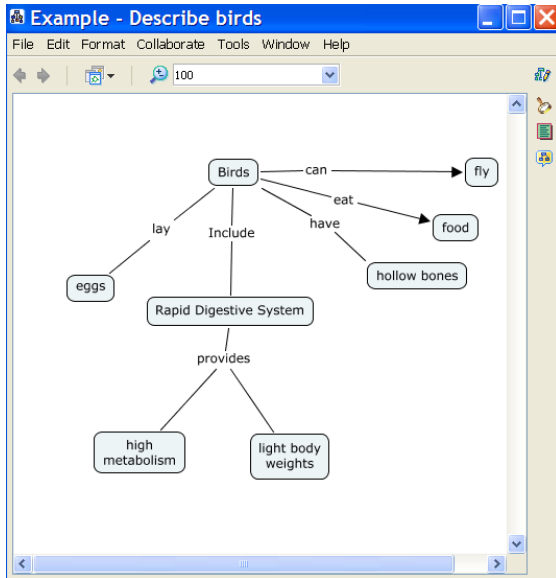
- Double-click on the modeling space to create concepts. While a newly created concept box is highlighted, start typing to replace the label of “????” with the label of your concept using keywords or phrases.



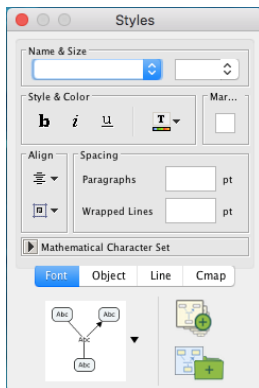
- Link concepts together to form propositions. Click on the first concept in the proposition. Click on the arrows symbol on top of the first concept. Click on the second concept in the proposition. An arrow should now be linking concepts 1 and 2. Repeat for all propositions. NOTE: Concept maps are generally read from top to bottom. By default, CmapTools does not display arrow heads for propositions read top to bottom.



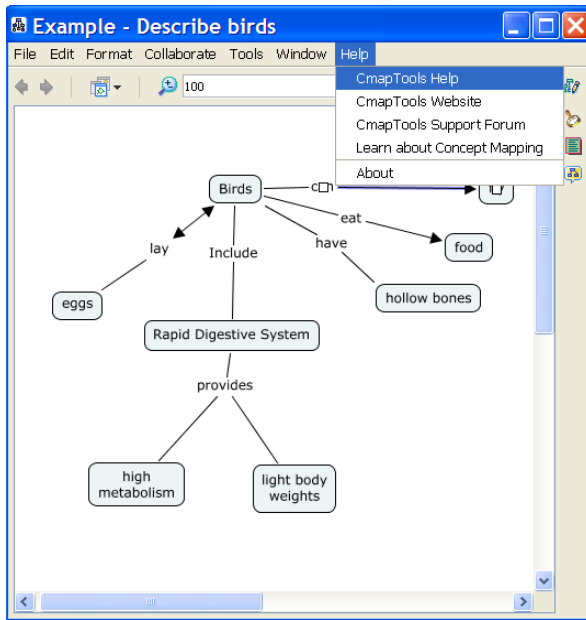
5. You may need to make branching linking lines. This is done by clicking on the description of the linking line (“provides” in the example below). Next click on the arrows symbol above the description. Click on the concept you wish to link (“light body weight” in the example below). You should now have three concepts linked together. You may repeat this process to link more than three concepts.



6. There are many other functions you can use in CmapTools. For instance if you select a concept or linking line, you can edit several of its features by using the “Styles” window. Advanced functions may facilitate but are not typically required for Cmap development.



7. For additional help with CmapTools, use the help menu. Click on “Help” on the CmapTools top toolbar. Next, click on “CmapTools Help.”



