WATERSHED GAME

Class Description:
Students will examine the relationship between land uses within a watershed, water quality and their community. Working in teams, students apply tools (practice, plans, and policies) to decrease water pollution while balancing financial resources. The goal of the lesson is to reduce pollution from various land uses to the stream without running out of money.

Total time: 1 hours 30 minutes (indoors)
Audience: 6-20 students, 8th grade through adult
Activity level: minimum
Travel: none
Total uphill travel: none

Wolf Ridge is an accredited residential environmental education school for persons of all ages. We offer immersion programs which involve direct observation and participation in outdoor experiences. Wolf Ridge programs focus on environmental sciences, human culture and history, personal growth, team building and outdoor recreation.

Our mission is to develop a citizenry that has the knowledge, skills, motivation and commitment to act together for a quality environment.

We meet our mission by:
• Fostering awareness, curiosity and sensitivity to the natural world.
• Providing lifelong learning experiences in nature.
• Developing social understanding, respect and cooperation.
• Modeling values, behaviors and technologies, which lead to a sustainable lifestyle.
• Promoting the concepts of conservation and stewardship.

This Curriculum was created by Minnesota Sea Grant.
I. Set-up (5 min.)

II. Introduction (10 min.)
   A. Greeting/Grabber
   B. Learn Names
   C. Behavior Guidelines
   D. Class Overview
   E. Assess Learner Level

III. How to Play
   A. Preparing Student Land Use Teams
      1. Review
      2. Land Use Maps
      3. Explain Rules
      4. Distribute Roles
   B. Land Use Team Play
      1. Starting Pollution
      2. Teams Report
      3. Watershed Clean Water Goal
      4. Goal Achieved?
      5. Evaluation
      6. Campaign
      7. Debate

IV. Conclusion (10 min.)
   A. Review
   B. Stewardship Actions

V. Clean Up

IX. Appendices
   A. Equipment
   B. References
   C. Safety Management
   D. Glossary
   E. Additional Information
   F. Optional Activities
   G. Pre and Post Activities
   H. Worksheets

CONCEPTS:
- A watershed is the area of land that drains to a particular lake, river or stream.
- Phosphorous and sediment levels can impact the health of a watershed if they are too high and unbalanced.
- Citizens, organizations and governments cooperate to make decisions about land use while factoring in economics and water quality.

OUTCOMES:
Upon completion of the Watershed Game students will be able to:

1. Describe how various land uses within a watershed may pollute a stream with sediment or excess phosphorous.
2. Recommend actions to minimize and prevent pollution throughout a watershed.
3. Understand that sediment and phosphorous are natural parts of a healthy ecosystem under normal conditions.
4. Examine the cost benefits of tools that decrease pollutants from the watershed.

MN GRADUATION STANDARDS:
Wolf Ridge has aligned the Center's entire curriculum to Minnesota Department of Education Academic Standards. The Center maintains a curriculum standards matrix for the following subject areas:

- Science
- Mathematics
- Social Studies
- Language Arts

The Matrices are organized by grade level and subject area, listing Strand, Sub-Strand, Standards, and Benchmarks. Every class addressing a benchmark is also noted. As the primary student audience at Wolf Ridge is from 4th-12th grade, the matrices address these grade levels. Teachers may request that their students focus upon a specific benchmark while attending Wolf Ridge.

Copies of our matrices are available on the Wolf Ridge website at www.wolf-ridge.org, found under the "Education" menu. If you cannot access the matrices via the website, request a printed copy by calling 218-353-7414 or e-mailing us at mail@wolf-ridge.org.
I. Set-up (5 min.)
All of the equipment for watershed game is located in a grey tub in your classroom. Tables and chairs will be set up prior to your arrival. Land use cards should be on students' tables for them to explore while you take inventory of your supplies and review the lesson plan.

II. Introduction (10 min.)
A. Greeting/Grabber
Greet the students as they enter the classroom. Ask students if they can name any lakes, rivers or streams that make up the watershed in their hometown? What about here at Wolf Ridge. What is in and around your watershed at home? Who lives there? (People, animals etc.)

Make a list on the board of all the lakes rivers and streams that students name. Title them Home and Wolf Ridge. This is a great opportunity for students to take note of all the parts of their own watershed and the one they have been interacting with here. Point out the land use maps on their tables and ask them if they can recognize these watershed components in their hometown.

B. Learn Students' Names
Take a few minutes to learn the names of your students and welcome them individually to the class. Repeat their names and strive to use them in every communication.

