Suggested Curriculum Plan – Urban Ecosystems for Earth System Science

Topic:	Urban Ecosystems	Grade Level	Middle/High	Subject	Science
Theme:	Introduction to Earth System Science & Urban Ecosystems (& Sustainability)				
Timeline:	Suggested study period of one to four weeks or special topics offering				

Principle Understanding Desired

(Urban Ecosystems and Environmental Hazards)

- Urban regions contain a wide variety of ecosystems with multiple relevancies
- Ecosystems respond in different ways to weather/climate & environmental conditions/hazards that affect lives and property
- To understand ecosystems and their responses, measurements are necessary to quantify their attributes, behaviors, and characteristics
- Diagnosis and Prediction of current and future ecosystem behaviors depends upon scientific principles applied to specific questions and locations
- Consideration of ethical, legal, socio-economic, cultural, and political views is necessary when applying science to issues or problems affecting people's lives and property and in order to provide sustainable systems

Questions to be Considered

(Urban Ecosystems: Who, What, Where, How, When, Why)

- What defines an ecosystem? What are its components? What are its benefits? Hazards? Is it sustainable?
- How do people interact with, and are affected by, various ecosystems and phenomena? What impediments exist to sustainability?
- How are urban ecosystems measured? How is this used to quantify their behaviors? What is the associated costs (economic, political, cultural, et cetera)
- What responses do ecosystems have to changing environmental conditions and why? How do these impact sustainable solutions?
- Can these responses be changed? Are these responses avoidance, mitigation, or prevention? How are these assessed? Are these robust in time and space?
- Why is diagnosis important? How is diagnosis used in response?
- How is prediction accomplished? How reliable is it and why (not)?
- What are the limitations on diagnosis and prediction? Why?
- How is scientific information used when applied to real issues or problems?
- What is the cost-benefit of scientific investigation or prediction?
- How is scientific investigation or prediction assessed or evaluated in terms of its effectiveness?

Selected Objectives
(Urban Ecosystems as the Scientific Method)
Students will know and/or be able to accomplish… ❖ Geosphere components as related to urban ecosystem settings & sustainability. ❖ The use a systems approach to apply the Scientific Method to ecosystem studies. ❖ Consider scientific literature and studies as a guide to investigation. ❖ Pose and find problems or issues of relevance in urban ecosystems. ❖ Consider sustainable solutions and their associated components. ❖ Measurement of urban ecosystems through direct observations. ❖ Integration of datasets and manipulation of data for statistical & physical understanding and conceptual model development. ❖ How to develop and test hypotheses developed based on data collection and analyses and concept mapping. ❖ Mapping and plotting of data in time and space for illustration and/or explanation. ❖ The limits and/or constraints imposed by their assumptions and datasets. ❖ How to evaluate diagnostic and predictive information for varying purposes. ❖ Develop new questions arising from investigations and conclusions. ❖ Consideration of cost analysis and impediments to change/implementation.
Relevant Content & Relationships
(Urban Ecosystems as a basis for scientific investigations)
Scientific method, quantitative data, qualitative data, classification, prediction, interpretation, inference, geosphere, atmosphere, hydrosphere, lithosphere, biosphere, hypothesis, procedures and methods, variables, graphing and plotting, analysis, conclusion and applications, assessment/evaluation, and literature/resource gathering (peer review). Problem identification and solving in a cross-, inter-, and trans-disciplinary manner with competing interests.
Resources/Materials
(Urban Ecosystems as a community concern)
Science textbooks, online (state, government sites; educational sites); human resources (i.e. as references/sources); observational equipment/instrumentation; datasets; and the development of critical analysis and assessment tools appropriate to the problem studied.

Instructional Strategies/Sequence	
(One to Four Weeks; Twice per week)	
Prior Knowledge (or what students know)	What is an ecosystem? What are its components? What factors determine and affect its behaviors? How? Why? How does it relate to a sustainable system? How does an ecosystem affect people? How serious are these impacts? Can these impacts be avoided, mitigated, or prevented? How?
Motivation (the hook)	Opportunities provided for students to 'build' conceptual model of what an urban ecosystem is, how it operates, what happens in it, and how these relate to their own and other activities by those in the biosphere. Compare/contrast systems.
Learning Activities	1. DO NOW – Discussion/Written answers to questions in prior knowledge (or hands-on assignment to review online/other resource to distinguish ecosystem components and variations, particularly in local region) 2. Later 'DO NOW' activities determined by length of timeline and depth of study for unit. 3. Students consider how to quantify/measure system in scientific and personal terms (qualitative) and why both important/essential. 4. Students gather data (field and/or online) using instrumentation. 5. Data analysis for errors, consistency, graphing, plotting, & interpretation. 6. Students define impacts of environmental conditions and hazards. 7. Impact avoidance, mitigation, and prevention weighed and methods to affect each are presented/defended/tested. 8. How to predict ecosystem phenomena and how to use that information. 9. Understanding what it means to be "sustainable" in an urban ecosystem. 10. How to incorporate sustainability "thinking" in problem solving.
Closure	Relate studies to personal life/situations and current events in the news.

Homework	Students collect information about their ecosystems. Students quantify their home/neighborhood ecosystems. Students identify sources and resources of data and information on systems. Students graph, plot, and analyze collected data/information from class/lab. Students debate solutions/reactions to environmental conditions & hazards. Students develop criteria to establish effectiveness of solutions & cost. Students predict & assess predictions for their accuracy, reliability, usefulness. Students practice sustainable solutions at home and in school and evaluate them.
Assessment	Breadth & depth evaluated for each phase/step covered. Logic and application of science and scientific principles/methods scored on simple rubric. Peer evaluation at various steps to determine justifications and robustness of solutions/answers. Test/Evaluate according to relevant science standards (national and state level).