8. A CmapTools Help webpage should open. Select the topic that aligns most closely with your question.

- Using CmapTools
- Create a Cmap
- Add a Concept
- Create Propositions
- Save a Cmap
- Open a Cmap
- Create a Folder
- Working with Resources
- Print the Cmap
- View Cmap as a Web Page
- How to Change the Language
- Modify Linking Lines
- Change Colors
- Change Fonts & Sizes
- Add Arrows to Linking Lines
- Nested & Merged Nodes
- Change Backgrounds
- Create Custom Styles
- Link Propositions Between Cmaps
- Using Autolayout
- Export Cmap as an Image
- Export Cmap as a Web Page
- Send Cmap as an Email
- Using Spell Check
- Collaborate Synchronously
- Permissions & Access Control
- Copy a Cmap to Places
- Add Annotations & Info
- Discussion Threads

## HOW TO BUILD A CONCEPT MAP

1. Identify a focus topic you wish to map.
2. Guided by this question, create a list of concepts that are pertinent to the topic using CmapTools®.
3. Sort through the concepts, and move to the side any that you do not fully understand or is not related to any other term.
4. Using CmapTools®, arrange the remaining concepts in a way that makes sense to you. Terms you see as related should be kept fairly close together. One approach is to place general concepts near the top of the map and specific concepts at the bottom of the map. Other layouts may also be appropriate.
5. Draw linkages using CmapTools® between concepts you see to be related.
6. Write on each line the nature of the relation between the terms.
7. Review your map and determine if there are any more concepts you can add. You may add to the map new concepts or concepts set aside in step 3. If you do add additional concepts, you should be sure to link them to other concepts and provide descriptive linkages.
8. Again review your map. Look for cross-links, which link together concepts in different areas of your map. Cross-links will help you to elaborate how concepts are interrelated.
9. Finalize your map. Make sure that appropriate concepts are linked and that all linkages are described.

### References

Borrego, M.; Newswander, C. B.; McNair, L. D.; McGinnis, S.; Paretto, M. C., Using concept maps to assess interdisciplinary integration of green engineering knowledge. *Advances in Engineering Education* **2009**, *1*, (3), 1-26.

White, R.; Gunstone, R., *Probing Understanding*. Falmer Press: Philadelphia, PA, 1992.

## PRE-FIELDWORK CONCEPT MAPPING ASSIGNMENT

### Overview

Posted to CANVAS are materials on how to work with and download CmapTools. You will complete a concept mapping exercise to benchmark your knowledge about community sustainability. You should take no more than 30-40 minutes to finish this assignment. Note that assignment completion factors into your course grade. Please upload your concept map to the open assignment entitled "Concept Map #1". Email [emily.weigel@biosci.gatech.edu](mailto:emily.weigel@biosci.gatech.edu) with any questions. Good luck!

### Learning Objectives

1. Construct concept map using CmapTools.
2. Summarize your knowledge of community sustainability

### Concept Mapping Activity

Use the following guidelines to create your concept map:

#### Focus Question:

Create a concept map on the focus question: "What is a sustainable community?"

#### What to Include:

1. Prior knowledge from other courses
2. Work experience, internships, service activities, etc.
3. Magazines, newspapers, and other reliable media sources
4. Many other possibilities...

#### How to Create Your Concept Map:

1. Use CmapTools to create your concept map.
2. The central topic should be: Sustainable Communities.
3. Include as many concepts as you can think of that are relevant to the central topic.
4. Show as many connections as you can between concepts. Remember, each connection should include a meaningful linking phrase.

#### CmapTools Reminders:

1. Double click on the workspace to create concepts.
2. Single click on a concept and click on the arrow above to connect concepts.
3. You may use the "autoformat" option:

Format → Autolayout → Keep default settings → Generate New Layout

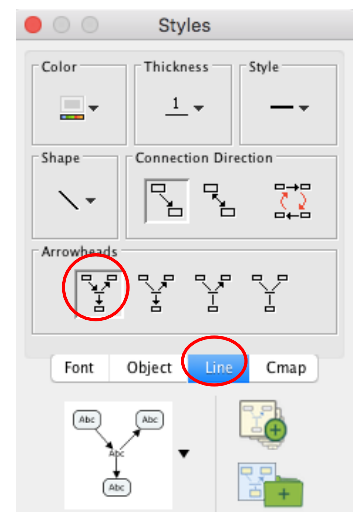
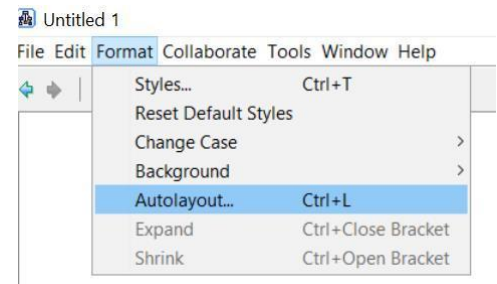
4. You may find it useful to use the "always show arrow heads" option:

Select entire cmap → go to Styles window → Format style → Click "Line" tab

→ Click the left-most option under arrowheads.

