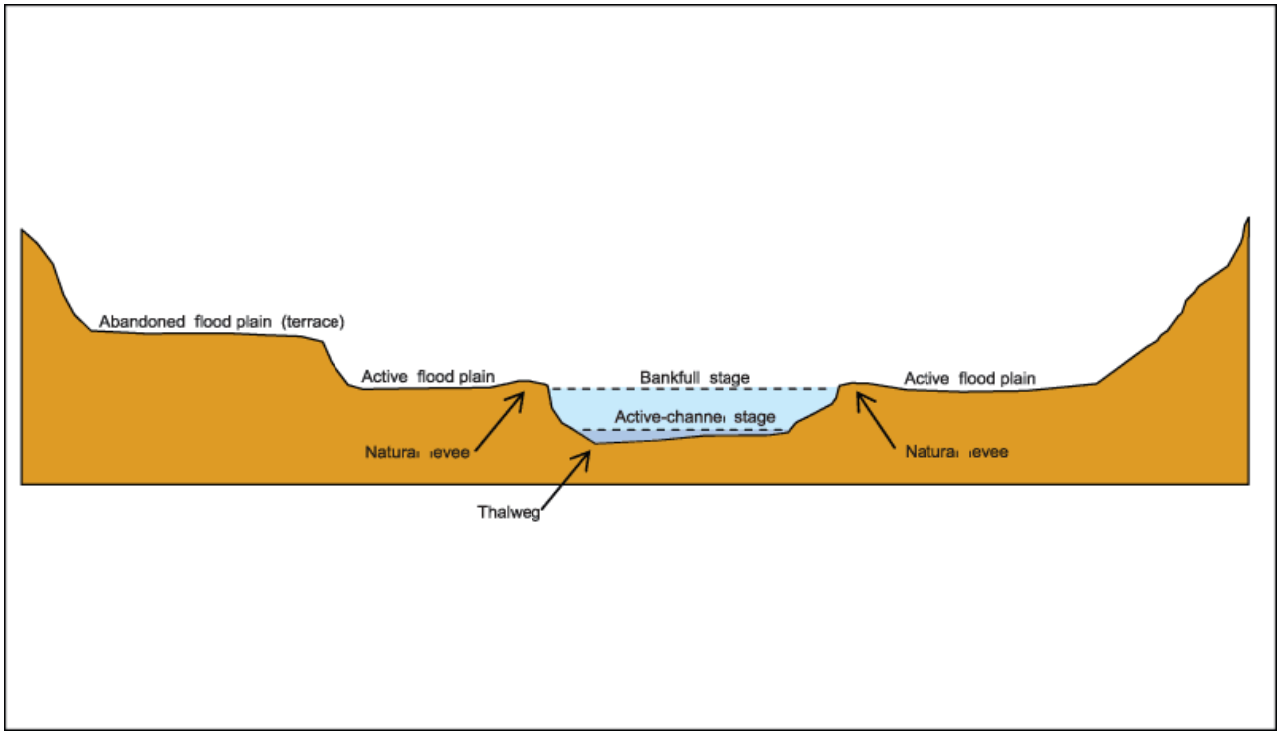
Unit Plan
SCED 481
Jordan Fink, Deanna Lloyd, Andy Nelsen

Stream Morphology and Processes



A five day unit for a 9th grade earth science class

Summary of Unit:

This unit will allow students to explore stream morphology, specifically in terms of channel morphology, discharge, and sediment load. Following an introduction to the concepts and terms, students will engage in creating cross sectional, longitudinal, flow rate, and sediment surveys of a local stream. The students will, in groups, engage in experimental design as they will be tasked with figuring out how to collect their data and will ultimately report their findings to the rest of the class in a symposium. We will use this data as well as inferential evidence in a later unit for evaluating the ecosystem health of the stream.

Introduction and Rationale:

Central to the understanding of how various factors can influence the state of health of a stream is an understanding of the natural processes and components of channel morphology. By investigating the physical features of a stream channel and associated flood plain, students can begin to understand how individual aspects of streams such as slope, discharge, sediment load and size can affect both morphology and stream health. The National Benchmarks as outlined by Project 2061 call for students to have an understanding of the processes that shape the earth. They address the fact that the numerous process involved are components of a deeper understanding of the intricacies and interactions of earth processes. Furthermore, the benchmarks also call for students to be familiar with the water and rock cycle. Fluvial geomorphology processes are major parts of these and deal with both water and sediment transport.

Streams are dynamic systems with many components that can have intricate interactions. Sediment is a natural feature of many streams, but a sediment load that is too high for the slope and discharge can lead to increased deposition, flooding, changes in channel location, and detrimental effects on fish and macro invertebrate habitat. Changes in discharge can also lead to streams undergoing significant channel change. Increase in flow due to deforestation, urbanization, or even climate change can cause flooding, streams to become entrenched, banks to become destabilized, salmon eggs to be

washed out, or any number of other impacts. Decreases in flow due to agricultural use, dams, and diversions can also cause streams to undergo morphological changes.

In the Pacific Northwest, rivers and fisheries are a big part of our lives and culture. We have numerous laws on activities such as logging, zoning and residences, dams, salmon, and industry that are directly associated with stream systems. The study of salmon is part of the science curriculum in Washington State. By studying stream systems and stream morphology we are bringing a local and relevant topic of investigation to the table. By investigating a local stream channel we are allowing students to engage in place based learning and have an opportunity to learn through inquiry.

One of the key elements of this unit is the performance task which has students engaged in experimental design, data collection, and data interpretation for investigating the morphology of a local stream channel. Washington State Essential Academic Learning Requirements (EALRs) and National Science Education Standards (NSES) call for students to actively engage in research and experimental design. By having students develop the methods they will use for their stream modeling project, conduct a channel morphology survey, and holding a symposium type class presentation we will be addressing NSES Standards A, E, F, and G. These standards deal with designing inquiry investigations, making models, using science and technology, research techniques, exploring ecosystem through observation and modeling, and introducing students to the nature of scientific knowledge. Through this unit we will also help students to recognize that creativity and knowledge are required components of any scientific study or investigation.

