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Dear Future Lake Scientist,

Are you ready to make a difference?

We all use water in many ways every day. Clean water is important to people, plants, animals and everything in the environment.

This field book will teach you some facts about lakes and what you can do to find out if a lake is healthy.

This book will also get you started and provide a place for you to record your own research.

Have fun!
What’s so important about clean water?

We all use water everyday! We use water for drinking, bathing, fishing, boating and swimming. Plants and animals need water, too. **Water quality** (the “cleanness” of water) is very important. Polluted water can kill fish and harm the environment. When water is dirty or polluted, it can affect all of our activities.

**Challenge**: Can you list some ways that bad water quality may affect plants, animals, or you?

1. __________________________________________
   __________________________________________
2. __________________________________________
   __________________________________________
3. __________________________________________
   __________________________________________

**Challenge**: Can you unscramble these water quality words?

- tzknonpllooa________________
- mnsigoar________________
- oisrvrere________________
- hisf________________
- soomceedp________________
- leka________________
- tviaerbosno________________
- ntsirtune________________
- yluiqat________________

Solutions: decompose, lake, observation, nutrients, quality
Challenge: Try out your "observation" skill on this water quality word search!

Word List
algae  organism
decompose  transparency
reservoir  zooplankton
nutrients  observation
water quality

A Year in the Life of a LAKE!

Did you know that lakes and reservoirs (lakes created when rivers are dammed) change throughout the year? These changes are important for fish and other living things in the lake.

The next four pages give more information about lakes for each season, spring, summer, autumn, and winter.
Spring

After the ice melts off the top of a lake in the early spring, the water in the lake is usually the same temperature from top to the bottom. This means that the water in the lake is mixed and all the oxygen and nutrients (plant food) are mixed as well. During this time of the year, the lake may turn greenish in color from the tiny plants living on the nutrients.

Challenge: Why are lakes sometimes green in color during the spring? _______________________
______________________________
______________________________
______________________________

Clues for puzzle:

Across
4. Plant food (such as phosphorus and nitrogen)
7. To watch carefully
8. Tiny, aquatic (water) animals
9. How clean water is (the “cleanness of water”)
10. A black and white disk used to measure transparency

Down
1. To rot or break down
2. Any living thing
3. Lake created when a river is dammed
5. Tiny, aquatic (water) plants
6. How clean water is

You’ll need these words:
Algae, Organism, Decompose
Transparency, Reservoir, Nutrients
Zooplankton, Water quality, Observation
Secchi disk

Solution:

Wallowa Lake, WA  Photo by L.L. Eytchison
Water Quality Games

**Challenge:** Try out your water quality knowledge on this crossword puzzle

```
1  2  3
   4
   5
  6
   7
   8
  9
10
```

As the sun warms up the surface water in the summer, a funny thing happens! Warm water is not as heavy as cool water, so the warm water stays at the top. This can cause problems for fish! The upper water may have enough oxygen for the fish, but can get too warm for them. The colder deep part of the lake, where fish like to live, has almost no oxygen. These two layers may not mix at all during most of the summer. It’s as if a warm lake is floating on top of a cold lake. You’ve probably experienced this if you’ve ever jumped into a warm lake and suddenly touched the much colder, deeper water.

**Challenge:** Why do fish like to hang out at the bottom of the lake during the summer?

---

Redfish Lake, Idaho       Photo by Leon Goodman
Autumn

As the air cools, so does the lake’s warm surface water. Eventually the surface is as cool as the deeper part of the lake. The water in the lake once again mixes from top to bottom, mixing all the oxygen and nutrients (plant food).

Challenge: What happens to the warm and cold water of a lake in the autumn?

Center of the lid. It should be large enough to put the eyebolt. Thread a washer and nut onto the eyebolt before putting the eyebolt through the lid, and then attach the washers in the order shown in the picture. Last, tie on the rope and go take a Secchi reading!
Challenge: Make your own Secchi disk
(Activity from David Josephs)

Materials list:
1) A clean one gallon paint lid
2) One 5/16 x 4 inch eyebolt
3) Two 5/16 inch nuts
4) Two 5/16 inch washers
5) Three 3x3 1/4 inch anchor bolt washers
6) A permanent marker
7) Masking tape
8) A tape measure
9) A 66 foot length of nylon rope
10) Small amounts of black and white paint
11) A hammer
12) A screwdriver
13) A ruler

Directions:
First, use the marker and ruler to make the four sections on the paint can lid. Use the masking tape to cover two sections on opposite sides and then paint the uncovered sections black. When the black paint is dry, paint the other sections white. When the paint is dry, use the hammer and screwdriver to punch a small hole in the lid.

Winter

Although warm water floats above colder water, ice is very light compared to liquid water, so it floats (think about the ice in a glass of lemonade). If a lake gets cold enough, an ice layer will form at the surface, but the water underneath will not freeze (although it will be very, very cold). When there is ice, the rest of the lake is sealed off from the air and no new oxygen comes in.

