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STEM
E-CONTENT
3D VIRTUAL REALTY

The Key To Global Life,
Digital Change Of Nature

Total Duration: 3 hours

Student's Age: 14-18 Years

Application Area:
- Water quality,
- Geography,
- Chemistry,
- Biology,
- Maths (graphs).

Keywords: Water, contamination, pollution, filter, sediments

W1 - Water Filter

Module
- Water and Healthy Food

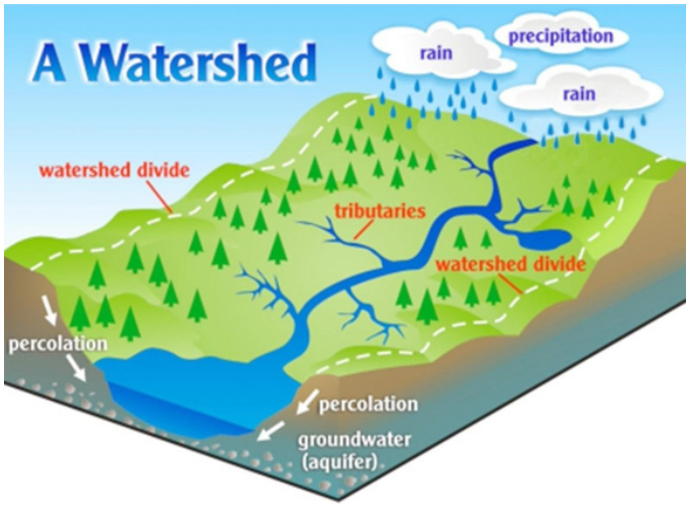
W1 - Water filter

Materials:
- **Coloured candy (M&M, skittles ...)**
- **Ziplock bags**
- **Graph paper (see attached document 1 , Attachment 1)**
- **Coloured pencils**
- **Pollutant labels**
- **Pictures of land uses**
- **Please visit visual aids (Attachment 2)**
- **See also eg. page 13-23 of this document (Attachment 3)**
- ½ l marsh/swamp water or tap water with mud/dirt (water quality is not important.)
- 2 litre plastic bottle with its lid/cap, 1000 ml beaker
- 2 x 560 ml plastic cups
- 1 tablespoon alum (aluminium potassium sulphate)
- 2 cups of fine sand (200 ml paper cup)
- 1 cup of coarse sand (200 ml paper cup)
- 1 cup small pebbles (200 ml paper cup)
- 1 filter paper or coffee filter (to help serve as water filter), 1 rubber band (elastic)
- 1 large spoon for mixing, 1 spoon to scoop alum (for placing aluminium potassium sulphate)
- A stopwatch/timer (or you can just use your phone)

Notes:
- The necessary precautions must be taken for cutting-drilling operations. If necessary, assistance from an adult is recommended.
- Water quality is not important for this activity. For example, tap or well water can both be used.
- The given quantities in the materials list have to be respected.

Introduction

A "watershed" is an area of land from which all the water drains to the same location, such as a stream, pond, lake, river, wetland, or estuary (see figure below). A watershed can be large, like the Colorado River drainage basin, or very small, such as all the water that drains to a small farm pond. Large watersheds are often called "basins" and contain many small watersheds (Picture 1)



Picture 1. Watershed

Watersheds can transport nonpoint source pollution. Nonpoint source pollution is associated with rainfall and snowmelt moving over or through the ground, carrying natural and human made pollutants into water sources.

Examples of nonpoint source pollutants are fertilisers, pesticides, sediment, gas, and oil. Pollutants accumulate in watersheds as a result of various human and natural activities. These pollutants, while sometimes inevitable, drastically alter the state of the ecosystem. If we can determine the type of pollutant and its cause, then we can classify the source of the pollutant and take preventative measures to reduce any further contamination.