C. Set Behavior Guidelines
Discuss clearly and specifically which behaviors you expect from your students during the next three hours. Explain the need for respect; for you, for each other, for the equipment, and for the environment. Students are accountable for equipment used in the class. Their school will be charged for any lost or damaged equipment.

D. Overview of the Class and Outcomes
Use the class description, instructional sequence and class concepts to give the students an idea of how things will run. Students will be more comfortable and agreeable if they are aware of activities, time schedule and travel plans.

E. Assess Learner Level
Ask students if they have been to Wolf Lake before, perhaps canoeing, Voyageur class, a night hike, or during Trees and Keys class? Find out if they have done any environmental testing of a lake or stream, either as individuals or as part of a class project. Do they live by a lake? Have they visited Lake Superior’s north shore before?

III. How to Play the Watershed Game
Goal: As students arrive, they gather around their assigned land use maps (one at each table). The goal of this game is to create and interact with a model watershed and reduce the pollution created by it without exceeding their money limit.

A. Preparing Student Land Use Teams:
Students land use teams are the individuals whom they are sitting at a table with. They will play the first portion of the game with the group and single land use map at their table.

1. Review
Go through the list of terms and definitions below. These are key components in the game and are a part of understanding how to keep your watershed clean without running out of money.
Watershed Game

Common Land Use Categories
Types and Sources of Pollutants
Impacts of Pollutants
Pollution Units
Pollutant Load
Watershed Clean Water Goal

After reviewing these key terms and concepts with students choose a pollutant of concern that you would like to explore throughout the game.

2. Land Use Maps
Demonstrate how the land use maps fit together to form a watershed, using the full watershed map. Students will be a part of one of the following land use teams.

Farmland    City
Forest     Residential

Point out the undeveloped land at the bottom of the map.

Emphasize that all land uses contribute sediment and phosphorous, including undeveloped land.

3. Explain Basic Rules
Explain the basic rules to students that are outlined below while showing students the game pieces and student worksheets (do not hand them out yet).

Student Worksheets
Teams will fill out the student worksheet by following the step by step instructions outlined on the sheet.

Role Cards
Team members will play specific roles during the game as described on the role cards; briefly review the roles. Each team will have a banker, reader, scribe, reporter, mapper and pollution specialist.

Money
Teams receive $60,000 dollars to buy tool cards. The team must keep at least $10,000 in the bank for future use.

Tool Cards
Teams will choose and use up to 3 of their Tool Cards to reduce pollution. Each team member will be responsible for one or more Tool Cards and will describe their Tool Cards out loud to their team, including what it is and how it reduces pollution.

4. Distribute Role Cards and Student Worksheets Only
Do not hand out the Tool Cards or money yet. Students will ask for these components after they have completed parts A-C of the worksheet.

Give students a little time to establish their roles with their groups and review the job of each role. If groups have more or less than 6 people students can share jobs, or one student may have more than one role.

Reader    Reporter
Banker     Mapper
Scribe     Pollution Specialist

B. Land Use Team Play
Tell students that each land use team has $60,000 dollars in the bank and is contributing 50 pollution units to the stream.

Scribes should write these numbers on their student worksheet in part F.
C. Full Class Game Play

Gather teams for reporting the results from their student worksheets.

Assemble team land use maps into the watershed game board.
Use an open floor space, wall, or large table to assemble the game board.

Tip: Be sure to include the two lower portions of the game board (score box and payment box map sections)

1. Starting pollution
Tell the class the total starting pollution reaching the stream from the entire watershed (205 PUs) show and explain where the total comes from.

\[
\begin{align*}
4 \text{ land uses} \times 50 \text{ PUs per land use} &= 200 \text{ PUs} \\
+ \hspace{1cm} \text{Undeveloped Land} &= 5 \text{ PUs}
\end{align*}
\]

\[
\text{TOTAL starting pollution for } = 205 \text{ PUs} \hspace{1cm} \text{entire watershed}
\]

2. Teams Report
Ask teams to report the following:

1. Use their land use map to show the class the pollution sources they identified in Part C of their student worksheet (Pollution Specialist).

2. Describe their chosen Tool Cards (Part F in the student worksheet), including what they are, how they reduce pollution, number of PUs reduced, and cost (Reporter).

3. Show where their 3 chosen Tool Cards fit on the watershed game board (Mapper)

4. Place their spent money in the payment box on the watershed board (Banker).

5. Report their remaining pollution units and remaining money from part G of the Student worksheet (Scribe).

As each team reports, record results on the score card you have chosen. Calculate and record the remaining PUs (still reaching the stream) and remaining unspent money from all land use combined. Remember to include the 5 PUs from the undeveloped land.