#### How to Submit Your Concept Map:

1. Save your concept map as: lastname\_firstname\_pre
2. Your concept map will be saved under: Documents → My Cmaps
3. Upload your concept map as a .cmap file to CANVAS



## POST- FIELDWORK CONCEPT MAPPING ASSIGNMENT

### Overview

You will complete a concept mapping exercise about your knowledge about community sustainability after participating in fieldwork. You should take no more than 30-40 minutes to finish this assignment. Note that assignment completion factors into your course grade. Please upload your concept map to the open assignment entitled “Concept Map #2”. Email [emily.weigel@biosci.gatech.edu](mailto:emily.weigel@biosci.gatech.edu) with any questions. Good luck!

If in need of a refresher, please open the file named “Concept Map Video + Instructions” on Canvas, which includes how to download CmapTools, a link to a training video on concept maps, and a step-by-step walkthrough on how to use CmapTools.

### Learning Objectives

1. Construct concept map using CmapTools.
2. Summarize your knowledge of community sustainability

### Focus Question:

Create a concept map on the focus question: “What is a sustainable community?”

### What to Include:

1. *Things you have learned from this fieldwork experience*
2. Prior knowledge from other courses
3. Work experience, internships, service activities, etc.
4. Magazines, newspapers, and other reliable media sources
5. Many other possibilities...

### How to Create Your Concept Map:

1. Use CmapTools to create your concept map.
2. The central topic should be: Sustainable Communities.
3. Include as many concepts as you can think of that are relevant to the central topic.
4. Show as many connections as you can between concepts. Remember, each connection should include a meaningful linking phrase.

### CmapTools Reminders:

1. Double click on the workspace to create concepts.
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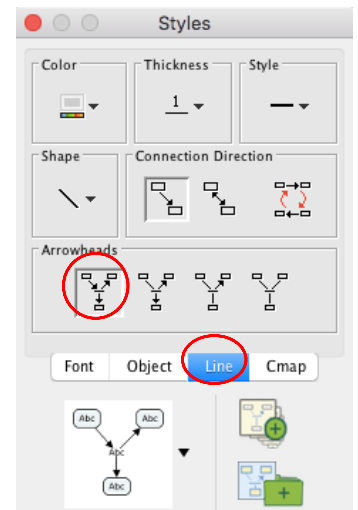
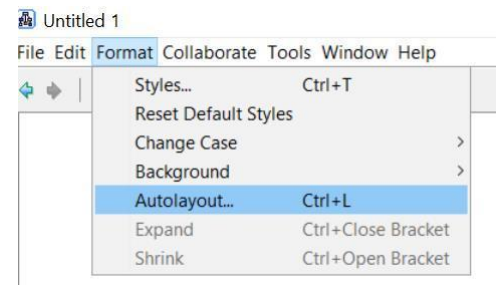
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4. You may find it useful to use the “always show arrow heads” option:

Select entire cmap → go to Styles window → Format style → Click “Line” tab → Click the left-most option under arrowheads.

### How to Submit Your Concept Map:

1. Save your concept map as: lastname\_firstname\_post
2. Your concept map will be saved under: Documents → My Cmaps
3. Upload your concept map as a .cmap file to CANVAS





## Mid-experience reflection questionnaire

Week 11 Ecology Lab  
Pre-Lab Reflection

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Name: \_\_\_\_\_  
Date: \_\_\_\_\_ Section: \_\_\_\_\_

You have now visited one area of the Proctor Creek watershed and will continue sampling at a new site this week. We ask you to now watch this video (<https://www.fws.gov/southeast/articles/life-in-proctor-creek/>) and reflect and respond to the following:

1. So far, what do your observations indicate about Proctor Creek? What information can you share with your peers or the community about your experience thus far?
2. What are some pre-existing attitudes or skills that have been helpful during this experience? What have you needed to adjust to or learn, and how have you done it?
3. What have you learned about yourself or your values as a result of this experience?
4. What are some broader social, cultural, and political issues you think your Proctor Creek experience will bring up (or has already brought up)? How does this experience fit into your broader understanding of Georgia Tech? Atlanta?
5. What is the relationship of your experience at Proctor Creek to the "real world?" To being a biologist?