



## Curriculum for the Bioregion<sup>1</sup>

### Mapping the Socio-Culturally Sustainable Classroom

This multi-day activity is appropriate for students studying education, math, sustainability, criminal justice, sociology, business systems, political science, etc.

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### Summary

Through the creation of a concept map students in a Masters in Teaching program will use mathematical ideas, including spatial and proportional reasoning, to view the classroom as a component of a closed and sustainable system.

In this student-centered, multi-day, active learning assignment; students will use mathematical ideas to view the classroom as one component of a larger closed and sustainable system. Students will have an opportunity to see that sustainability does not simply mean whether or not something can last. Sustainability also addresses how particular initiatives can be developed without compromising the development of others in the surrounding environment, now and in the future (Hargreaves and Fink, 2000).

By constructing spatially accurate concept maps that depict the socio-cultural relationships and systems within classrooms, locating the teaching role within a layered, multifaceted and ideally sustainable system, participants will add to their view of sustainability as the capacity of a system to engage in the complexities of continuous improvement consistent with deep values of human purpose (Fullan, 2004). Students and faculty will assess student learning by pre and post tests with the first and final draft of the group-generated concept maps and written metacognitive self-reflection. Mathematical components include scale, spatial and proportional reasoning, and graph theory. At the culmination of

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the lesson, students will engage in a metacognitive activity and develop a concept map of the multi-day lesson.

## Short Description

This activity is for students to use mathematical ideas to view the classroom as a component of a closed and sustainable system. A student-generated concept map, which is the primary mathematical idea of this activity, will include additional mathematical concepts including spatial reasoning (how does locating the topics in the concept map impact meaning and how does the directionality of the concept map impact meaning) and proportional reasoning (how does the size – area and/or diameter- of the topic in the concept map and the proximity of different topics impact meaning).

## Learning Goals and Big Ideas

Students will use mathematical ideas, including spatial and proportional reasoning.

This multi-day activity supports the realization and understanding that continuous improvement, consistent with deep values of human purpose, is an important aspect of a healthy sustainable socio-cultural relationship and/or system.

They will see that sustainability does not simply mean whether or not something can last; it also addresses how particular initiatives can be developed without compromising the development of others in the surrounding environment, now and in the future.

Students will learn how to create concept maps.

**Key words:** spatial reasoning, concept map (graph theory), proportional reasoning, systems thinking

## Context for Use

The activity will be imbedded in the second quarter of a six-quarter Master in Teaching program at The Evergreen State College. Students will have addressed issues of sustainability during fall quarter. During fall quarter, students will read, analyze, synthesize, discuss, and write about numerous readings related to teaching and sustainability. The anticipated time frame for the lesson is a three-hour workshop on three successive weeks.

**This activity is applicable to** any discipline that includes topics of socio-cultural structures and systems, such as criminal justice, sociology, business systems, political science, etc.

## Description and Teaching Materials

**A concept map is:** a diagram showing the relationships among concepts. They are graphical tools for organizing and representing knowledge used to communicate complex ideas and transform tacit knowledge into an organizational resource. When used in instructional design, concept maps provide an initial conceptual frame for subsequent information and learning. As a mathematical idea, graph theory can be defined as the study of mathematical structures used to model pair-wise relations between objects from a certain collection. The concept map is a graph made up of a collection of vertices and a collection of *edges* that connect pairs of vertices. A concept map graph may be *undirected*, meaning that there is no distinction between the two vertices associated with each edge, or its edges may be *directed* from one vertex to another. Introductory graph theory is commonly found in Discrete Mathematics and Contemporary Math classes. The concept map graphs created in this activity should not be confused with graphs of functions or other, more familiar, types of graphs.

**As a part of this activity**, students will participate in two faculty-lead presentations focusing on introductory graph theory, and spatial and proportional reasoning.

Students will read, analyze, synthesize, discuss, and write about numerous readings related to teaching and sustainability. The anticipated time frame for the lesson is a three-hour workshop on three successive weeks.

These readings will be assigned to help develop students understanding of sustainability in educational settings, systems thinking, and mathematical ideas.

Please see the **attachments** “*Schedule for Students and Teachers*” and “*Questions, Reflections and Homework*” for more details and use as teaching materials.

### Sustainable Classrooms

- *Learning Organizations for Sustainable Education Reform*  
Journal article by Lauren B. Resnick, Megan Williams Hall; *Daedalus*, Vol. 127, 1998

### Sustainable Leadership

- *Sustainable leadership*. A Hargreaves, D Fink - The essentials of school leadership, 2005 (PDF)
- *Education for sustainable development toolkit*  
R McKeown, C Hopkins, R Rizzi - Retrieved October, 2002 - es.lavola.com [PDF]

Students will also read about systems thinking. Perhaps:

- *Fifth Discipline* by Peter Senge’s (which we did in the 2009 cohort), and be able to identify the ways in which education operates as a system, and

where they fit in the system, and ways they act will keep the system in tact, or perhaps make a change (perturbation) in the system.

- *Thinking in Systems* by Donella Meadows.
- *Statistical Reasoning for Everyday Life, Second Ed.* Bennett, Briggs, and Triola. Addison Wesley. 2003. Sections 3.3 and 3.4
- *Discrete Mathematics: Mathematical Reasoning and Proof with Puzzles, Patterns, and Games.* Ensley and Crawley. T. J. Wiley and Sons. 2006 7.1, 7.5, and possibly 7.4

Faculty may assign other readings specific to education that address systems thinking and sustainability issues.

Faculty have imbedded pedagogical strategies in the lesson to provide multiple entry points for diverse learners and maximize student learning.

## **Attachments**

- **Schedule of Activities for Students and Teachers**
- **Questions, Reflections, and Homework**

## **Teacher Notes**

This teaching team won't teach this module until the 2011-12 academic year.

## **Assessment**

Students and faculty will assess student learning by pre and post tests, with the first and final draft, of the group-generated concept maps and written metacognitive self-reflection. Faculty members are in the process of developing an evaluation rubric.

## **References and Resources**

Students may choose to access information about local/regional/state/federal educational systems.

Faculty may assign other readings specific to education that address systems thinking and sustainability issues.