Challenge: What happens to the rest of the lake if the surface freezes during the winter?_______________________________
____________________________________
____________________________________
Healthy lakes

Healthy lakes contain a whole community of plants and animals. You may only care about the fish in a lake, but there are a lot of other very important organisms (an organism is any living thing). Fish feed on tiny animals called zooplankton, which in turn eat algae (tiny aquatic plants).

The fish and zooplankton also depend upon the oxygen produced by the algae and other plants. The algae need nutrients (phosphorus and nitrogen) to grow. The nutrients in a lake are usually mixed up from the lake bottom, or come with the water that enters the lake. Many organisms in a lake depend on others to survive. This is called the food chain.

Challenge: Can you fill in the missing organisms?

______________ eat zooplankton which eat ____________ which use nutrients.

Does your site have water? Yes ____ No ____

If yes, is it moving water or standing water?
________________________________________

Describe the appearance of the water:_____
________________________________________
________________________________________
________________________________________

Have you observed wildlife at your habitat? Yes ____ No ____ (Your little brother DOES count as wildlife!)

If yes, describe the appearance and behavior of the wildlife:___________________________
________________________________________
________________________________________
________________________________________
________________________________________

Any other things about your site you would like to describe:___________________________
________________________________________
________________________________________
________________________________________

Source: Great Lakes Diatom Home Page
More Research, Projects, and Activities

Observations are the careful watching and recording of something that is happening. For example, all the things you observed and recorded on your data sheets are observations.

Challenge: Make observations of a habitat you live in or visit.

Study site: __________________ (the habitat you are observing, for example: woods by my house or pond at the park or Mom’s garden in the backyard)
Date: ___________ Time: ___________
Recent weather: ____________________________________________
What does the vegetation (plant life) look like at your site? (describe types, if it looks healthy, etc.)
________________________________________
________________________________________
________________________________________
________________________________________

Healthy lakes, continued...

In the spring, nutrients and oxygen are plentiful throughout the lake. In a healthy lake, the algae will grow rapidly, the zooplankton will have enough food, and the fish will be well fed. In the summer, nutrients usually become scarce in the upper, warmer part of the lake, so less algae grow. The zooplankton are such good “grazers” that they may eat most of the algae, resulting in very clear water. Often the fish will move to the cooler, deeper, darker waters. In the fall, as the lake mixes, nutrients are returned to the surface waters, and the algae may grow rapidly again until winter temperatures become too cold.

Challenge: Think back... Why does the lake mix in the fall?
________________________________________
________________________________________
________________________________________
________________________________________

Zooplankton feed on algae in lakes and reservoirs.
What can go wrong with water quality?

When a lake has too many nutrients, it can cause so much algae growth that the zooplankton can’t eat them all. The algae cause the water to turn a green color and may even form a scum at the surface. This can look really bad, but the real problem is with excess algae. The algae that aren’t eaten die and sink to the bottom of the lake to decompose (to rot or break down). Decomposing algae uses up oxygen, and sometimes removes all the oxygen in the lower, cooler part of the lake where the fish like to hang out. When this happens, there’s not enough oxygen in the deeper part of the lake for fish to breathe. The surface water during the summer is too warm for many fish, so the fish are in trouble!

Challenge: True or False?
Decomposing algae makes more oxygen for fish.

Share what you’ve learned!

Your research and careful use of water will really help improve water quality! What next?

➢ Tell someone!
➢ Do a science fair project on water quality
➢ Ask your teacher for more information
➢ Pay attention to what things look like outside. Good science is good observation!
➢ Check out the web!

Here are some good water sites:

• The USU Water Quality Extension page: www.extension.usu.edu/waterquality
• The Department of Natural Resources kids page: www.metrokc.gov/DNR/kidsweb/index.htm
• The US Geologic Society kids page: http://ga.water.usgs.gov/edu/index.html
• The Environmental Protection Agency kids page: www.epa.gov/water/kids/waterforkids.html
• The National Wildlife Foundation kids page: www.nwf.org/kids
• The Great American Secchi Dip-In: http://dipin.kent.edu

Excess algae in a stream
Photo source: USU Water Quality Extension
My Water Quality Plan

**Challenge:** List 3 things I can do to keep water clean.

1. __________________________________
2. __________________________________
3. __________________________________

**Challenge:** List 3 ways I can conserve water.

1. __________________________________
2. __________________________________
3. __________________________________

**Challenge:** List 3 people I can teach about how to keep our water clean and conserve water, too!

1. __________________________________
2. __________________________________
3. __________________________________

---

**About transparency…**

Transparency is a measure of how clear the water is. Because the lake water gets cloudier as more algae grow in a lake, transparency is a good way to tell how healthy a lake is. Transparency is measured with a black and white disk, called a **Secchi** (pronounced “sek-ee”) disk. The Secchi disk is lowered into the water until it is no longer visible from the surface. We measure how far it was lowered and call that the “secchi depth.” If the secchi depth gets shorter from year to year, it tells scientists that a lake may be getting too many nutrients and the fish may be in trouble.

