LESSON PLAN

Course: Green Technology IV (or similar upper-level environmental science course)  
Instructor: Gregory Rusciano

TOPIC: Stream Ecology  
(with Stream Visual Assessment Protocol culminating project)

STANDARD(S) & INDICATOR(S):
Science:
5.4.8.G.2. Investigate a local or global environmental issue by defining the problem, researching possible causative factors, understanding the underlying science, and evaluating the benefits and risks of alternative solutions.

OBJECTIVE(S): Students will be able to:
1. Understand the ecological components of a stream.
2. Identify the difference(s) between a healthy stream ecological system.
3. Assess a nearby stream using Stream Visual Assessment Protocol (SVAP) as a culminating project/lab report.
4. Formulate solutions to environmental problems that lead to stream ecology degradation.

MATERIALS:
• Digital camera
• Outdoor clothing
• Clip board with blank SVAP worksheets
• SVAP manual
• SVAP “cheat sheet” photo guide
• Invasive plant species field guide
• Binoculars (optional)
• 100 foot tape measure or measuring wheel (optional)

LIST OF HANDOUTS (attach original copies of each handout)
• SVAP worksheet

BACKGROUND INFORMATION:
Stream Visual Assessment Protocol (SVAP), developed by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) is a method for quickly assessing streams so that they may be prioritized with regard to protection and restoration plans.
SVAP provides useful preliminary data that may lead to more extensive physical, chemical and biological monitoring. SVAP can be conducted by anyone and it is often used to train volunteers and farmers as the first line of defense. Since anyone can use SVAP, it becomes a great tool for the classroom. It combines field observations, satellite imagery and photo interpretation, making it a fun and exciting activity for students learning about ecology and the environment.

As a faculty member with Rutgers Cooperative Extension, I used SVAP to train volunteers and prioritize watershed restoration projects. At the same time, it empowered community-based organizations who felt the need to fill the gap between activism and professionally managed scientific projects.

This is a multi-day lesson plan that utilized SVAP to reinforce concepts in ecology, earth systems and biogeochemical cycles like the hydrologic cycle. At the same time, the lesson is project-based and requires independent work and critical thinking skills for completion of a culminating assignment.

There are 10 primary SVAP elements:
- channel condition,
- hydrologic alternation,
- riparian zone,
- bank stability,
- water appearance,
- nutrient enrichment,
- barriers to fish movement,
- in stream fish cover,
- presence of pools, and
- Invertebrate habitat.

In addition, there are elements that should only be scored if applicable. These are canopy cover, manure presence, salinity, riffle embeddedness, and observed macroinvertebrates. Elements are scored 1 to 10 (poor to excellent) with the exception of observed macroinvertebrates, which uses a scale ranging from 1 to 15.

**EDUCATION TECHNOLOGY INTEGRATION:**
Passive:
- Powerpoint lectures
Active:
- Using Google Earth or Arc GIS for satellite imagery and evaluation of stream ecology/condition.
- Photo journaling.
- Lab report writing and formatting
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<tr>
<th>Activity 1</th>
<th>Introduction to stream ecology</th>
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<td>(1-2 class periods)</td>
<td>In this teacher-centered activity, students will be provided with an overview with PowerPoint slides and example photos. Stream ecology involves a variety of factors that will be displayed in example photographs on the slides. Students will be shown slides that compare streams with good ecological condition and poor ecological condition in a number of categories.</td>
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<th>Activity 2</th>
<th>Photo interpretation</th>
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<td>(1-2 class periods)</td>
<td>Individually, students will be provided photos of stream conditions from different categories of SVAP. They will be asked to give a ranking for each and prepare an explanation. They will need to refer to the previous class notes and SVAP reference materials. All individuals with the same photos will then be groups so that that may discuss their findings with each other and answer a series of questions provided by the teacher. Each group will share their findings with the full class.</td>
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<th>Activity 3</th>
<th>Aerial/satellite imagery interpretation</th>
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<td>(1-3 class periods)</td>
<td>Students will be provided with a location to look up and analyze with regard to stream condition. They will need to look for specific land use indicators. For example, a large parking lot very close to a stream is an indicator of poor stream ecology. They will also need to observe the distance of vegetative buffers between the stream banks and development. They will use the measurement tools in the software to determine stream length, width and similar measurements.</td>
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The next day, students will report to the full class about their findings and provide justification for their conclusions about whether or not the stream should be considered in good or poor ecological condition. |

