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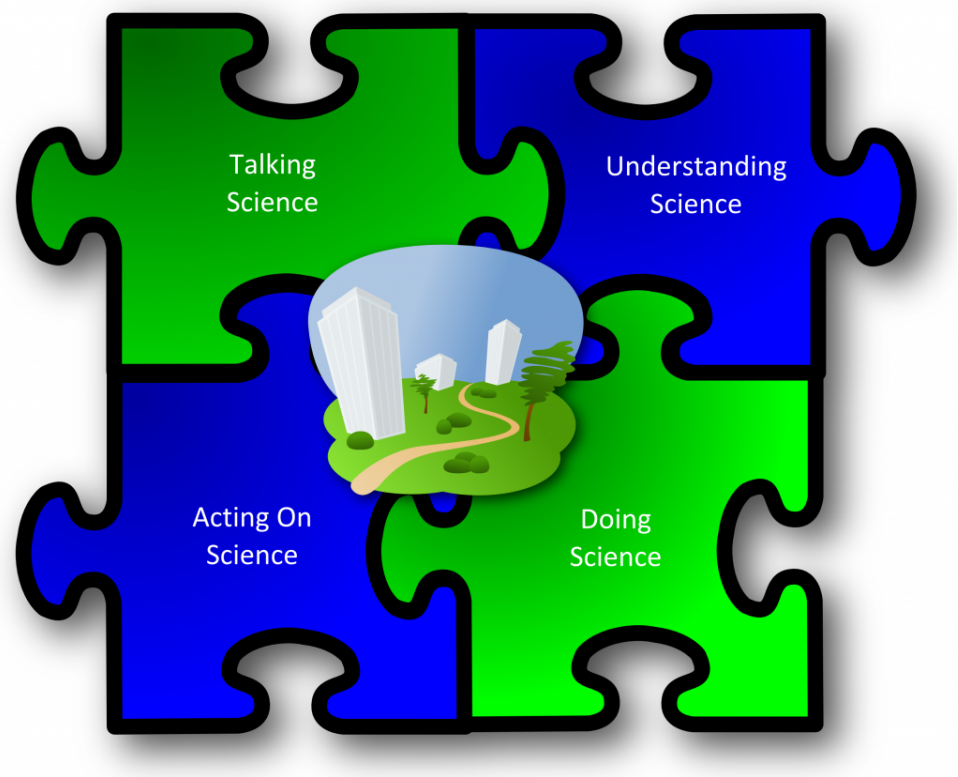
Four Ways of Knowing Urban Ecology



The Four Ways of Knowing Urban Ecology not only provide a conceptual knowledge base upon which students can build, but also provide a framework for using and communicating that knowledge. We have found the Four Ways to be a helpful guide for planning learning goals, selecting materials, shaping activities, and structuring assessments. They also connect very well to the new and emerging skills necessary to participate in scientific life in the 21st century.

Understanding Science provides the conceptual knowledge base for students to understand science content. Understanding science in the 21st century requires that we integrate the different fields of science and consider the social aspects of how scientific understandings are acquired and applied. With this interdisciplinary approach, Understanding Science provides a solid framework to help students develop the 21st century skill of systems thinking.

