

**Table 2** Advantages and Disadvantages of Alternative Water Purification Methods

Purification method	Advantages	Disadvantages
reverse osmosis	<ul style="list-style-type: none"> <li>produces high quality drinking water</li> </ul>	<ul style="list-style-type: none"> <li>membrane gets clogged by bacteria, hard water scale, iron, and silt</li> <li>does not remove nitrates</li> <li>membranes cannot tolerate chlorine</li> <li>maintenance of equipment is critical</li> <li>require adequate pressure to force the water through the membrane</li> </ul>
biological treatment	<ul style="list-style-type: none"> <li>can treat water that contains much dissolved organic matter</li> </ul>	<ul style="list-style-type: none"> <li>maintenance of conditions for biological organisms important</li> </ul>
ceramic filter	<ul style="list-style-type: none"> <li>easy to use</li> </ul>	<ul style="list-style-type: none"> <li>limited volume of water can be treated</li> <li>not able to remove certain viruses</li> <li>filters plug up quickly if the water contains particulate matter or is turbid</li> </ul>

## 4.6 CASE STUDY: PROTECTING CANADA'S GREAT LAKES ENVIRONMENT

### SECTION 4.6 QUESTIONS

(Page 292)

#### Understanding Concepts

- The Great Lakes Action Plan for Hamilton Harbour has addressed the following goals and objectives:
    - to establish a healthy environment
    - to restore an area of concern
    - to control the introduction of non-native species
    - to protect and promote human health
    - to reduce harmful pollutants
    - to promote the sustainable use of the Great Lakes Basin
  - Student answers may vary. Students may answer that it is important to strive towards meeting each goal and objective of the Great Lakes Action Plan. However, it may not be necessary to achieve each target before an AOC is removed from the list.
- Student answers may vary. One reason for the success of the RAP for Hamilton Harbour has been the direct involvement of local citizens. The contribution of many community members working together significantly decreased the amount of waste entering the water.
- Student answers may vary. Two possible examples of evidence of the successful restoration of Hamilton Harbour include the construction of shoreline trails and parks for human recreation and a significant increase in local fish populations.
- Decreased exposure to water-borne contaminants has improved the health of Hamilton's citizens. Improved access to shoreline trails has made it possible for people to participate in physical fitness activities in and around the harbour.

#### Extension

- Student answers will vary depending on the AOC selected for study. Detailed information on each of the 42 Great Lakes Remedial Action Plans may be found at <http://www.on.ec.gc.ca/water/greatlakes/raps/>.

#### Thunder Bay

Thunder Bay, located on the north shore of Lake Superior, is one of Canada's major ports. This area has been identified as an AOC because of poor water quality resulting from discharges from the forest products industry. There are four pulp and paper mills that operate in the Thunder Bay AOC. Industrial and municipal waste, agricultural runoff, and pollutants all contribute to the problems identified in **Table 1**.

**Table 1** Thunder Bay Status

Use	Status
fish and wildlife consumption	restricted
degradation of fish and wildlife populations	impaired
deformities (tumours) of fish	impaired
beach access (closures)	restricted
degradation of aesthetics	impaired
loss of fish and wildlife habitat	impaired

**Status of the Thunder Bay AOC**

Although no objectives have been completed, improvements have been made to several areas of impairment. For example, wildlife and fish populations have been restored to approximately 90% of the projected level.

Thunder Bay is achieving its RAP objectives by encouraging public awareness and support. A “Lake Superior Day,” held each year in July in numerous provincial, state, and federal parks around the lake, helps to raise awareness.

Process changes and improved effluent treatment at local pulp and paper mills are helping to address water quality issues. There are also projects involving the restoration or creation of fish and wildlife habitats in the AOC. Rehabilitation programs are also being developed for threatened populations of lake sturgeon in the AOC.

## 4.7 ACIDS AND BASES

**PRACTICE****(Page 300)****Understanding Concepts**

- The evidence that shows that solutions of bases and solutions of acids are composed of separate ions is that both acids and bases are good electrolytes in aqueous solution. This observation suggests that bases dissociate and acids ionize into positively and negatively charged ions.
- $\text{HNO}_3(\text{aq})$ —acidic solution
  - $\text{LiOH}(\text{aq})$ —basic solution
  - $\text{Ba}(\text{OH})_2(\text{aq})$ —basic solution
  - $\text{NaCl}(\text{aq})$ —neutral solution
  - $\text{CH}_3\text{OH}(\text{aq})$ —neutral solution
- $\text{KBr}_{(\text{s})} \rightarrow \text{K}^+_{(\text{aq})} + \text{Br}^-_{(\text{aq})}$  (dissociation)
  - $\text{Al}(\text{OH})_3(\text{s}) \rightarrow \text{Al}^{3+}_{(\text{aq})} + 3 \text{OH}^-_{(\text{aq})}$  (dissociation)
  - $\text{MgCl}_2(\text{s}) \rightarrow \text{Mg}^{2+}_{(\text{aq})} + 2 \text{Cl}^-_{(\text{aq})}$  (dissociation)
  - $\text{HI}_{(\text{aq})} \rightarrow \text{H}^+_{(\text{aq})} + \text{I}^-_{(\text{aq})}$  (ionization reaction)
- $\text{KOH}_{(\text{aq})} \rightarrow \text{K}^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})}$   
 1 mol  $\text{KOH}_{(\text{aq})}$  dissociates to produce 1 mol  $\text{K}^+_{(\text{aq})}$  ions and 1 mol  $\text{OH}^-_{(\text{aq})}$  ions.  
 Therefore, 0.45-mol/L  $\text{KOH}$  dissociates to produce 0.45-mol/L  $\text{K}^+_{(\text{aq})}$  ions and 0.45-mol/L  $\text{OH}^-_{(\text{aq})}$  ions.
  - $\text{NaCl}_{(\text{aq})} \rightarrow \text{Na}^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})}$   
 1 mol  $\text{NaCl}_{(\text{aq})}$  dissociates to produce 1 mol  $\text{Na}^+_{(\text{aq})}$  ions and 1 mol  $\text{Cl}^-_{(\text{aq})}$  ions.  
 Therefore, 0.50-mol/L  $\text{NaCl}_{(\text{aq})}$  dissociates to produce 0.50-mol/L  $\text{Na}^+_{(\text{aq})}$  ions and 0.50-mol/L  $\text{Cl}^-_{(\text{aq})}$  ions.
  - $\text{HI}_{(\text{aq})} \rightarrow \text{H}^+_{(\text{aq})} + \text{I}^-_{(\text{aq})}$   
 1 mol  $\text{HI}_{(\text{aq})}$  ionizes to produce 1 mol  $\text{H}^+_{(\text{aq})}$  ions and 1 mol  $\text{I}^-_{(\text{aq})}$  ions.  
 Therefore, 0.375-mol/L  $\text{HI}_{(\text{aq})}$  ionizes to produce 0.375-mol/L  $\text{H}^+_{(\text{aq})}$  ions and 0.375-mol/L  $\text{I}^-_{(\text{aq})}$  ions.