Follow the Flow - Watersheds, Water Quality, Glaciers

Objectives

Students will:

- identify their watershed and drainage basin
- find the Columbia Icefield on the map
- define persistent chemicals
- investigate factors that contribute to water quality
- develop an understanding of how climate change will affect the quality and of our drinking water.

Materials

Projector and Speakers
Lesson Plan

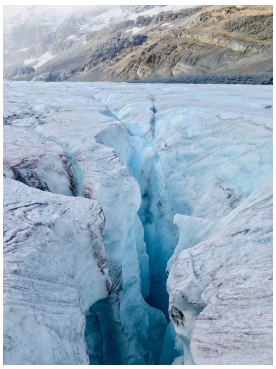
Video Links
Internet Connection

Overview

Part A: What is a watershed?

Part B: Alberta's Watersheds
Part C: Where does your water come from?
Part D: What is water quality

Part E: Climate Change and water quality
Part F: Extension: Investigate Water Quality in your own Watershed



Time Required

60 min

Follow the Flow

Alberta Curriculum LInks:

Grade 5 Social Studies: Physical Geography of Canada
Grade 5 Science: Wetland Ecosystems
Grade 7 Science: Interactions and Ecosystems
Grade 8 Science: Freshwater and Saltwater Systems
Grade 9 Science: Environmental Chemistry
Science 10: Energy Flow in Global System
Science 20: Change in Living Systems
Biology 20: Energy and Matter Exchange in the Biosphere
Science 14: Investigating matter and Energy in the Environment
CTS: Agriculture 1010
CTS: Environmental Stewardship 1110
CTS: Environmental Stewardship 1115
CTS: ENvironmental Stewardship 3040

Procedure:
Introductory Activity:

1. Fill a large beaker with water. Ask the students what's in the water? Just water?

It may look pure, but in fact there are minerals, inorganic compounds, and possibly bacteria that we can't see. Sometimes you look at water and "know" it is unclean, but when it is clear, it's harder to tell.

2. As the students, what makes water quality good or bad? When we test water quality, we look at parameters like temperature, pH (acidity), dissolved solids, particulate matter, dissolved oxygen and more.
3. Ask the students what contributes to bad water quality?

A number of suggestions may be offered. In the end, anything we do on the land or air can affect water quality. For example putting excess fertilizer on the land can lower water quality by contributing to eutrophication of water bodies which in turn can affect the level of dissolved oxygen in the water. . Too much activity around water bodies from cattle, or off highway vehicle use can increase the turbidity of the water lowering the quality. Anything that can settle out of the air onto the land or into the water can also affect water quality.

Basically, anything that happens in the watershed can affect the water quality.

Student Worksheet:

Have the students work through the student worksheet, watching video and reading graphs and charts.

PART A: What is a watershed? **Teacher Answer Key**

1. ASK THE STUDENTS WHAT THEY THINK A WATERSHED IS.

   Definition: Watersheds are the sum of the streams that gather from heights of land and flow into a common water basin. Sometimes called catchment basins, watersheds are made up of many sub-basins, or tributary basins

Part B: Alberta's Watersheds

2. Goto www.albertatomorrow.ca and create an account
3. Go to Explore and find your community on the map.
4. Using Alberta Tomorrow and Figure 2 and 3, label the following on Figure 1
   a. Columbia IceField
   b. Calgary
   c. Edmonton
   d. Red Deer
   e. Fort MacMurray
   f. Lethbridge
   g. Grand Prairie
   h. Medicine Hat

5. Using the following table, record the number of glaciers for each watershed and the total area of glaciers on figure 1.

Table E1. Glacier count, area and volume estimates for Alberta river basins, based on the WC^{2}N glacier inventory for 2005. Best estimates are based on the mean prediction from four different methods for ice volume estimation.

			Glacier Volume (km^3)	
Basin	*Count*	*Area (km^2)*	*Range*	*Best estimate*
Bow	96	60.1	2.1-3.6	3.0 ± 0.7
Red Deer	22	16.6	0.6-1.0	0.9 ± 0.2
North Saskatchewan	258	286.3	13-19	17.5 ± 4.4
Athabasca	271	320.5	12-18	16.7 ± 4.2
Peace(AB)	94	107.6	6-14	8.8 ± 1.4
Peace(AB and BC)	363	276.7	13-23	16.9 ± 4.2
Alberta	741	791.1	35-55	47 ± 13
Eastern slopes	1010	960.3	43-67	55 ± 15

(Marshall, White 2010)

6. Can you tell which of Alberta's watersheds are supplied by water from the Columbia Icefield?

   North Saskatchewan and Athabasca

7. Watch the video of Peter Lemieux discussing where water from the Columbia Icefield flows to:

Video: Watershed Great Divide

Video: Where does water go from Snow Dome?

Sunwatpa, Athabasca RIvers, Columbia River, Saskatchewan River, Hudson Bay

8. Which oceans does water from the Columbia Icefield drain into? (See figure 5)

Pacific, Atlantic and Arctic Oceans

Part C: Where does your water come from?