This short unit on channel morphology is meant to be part of a larger unit of a 9th grade environmental science class on the water cycle and hydrologic systems. Prior to this unit, students will have investigated climate and weather, as well as had an introduction to watershed studies. Following this mini-unit we will begin investigations of streams in terms of biology and ecosystem health focusing on aquatics and the riparian zone. We will end the unit with an integrated study of watershed analysis that incorporates stream morphology as well as human impacts on streams and watersheds.

Misconceptions about streams

Below are several misconceptions about stream flow and their sources. There is not a huge body of research done on misconceptions about streams and stream morphology, though people undoubtedly have their own ideas regarding these topics.

http://www.wastatelaser.org/_support/toolkits/stc/land_and_water/misconcepts.asp
accessed 5:45pm December 6, 2007

Description of a student preconception
Make sure students understand the difference between weathering and erosion. Students frequently think that weathering means that weather caused the material to move. Unless there is a big chuck of packed sand that breaks down into little sand pieces, there is little weathering occurring in this model.

Correct conception by the end of the unit
Weathering is when rocks and materials are broken down and erosion is when materials are moved from place to place. Make sure during the discussion that students do talk about erosion and weathering correctly. It is very important in this lesson since the sprinkler head is simulating a weather phenomena (rain) in this model.

Description of a student preconception
Preconception: Many students think that the earth's surface only changes because of earthquakes and volcanoes.

Correct conception by the end of the unit
During the discussion, focus on the things that are observable. Make note of which students have this preconception and monitor their thinking throughout the unit. Check for student understanding of the impact of moving water on the Earth's surface. Corrected preconception: Lots of things, including water, change the Earth's surface.

http://www.dcnr.state.pa.us/topogeo/groundwater/bad_hydro.aspx
accessed 6:04pm December 6, 2007

Misconception: Groundwater flows in underground rivers.

Little groundwater flows in open channels beneath the surface. Most flows through fractures in the rock, through millimeter sized opening between layers, and between the grains of the rock.

Misconception: Groundwater and surface water are separate.

Groundwater, surface water, and atmospheric water are intimately related through the earth's water recycling machine, called the hydrologic cycle. Water passes repeatedly through all three parts of the cycle. Groundwater provides 2/3 of the flow to streams in Pennsylvania. As groundwater levels drop, stream flow decreases.

Misconception: The water level in wells is the water table.

The water level in wells is not the same as the water table. After all, the water table at the site of a flowing well is not above the ground. If it were, you would be standing in a lake. The water table is the boundary between saturated and unsaturated media. The water level in a well is at the water table only if the well is within a few feet of the water table. Upon deeper drilling, the water level in the well will either rise or fall, depending on whether the well is in a discharge area or a recharge area. At a particular site, the water level in the well will probably be different for different aquifers. This is especially true in fractured rocks, where the water level in a well is often the function of which and how many fractures were intercepted by the borehole.

In an effort to utilize pedagogies that support inquiry based learning, this unit was designed using Understanding by Design templates.

Unit Designed by: Andy Nelsen, Jordan Fink, Deanna Lloyd
Subject/Topic Area(s): Earth Science/ Stream Morphology
Grade Level(s): 9 - 12
Unit Title: Introduction to Stream Morphology
Time Frame: Spring Semester

Brief Summary of the Unit (including curricular context and unit goals):

Upon completion of this unit, students will be able to identify different structures in streams associated with morphology and be able to identify potential hazards. Additionally, students will increase their understanding of how to conduct a safe and accurate scientific investigation.

Desired Results

Established Goals:

***GLE 1.2.1*:** Analyze how systems function, including the inputs, outputs, transfers, transformations, and feedback of a system and its subsystems.
(9) Describe the function of a system's parts or subsystems.
(9) Explain inputs, outputs, transfers, transformations, and feedback of matter, energy, and information in a system.
(10) Explain the interconnections between a system's parts or subsystems.
***GLE 1.3.4*:** Analyze processes that have caused changes to the features of earth's surface, including plate tectonics.
(9) Describe the processes that cause the movement of material in Earth's systems (e.g., pressure differences that cause convection resulting in winds, mantle movement, and ocean currents; erosion and deposition).
(9) Describe the effects of floods on the Pacific Northwest.
(9) Explain how substances change as they move through Earth's systems (e.g., carbon cycle, nitrogen cycle, burning of wood and fossil fuels).
GLE 1.3.10: Analyze the living and nonliving factors that affect organisms in ecosystems.
(9) Describe the living and nonliving factors that limit the size and affect the health of a population in an ecosystem.
***GLE 2.1.1*:** Understand how to generate and evaluate questions that can be answered through scientific investigations
(9, 10) Generate a new question that can be investigated with the same materials and/or data as a given investigation.
(9, 10) Generate questions, and critique whether questions can be answered through scientific investigations.

GLE 2.1.2: Understand how to plan and conduct systematic and complex scientific investigations

(9, 10) Make a hypothesis about the results of an investigation that includes a prediction with a cause-effect reason.

(9, 10) Generate a logical plan for, and conduct, a systematic and complex scientific controlled investigation with the following attributes:

- hypothesis (prediction with cause-effect reason)
- appropriate materials, tools, and available computer technology
- controlled variables
- one manipulated variable
- responding (dependent) variable
- gather, record, and organize data using appropriate units, charts, and/or graphs
- multiple trials
- experimental control condition when appropriate
- additional validity measures

(9, 10) Generate a logical plan for a simple field investigation with the following attributes:

- Identify multiple variables
- Select observable or measurable variables related to the investigative question

(9, 10) Identify and explain safety requirements that would be needed in an investigation.

GLE 2.1.3: Synthesize a revised scientific explanation

(9, 10) Generate a scientific conclusion, including supporting data from an investigation, using inferential logic.