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<th>Activity 4</th>
<th>Field work</th>
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<td>(2-4 class periods)</td>
<td>Students will work in pairs. They will evaluate the condition of a nearby stream according to SVAP. Each pair will be given one or more categories to evaluate. They will be required to complete the SVAP field worksheet with sketched and other observations.</td>
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A teacher-center demonstration will begin the activity to serve as an example of how to make observations and recordings. Indicators around the stream will be pointed out by the teacher. |

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<th>Activity 5</th>
<th>Lecture: Human impacts on watershed and stream condition</th>
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<td>(1 class period)</td>
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<th>Activity 6</th>
<th>Lecture: Environmental restoration project methods and examples.</th>
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Activity 7 (optional) | **Engineering design process**
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Engineering design process may be useful in providing a more comprehensive approach to identifying environmental problems and linking them to human activities. Students can then design solutions that either prevent problems or manage them with a variety of proven engineering designs. They may also come up with their own creative solutions using the design process methodology.

Activity 8 (3-5 class periods) | **Culminating Project**
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Culminating Project
Students will be required to prepare a lab report. They must choose a reach of a stream or river and conduct the same steps in their own. They must print an aerial image and make land use calculations and draw preliminary conclusions from the images. They must then confirm their findings by visiting the stream in person. They must take digital photos and include them in the report. They must also conduct SVAP and provide a stream ecology score for each of the categories. They must complete the report by making recommendations about how to improve the condition of the stream or protect it.

**SAMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:**
1. How have humans altered the condition of streams both directly and indirectly?
2. Why do certain types of land use lead to more serious problems with stream conditions? List each land use type and explain how it impacts the stream differently.
3. If given a aerial image, explain the steps involved with locating and interpreting the possible conditions of the stream? What are some of the indicators to look for?
4. Explain how the hydrologic cycle is an important factor in stream ecology and health? Which components of the cycle are observed in streams?
5. Explain how the food chain, competition and other ecological processes can be observed in a stream. How would these differ in a poor quality and good quality stream?

**HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:**
Students will be required to set milestones for the culminating project that will need to be approved and checked by the teacher over the course of 1-2 weeks until the project deadline.

**REFERENCES:**
PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:
Culminating project rubric

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<th>Components</th>
<th>Maximum points</th>
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<td>Aerial photo analysis</td>
<td>The student properly identifies the key land use indicators of stream health and the vegetative buffer distance between the stream bank and land development.</td>
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<tr>
<td>Aerial photo identification</td>
<td>The student properly labels the stream and explains how certain indicators of stream meandering and similar evidence can be used to determine its location and course.</td>
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<td>Report layout</td>
<td>Students properly create the report with all required headings and content: introduction/background, materials, methods, results, discussion, conclusions and recommendations. Supporting materials such as maps, data sheets, and photos should be included as appendices.</td>
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<td>Photo journal quality</td>
<td>Photos of the stream must be clear and able to show what certain categories were ranked according the SVAP scale.</td>
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<td>Validity of recommended environmental/ecological solutions</td>
<td>Students must evaluate the condition of the stream and explain why it is in such a condition. They must attempt to trace its condition to both natural and human activites. They must propose methods for either protecting or improving its conditions based on references and class materials.</td>
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CLOUD COMPUTING ADDENDUM
The lesson plan that follows can be enhanced by integrating cloud computing into several steps along the entire lesson as follows:

1. The Cloud will serve as a clearinghouse for lengthy references that would otherwise need to be circulated in a binder for all students to share. While one hard copy will be kept in the classroom, students will be encouraged to access the references from the cloud to assist with report preparation and homework assignments. References include the SVAP manual, PowerPoint presentations with reference photos, sample worksheets and field guides.

2. An additional activity using the cloud can be added to make the lesson more geared towards student-driven learning, student collaboration/interaction and making it more relevant to students’ community. The culminating project will focus entirely on one stream in the community. Each student will be assigned a section of the stream to evaluate for his/her report. The results will be entered in a centralized spreadsheet or database housed in the cloud. As students update the data, it will become a discussion point for evaluating the environment in their own community. It may inspire some students to take additional action with a special project and outreach campaign.

As an additional component of the report (or a group presentation), students must make a whole stream evaluation and recommendation by evaluating the data entered by the rest of the students into the central database. This will encourage students to complete their portion
on time and empower them the accurately and complete report data to the rest of the class. It also leads to student-driven conclusions with regard to the learning objectives.

Students will receive more points on the project for uploading data to the cloud in a timely manner and for making connections between their own data and the data of other students’ stream sections.

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Supporting Program: Center for Pre-College Programs, at the New Jersey Institute of Technology

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