Use the information below to help you fill out your one pager infographic.

Evaluating Water System Health

River and lake water must have certain qualities to support life. Scientists monitor water systems over time to identify problems and improve water system health by using a variety of *physical, chemical, and biological indicators* to determine the health of a water system. These indicators include **temperature, dissolved oxygen** (DO), **pH**, **turbidity**, **bio-indicators**, and the **presence of nitrates**.

Physical Indicators
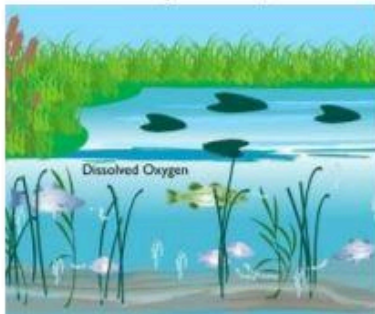
Temperature, dissolved oxygen, and turbidity are a few of the **physical indicators** used to determine water system health. A healthy water system has moderate to cool temperatures, high dissolved oxygen, and low turbidity (clear water).

Healthy cool **temperatures** of a water system, such as a river or lake, can be affected by several factors including how much sunlight it gets and if it is shaded or not by vegetation. **Thermal pollution** occurs when industries return heated water they used to cool their machines back to the source. Also, storm runoff from the cities with a lot of pavement and asphalt can warm up the waters as it enters a lake, river, or stream. In murky water (high turbidity), particles in the water, such as dirt or algae, can make the temperature increase because the particles absorb more solar energy.

Aquatic organisms obtain nutrients and the oxygen they need to survive from the water in which they live. **Cold water** can hold more dissolved oxygen than warmer water can. Thus, dissolved oxygen levels are related to water temperature. Measurements that show high water temperature or low dissolved oxygen are indicators of an **unhealthy** water system. *As water temperatures increase, the dissolved oxygen levels decrease.* This can cause stress to fish and other water organisms, making them more vulnerable to disease. The low dissolved oxygen content (*less than 5 mg/l*) in very warm water-temperatures above 35°C-can result in enough stress to cause **fish kills**. (See picture)

Turbidity is a measure of how clear water is. High turbidity, or unclear water, is a sign of an unhealthy water system. Silt and sediment that enter water in run-off can increase turbidity. Dumping industrial wastes and sewage, as well as construction and soil erosion, are ways that the turbidity of water is increased **Algal blooms**, rapid growth of algae encouraged by too many nutrients in the water, also cause high turbidity. When turbidity is too high, the particles in water may keep plants and algae from getting enough light to perform pho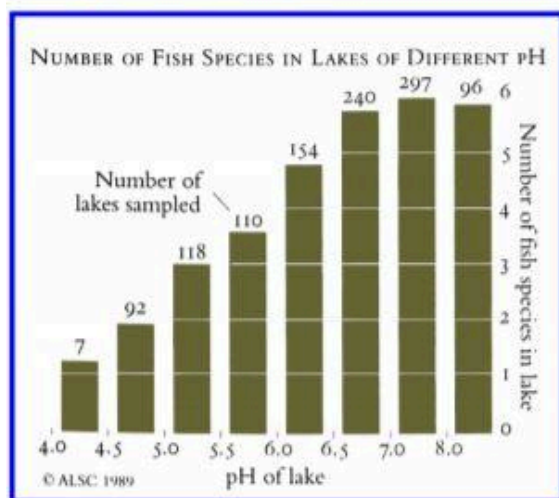tosynthesis. Too many particles in water can also clog the gills of fish. Turbidity is measured by dropping a **Secchi** disk into the water to until it can't

be seen. It is measured in *nephelometric turbidity units*, or NTUs. Drinking water should be under 1 NTU and plants need a value of fewer than 5 NTUs to carry out photosynthesis. Water with a **55 NTU** measurement is harmful for fish.

Chemical Indicators

Scientists will test waters for the presence of **nitrates** and **phosphates,** which are chemical indicators of water system health. High nitrates and phosphates can indicate an unhealthy water system because they cause an over growth of algae in an algal bloom. Sewage and fertilizers often contain nitrates. Sewage may enter surface waters through septic tanks, sewage treatment plants, and animal waste from farms. Fertilizers can enter water systems in run-off from farm fields, feedlots, golf courses, or lawns. **Algal blooms harm water systems**. Some algae release chemicals that are toxic to other organisms. As the overgrown algae starts to die and decompose, *the process of decomposition by bacteria removes oxygen from the water* making it an unhealthy water system. The only organisms that can live in this water are disease-causing organisms that can survive in an oxygen-free environment.