(9, 10) Describe a reason for a given conclusion using evidence from an investigation.

(9, 10) Generate a scientific explanation of an observed phenomenon using given data.

(9, 10) Predict and explain what logically might occur if an investigation lasted longer or changed.

What understandings are desired?

Streams are a dynamic system

Streams are affected by both anthropogenic and non-anthropogenic factors.

Scientific tools can be used to increase understanding of a system

Understanding can be created through observation and measurement.

Scientific ideas and findings are subject to the scrutiny of peers and are checked numerous times by different parties for accuracy and bias.

Pre-existing research can augment a scientist's field data and serve to create a larger understanding or broader applicability of one's findings.

What essential questions will be considered?

"Why is it important to conduct scientific research in a systematic manner?"

"How does science discovery benefit us?"

"How will understanding the human and non-human influences on streams affect my interactions with stream ecosystems?"

Course Sequence

Previous Unit Topic and Key Understandings

This unit will serve as an introduction to stream morphology while reinforcing students' understand and knowledge regarding scientific field research, data presentation and analysis. Prior to students will have studied climate and weather as well as an overview of watershed systems

Next Unit Topic and Key Understandings

In the next unit, students will learn more about the human impacts on streams. Key understandings will include how land use affects streams, how geology and stream morphology are interrelated. Students will be expected to further their understanding of scientific research by conduction another scientific investigation.

What prerequisite knowledge is required of learners at beginning of unit:

Students must know:	*Students must be able to:*
• Basic science terminology (e.g. inference, observation, mass, volume) • How to use the metric system for measurement	• Keep an accurate record of work done in the class (i.e. a science journal/notebook) • Record observations and measurements while in the field • Use the Internet to conduct research on their topic

What key knowledge and skills will students acquire as a result of this unit?

Students will know:	*Students will be able to:*
• That different tools are used at different times to conduct scientific research • Different types of research methods are more applicable than others depending upon the type of results one is pursuing. • Combining one's results with other findings serves to enhance understanding of systems as a whole.	• Conduct an accurate scientific research project • Identify and use the proper tools for a scientific investigation • Identify certain characteristics of a stream (e.g. bank, cut bank, point bar, sinuosity, slope)

What Evidence Will Show That Students Understand?

1. **Performance Tasks**
   Students will design stream investigations that will show what they want to discover as well as how they will plan to find these things out given the materials and tools available to them. Student investigations will be graded by rubric and returned to students before they head out in the field. Student groups will present their data on the final day of the unit in a 10 -15 minute presentation. The presentations will be part of a science symposium where results are analyzed by peers and ideas for future study are presented. The presentations will be graded by rubric.

2. **Other Evidence**
   Exit slips will show what types of understandings students are entering the class with and will provide them with the opportunity to monitor their own learning.

3. **Student Self-Assessment and Reflection Tasks:**
   Students will be asked to conduct self-evaluation on their in-class group work performance on the project as a whole.

Performance Task Blueprint

Which understandings/goals will be assessed through this task?

Student understanding of how to conduct and plan a meaningful scientific research project will be assessed through this task.

How will students use information to demonstrate understanding?

Students will collect data (e.g. observations, quantitative measurements) that characterizes the section of stream to which they have been assigned

Through what authentic performance task will students demonstrate understanding?

The task at hand is to accurately and concisely characterize a stretch of stream using the tools available to them. Student groups will convene on a section of stream near the school and will apply their nascent understandings there.

What student products/performances will provide evidence of desired understandings?

Clear, concise language in the reports will demonstrate an ability to write in a scientific manner. Clarity of thought and flow in the proposal for research will demonstrate that students understand how to conduct valid research project.

By what criteria will student products/performances be evaluated?

Proposals will be graded by rubric.

Performance Task Blueprint

Which understandings/goals will be assessed through this task?

Student understanding of the process of analyzing and presenting research findings will be assessed through this task.

How will students use information to demonstrate understanding?

Students groups will present their findings from their day on the stream and Internet researching to the rest of the class.

Through what authentic performance task will students demonstrate understanding?

The goal for your group is to accurately and concisely show your peers what you have learned about the stream near the school by presenting your data during a symposium. You will construct a visual representation of your data (poster board, PowerPoint, short video, etc.) and will discuss the contents with the group. You will field your peers' questions as well as give suggestions for future research.

What student products/performances will provide evidence of desired understandings?

A logical flow of ideas and inferences based on Internet and actual research will show that students actively participated in the research project and understand what happened during the data analysis portion of the project.

By what criteria will student products/performances be evaluated?

Symposium performances will be graded by rubric.

Unit Assessment Plan

Unit Name: Stream Morphology

Day	Task Name	Purpose	Format	Scoring	Feedback	Notes
1	Student Pre-Assessment	To uncover student knowledge level and preconceptions	Short, informal concept mapping exercise, recall diagram format	None	None	For personal use at the planning level, will use for reflected self evaluation at end of unit
1	Exit Slips	To give students incentive to learn about stream morphology	"What do you want to learn about stream morphology?"	Points for completion	None	For personal use at the planning level
2	Research Proposal	To show that students have planned what they hope to gain by going afield	Students will write a materials and methods list as well as a justification for their research	By rubric	Comments and suggestions will be written on student work	Student self-assessment on field work participation
5	Symposium Performance	Students will synthesize their knowledge with existing resources. Students will present findings to peers	Ten – fifteen minute presentations	By rubric	Comments and probing questions to students, summative grading	

