Science 21 Resource Package

CHEMISTRY: Water – Our Liquid World

Suggested Lessons and Activities

Course Outline

The course will consist of three units selected from the following four units of study:

1. Biology (Human Body Systems)
2. Chemistry (Our Liquid World – A Focus on Water)
3. Physics (Waves and Optics in Everyday Life)
4. A unit of study determined by local interest and selected by the teacher and the student.

The teacher may use the three units selected from this course, or any two of these units as well as a locally determined unit of study. Each unit consists of a series of suggested lessons that are designed to meet the foundational objectives for the unit. Each lesson contains the learning objectives covered in the lesson, an overview of the lesson, a list of instructional documents that are included within the unit, and a list of supporting resources. The supporting resources may include reading materials to support the lesson or additional lesson ideas and activities that meet the objectives that are outlined for the lesson.

The units within this course outline are not intended as a complete Science 21 course. Teachers should integrate some of the suggested lessons within their own unit plans and modify the suggested lessons to meet the diverse needs of their students. Some of the objectives are addressed in more than one of the suggested lessons within a unit; therefore, not all of the suggested lessons need to be used. Teachers may request an electronic version of this course outline from their school division office so that they can modify the instructional documents to meet diverse needs.

Introduction

The intention of this unit is to facilitate students' understanding of the importance of water for life and the responsibility that humans have to protect and preserve this resource. The study of water is mainly qualitative - the more challenging concepts involving water that are found in senior chemistry courses have not been included. Students begin by studying the unique chemical properties of water through activities and lab work. Next, the basics of the water cycle are considered. This leads into discussion and activities on freshwater – the global shortage, methods of contamination, how water and sewage are treated and how water is tested. The controversy surrounding bottled water is researched and discussed. Students consider their own water usage, compare this to given averages, and compile a list of changes that they can make to decrease their water consumption. The unit ends with a project that involves students researching the effects of different types of water contamination and proposing solutions to the problems faced.

NAME
DATE

④ BIGGER PICTURE

SCIENCE 21

② **LAST UNIT**/Experience

① **CURRENT UNIT**

CHEMISTRY: Our Liquid World

③ **NEXT UNIT**/Experience

⑤ **UNIT MAP**

is about...

Water

A. Recognize some of the unique chemical properties of water
- polarity
- cohesion & adhesion
- capillary action
- surface tension

B. Recognize the importance of water for the survival of life
- available freshwater
- water cycle
- water content in organisms
- water usage & conservation
- water & sewage treatment
- water testing

C. Explore how water contamination affects our planet
- mining
- cosmetics
- sewage
- medication
- construction
- textiles & plastics
- recreation
- nuclear energy
- household
- pulp & paper mills
- agriculture & fisheries
- fossil fuel combustion

⑧ **Student Activities or Assignments**

1. **PROPERTIES OF WATER**
   - vocab, reading & Qs
   - water olympics
   - lab
   - quiz
2. **WHERE ARE WE IN THE WATER CYCLE**
   - activity
   - notes, Qs, role play
   - internet research
   - online activity
3. **WATER & SEWAGE TREATMENT**
   - notes & discussion
   - internet research
4. **WATER TESTING**
   - laboratory
5. **WATER CONTAMINATION**
   - research project

⑦ **UNIT SELF-TEST QUESTIONS**

1. Why is water a polar molecule?
2. a. Define cohesion & adhesion & provide examples of each.
   b. How can cohesion & adhesion explain capillary action & surface tension?
3. Identify the solvent and solute in a given mixture.
4. Provide examples of homogenous and heterogeneous mixtures.
5. a. What are the main components of the water cycle?
   b. How are they connected?
6. Why is the majority of the Earth's water not available as fresh water?
7. What are some practical ways to conserve water in the home?
8. How is water and sewage treatment different in rural vs. urban areas?
9. Discuss some of the issues associated with bottled water.
10. Explain why water piped into our homes needs to be regularly tested.