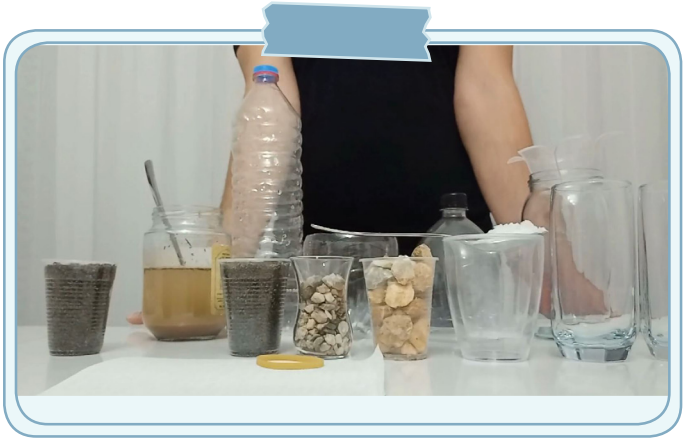
This activity will be a filtration activity which we can call anti-pollution or mitigation. Filtration is any of the various mechanical, physical or biological processes that separate solids from liquids (liquids or gases) by creating an environment where only liquid can pass through.

At the end of the activity, students will reflect on the importance of clean water and the water cycle in nature. They learn by discussions how water in nature goes and is collected in basins, and that pollution is carried by the arms that feed the basin.

Students are expected to design a device that can filter a sample of dirty water after brainstorming solutions for these pollutant situations.

It is important to stimulate them to produce different solutions.

Considerations



Picture 2. Materials

- Prepare the materials before starting (Picture 2).
- The necessary precautions must be taken for cutting-drilling operations. If necessary, assistance from an adult is recommended.
- Water quality is not important for this activity. For example, tap or well water can both be used.
- The given quantities in the materials list have to be respected.

Aim of the Activity

- To describe and identify the link between land use activities within a watershed and water quality.
- To understand what a pollutant is and that different land uses may cause different kinds of pollution.
- To apply the engineering design cyclus to design and build a working device, testing and evaluating the results and making improvements.
- To learn to evaluate, graphically and apply the scientific method.

Activity Process

Before Activity

1. Discuss possible solutions of the design challenge. Watch this video for an example:
https://www.youtube.com/watch?v=OMZpzcItQkc&t=131s

2. Prepare a sample of polluted water. Divide the candy into the ziplock bags (you may want to manipulate the bags so that the assortment of candy represents a particular land use area by adding more of a certain type of pollutant, rather than relying on a random mix). You may either have one bag per student or one bag per group of students. You should have about 30 pieces of candy per bag. Each bag represents a water sample from a watershed.

   A possible mix of candies per land-use might be as follows:

Land use	*purple*	*red*	*green*	*yellow*	*orange*
Agriculture	8	5	4	2	0
Sport ground	6	5	8	2	0
Residential area	5	0	0	5	0
Industry	10	2	5	5	10
Nature reserve	5	8	8	5	0

3. Ask the class to define the word pollutant. Tell them that each colour of candy represents a different kind of pollutant. You might want to prepare visual aids to hang up in the classroom, see eg. the attachment (Attachment 2).
   PURPLE = Sediment
   RED = Pesticides
   GREEN = Fertilisers
   YELLOW = Oil and Gas
   ORANGE = Toxic Waste
Discuss each of these pollutants with the students. Ask them where they come from, what they are used for, how they can be beneficial, and how they may be harmful. Discuss what land-use means, and what kind of land use may cause the different kinds of pollution.

4. Distribute the graph paper to each student or group. Tell the students that they will be drawing a bar graph to show the number of pollutants found in their “water sample.” Show them the sample graph provided. Have the students label the x-axis with the pollutant types and the y-axis with the amount of pollutants.

4. Give each group a "water sample." Tell the students to separate and count the number of each pollutant and graph them on the paper. Remind the students that they cannot eat the coloured candy until they are finished with their graph!

5. Ask the students to try and determine what land use activities are occurring in their watershed according to the "water sample."

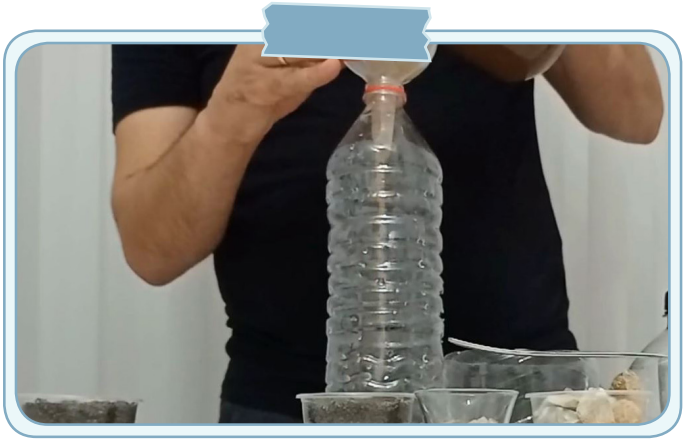
For example, a water sample from an area with a lot of agricultural use may have more sediment, fertiliser, and pesticides.