Unit Schedule

Unit Name: Stream Morphology

Day 1	Day 2	Day 3	Day 4	Day 5
Objectives - GLE: 1.2.1	**1.2.1, 1.3.4, 1.3.10, 2.1.1, 2.1.2**	**1.3.4**	**1.2.1, 1.3.10**	**2.1.3**
Lecture *Introduction*: Introduce lesson vocabulary, place in the context of the unit. Explain the narrowing of the focus of the unit. Describe the study site. *Assessment*: Formative assessment to determine students' pre-existing ideas about the nature of scientific research, experimental design and streams. *Exit Slips*: Students will complete an exit slip describing what they hope to learn in the upcoming mini-unit on streams.	Lecture/tools *Lecture*: Continue to lecture about stream morphology, PPT with pictures matching landforms and vocabulary *Introduction*: Students will be shown various tools stream ecologists utilize while in the field. *In-class assignment:* Student groups will create a schema for their investigations. Students will create a cogent plan of study by following the rubric that they will turn in before the end of class. *Assessment:* Student investigations will be graded by rubric.	Field Day *Return Assignments:* Student work plans will be redistributed with grades and suggestions for revision. Students will work on their study as described in their revised group plan of action. *Assessment*: Student behavior will be monitored while in the field. Off-task behavior will be noted and may impact final project grades.	Data Analysis *Student work:* Students will be given class time to analyze their data. If necessary the class will go to the computer lab to gather background research and to create graphs and tables. *Materials*: Students will be given a handout showing proper citation techniques, good websites to search and examples of ones to avoid.	Presentations *Teacher-facilitated symposium*: Students will present their findings to the class. Teacher will moderate discussions and probe student understanding of the topics brought forth during class. *Assessment:* Student work will be graded by rubric

Daily Lesson Plan
Unit: Stream Ecology Day 1

Grade Level/Class: 9th - 12th grade Earth Science | Time: spring semester

Instructional Objectives & Essential Learning(s): Students will create a concept map that allows them to conceptualize a stream system. Students will understand that streams have numerous components, influencing factors, and inputs/outputs in terms of both matter and energy that affect its morphology. Students will reflect upon their own observations as well as pictures of rivers and streams to classify discrete components of streams such as slope, discharge, sediment load, etc. Students will also be introduced to terms and will begin to investigate how components of streams can affect the whole.

Hook (4 minutes): Watch Video-http://video.google.com/videoplay?docid=3495966801107038720&q=flood&total=27420&start=0&num=10&so=0&type=search&plindex=0

Prompt: We will be investigating stream systems this unit! Although we are not investigating floods specifically right now, I thought that this video of a flash flood was cool and would help get you focused on the topic of stream ecosystems. Part of this will have us going out into the field and collecting data, doing physical surveys and making observations. I've got a bunch of hip waders ready for you all, but first we need to make sure we know what we are talking about and what we need to look at. The point of all of this is to investigate the health and morphology of a local stream.

Time	Teacher's Activities	Student Activities	Lesson Aids
10 minutes	Warm up journal response	Journal entry	
20 minutes	Concept map – Students will create a concept map in recall diagram form delineating components of streams. Think-pair-share	Students will work individually for 5 minutes to come up with as many aspects of streams as they can think of in list form. They will then create a concept map using their terms. Students will compare their diagrams with a partner, adding things that they might have not included. Class will share as a whole	Power point – images of streams
25 Minutes	Lecture about stream features	Take notes	Power point presentation
20 Minutes	Impacts on stream morphology – Class discussion from worksheet	Students will share ideas about what a natural, un-impacted stream looks like and how different human activities can affect stream morphology.	Worksheet- guiding questions. Follow up – reading for homework

Strategy: Awareness; Debate; Encouraging Creativity; Discovery Learning; Discussion & Questioning; Lecture & Presentation; Simulations and Games; Cooperative Learning

Multiple Intelligences: Verbal/Linguistic; Visual/Spatial; Body/Kinesthetic; Musical/Rhythmic; Logical/Mathematical; Interpersonal; Intrapersonal

Day 1 Continued -

Assessment:
Students will be formatively assessed on journal responses, participation in activities/ discussion, and active note taking. The concept mapping exercise and initial journal activity will be used to gauge student's prior knowledge and pre-conceptions.

Journal response question: If you were to look at a stream, what would you analyze to determine if was impacted by human activities. Please explain why you would use these features to help you to determine what is going on.

Concept Mapping: Begin by explaining to students that they will be creating a recall diagram type concept map on the subject of stream morphology and ecosystem health. Model the exercise with two or three branches. Offer guiding questions to help students focus. Have them generate a list of terms or ideas before they begin the mapping so as to help them see the things they come up with before trying to figure out where they go. Students will share their maps with a colleague using a different color pencil to add anything they want to their original map. Following this, we will comeback together as a class and discuss the features identified and how they relate to one another.

Probing questions:
What are some features of a stream that you can think of? Be specific.
Are you only concerned with the channel it self or are there other things that might be associated with the stream?
Can the appearance of a stream change along its length? Can it change over time? Please explain.

Lecture: Power Point presentation

Healthy streams: Think-pair-share- What things affect stream morphology and how? Should the water be totally clear? How much sediment should a stream have? How do changes in water flow affect stream morphology?

Daily Lesson Plan

Unit: Stream Ecology Day 2

Grade Level/Class: 9th - 12th grade Earth Science | Time: spring semester

Instructional Objectives & Essential Learning(s): Introduce more terms regarding stream morphology to students. Show photos in a PowerPoint and describe how and where they form. Show students the different tools that will be available to them during their upcoming outdoor research project. Have students create research study plans to follow while they are in the field

Motivational Statement (Hook): Soon we will be heading out into the field, but before we do this we will need to become more familiar with different parts of the streams we will be studying and the tools that will be available to us.

Activity: Interactive PowerPoint lecture, introduce field study area and assign groups. Introduce tools for students to utilize while in the field.