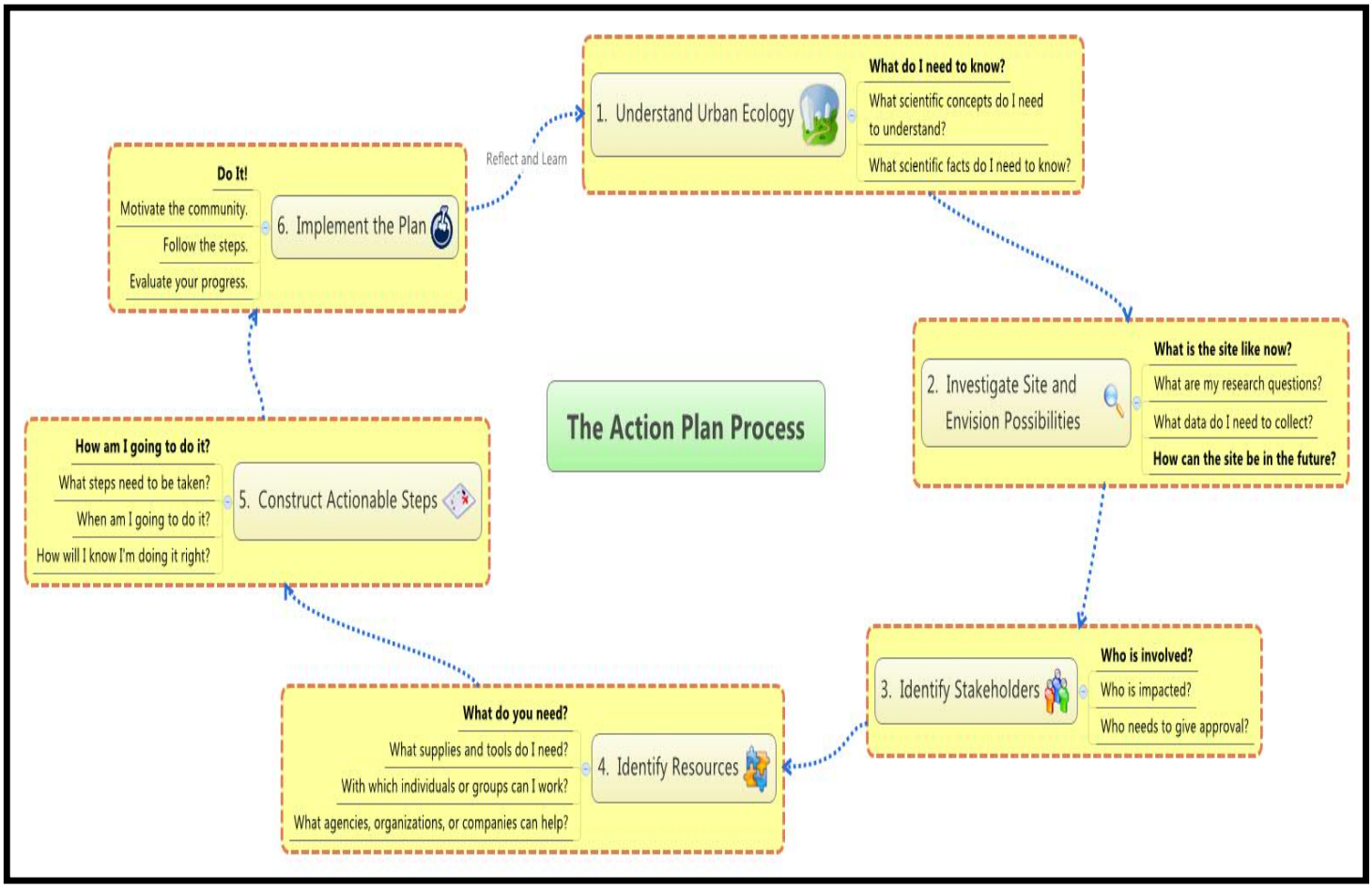
The goal of Doing Science is to provide students with inquiry-based authentic experiences of conducting research such as developing research questions and collecting and analyzing data. Through these experiences and activities, students develop a number of 21st century skills, including adapting to the real-world conditions of an outdoor study site or laboratory, learning and developing non-routine problem solving skills, and self-management and self-development skills in order to conduct research and complete an authentic scientific task.

Talking Science is an important, yet frequently overlooked, Way of Knowing in the 21st century. Talking science involves learning to communicate scientific information differently to different audiences while maintaining fidelity to the findings and interpretations of science. This includes learning to use scientific argumentation to make claims backed by evidence utilizing appropriate scientific terms and concepts. This also includes learning to communicate scientifically-based knowledge to a non-scientific audience, such as peers, community members, and policy makers. Activities such as role playing various participants at a community meeting in which an environmental issue is discussed or engaging in scientific argumentation to make the case for a finding made in the field are examples of Talking Science. Such activities help students develop complex communication and social skills.

Acting on Science brings many of the 21st century skills together. There are many ways to act on science, but the action planning framework (Figure 2) is one systematic approach that we developed to address this Way of Knowing Science. The action planning framework provides a guided pathway for students to engage in having a positive impact in their school or communities.

