Name: Jackson
Science 8A 8B
Due Date:

Water Quality Factors

Learning Targets:
I can construct an evidence-based argument that evaluates and describes the health of Tumalo Creek - I can make an evidence-based evaluation of the health of Tumalo Creek based on water quality data.

What?

Name of Factor: Dissolved oxygen

What is this factor? What does it measure? What do your classmates need to know about the water quality factor? Any examples that would make this clearer?

Dissolved oxygen is the amount of oxygen concentrated in a river. It is measured in the amount of oxygen particles in each liter of water. A healthy level of dissolved oxygen is 8 mg. per liter or higher. The higher the level is the larger the variety of species a the river can sustain. Salmonids require a high level of dissolved oxygen to survive.

So What?

What affects this factor and how does it affect it?

The faster and shallower sections of rivers allow more oxygen to enter the water, whilst slower deeper parts decrease it. Colder water has more dissolved oxygen in it, than warmer water. Plants also release oxygen into the river providing more oxygenation. The more solids (dissolved or suspended, like salt water) a river has, the less oxygen can enter the water. Negative effects happen similarly to this when caused by humans, just that when they occur it'd from runoffs, or polluting sewage, or dams.

What does this factor affect and how does it affect it?

This factor affects wild life's ability to grow. Almost all organisms have a necessity for oxygen, and dissolved oxygen is just the measurement of how much oxygen is available to the creatures living in a body of water. The more DO (dissolved oxygen) there is, the easier it is for organisms to exist in the river, these animals are necessary to stream health.

What is the optimal range for Salmonids?

Greater than 6 mg is survivable, but can't be spawned in, while 11mg or higher functions for spawning.

Now What?

How might the health of the riparian vegetation affect this water quality factor?

The riparian vegetation provides the lake with a large amount of its dissolved oxygen. By dispersing oxygen through its root system into the water.

How might human activities affect this water quality factor?

Human activities (dams, sewage systems, farming) all decrease the levels of dissolved oxygen in the water, which is damaging to the health of the river.

GIST STATEMENT – Summary Statement:

Dissolved oxygen is the measurement of the quantity of oxygen in a body of water. Depending on the level of DO, river health can fluctuate. Higher DO allows, for a wider variety of animals to live in the river, a high amount of DO is >8. Levels of DO are affected by a large array of things, which makes it a good indicator of overall health, because you can see if something is happening that is detrimental to the fish living in the river.

Learning Target	**Developing**	**Proficiency**	**Mastery**
I can make an evidence-based evaluation of the health of Tumalo Creek based on water quality data.	All questions in "what" section answered clearly – at least <u>two</u> "so what" questions attempted	Clear answers for the "what" and "so what" questions and inclusion of this information in a gist statement	Clear, complete, thoughtful answers for all of the questions (or all but one) and a gist statement the briefly captures all of the information

Craftsmanship: I can create a product that clearly and professionally presents information	Product gets the job done; sloppiness does not distract from the product or information	Product is neat, clear, and complete; wording is original; figures add to understanding	Exceptional clarity, examples, color, and production quality
Participation: I can work effectively and with focus in a group	Contribute to product with minimal reminders	Contribute content to product without reminders	Take ownership and leadership over at least one aspect of the product

After you have collected the above information, prepare a visual aid that you will use to present this information to the class.

DISSOLVED OXYGEN

Almost all plants and animals, whether living on land or in the water, need oxygen for their growth and survival. This life-giving gas is present in the water in a dissolved form. Compared to the atmosphere, there is a lot less oxygen available in water. Thus aquatic organisms have devised specialized means of extracting and storing oxygen from the water. Many aquatic plants have spongy tissue that enables them to store oxygen. Most aquatic animals possess gills or other types of specialized breathing adaptations.

Oxygen enters water from the air at the surface of the stream. Oxygen also enters the water from aquatic plants and algae. It is a by-product of **photosynthesis**, the process by which green plants use sunlight and carbon dioxide to produce their energy source, carbohydrates.

The amount of oxygen dissolved in water is expressed as a **concentration**. A concentration is the amount in weight (mass) of a particular substance per a given volume of liquid. The dissolved oxygen concentration in a stream is the mass of the oxygen gas present, in milligrams (mg), per liter (l) of water. Milligrams per liter (mg/l) can also be expressed as parts per million (ppm).