Time	Teacher's Activities	Student Activities	Lesson Aids
3 min	Minute paper: "What is garbage?"	Answer prompt, share ideas with their neighbors	
20 min	PowerPoint covering different parts of a stream	Take notes	PowerPoint Presentation
20 min	Show students the different tools researchers use while in the field	Familiarize selves with the tools, reflect on what tools they might like to work with.	Inclinometer, stadia, 30m tape measures, GPS units, digital camera, flow meter.
40 min	Introduce research component, assign student groups	Students will assemble into groups and design their research proposal	Checklist for student research projects

Strategy:
- Awareness
- Debate
- Encouraging Creativity
- Discovery Learning
- Discussion & Questioning
- Lecture & Presentation
- Simulations and Games
- Cooperative Learning

Multiple Intelligences:
- Verbal/Linguistic
- Visual/Spatial
- Body/Kinesthetic
- Musical/Rhythmic
- Logical/Mathematical
- Interpersonal
- Intrapersonal

Daily Lesson Plan

Unit: Stream Ecology — Day 3

Grade Level/Class: 9th - 12th grade Earth Science — Time: spring semester

Instructional Objectives & Essential Learning(s): Students will have their inquiry question returned to them with grades and suggestions for revision allowing more feedback regarding the formulation of a good scientific question. Students will then apply their knowledge of using scientific instruments, observing and collecting data by going out into the field and performing an investigation of a nearby stream. Students will be expected to clearly record their data, work cooperatively as a group, and maintain safety

Motivational Statement (Hook): I hope you are all prepared to enjoy the weather and get to know our local stream a bit better because we're heading outside today in order to commence with your investigations.

Activity: Return investigative questions. Travel to and study selected environment. Students will respond to a prompt in their journals for homework – "What have you learned today/what new skills have you acquired? Has this investigation helped you to understand the concepts of stream morphology?"

Time	Teacher's Activities	Student Activities	Lesson Aids
5 min	Return investigative questions to student groups	Review suggestions as a group and discuss what final question will be.	Returned assignments
5 min	Distribute materials	Gather necessary equipment for study.	Inclinometer, stadia, 30m tape measures, GPS units, digital camera, flow meter, science notebooks
10 min	Travel to study site	Travel to study site in an appropriate and safe manner.	Chaperones (2-3)
60 min	Monitor groups to make sure they are on task. Question students while they are working to assess metacognition.	Students will work as a group to investigate their question by making observations, using scientific instruments to collect data and documenting their process.	Inclinometer, stadia, 30m tape measures, GPS units, digital camera, flow meter, science notebooks, chaperones
10 min	Travel back to school	Travel back to school in an appropriate and safe manner.	Chaperones (2-3)

Strategy: Awareness; Debate; Encouraging Creativity; Discovery Learning; Discussion & Questioning; Lecture & Presentation; Simulations and Games; Cooperative Learning

Multiple Intelligences: Verbal/Linguistic; Visual/Spatial; Body/Kinesthetic; Musical/Rhythmic; Logical/Mathematical; Interpersonal; Intrapersonal

Daily Lesson Plan

Unit: Stream Ecology — Day 4

Grade Level/Class: 9th - 12th grade Earth Science — Time: spring semester

Instructional Objectives & Essential Learning(s): Students will have class time to analyze their stream data and determine how this relates to their initial question. They will also spend time on the computer researching information related to their investigation. All of this is in preparation for the symposium on the following class day.

Motivational Statement (Hook): With all that hard-earned data you collected yesterday we are now going to spend the period analyzing it in relation to your initial question as well as have computer time to research additional information for your presentation. Remember this is the last class day before the symposium so please use your time wisely.

Activity: Research investigative question and analyze data that was collected. Prepare information for the symposium tomorrow.

Time	Teacher's Activities	Student Activities	Lesson Aids
10 min	"What additional information do you need to answer your investigative question?"	Journal responses to this question to get the mind back on the topic of the field trip and investigative question.	Individual science notebooks
5 min	Distribute list of web resources and remind about proper use of time and internet. Remind them this is the last bit of classroom time until the symposium.	Listen patiently	Web resources handouts, classroom computers
75 min	Monitor student groups and computer access to make sure they are on task. Question students while they are working to assess metacognition and understanding of what they are discovering.	As a group collaborate to investigate question via the internet or by analyzing collected data. Once adequate information is found, start working on presentation for the symposium.	Classroom computers, a few classroom calculators, graph paper, colored pencils
5 min	"Do you feel ready for your presentation tomorrow? Why?"	Journal response to this question to get students thinking about what they made need to finish up or to reflect on the process.	Individual science notebooks

Strategy:

Awareness	Discovery Learning	Simulations and Games
Debate	Discussion & Questioning	Cooperative Learning
Encouraging Creativity	Lecture & Presentation	

Multiple Intelligences:

Verbal/Linguistic	Musical/Rhythmic	Interpersonal
Visual/Spatial	Logical/Mathematical	Intrapersonal
Body/Kinesthetic		

Daily Lesson Plan

Unit: Stream Ecology — Day 5

Grade Level/Class: 9th - 12th grade Earth Science — Time: spring semester

Instructional Objectives & Essential Learning(s): Students will present their data during a symposium. Students will evaluate each other's work as well as their own. Students will revisit their initial ideas on streams and their concept maps from the first day and reflect on the evolution of their ideas through out the course of the unit.

Motivational Statement (Hook): A large part of science is participating in the scientific community and the process of sharing ideas and revising one's thinking through analytic thought processes. Today we will participate in a scientific *symposium*.

Activity: Students will take part in a symposium, share ideas and reflect on their own performance. To close, students will revisit their initial ideas and trace the evolution of their understanding through a take-home journaling assignment.

Time	Teacher's Activities	Student Activities	Lesson Aids
3 min	Introduce the symposium and re-emphasize the classroom norms	Listen, organize into groups	
90 min	Observe groups, ask probing questions	Students will have 10-15 minutes to present their methods, data, observations, and results. Students will listen to their colleagues, ask clarifying questions.	Watch for keeping track of presentation length
7 min	Introduce final activity: "Reflect on your initial ideas and trace the evolution of your understanding of stream morphology citing specific examples"	Take notes, gather journals and concept maps to guide journal writing at home.	