6. Discuss how each water sample is different. While some samples might contain an abundance of one type of pollution, almost all types of pollutants can be found in every sample (even if they are small amounts). Discuss strategies to reduce pollution. How can the students do this on a large scale (in their community) or small scale (in their own home)?

Let's Start

- Design and build a device that can clean a dirty water sample using materials around your home.
- Possible outcome: Make a water filter using plastic bottles and stickers to indicate the different layers.
- Watch Video:
- https://www.youtube.com/watch?v=OMZpzcltQkc&t=131s

1 Design Challange:

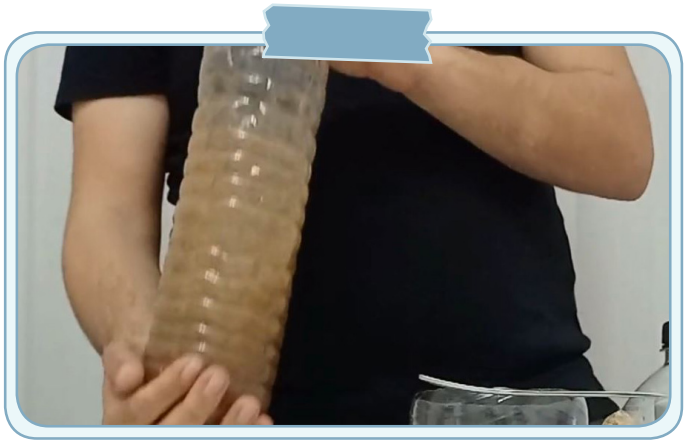


Picture 3. Pour swamp water

- Put the lid on the bottle and shake vigorously for 30 seconds. Then pour the water back and forth between the two cups about 10 times. (Picture 4)

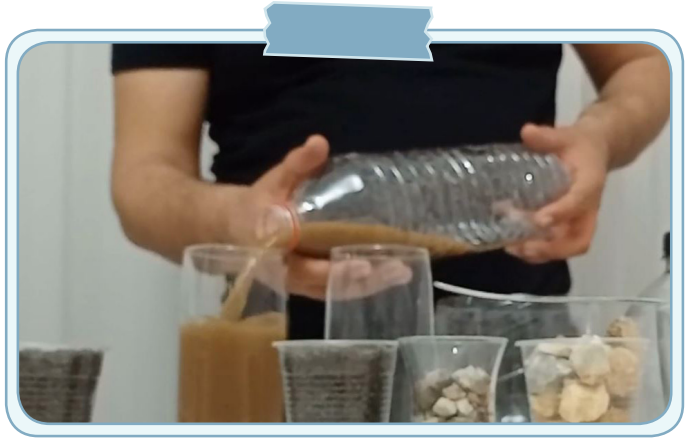
2 Design Steps:

- In the following part you find the steps that can be used to build a possible solution of the water filter challenge.
- Pour swamp water in the 2-litre bottle with a cap. Notice how it looks and smells (Picture 3).

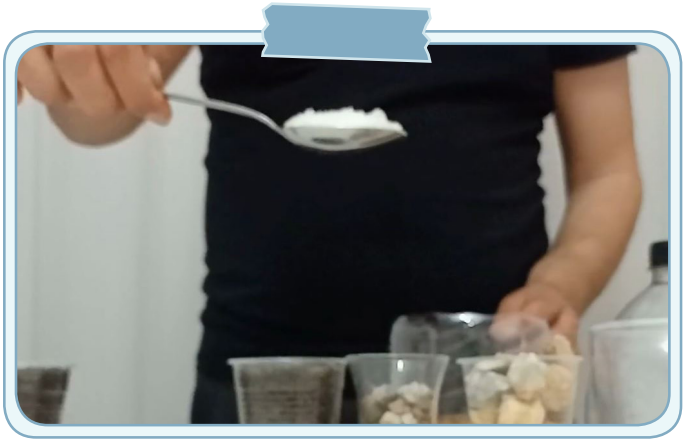


Picture 4. Shake 30 seconds

- Pour the water into the bottle with its top cut off. Again notice how the water looks and smells. (Picture 5)