Natural Factors Affecting Dissolved Oxygen

The concentration of dissolved oxygen in a stream is affected by many factors:

- **Temperature:** Oxygen is more easily dissolved in cold water. Thus stream organisms that require high levels of dissolved oxygen, such as salmonids and many types of mayflies, stoneflies, and caddisflies, usually inhabit cold water streams.

- **Flow:** Oxygen concentrations vary with the volume and velocity of water flowing in a stream. Faster flowing white water areas tend to be more oxygen rich because more oxygen enters the water from the atmosphere in those areas than in slower, stagnant areas. Also, slower moving water can heat up more from the sun, thus reducing oxygen levels.

- **Aquatic Plants:** The presence of aquatic plants in a stream affects the dissolved oxygen concentration. As mentioned above, green plants release oxygen into the water during photosynthesis. Photosynthesis occurs during the day when the sun is out and ceases at night. Thus in streams with significant populations of algae and other aquatic plants, the dissolved oxygen concentration may fluctuate daily, reaching its highest levels in the late afternoon. Because plants, like animals, also take in oxygen, dissolved oxygen levels may drop significantly by early morning.

- **Altitude:** Oxygen is more easily dissolved into water at low altitudes than at high altitudes.

- **Dissolved or suspended solids:** Oxygen is also more easily dissolved into water with low levels of dissolved or suspended solids. Thus salt water tends to have lower concentrations of dissolved oxygen than fresh water.

Human Activities Affecting Dissolved Oxygen

There are many ways our activities influence the amount of oxygen dissolved in stream water:

- **Removal of riparian vegetation** may lower oxygen concentrations due to increased water temperatures resulting from a lack of canopy shade and increased suspended solids resulting from erosion of bare soil.

- **Typical urban human activities** may lower oxygen concentrations. Runoff from impervious surfaces bearing salts, sediments, and other pollutants increases the amount of suspended and dissolved solids in stream water.

- **Organic wastes and other nutrient inputs** from sewage and industrial discharges, septic tanks, and agricultural and urban runoff can

result in decreased oxygen levels. Nutrient inputs often lead to excessive algal growth. When the algae die, the organic matter is decomposed by bacteria. Bacterial decomposition consumes a great deal of oxygen.

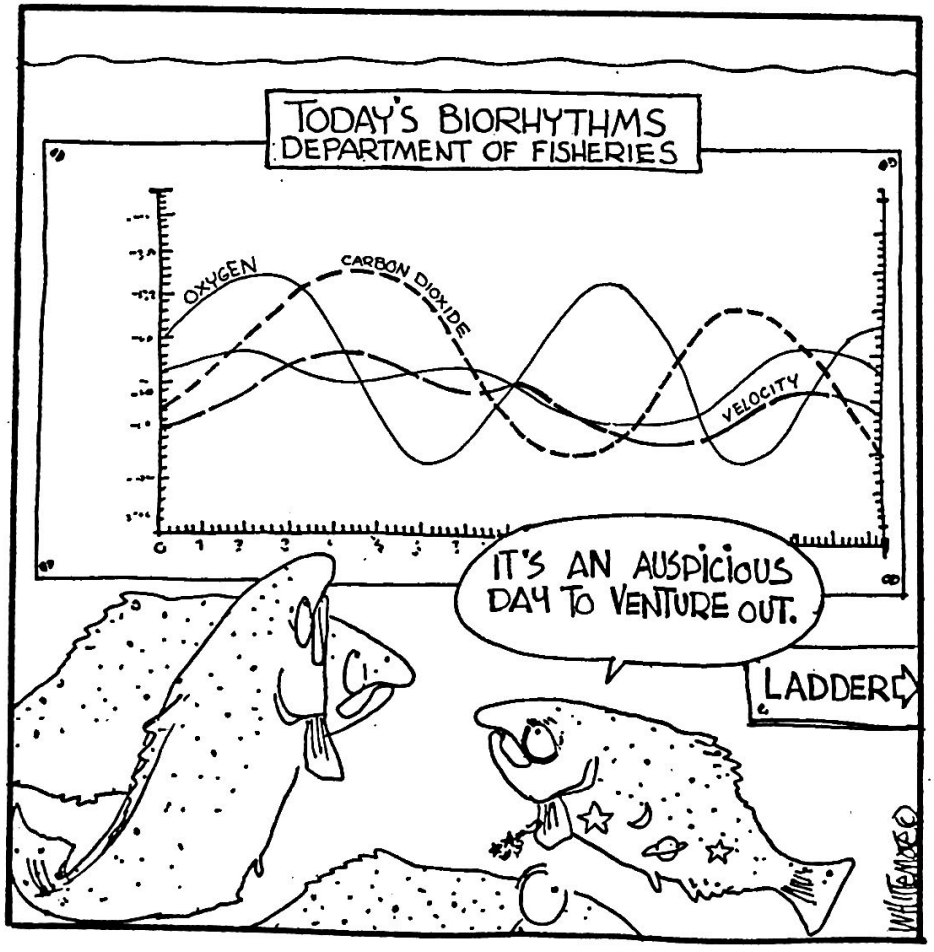
- **Dams** may pose an oxygen supply problem when they release waters from the bottom of their reservoirs into streams and rivers. Although the water on the bottom is cooler than the warm water on top, it may be low in oxygen if large amounts of organic matter (in the form of plant and animal remains) has fallen to the bottom and has been decomposed by bacteria.