9. What watershed do you live within?

10. What glaciers provide you with drinking water?

Part D: What is water quality?

Use the at simulator to determine how water quality has changed in your watershed since 1900. Watch the water quality video found in the videos section on the left hand side.

What factors contributed to the decline in your water quality? agricultural and urban runoff mostly

11. Click on "Create new scenario"

12. Create a "Historic" scenario and choose your watershed. Use the following chart for reference

Landscape Type/ Landuse	Color
Orange	Agriculture
Yellow	Natural Grassland

Blue	**Water**
Light Green	**Wetland**
Dark Green	**Forest**
Purple	**Urban**
Grey	**Industry and Transportation**
White	**Alpine and Exposed**

13. Click "run scenario" Once it has loaded hit the play button.

What was the water quality in your area in the year 1900?
Answers will vary.

14. What was it in 2020?

Answers will vary.

15. What factors do you think contributed to the decline in water quality?

Mainly agricultural and urban runoff

Part E: Climate Change and water quality

16. Watch the following videos to see what finds Dr. Cristiciello finds when she analyses ice cores.

Follow the Flow

Video: What we learn from ice cores.

What oxygen isotopes are present and therefore what the climate was like when the ice was formed
What contaminants are in the ice

Video: How do atmospheric chemicals get into the water?

17. Research what CFCs are. Why are they a problem?

The definition of CFC's: any of several simple gaseous compounds that contain carbon, chlorine, fluorine, and sometimes hydrogen, that are used as refrigerants, cleaning solvents, and aerosol propellants and in the manufacture of plastic foams, and that are believed to be a major cause of stratospheric ozone depletion —abbreviation CFC

They are a problem because they are persistent in the environment.

18. What are persistent chemicals?

Persistent organic pollutants (POPs) are chemical substances that persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment. This group of priority pollutants consists of pesticides (such as DDT), industrial chemicals (such as polychlorinated biphenyls, PCBs) and unintentional by-products of industrial processes (such as dioxins and furans)

19. Watch Video: Persistent chemicals

What does Dr. Criscitiello say about the replacement compounds to CFC's?

The replacement chemicals are likely as bad as what they replaced.

20. DDT has been banned in Canada since 1972. How did DDT get in the ice?

DDT settled on the ice when it was still legal to use. It's been locked up in the ice, but as the glacier melts, it will be released back into the environment.

21. What are the impacts of melting glaciers on the levels of DDT released into the environment?

We will be drinking that water.

In Alberta and BC, Forest fire season has been severe over the past few years.

22. Watch Video: How do forest fires affect the glacier?

The main way forest fires affect the glaciers is that dark ash gets deposited on the glaciers. This decreases the ALBEDO or reflectivity of the ice, therefore speeding up the melt.

Part F: Extension

Go out into your watershed. Use the www.albertatomorrow.ca simulator to look at the landuses surrounding your local body of water to understand what may be affecting that water quality.

Measure parameters you have test kits for: dissolved oxygen, phosphates, nitrates, turbidity, etc and record your findings in the "observations" section of the Alberta Tomorrow simulator.

Data can be entered into the Alberta Tomorrow simulator citizen science App or website under observations.

Compare your observations to those of others across the province.

Resources:

"Alberta WaterPortal." Alberta WaterPortal, albertawater.com/glaciers-overview.

GLIMS Viewer, www.glims.org/maps/glims.

Canadian Glacier Inventory Project, cgip.wikifoundry.com/page/1. Rocky Mountain Introduction.

http://cgip.wikifoundry.com/page/1.+Rocky+Mountain+Introduction

"Dynamics of Alberta's Water Supply." Glacier Inventory and Ice Volume Estimation, albertawater.com/dynamics-of-alberta-s-water-supply/44-learn/source/glacier-inventory-and-ice-volume-estimation .https://albertawater.com/docs-work/projects-and-research/dynamics-of-albertas-water-supply/18-alberta-glacier-inventory-and-ice-volume-estimation-marshall-et-al/file

Ommanney, C.S.L.. (2002). Glaciers of the Canadian Rockies. US Geological Survey Professional Paper. J199-J289.https://pubs.usgs.gov/pp/p1386j/canadianrockies/canrock-lores.pdf

Origin and Distribution of Surface Water in Alberta

STUDENT WORKSHEET NAME:_____

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1.

Part B: Alberta's Watersheds

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7. Watch the video of Peter Lemieux discussing where water from the Columbia Icefield flows to:
   Watch the video: Ali watershed great divide
   Watch the video: Where does water go from Snow Dome?

8. Which oceans does water from the Columbia Icefield drain into?

Part C: Where does your water come from?
Determine where your water comes from and where it ends up.

9. What watershed do you live within?

10. What glaciers provide you with drinking water?

Part D: What is water quality?

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Figure 1: Alberta's Watersheds:

Figure 2: Major Drainage Basins in Alberta

Figure 3: Major Glaciers of the Rocky Mountains