**Challenge:** True or False? A short secchi depth means less nutrients.
**Time for your own research!**

**Challenge:** Make an observation (to watch carefully) about what the water transparency (or how clear the water is) at the lake you are visiting. Is it muddy, clear, full of algae or plants?________

____________________________________

____________________________________

____________________________________

*Note:* Along with transparency, scientists usually also measure nutrients and the amount of plants in a lake when determining water quality.

You can help scientists monitor water quality by taking Secchi disk measurements, yourself!

---

**Did you know?**

The Secchi disk is named after Father Pietro Secchi (1818-1878), a scientific advisor to the Pope. The Secchi disk was first used in 1865 in the Mediterranean Sea.

---

**More thinking about water conservation!**

**Challenge:** Now that you’re thinking about ways to help improve water conservation, observe how your friends and family are using water:

<table>
<thead>
<tr>
<th>Used for what purpose?</th>
<th>Approximate amount of water used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>4 gallons</td>
<td>Dad washed the car</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total water used today:
Thinking about water conservation

We not only need to keep our water clean, but we also need to conserve it!

Challenge: Observe and record how much water you use in one day. To estimate amounts, remember a milk jug is one gallon and a glass of water is about one cup.

<table>
<thead>
<tr>
<th>Used for what purpose?</th>
<th>Approximate amount of water used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>6 gallons</td>
<td>Washed the dog</td>
</tr>
</tbody>
</table>

Challenge: Do this activity again tomorrow. Can you use less water?

How to take a Secchi Measurement!

*If you don’t have Secchi disk, see page 27 to make your own!

1) Bring an adult, wear a life jacket, hat, & sunscreen, only go out in good weather conditions, and take the measurement off the dock or boat!

2) Lower the disk into the water until it disappears.

3) Slowly raise the disk until you can just start to see it again. Mark the rope at the water surface, pull the disk out, and measure from the disk to the mark on the rope with a tape measure. This is the Secchi depth.

4) It is a good idea to take several measurements over a couple of weeks or months.

*The next 4 pages are data sheets for you to record information for 4 Secchi measurements.
Data Sheet

Date_________________________________
Time_________________________________
Study site ____________________________________________________________
(lake name)
Weather________________________________________

How does the water look?
1) clear
2) green
3) blue/green
4) brown
5) other (describe it!)
Comments______________________________________________
_____________________________________________________________________

What does the land look like around the water?
1) Nice with lots of plants 3) OK, with few plants
2) OK, with a some plants 4) Bad with little or no plants
Comments______________________________________________
_____________________________________________________________________

Secchi Depth_________________________________________meters

*Remember a short Secchi distance can mean there is too much plant life (algae) in the lake.

How can I make a difference for water quality?

When visiting a lake or reservoir:
• Use fish washing stations.
• Camp only in designated sites.
• Use restrooms instead of the bushes!
• Pick up litter.
• Stay on trails and avoid trampling plants along the shore.

At home:
• Remember, storm drains are not for dumping (The storm drains usually take water directly to your local river or reservoir).
• Household cleaners & oil should not be put down the drain or into ditches.
• Encourage your parents to use the correct amount of fertilizer or pesticide on your lawn—more will not make it work better!
• Clean up pet waste and dispose of it properly.
• When using sprinklers, water the grass, not driveways or sidewalks.
• Don’t wash grass clippings and other green waste into ditches or drains.
• Clean driveways with a broom, rather than a hose
• Wash your car on the grass, rather than the driveway.
What did you learn from your 
Secchi measurements?

<table>
<thead>
<tr>
<th>Secchi distance:</th>
<th>Water quality:</th>
<th>So what?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 12 feet (4 meters)</td>
<td>very high</td>
<td>Lake is healthy!</td>
</tr>
<tr>
<td>6-12 feet (2-4 meters)</td>
<td>fair to good</td>
<td>If too many more nutrients enter the lake, fish could have problems and lake health would worsen.</td>
</tr>
<tr>
<td>Less than 6 feet (2 meters)</td>
<td>poor</td>
<td>Lake health is bad and fish are at risk!</td>
</tr>
</tbody>
</table>

Data Sheet

Date_________________________________
Time_________________________________
Study site _____________________________________________
(lake name)
Weather_________________________________

How does the water look?
1) clear
2) green
3) blue/green
4) brown
5) other (describe it!)

Comments______________________________________

What does the land look like around the water?
1) Nice with lots of plants
2) OK, with a some plants
3) OK, with few plants
4) Bad with little or no plants

Comments______________________________________

Secchi Depth___________________________meters

*Remember a short Secchi distance can mean there is too much plant life (algae) in the lake.
Data Sheet

Date_________________________________
Time_________________________________
Study site ________________________________
   (lake name)
Weather_________________________________

How does the water look?
   1) clear
   2) green
   3) blue/green
   4) brown
   5) other (describe it!)
Comments_________________________________

What does the land look like around the water?
   1) Nice with lots of plants
   2) OK, with a some plants
   3) OK, with few plants
   4) Bad with little or no plants
   5) other (describe it!)
Comments_________________________________

Secchi Depth______________________ meters

*Remember a short Secchi distance can mean there is too much plant life (algae) in the lake.