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TOTAL APPROXIMATE TIME FOR UNIT → 13 hours

Foundational Objectives:

- Understand the unique properties of water.
- Explain the impact that the water cycle has on the environment.
- Differentiate between water and sewage treatment processes.
- Understand how water quality indicators provide an indication of the health of water.
- Examine how humans can help eradicate water pollution.
- Examine the impact of historical and contemporary human activity on the biosphere.
- Identify ways that the impact of human activity on the biosphere can be reduced.
- Analyze the effect/impact of the environment on personal activities and lifestyles, and the effect of personal activities on the environment.

Lesson 1 – Investigating the Chemical Properties of Water

Learning Objectives:

- Recognize the importance of water for the survival of life.
- Investigate the unique properties of water.
- Investigate and classify mixtures and solutions.
- Understand and interpret the pH of a solution.
- Recognize the importance of water as a solvent.
- Use terminology related to the chemical properties of water: polar molecule, adhesion, cohesion, surface tension, capillary action, mixture, solution, solvent, solute, homogeneous, heterogeneous, acid, base, and pH.
- Analyze data to create hypotheses and predictions.
- Propose generalizations which explain relationships.

Lesson Overview:

In this lesson, students are introduced to the unique chemical properties of water through reading and questions, demonstrations, a Water Olympics activity and an investigative lab.

Suggested Timeline: 3.5 hours

Instructional Document(s):
- Chemistry: Our Liquid World – Unit Organizer (Teacher Support Material)
- The Word on Water (Student Handout)
- Water Olympics (Teacher Support Material)
- Water Olympics (Student Handout)
- The "Abnormal" Behavior of Water Lab (Student Handout)
- QUIZ – The Chemical Properties of Water (Student Handout)

Supporting Resources:

1. Water and Solutions, pp. 161-165 *Glencoe Science Biology*

2. Solvents, Solutes and Solutions, pp. 8-11 *Nelson Science*

3. Activity 4.2 – Investigating the Abnormal Behavior of Water, pp. 69-70 *Investigating Aquatic Ecosystems*

4. H_2Olympics, pp.30-34 *Project Wet Curriculum and Activity Guide*

Lesson 2 – Where Are We in the Water Cycle?

Learning Objectives:

- Use terminology related to the water cycle: condensation, precipitation, percolation, runoff, evaporation, transpiration, ground water, and water table.
- Recognize the importance of water for the survival of life.
- Explain the movement of water through the water cycle.
- Value water as an important renewable resource.
- Suggest ways in which water consumption can be reduced around the home.
- Assess various water conservation strategies.

Lesson Overview:

Through a group activity and a series of demonstrations, students learn how much of the world's water is available fresh water. Students continue to learn the importance of water and the components of the water cycle through notes, discussion and a role play. The place of humans in the water cycle is then studied by considering water usage and methods of conservation.

Suggested Timeline: 3 hours

Instructional Document(s):
- Water, Water… Everywhere? (Teacher Support Material)
- World's Available Water (Teacher Support Material)
- Water, Water…Everywhere? (Student Handout – Individual)
- The Water Cycle (Student Handout – Individual)
- The Water Cycle (Student Handout – Group)
- The Water Cycle (Teacher Support Material)

Supporting Resources:

1. Alice in Waterland, pp. 381-384 *Project Wild Activity Guide*

2. http://www.epa.gov/OGWDW/kids/flash/flash_qagame.html - online water cycle review game

3. www.ec.gc.ca – Environment Canada website with water resources

4. A Drop in the Bucket, pp. 238-241 *Project Wet – Water Education for Teachers*

5. *Vanishing Ice* V9899, 2005 (20 min) – video describing how our freshwater supply is diminishing

6. *Fresh Waters Flowing: Biological Monitoring Protocol*, 2002 (37 min) – video describing salmon and the health of rivers and streams

7. www.lamotte.com/pages/edu/3608.html - order information for a simple tablet water test kit

8. http://boreal.com – order information for water pollution detection kit, stream ecology test kit and water safe science project kit

Lesson 3 – Water and Sewage Treatment

Learning Objectives:

- Describe water and waste water treatment processes.
- Understand the differences between bottled water and tap water.
- Appreciate the importance of water in food production.