Effects on Aquatic Life

If the dissolved oxygen concentration falls too low due to any of the above factors, a stream may not be able to support aquatic life. Most stream organisms have specific oxygen requirements and can only live in streams or in areas of streams that meet their needs. Some organisms, such as salmonids, and many species of mayflies, stoneflies, and caddisflies, require high levels of oxygen, while others can get by with much less. Each organism prefers to live in the conditions to which it is best adapted.

Usually streams with high dissolved oxygen concentrations (greater than 8 mg/l) are considered healthy systems. They are able to support a greater diversity of aquatic organisms. They are typified by cold, clear water, with enough riffles to provide sufficient mixing of atmospheric oxygen into the water.

In streams that have been impacted by any of the factors discussed above, summer is usually the most crucial time for dissolved oxygen levels because stream flows tend to lessen and water temperatures tend to increase. For example, when dissolved oxygen levels fall below 6 mg/l in trout, a fish kill can result.



Chapter 7

Dissolved Oxygen Protocol

Background

The term "dissolved oxygen" (DO) refers to the amount of oxygen that is dissolved in water at a given temperature and a given atmospheric pressure. DO is critical to the entire biological community in surface waters and is a key element of healthy salmon habitat. DO is one of the principal parameters used to measure water quality. In Oregon, water quality criteria have been developed for DO based on the life history requirements of aquatic species, particularly salmonids (DEQ 1994).

DO is usually measured in parts per million (ppm) or the equivalent of milligrams per liter (mg/l). Water can hold more dissolved oxygen (DO saturation) at low temperatures than at high temperatures. For example, at 08C and 1 atmosphere of pressure, the maximum concentration of DO (100% saturation) is 14.6 mg/l; at 308C the same water sample would contain only 7.55 mg/l (Hitchman 1978).

In waters supporting salmonids, the necessary DO levels range from 11 mg/l in spawning and rearing waters (in order to support embryo and larval production stages with no impairment) to 6 mg/l in non-spawning waters (the absolute minimum to avoid acute mortality).

In addition to temperature, various supplies and demands influence the concentration of DO in water. The primary *sources* for dissolved oxygen are photosynthetic activities of aquatic plants and reaeration (as water spills and splashes downstream, atmospheric oxygen is trapped and dissolved in the water). The major *demands* on DO concentration come from plant respiration and the biological breakdown (or decomposition) of organic material by bacteria and other microorganisms.

The DO protocol described here is for sampling surface water DO concentration (DEQ 1995; DEQ 1997; EPA 1986; MacDonald, Smart, and Wissmar 1991). Intergravel DO concentration is also an important measure of stream habitat for salmon (McCullough and Espinosa 1996; MacDonald, Smart, and Wissmar 1991). Intergravel DO samples can be collected by pumping a water sample from the gravel near potential redds. However, DEQ does not recommend that these types of samples be collected by watershed councils. Additional information of intergravel DO sample collection should be referred to the mentor.

Mentors

As with any monitoring project, questions will come up that are not answered or covered sufficiently in this protocol. Therefore, a group of mentors that are agency experts in monitoring have been identified . These mentors may be contacted with specific questions about a particular monitoring effort.