Action Planning Framework

The action planning framework starts with students gaining a deep and thorough understanding of scientific processes and concepts. Next students investigate the site they wish to improve using sound data collection methods as well as envision ways the site can improve. Students then identify the people and stakeholders who need to be involved in the process and seek out resources, from tools and materials to people who can help. Constructing concrete and actionable steps to complete the process as well as determining markers of success is the next stage of the process. The last step of the framework is implementing the plan, and putting ideas into action.



Action Planning Framework

1. **Science Knowledge:** What do we need to know in order to understand the site? What science concepts and facts do we need to draw upon in order to write up our action plan?

2. **Investigate Site:** What's the site like now? You may use several different ways to describe the site, through the scientific data you will be collecting, written descriptions, photographs, drawings, etc.

3. **Envision Possibilities:** How could your site be? Can it be maintained so that environmental and ecological health is sustained, or can the site be improved to make the site even better for the ecological community, and the neighborhood around the site?

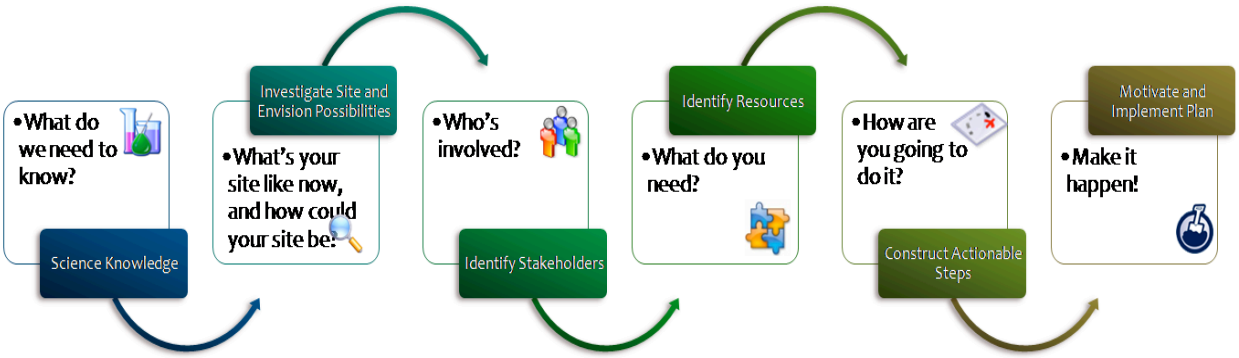
4. **Identify Stakeholders:** Who's involved? Who is impacted by the action plan, and who needs to approve it? Who owns the site?

5. **Identify Resources:** What do you need to make your plan happen? What materials do you need? Are there any community or city-wide organizations or agencies who might be able to help? Are there any companies, stores, or agencies which might donate supplies, time, or money?

6. **Construct Actionable Steps:** How are you going to make it happen? What can be done? When can you do it? vii. Motivate and Implement: If you're able, motivate everyone to get involved, and make it happen!

Working Through the Action Planning Framework

You and your research team must investigate your field site/habitat, record and analyze data, and recommend an action plan for sustaining or increasing biodiversity in your community. Your goal is to increase the biodiversity by altering current conditions. To do this you must use your knowledge of cities as systems and the needs of an urban ecosystem. To decide what should be done, you will create an action plan. Below is a figure of the components that make up an action plan.



- **Science Knowledge**- the scientific information needed to make changes
- **Investigate Site and Envision Possibilities**- goals for the site changes
- **Identify Stakeholders**- the people involved in the changes
- **Identify Resources**- materials needed to make changes
- **Construct Actionable Steps**- the process to make your planed changes
- **Motivate and Implement Plan**- making the changes happen

To brainstorm your ideas on how to manage sustain or increase biodiversity, answer the planning questions below. **Remember: There is no "correct" answer. Each group may have a different plan.**

Science Knowledge:
What science do I need to know?