NUMBER OF FISH SPECIES IN LAKES OF DIFFERENT pH

Number of lakes sampled

240   297   96   6

154

118   110

92

7

4.0   4.5   5.0   5.5   6.0   6.5   7.0   8.0

© ALSC 1989   pH of lake

Number of fish species in lake

Another chemical indicator of the water is if it acidic, basic, or neutral which are determined by using a pH strip. High or low pH readings are signs of an unhealthy water system. The strip reveals a color which represents a number of 0-6 as acidic, 8-14 as basic or alkaline, and 7 as neutral.. Most aquatic life functions best in water at a neutral or slightly basic (8.0 to 9.0) pH. Some swamp organisms (moss) do well in more acidic water, with a pH from 3.0 to 5.0. Larger animals may be able to handle slight changes in acidity. But eggs and developing young aquatic organisms have little or no protection. Water may become too acidic (low pH) from acid rain. Water may become too basic (high pH) from an overgrowth of algae.
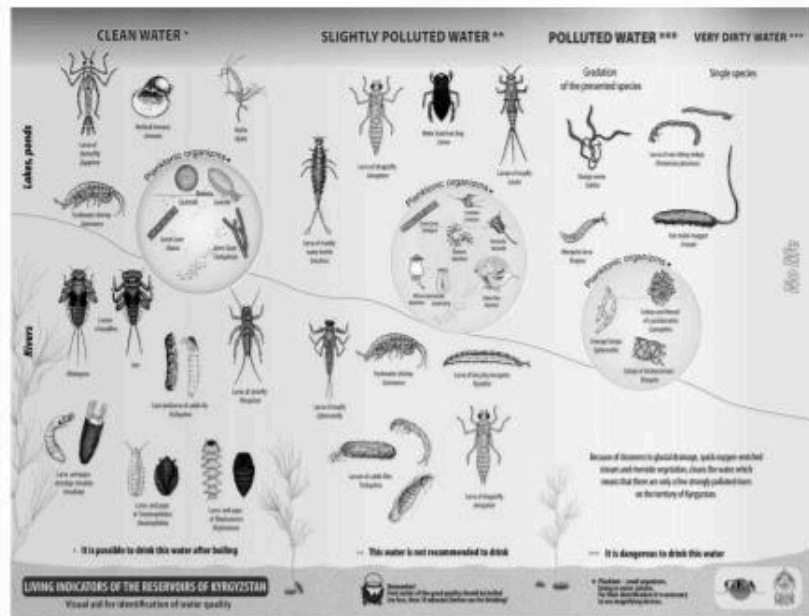
Biological Indicators

All ecosystems include abiotic and biotic factors. **Abiotic factors** are things that are not alive, such as the air, the temperature, water, soil, rocks, etc. **Biotic factors** are living things, such as plants, insects, animals, etc.

Biological indicators, – or **bioindicators** for short, are organisms or parts of organisms that are used to assess ecosystem health. For example, trout are a sensitive fish species. The presence of such species in water can show that a water system is healthy. The presence or abundance of certain shellfish or insects can also show water system health. Some macroinveretebrates (tiny invertebrates

you can see without a microscope) cannot tolerate pollution and will **disappear, while some can handle a few changes in the environment, and then there are others that tolerate it.** The presence of tolerant macro- organisms is a biological or bio-indicator that the water system is unhealthy.

Another bioindicator is the condition or health of water organisms. If fish or frogs suffer from disease, their condition shows that the water system is unhealthy.

<mark>Requirements for One Pager Infographic</mark>

1. Include ALL the following water quality indicators with EITHER a picture OR a BRIEF description of how the indicator determines water quality: <mark>**CAN have picture and description</mark> a. Temperature, bio-indicator, sediment, turbidity, pH, hardness, phosphates/nitrates, color, point source pollution, nonpoint source pollution, and dissolved oxygen	_____/ 20 pts
2. Include the title "Water Quality" large, bold, and in the center OR top of the page	_____/ 4 pts
3. Include picture **AND** brief information of "fish kills," "algal blooms," and an insect that is used as a bioindicator	_____/ 6 pts
4. MUST have AT LEAST 5 pictures that are COLORFUL <mark>**CAN include the 3 required for the fish kills, algal bloom, and insect</mark>	_____/ 10 pts
5. Your writing MUST be NEAT and EASILY read (**should NOT just be in pencil → SHOULD be** ink, colored pencil, crayon, **OR** marker) <mark>**or done online with color**</mark>	_____/ 3 pts
6. Your entire infographic MUST be organized and colorful	_____/ 2 pts
TOTAL Points Earned	_____/ 45 pts