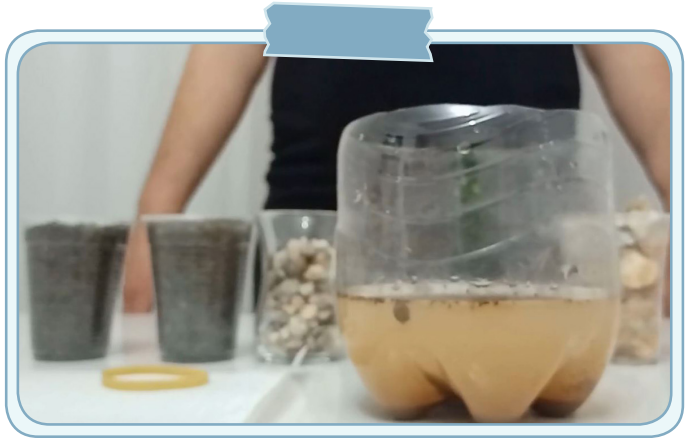
Picture 5. Pour the water



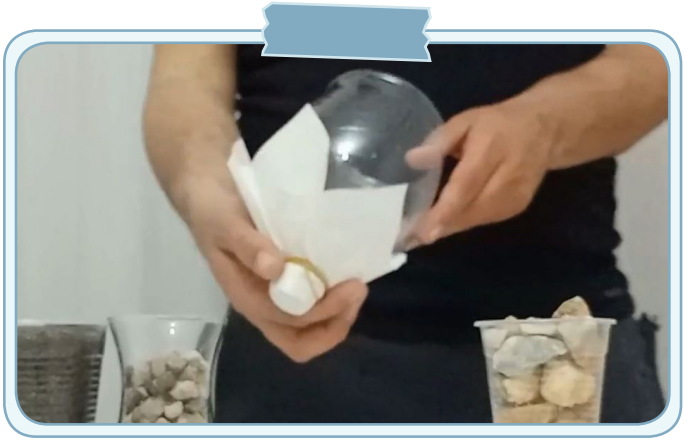
Picture 6. Add 2 tablespoons

- Add 2 tablespoons of alum to the water in the bottle with the top cut off. Use the spoon to slowly stir the water for five minutes. What do you notice about the water as you stir it? (Picture 6)

- Now let the water sit undisturbed for 20 minutes, checking it every five minutes to note how it looks and smells (without moving it). (Picture 7)



Picture 7. Wait for 20 minutes

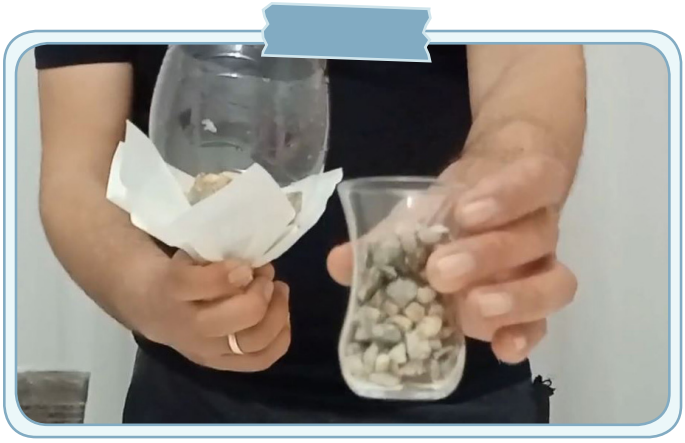


Picture 8. Filter paper

- Use a rubber band to secure the filter paper to the mouth of the bottle with its bottom cut off. Put it upside down in the beaker. (Picture 8)

- Pour the pebbles into the bottle. Then pour the coarse sand on top of the pebbles and the fine sand on top of the coarse sand. (Picture 9)

Picture 9. Pour the pebbles



Picture 10. Pour the pebbles

- Pour the top 2/3 of the swamp water through the filter, taking care to leave any sediment in the swamp water bottle. (Picture 11)

Picture 12. Swamp water with contaminants

- Compare the results (Picture 13).