For more information on dissolved oxygen, contact:

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OR

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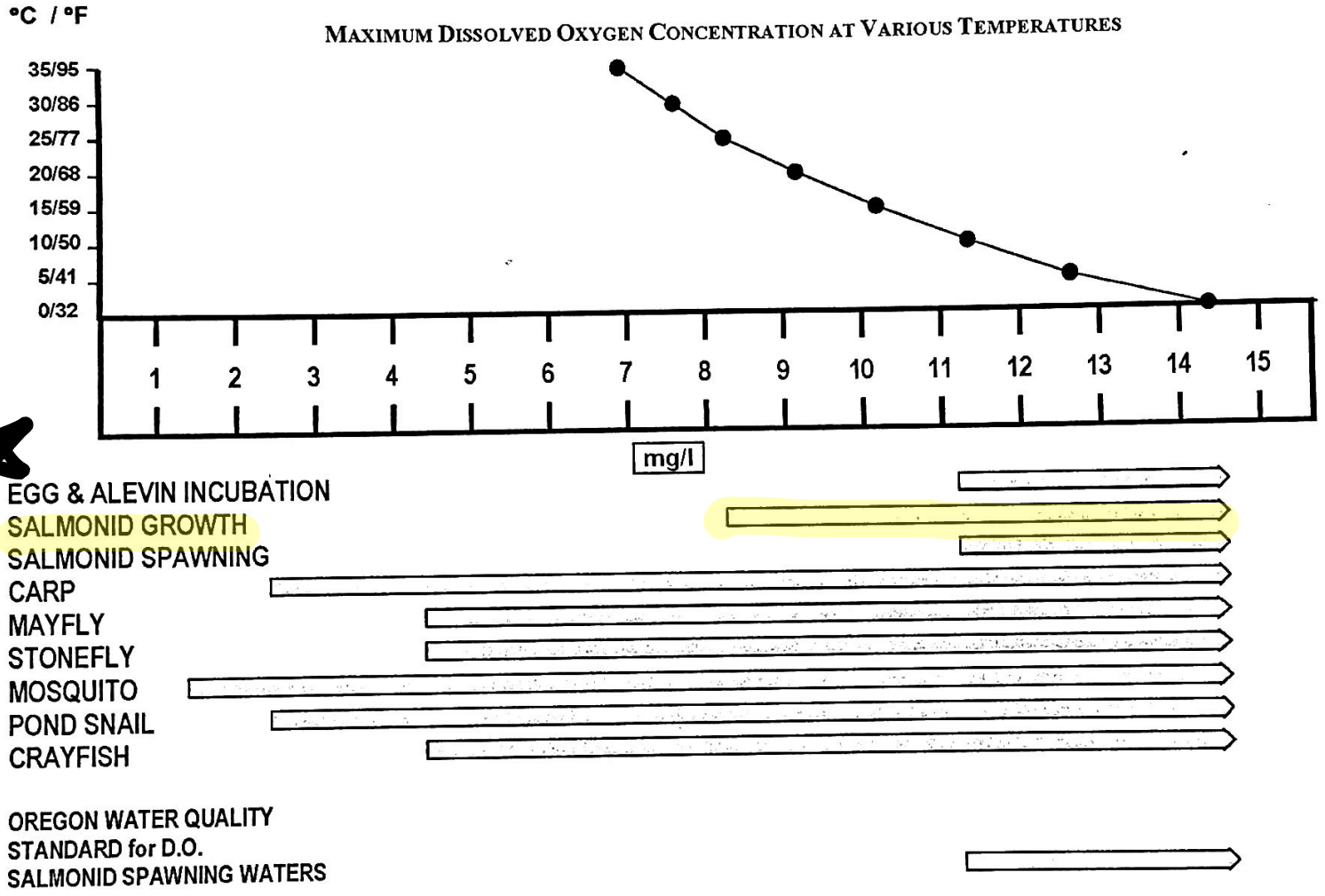

OPTIMUM DISSOLVED OXYGEN LIMITS FOR AQUATIC ORGANISMS

Compiled from Streamkeepers Field Guide, DEQ Adminstrative Rules, Project WILD Aquatic, Stream Scene, Investigating Our Ecosystem.