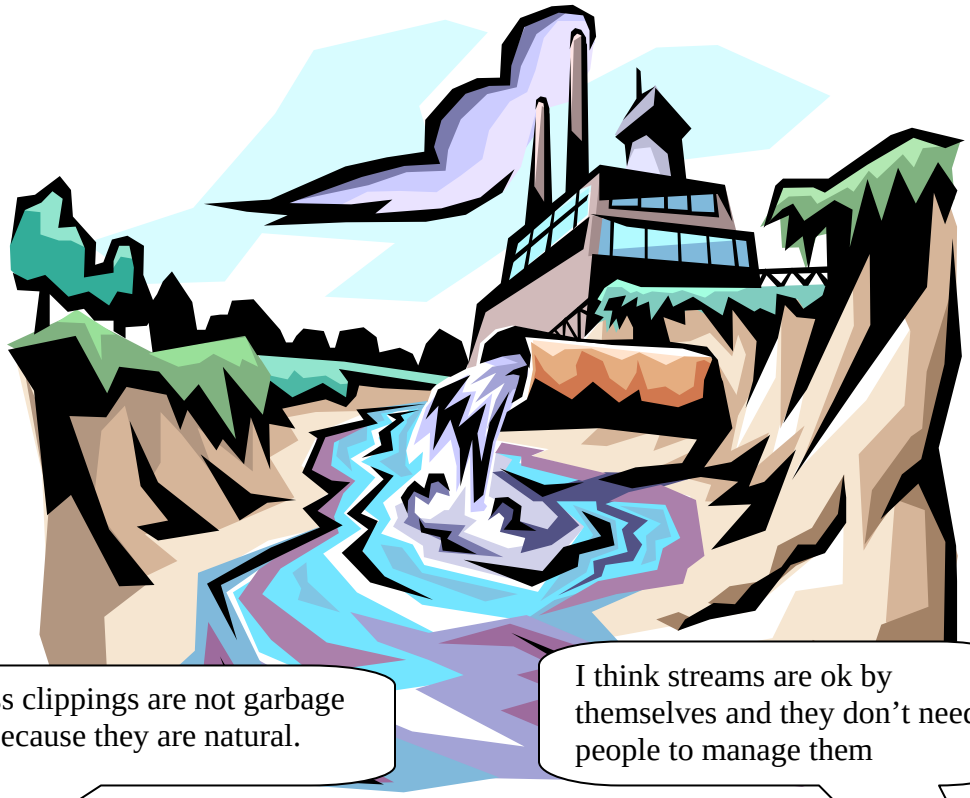
Strategy: Awareness; Debate; Encouraging Creativity; Discovery Learning; Discussion & Questioning; Lecture & Presentation; Simulations and Games; Cooperative Learning

Multiple Intelligences: Verbal/Linguistic; Visual/Spatial; Body/Kinesthetic; Musical/Rhythmic; Logical/Mathematical; Interpersonal; Intrapersonal

Stream Concept Inventory Cartoon:
What is garbage?

I think it is ok to put garbage in streams because the water is moving.

I think streams need people to help keep them clean. Without people streams would be full of wood and sticks.



Grass clippings are not garbage because they are natural.

I think streams are ok by themselves and they don't need people to manage them

Group name: Assigned station:

Student Checklist for Stream Morphology Analysis:

- ☐ All materials to complete my study are listed
  My will need the following materials:

  _____

  _____

  _____

  _____

  _____

  _____

- ☐ All materials for the study have been collected and set aside
- ☐ A complete, repeatable study has been described and outlined
  - Our study proposal includes:
    - Concise, repeatable methods
    - A clear concise objective is outlined
    - Our specific study location
    - What we expect to find based on our pre-analysis of the site
    - Data collection tables have been created including labels
  - Attach your groups study proposal to this sheet
- ☐ Turn this sheet in with all materials listed and study proposal by the end of the class period.

Assessment

Assessment for this unit will incorporate both formative and summative assessments.

Day 1: The pre-assessment will be a concept mapping exercise where students will first list all terms that they can think of with definitions and use the terms to create a concept map concerning stream morphology. This will not be graded but used to gauge students' prior knowledge and any misconceptions they may hold.

Day 2: Formative assessment for classroom participation. Rubric for field methods proposal.

Day 3: Formative assessment on appropriate field behavior and participation in activity. Formative assessment of journal response

Day 4: Formative assessment
We will use the pre assessment for metacognitive assessment by comparing a similar concept map that they create following the unit. They will also be asked to do some reflective writing using their concept maps to discuss the learning process and what new knowledge they have gained. Journal and verbal responses as well as participation will be assessed formatively. The following are student response forms and the rubric for the performance task.

Day 5 Assessment
Whole Class Evaluation of Stream Morphology Presentations

Name of Evaluator:_____

Names of People Presenting:_____

_____

One thing you thought the group did well:_____

_____

One thing you thought the group could improve on:_____

_____

Did the group adequately support their information with science? YES NO
Please explain your reasoning:_____

_____

One thing you learned that you didn't know before:_____

Self Assessment –Day 5
Name:
Research Team Name:

Scale: 4 3 2 1
Excellent ----------> Needs Work

Use the scale above to rate your team's performance.

_____ My team stayed on task and managed time efficiently
Give some examples:

_____ Each team member contributed to the overall product
What are some instances where this happened?

_____ My overall contribution to the finished product
Specific examples:

Fields Methods Rubric Day 2
Research Team Name:_____
References to Essential Academic Learning Requirements (EALRs) for Washington State:

	4	3	2	1
Objective	Objective of field research is clearly stated	Objective clearly stated but lacks detail (e.g. what do you hope to learn? How will this enhance your current understanding?)	Objective unclear or is in need of substantial improvement	Objective of research is absent
Materials and Tools List	All required materials and tools are accounted for in plan	Most tools and materials accounted for	Few tools or materials accounted for	Materials list is absent
Logical, well thought out plan of research	Reasons and methods for particular study are justified and show evidence of critical thinking	Reasons and methods clearly stated but require more insight and forethought (what will you do before you get into the field?, after?)	Reasons and methods only partially discuss plan of action (include: steps you will cover in the field, what you will do with your data)	Plan for research is absent
Tables and Charts	Tables and charts to record data are well constructed (labels and units where appropriate, proper scale, title, key, etc.)	Tables and charts lack specific detail (manipulated or responding variable, improper units)	Tables and charts are present but lack all units and labels	Tables and charts are not present