- Carefully pour about two litres of clean tap water through, and be careful not to disturb the top layer of sand. Pour the tap water out of the beaker. (Picture 10).

Picture 11. Swamp water

- Once all the water has passed through the filter, compare the swamp water with contaminants to the filtered water.
- How do they look and smell different? (Picture 12).

Picture 13. Compare the Results

Assesment

Evaluation

- The design of students can be displayed within the school. Different products can be created by diversifying waste materials used.The teacher evaluates them through the Rubric.

Goals	Must be Improved (1)	Medium (2)	Good (3)	Very Good (4)
Expressing yourself	(.....)	(.....)	(.....)	(.....)
Participating discussion	(.....)	(.....)	(.....)	(.....)
The Originality of Developed Design	(.....)	(.....)	(.....)	(.....)
Relationship between the developed design and theme	(.....)	(.....)	(.....)	(.....)
Harmony with the group	(.....)	(.....)	(.....)	(.....)
Using Scientific process skills	(.....)	(.....)	(.....)	(.....)
Effectiveness of presentation	(.....)	(.....)	(.....)	(.....)
Total				

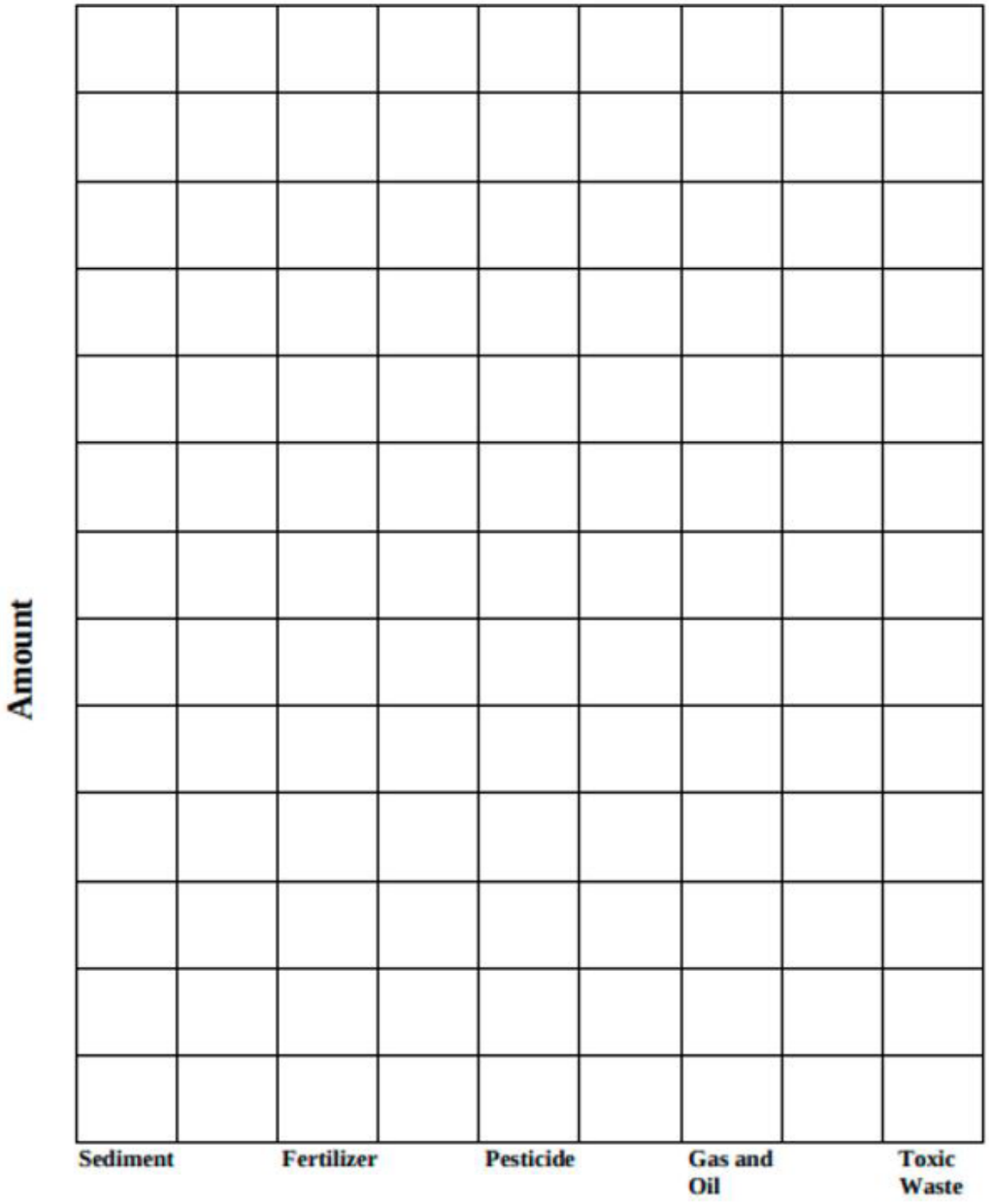
Links

- Freepik Company, S. L. Images. Retrieved 12.09.2022 from https://www.freepik.com/
- H2Odistrubutors. (2022). Making an Emergency/Makeshift Water Filter. https://www.h2odistributors.com/pages/info/how-to-make-a-water-filter.asp
