

Teacher Guide

RiverWeb Jigsaw 2003

Introduction

Jigsaw is one approach to a comprehensive use of the RiverWeb Water Quality Simulator (WQS). It should be supplemented with wet labs and field experiences for students. We have adapted the “jigsaw” approach to team-based, cooperative learning (Aronson, 1978, Brown, 1992; Slavin, 1980). In our case we have used the technique to structure multiple learning activities required to understand the archetypal river system while supporting individual accountability during group work. “The jigsaw classroom is not a loose, ‘anything goes’ situation. It is highly structured. Interdependence is required. It is the element of ‘required’ interdependence among students which makes this a unique learning method, and it is this interdependence that encourages the students to take an active part in their learning.” (Aronson et al, 1978, p. 28).

In the jigsaw technique students are assigned to small groups to study a large topic. Each group member is assigned a subtopic on which they will become an expert and be responsible to teach their fellow group members. The grouping is then changed placing the students responsible for the same subtopic from each group together. In these subtopic groups these “expert” students investigate and learn about their subtopic. Once back in their original groups each member explains what they found out about their subtopic, thus each student becomes familiar with every subtopic.

For more information about jigsaw and tips on how to implement it check out the Jigsaw Classroom web page at www.jigsaw.org. Another good source is the National Institute for Science Education (NISE) whose Doing CL (Cooperative Learning) web page has links to both jigsaw information and hints on how to create and grade the student groups, www.wcer.wisc.edu/nise/cl1/CL/doingcl/DCL1.asp.

Here we apply the jigsaw technique through the following class activities:

- I. Opening Discussion, Introduction to the Effect of Land Use on the Watershed (1 class period)
- II. RiverWeb Tour (1 to 2 class periods)
- III. Developing an Initial Water Quality Concept Map (1 class period)
- IV. Jigsaw #1 - Land Use Groups (1 class period)
- V. Jigsaw #2 - Expert/Indicator Groups (1 to 2 class periods)
- VI. Jigsaw #3 - Regroup into Land Use Groups (1 class period)
- VII. Concluding Discussion Group Concept Map (1 class period)

Activity Overviews:

I. Opening Discussion:

Students are provided a visual introduction to interpreting graphs. Using the Generic Graph Questions, students can describe a graph using similar terms. Students are also introduced to scatter plots. They will collect data and plot a scatter plot. Students will use simple terms to describe the trend of a graph.

II. Developing an Initial Water Quality Concept Map:

Students look at the water cycle and use the terms provided to complete the concept map provided. They will also develop a concept map depicting how precipitation and their particular land use affects water quality.

III. RiverWeb Tour:

Students are introduced to the RiverWeb Water Quality Simulator through the WQS Tour. Beyond familiarizing students with the mechanics of how to use RiverWeb, students begin hypothesizing how and why the indicator levels at the river mouth are changed from their original pristine forest levels as the water flows through a variety of land uses.

IV. Jigsaw #1: Land Use Groups

Each student should be given a copy of Jigsaw1 Table of Averages of Indicators. Prior to the start of this assignment the teacher should divide the class into the specific Land Use (stations) Groups. You may want to Sub-divide the class according to the directions in Jigsaw 2.

Four or five students will be assigned to each of the following different Land Use Groups: Forest with Lumbering, Agricultural Area, Residential Area, Commercial Industrial Area, Wetlands Area, and Urban Area. If there are too few students, skip Wetlands. The students look at the effects of seasonal variation on water temperature. They compare certain indicators in the Pristine Forest (Station 0) and in their assigned station. Within their original, land use grouping students order the amount of change of each specific indicator, considering at least runoff, sediments, phosphorous, nitrogen, water temperature, and dissolved oxygen. Students in the Commercial Industrial and Urban Land Use Groups rank heavy metal and toxins in place of nitrogen and phosphorous. Each student is assigned one of the most highly ranked (most polluting) indicators and moves to the corresponding Expert/Indicator Group.