Lesson Overview:

In this lesson, students learn the basic parts of urban and rural water and wastewater treatment facilities through notes and online research. Through discussion and online research, students then discover facts about bottled water and consider issues associated with it.

Suggested Timeline: 2 hours

Instructional Document(s):

- Watery Facts (Teacher Support Material)
- Water and Sewage Treatment (Teacher Support Material)
- A Closer Look at Water Treatment – Teacher Key (Teacher Support Material)
- All Tapped Out? – A Look At Bottled Water (Teacher Support Material)
- Water and Sewage Treatment (Student Handout – Individual)
- Water and Sewage Treatment (Student Handout – Group)
- A Closer Look at Water Treatment (Student Handout)
- All Tapped Out? – A Look At Bottled Water (Student Handout)

Supporting Resources:

1. http://www.city.saskatoon.sk.ca/org/water_treatment/water_treatment/water_treament_home.asp - City of Saskatoon Water Treatment Plant website

2. http://www.cbc.ca/news/background/consumers/bottled-water.html - CBC article on bottled water

3. http://www.sciam.com/article.cfm?id=bottled-twaddle – Scientific American magazine article preview on bottled water issues

4. http://www.hc-sc.gc.ca/fn-an/securit/facts-faits/faqs_bottle_water-eau_embouteillee-eng.php – Health Canada information on bottled water

5. *Crapshoot*, 2004 (52 min) - video that examines our current sewage disposal system and considers alternatives

Lesson 4 – Qualitative Water Analysis

Learning Objectives:

- Recognize the importance of water as a solvent.
- Describe how to perform tests on solutions to determine which ions or ion groups are present.
- Describe how to separate ions in solution by selective precipitation.
- Distinguish between hard and soft water.
- Investigate the presence of ions in water.
- Test the pH of different water samples.
- Identify some contaminants commonly found in water.
- Understand the importance of the various water quality indicators: temperature, turbidity, transparency, speed, oxygen, carbon dioxide, pH, hardness, nitrogen, phosphorus, and chloride.
- Consider all evidence before drawing conclusions and developing generalizations.

Lesson Overview:

In the laboratory, students first learn about a number of water quality indicators. They then use a number of chemicals to qualitatively analyze a sample of water that they have collected and interpret their results.

Suggested Timeline: 1.5 hours

Instructional Document(s):
- Water Quality Indicators for Lakes and Ponds (Teacher Support Material)
- Qualitative Water Analysis (Student Handout)

Supporting Resources:

1. Testing Water, pp. 838-841 *Modern Chemistry*

2. http://www.sciam.com/article.cfm?id=second-thoughts-on-fluoride – Scientific American article preview on the fluoride debate

3. *Investigating Aquatic Ecosystems*, Prentice-Hall Canada Inc.

Lesson 5 – Water Woes – Pollution and Solutions

Learning Objectives:

- Value water as an important renewable resource.
- Identify some contaminants commonly found in water.
- Explain some of the ways in which water pollution threatens aquatic life.
- Discuss how water contamination affects human life and activity.
- Withhold judgement when the evidence and reasons are insufficient.
- Analyze data to create hypotheses, predictions and estimates.
- Consider all evidence before drawing conclusions and developing generalizations.

Lesson Overview:

Students learn about the major classes of aquatic pollution. Through research, students then explore how one method of water contamination affects our planet and investigate eco-friendly alternatives. Students' research is shared with the class via a presentation or display.

Suggested Timeline: 3 hours research time + presentation time (if applicable)

Instructional Document(s):
- Water Woes (Teacher Support Material)
- Water Contamination – Research Project (Student Handout)

Supporting Resources:

1. Deadly Waters, pp.322-326 *Project Wild Activity Guide*

2. http://www.ec.gc.ca/water/en/manage/poll/e_poll.htm - Environment Canada water pollution information

3. http://esask.uregina.ca/entry/water_quality.html - University of Regina Saskatchewan water pollution information

4. http://www.cbc.ca/canada/saskatchewan/story/2008/08/01/saskatoon-sewage.html - CBC News coverage on sewage spill into the South Saskatchewan River