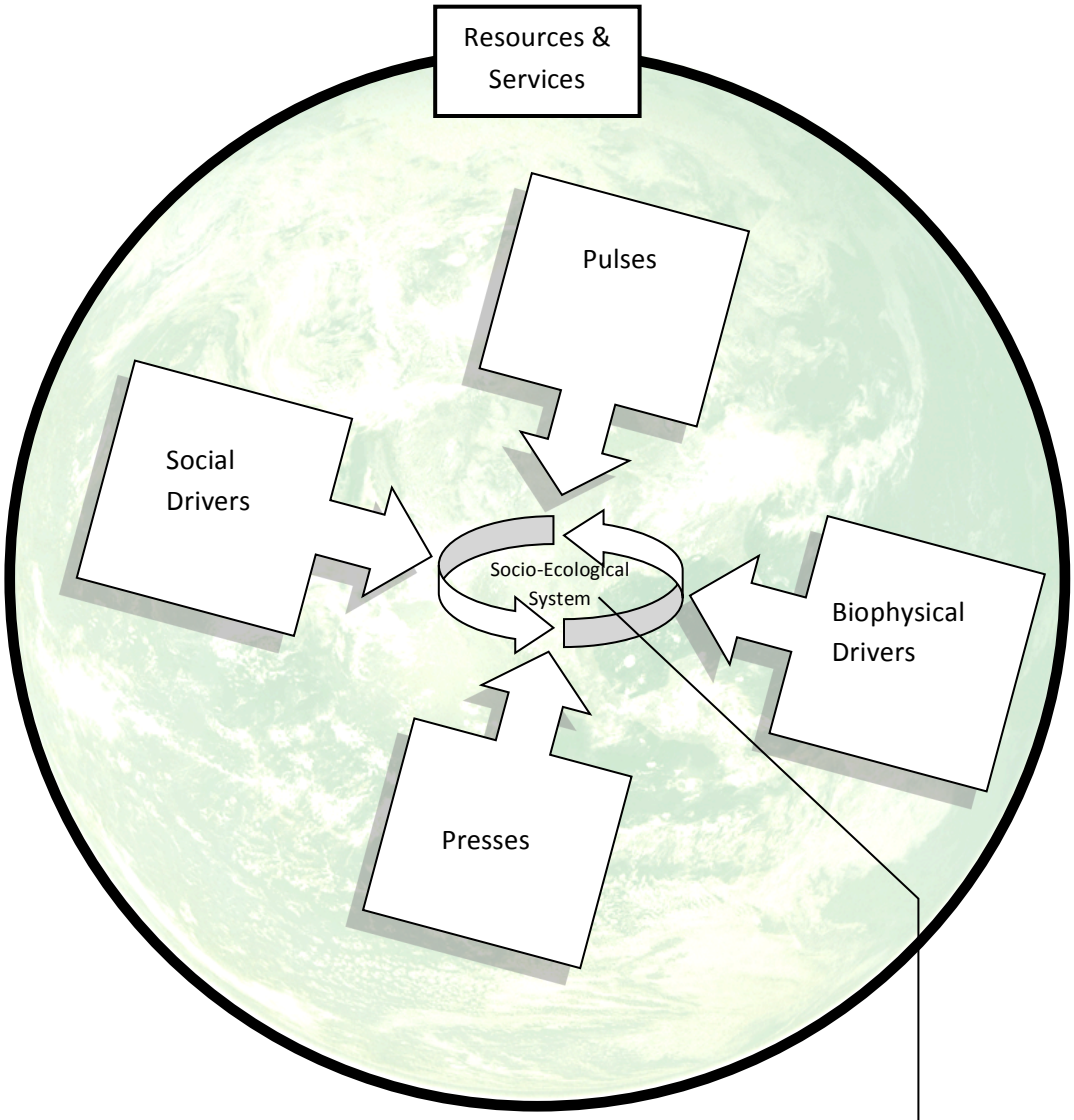
Investigate Site and Envision Possibilities:
What can I change about my community to increase or sustain biodiversity?

Identify Stakeholders:
Who can help make changes in my city?

Identify Resources:
What resources are needed to make my changes?

Construct Actionable Steps:
What steps are needed for my action plan?

Forces and Drivers in the Urban Ecosystem



Scientists measure the health of these systems by investigating *processes*, *patterns*, and *changes*.

Field Site Criteria

Physical Observations of a Site

The bulk of the data that students will gather during the site survey will be on the physical aspect of the site. This includes what does is look like, what does sound like, what are any other unusual characteristics around the site.