Rubric for Stream Morphology Whole Class Presentation – Day 5

	3	2	1	0
Scientific Support	ALL information presented is supported by research, data or observations.	MOST of the information presented is supported by research, data or observations.	LITTLE of the information presented is supported by research, data or observations.	NONE of the information presented is supported by research, data or observations.
Knowledge of Content	Can answer ALL questions about the information presented.	Can answer MOST of the questions about the information presented.	Can answer LITTLE of the questions about the information presented.	Can answer NONE of the questions about the information presented.
Use of Visuals	At least 3 visuals (including diagrams, charts, drawings, pictures, play, etc.) are used to support the material you present.	2 visuals are used to support the material you present	1 visual is used to support the material you present.	No visuals are used to support the material you present.
Quality of Work	Work is of the highest quality.	Work for the most part is of high quality but a few sections could be checked and redone.	Most of the work could be checked and redone before presenting.	Work is of the poorest quality.
Grammar and Spelling	Mistakes are rarely found.	Occasional mistakes are found.	Frequent mistakes are found.	Abundant mistakes are found.
Teamwork	All team members contributed, kept on track and were appreciated.	Sometimes team members did not stay on track, contribute equally or listen to others.	Most of the time the team was off track, with only a few members helping, or listening.	No one could accomplish anything.

References to Essential Academic Learning Requirements (EALRs) for Washington State:

GLE 1.2.1: Analyze how systems function, including the inputs, outputs, transfers, transformations, and feedback of a system and its subsystems.
GLE 1.3.4: Analyze processes that have caused changes to the features of earth's surface, including plate tectonics.
GLE 1.3.10: Analyze the living and nonliving factors that affect organisms in ecosystems.
GLE 2.1.1: Understand how to generate and evaluate questions that can be answered through scientific investigations
GLE 2.1.2: Understand how to plan and conduct systematic and complex scientific investigations
GLE 2.1.3: Synthesize a revised scientific explanation

References to National Science Education Standards (NSES):

Content Standard "A": Students will have the abilities necessary to do scientific inquiry

- Students should demonstrate appropriate procedures, a knowledge base, and conceptual understanding of scientific investigations
- Students can design and conduct scientific investigations while accounting for safety, lab materials, methodological problems. Student investigations will be synthesized with the existing literature to create a deeper understanding
- Students can revise scientific explanations based on their observations and measurements

Content Standard "D": Students will learn about system dynamics and cycles

- Students will begin to understand how earth systems change over time

Content Standard "E": Science and Technology

- Students will learn to communicate the problem they are researching, the process they used to research the problem as well as the solution to which they arrived.
- Students will use their creativity and imagination to solve logistical problems

Content Standard "F": Science in Personal and Social Perspectives

- Humans can impact ecosystems as ecosystems can impact humans.
- Many factors affect environmental health and quality

Content Standard "G": Science as a Human Endeavor

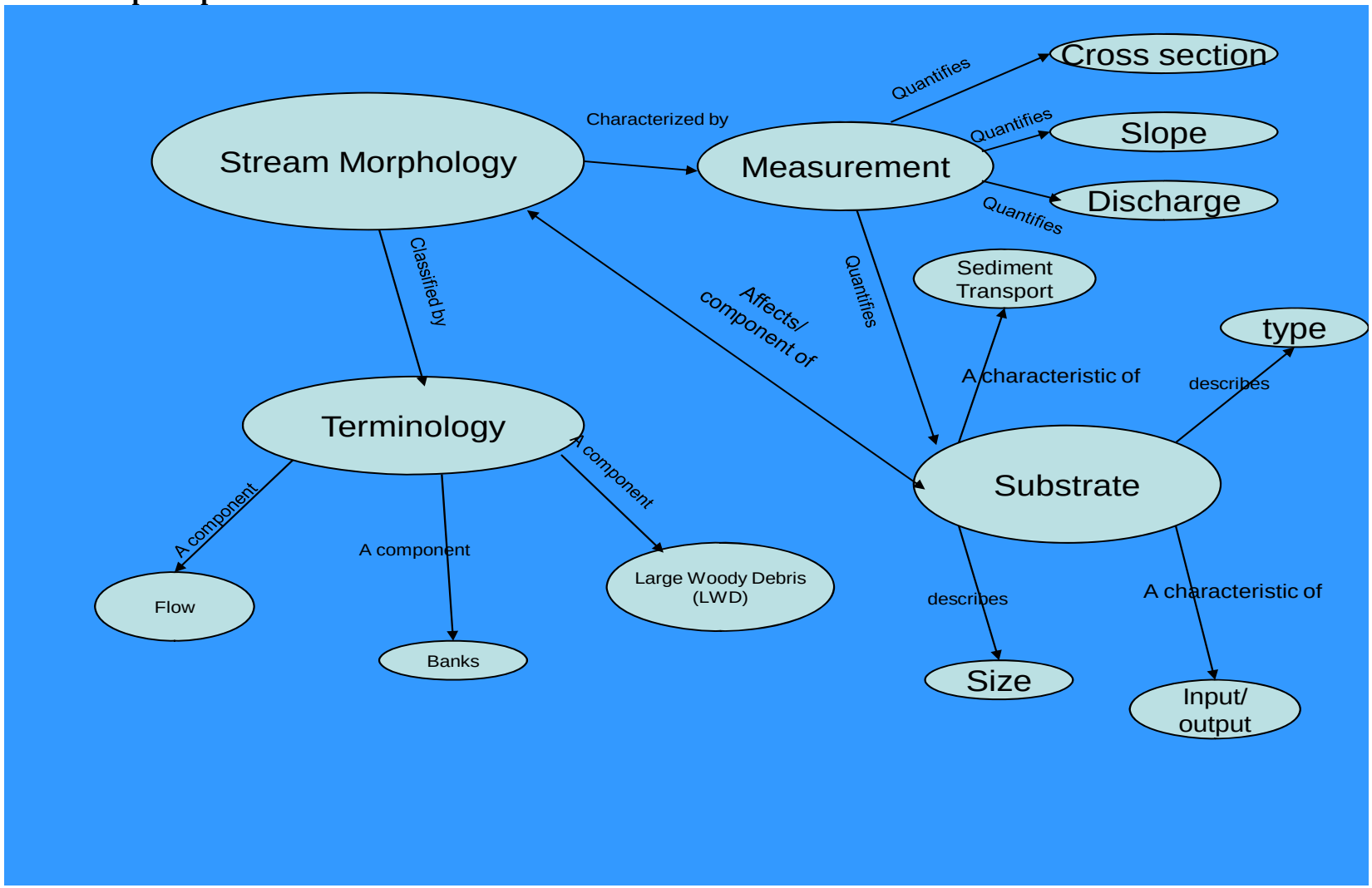
- Individuals and teams contribute to the scientific endeavor
- Different studies require different study methods
- Scientists have ethical values which include the sharing of data and peer review