- Specialty, S. (2022). 21 Easy Homemade Water Filter Plans. https://www.sunrisespecialty.com/how-to-make-water-filter

Attachments

1

Water Pollution Graphing Activity



2

SEDIMENT

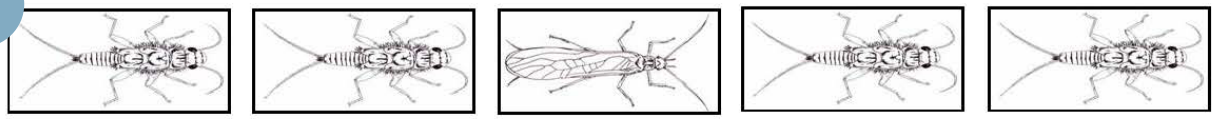
FERTILIZERS/ NUTRIENTS

TOXIC WASTE

PESTICIDES

OIL AND GAS

3



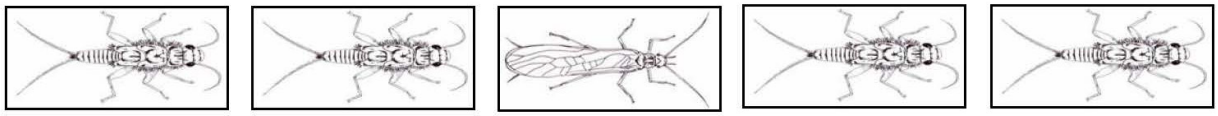
Suggested combinations of skittles for different land uses:

Land use	Purple	Red	Green	Yellow	Orange
Agriculture	8	5	5	2	0
Golf Course	5	5	8	2	0
Factory/Industrial	5	2	5	5	10
Construction	10	0	0	5	0
Neighborhood	2	5	8	5	0

Pictures of land uses:

Agriculture:

Pasture/grazing land
Poorly managed grazing and/or a concentration of animals near streams can cause a loss of riparian vegetation and an increase in erosion.

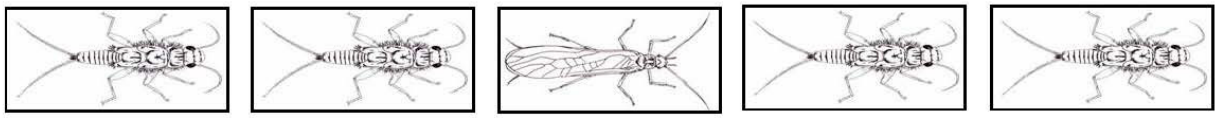


Fertilizer and pesticide application
When fertilizers and pesticides are applied in large quantities they can enter the groundwater or get washed away into nearby water bodies.

Harvesting crops
Fields left empty after harvesting can easily be eroded away. This soil often gets washed into nearby streams and rivers.

Construction:

Sediment runoff
Dirt and soil from construction sites is easily washed into storm drains during rain storms.



Forestry:

Deforestation
Removing trees and other vegetation causes an increase in erosion. More sediment is washed into streams and rivers.