Weather

Current weather conditions are important in determining if events occurring at your site are typical or circumstantial. A recent storm event or even just a moderate amount of rain can affect the plants and animals along with river depth, width, and flow. Cold and/or cloudy conditions can influence the presence and activity of plants and animals.

Plants and Animals

Humans also have an effect on the presence of specific plants and animals found in open areas. Field study sites will vary depending upon how much landscaping has been done in the area. Sites may vary from being wild and overgrown to being garden-like.

Terrestrial Habitats

There are many different habitats that make up terrestrial environments. Habitat is the place or type of environment where an organism typically lives. These are defined by the predominate features of the area. For example, forest habitats are dominated by tree species while grasses dominate in field habitats.

Trash

Trash is present at many sites and should not be seen as a deterrent to conducting ecological studies. Even pristine sites have trash in the form of soda bottles that float down stream or a plastic bag that has been snagged in a tree. Have students think about their own habits regarding trash and how trash can affect an area, both visually and ecologically.

Field Site Criteria

Pollution

No sites remain untouched by humans. Even those sites termed ecologically pristine are not free from human impact. Identifying sources of pollution at a field site will help answer questions about behavior and distribution of the organisms found there. Some sources of pollution found outside of the bounds of the site may still have an impact on things within the site. For example, an industrial pipe upstream may have a large impact on the stream's health. Best guess estimates should be used to complete this section.

URBAN ECOLOGY FIELD STUDY GUIDE

MAKING AN OBSERVATION	DEVELOPING A HYPOTHESIS
NAMING THE PROBLEM	DEVELOPING A FORMAL RESEARCH QUESTION

SCIENCE ACTIVITIES FOR ENGLISH LEARNER SUPPORT

SCIENCE IN ACTION		
ROUTINE	**DESCRIPTION**	**PURPOSE**
Urban Ecology Field Study	1. **Making an Observation** Encourage your students to examine the field site widely without preconceived notions or expectations. Have students focus in on one or more points of interest. 2. **Developing a Hypothesis** Support your students in developing a logical link between what they observed and what they think is happening. 3. **Naming the Problem** Support your students in describing the issue or challenge succinctly. 4. **Developing a Research Question** Support your students in coming up with a testable research question that can be investigated.	• Engage students in authentic scientific inquiry experiences. • Foster students' habits of developing testable research questions based on initial evidence. • Familiarize students with the practices of science professionals at a developmentally appropriate level.
Four Ways of Knowing Science	1. **Understanding Science** – Provide the conceptual knowledge base for students to understand science content. This is the core content knowledge associated with the activity. 2. **Doing Science** – Provide students with inquiry-based, often hands-on, authentic experiences of conducting research such as developing research questions and collecting and analyzing data. 3. **Talking Science** – Support and encourage students in using scientific argumentation (making claims based on evidence and using the appropriate scientific terms	• Explicate the full range of inquiry practices, i.e. drawing on content knowledge, hands-on, interactive activity, argumentation and explanation, and implementing informed action for change. • Extend the traditional beliefs of scientific inquiry as only hands-on,

SCIENCE ACTIVITIES FOR ENGLISH LEARNER SUPPORT

SCIENCE IN ACTION		
ROUTINE	**DESCRIPTION**	**PURPOSE**
	and concepts) and communicating scientific information differently to different audiences while maintaining fidelity to the findings and interpretations of science. **4. Acting on Science** Support students in using their growing scientific understandings to mobilize positive change in their schools or communities.	student-led activity.
Action Planning	1. **Science Knowledge** What do we need to know? The scientific information needed to make changes. 2. **Investigate Site and Envision Possibilities** What is your site like now and what could your site become? The goals for the site changes. 3. **Identify Stakeholders** Who is involved? The people involved in the change-making process? 4. **Identify Resources** What do you need? The materials needed to make changes. 5. **Construct Actionable Steps** How are you going to do it? The process to make your planned changes. 6. **Motivate and Implement Plan** Implement the plan and make the changes happen.	• Scaffold the most novel and ambitious component of scientific inquiry (acting on science) into discreet steps with clarified questions of purpose.