Resources:

Office of the Superintendent of Public Instruction (OSPI). (2005). *K-10 Grade Level Expectations: A new level of specificity*. Olympia, WA: OSPI

National Research Council. (1996). *National Science Education Standards*. Washington, D.C.: National Academy Press

Unit Concept Map



Safety Considerations for Stream Ecology Unit

Although this unit uses no harmful chemical or has any labs, the field trip requires a fair bit of safety considerations. Things that need to be taken into account include:

- Permission slips signed by parents for the field trip
- 2-3 Chaperones (parents, volunteers, college students) to assist with the field trip
- Keeping students within line of sight of an adult during field trip
- Risk of drowning, remind yourself about CPR and have a cell phone ready
- Read students a prepared statement about risks they may encounter and how they are to responsibly act while in the field
- Be sure to teach students how to quick release hip waders in case they fall in the water and the waders start to fill with water

Permission slip

Dear Parent or Guardian,

We are currently planning on a field trip as part of our current investigation into stream systems. Your student will be participating in a survey of a stream next Friday during class. This trip will not interfere with their normal class schedule, but as we will be outside of the class room and engaged in hands on scientific inquiry, I need parent permission for being outside of the building. Please make sure that students wear appropriate clothing for the weather. I will provide waders for students who will be in the stream. Also, if you are interested in helping to chaperone the class, please check the box below.

Thank you,

Teacher's name here

Name of student_____

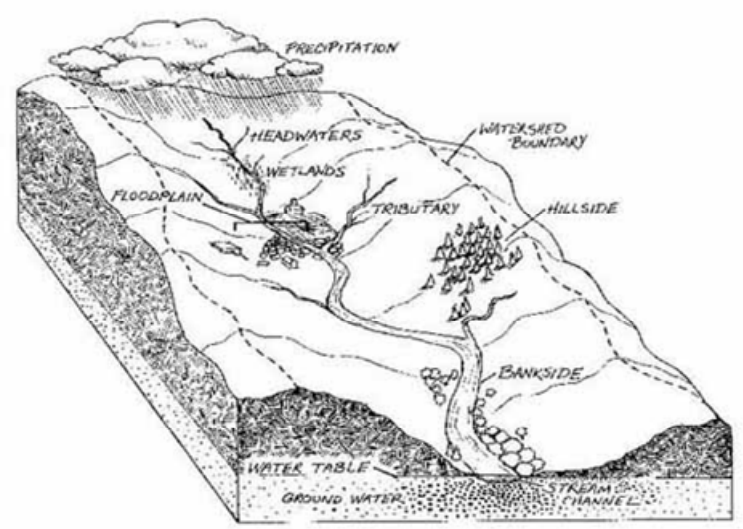
Parent/Guardian signature_____

Date_____

Interested in chaperoning? _____

Power Point Lecture Slides for Day One Lesson

Stream Morphology and Environment



Physical Features of Streams

- Channel – The area defined by the banks where water generally flows.
  - May appear in many different ways (braided, meandering, entrenched, etc.)
  - Physical features include:
    - Slope (percent)
    - Discharge (cubit feet per second)
    - Sediment size
    - Sediment load

Channel continued

- Channels can vary in different dimensions
  - Across is called the cross section (deepest part is called the *Thalweg*)
  - Along the length
    - Different features can include pools, riffles, water falls, etc
    - Slope, width, depth, flow, and sediment can change along the length of a stream

Slope

- Slope is an important feature of streams and greatly affects the ability of the stream to do work (carry sediment for example) and can affect its overall appearance
- Slope is the rise over the run of a stream
  - A very steep stream is 5-10%
  - The vertical loss divided by the linear length time 100

Sediment

- All sediment in a stream is called the total load
- Bed load are all sediment associated with the bed of the stream
- Suspended load are sediment that are moving off of the bed in suspension
- Grain size distribution is an important factor in stream morphology
  - Gravel, Sandy, Silty, etc
- Too much or too little sediment can be bad for a stream and can cause changes in morphology

Banks

- A stream bank is the area that borders the main channel
- It can be gradual or steep
- Entrenchment is when the banks are too steep for the river to change its channel
- Often have vegetation associated with the banks
  - Roots and organic material provide stability

Riparian Zone

- The Riparian Zone is the area along a stream that supports plant and animal life which is affect by or affects the stream.
  - Plants, trees, birds, insects and other animals often depend on riparian zones for habitat
- Salmon provide many important nutrients to riparian zones in the Pacific Northwest when they die

Human impacts

- How might human activities affect some of the various features of the stream?
  - Dams
  - Deforestation
  - Roads
  - Pollution
  - Development