V. Jigsaw #2: Expert/Indicator Groups

Each student should be given a Jigsaw2 Individual Chart, but it depends on which indicator they are assigned to. The teacher should determine the assignments prior to the start of this activity, and sort the charts according to individual assignments. More than one student may be assigned to the same Land Use and Indicator.

Once students appreciate how the indicators vary in their assigned land use region relative to Pristine Forest, they regroup in Expert/Indicator Groups. For example, all the students responsible for nitrogen are grouped together. Likewise for sediments. And so on. Within their Expert/Indicator groupings students discuss the % change of their indicator seen at their assigned station. This is set up as a discussion session. Students should write down in the appropriate boxes in their chart (Jigsaw 2 Individual Chart) Teachers should monitor this activity carefully so students are not just copying from each other's charts. Students may also access the Resources section in RiverWeb by typing

<http://mvhs1.mbhs.edu/riverweb/students.html>
<http://mvhs1.mbhs.edu/riverweb/indicators.html>

There they will obtain other information about their indicator. Students with the same indicators will then Order their indicators (again) from smallest percent change to greatest. Monitor students to make sure they are not copying the order number from Jigsaw 1. This new order is to determine which land use has the greatest impact on specific indicators. Finally, Each student should write a paragraph depicting how their assigned indicator is impacted by specific land use.

For example, students may discover that Agriculture and Residential Areas have the most effect on nitrogen. Is that because runoff is greater for these two land use regions than for others? Or is it just the amount of nitrogen in the runoff? Many of the resources available to students will document the effect for nitrogen in farm and lawn fertilizer. Is this the source of the nitrogen in the other land use regions too? The expert group explores additional causes for excess indicator level for the rest of their land use stations. Before students can answer that question, they must re-group with their original members.

VI. Jigsaw #3: Regroup to Land Use Groups

Each student should be given a "Jigsaw3 Correlation of indicators using Scatter Plots" Chart (Sub Group 1 or Sub Group 2 depends on which indicator they are assigned). The teacher should determine the assignments prior to the start of this activity, and sort the charts according to individual assignments. More than one student may be assigned to the same Land Use and Indicator.

Each student should also be given an Indicator relationship chart (Chart 2)

Students report back to their Land Use Groups to address three questions:

- Which other land use regions rank higher in pollution potential?
- In which areas are safe levels exceeded for each indicator?
- What could be causing the excess indicator levels in those land use regions?

Group discussions may lead students to consider the seriousness of indicator level based on state and national recommendations in addition to average and maximum increase over the Pristine Forest.

Students then investigate further using the scatter plot tool. Each student should pair up with another student in his/her land use station. Together they should look at the indicators within their station and compare them using the scatter plot button. Students will indicate whether the relationship is positive or negative, strongly related or weakly related or does not show a relationship. To better describe what they see, students should draw a sketch of graph in the first row of Jigsaw 3 Chart 1.

Once each pair of students has completed Chart 1, they will re-group with the members of their group and complete Jigsaw 3---Chart 2. Here, students will discuss the strengths and weakness of indicator relationships. They will categorize the indicator relationships as strongly related, weakly related or not related. This will prepare them to make a more educated decisions when creating the final group concept map.

Concluding Discussion:

Each land Use Group will use information from each of the jigsaws (1, 2 & 3) to create a concept map describing how their land use affects water quality. Upon completion of the maps, each group reports their findings back to the entire class. The class creates a final concept map, incorporating each of the land use maps. You will find that many maps are similar. Some stations include metals and toxins while others show high nitrogen.

An Overview of the RiverWeb Water Quality Simulator Watershed Regions

<u>Station</u>	<u>Land Use Region</u>
0	Pristine Forest
1	Forest with Lumbering
2	Agricultural Area
3	Residential Area
4	Commercial Industrial Area
5	Wetlands
6	Urban Area
7	River Mouth