3. Introduce the Watershed Clean Water Goal
Write the Watershed Clean Water Goal on the watershed score card.

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\begin{align*}
\text{Phosphorus} &= 75 \text{ PUs} \\
\text{Sediment} &= 40 \text{ PUs}
\end{align*}
\]

Tip: The Watershed Clean Water Goal is a specific pollution unit limit determined by water quality scientists that will protect the stream’s aquatic life.

4. Determine whether the class has met the Watershed Clean Water Goal.
How many PUs still need to be removed?
Discuss with the students whether they have met their goal and what still needs to be removed from the watershed.
5. Cooperation and Evaluation

Ask the class how they could achieve the Watershed Clean Water Goal.

Introduce cooperation among the Land Use Teams.

Tips: Try to help students realize on their own that they will have to work together to achieve the Clean Water Goal.

**Students will need to:**
- Pool their remaining money
- Choose from extra tool cards that each team pre-selected

6. Pollution Specialist Campaign

Have each team’s Pollution Specialist present and campaign for their extra Tool Card to the rest of the class. Their argument should include the following:

- Title
- Why their team’s Tool Card should be chosen
- Action
- Pollution Reduction (PUs)
- Other benefits their chosen Tool Card could provide
- Cost

Tip: Have them stand in front of the class to report.

7. Debate

Have class debate and choose which extra Tool Cards to use. Class can use as many cards as they can afford to reach the Watershed Clean Water Goal, but as a class they cannot spend more money than they have.

Hold a vote if students can’t agree.

Once students have come to an agreed upon solution the game play is over.
IV. Conclusion
Lead a discussion with the class to re-emphasize the watershed game goals and objectives.

**Assessment (Outcome 1):** Describe how various land uses within a watershed may pollute a stream with sediment or excess phosphorous.
**Answers:**
- Water can flow too fast through culverts and damage existing vegetation.
- Parking lots of businesses and schools can flood, causing pollutants to leach.
- Erosion from farm fields can cause pollutants from pesticides and fertilizers to be transferred into the waterway as well as sediment from the eroding banks.

**Assessment (Outcome 2):** Recommend actions to minimize and prevent pollution throughout a watershed.
**Answers:**
- Students will have to decide on a solution to reduce water pollution. Teams will have a different answer based on their designated land use.

**Assessment (Outcome 3):** Understand that sediment and phosphorous are natural parts of a healthy ecosystem under normal conditions.
**Answers:**
- Phosphorous and sediment are only pollutants when there is an excessive amount that enters our lakes, rivers, streams and wetlands.
- Some erosion is natural and important- enriching the surrounding soil with nutrients.
- Nutrients like phosphorous cycle through the system enriching plants, animals and the environment that supports life.

**Assessment (Outcome 4):** Examine the cost benefits of tools that decrease pollutants from the watershed.
**Answers:**
- Some solutions and recommendations can be controversial amongst land use teams, they can also cost a lot of money. While an expensive solution may seem like the best option sometimes teams have to problem solve due to conflict and lack of funding or resources.

V. Clean Up
Please return all of the game pieces to the classroom Kit tub. All of the cards and money should be placed in their proper container. Erase the scores from the score board. Please take an opportunity to stack the chairs in piles of five and take down the tables. Tables can be put against the wall. Thank you for your help in keeping our classrooms neat and tidy.
IX. Appendices
A. Equipment
Classroom Equipment:
• Watershed Game Board
  • Land Use maps (4)
  • Score Box Map Section
  • Payment Box Map Section
• Full Watershed Map
• Role Cards (2 per Team)
• Money ($60,000 per team)
• Student Worksheet
• Pencils
• Score Board

Sources:
• Minnesota Sea Grant
  www.northlandnemo.org/watershedgame.html
• Lake Superior Graphic
  National Oceanic Atmospheric Association
  http://www.glerl.noaa.gov/pr/ourlakes/lakes.html
• Great Lakes Watershed Graphic
  “The Geography of North America”
  http://48ounces.com/?page_id=271

B. References
  1. Minnesota Sea Grant
     www.northlandnemo.org/watershedgame.html

C. Safety Management
Instructor will adhere to and be familiar with all safety practices designated by this lesson plan or updated training from a Wolf Ridge permanent staff member.

D. Glossary
Watershed

Common Land Use Categories

Sources of Pollutants

Impacts of Pollutants

Pollution Units

Pollutant Load

Watershed Clean Water Goal

E. Student Information Sheets
  1. Student Worksheets (2 pages)
  2. Watershed Game Board
  3. Role Cards
  4. Tool Cards
  5. Full Watershed Maps