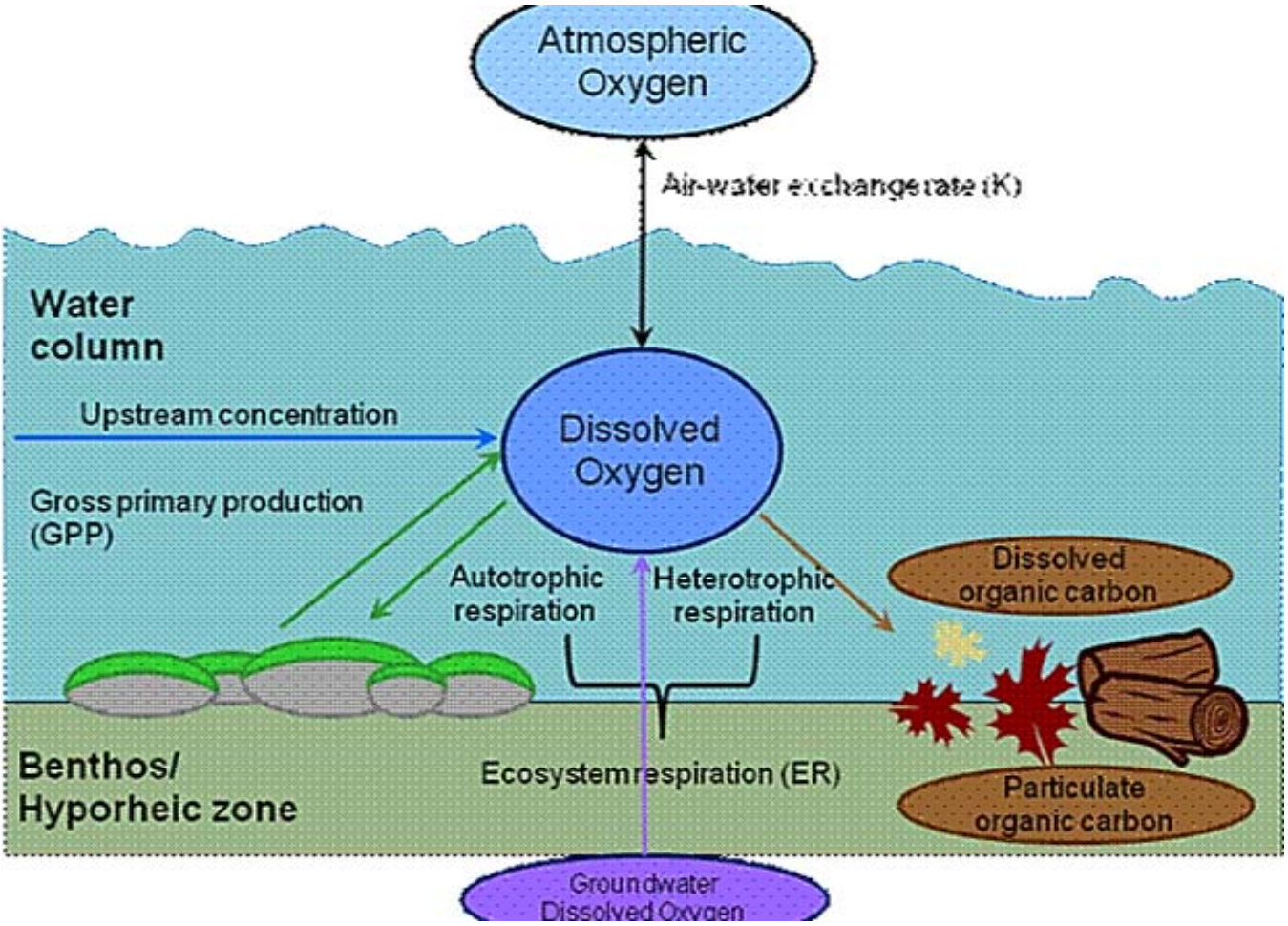
Conceptual model for dissolved oxygen analysis in river reaches

Dan Sobota
Environmental Solutions Division, Oregon Department of Environmental Quality
811 SW 6th Avenue, Portland, OR 97204
503-229-5138; sobota.daniel@deq.state.or.us

This conceptual model illustrates primary processes influencing dissolved oxygen concentrations in a stream or river reach. Dissolved oxygen concentrations in upstream reaches and groundwater inflow set the baseline for local processes (air-water exchange, gross primary production, and ecosystem respiration) to influence dissolved oxygen concentrations in a downstream reach. A glossary of terms in this figure can be found on the reverse side of this handout.


Atmospheric Oxygen
Air-water exchange rate (K)
Water column
Upstream concentration
Dissolved Oxygen
Gross primary production (GPP)
Autotrophic respiration
Heterotrophic respiration
Dissolved organic carbon
Benthos/ Hyporheic zone
Ecosystem respiration (ER)
Particulate organic carbon
Groundwater Dissolved Oxygen

Glossary

Air-water exchange rate (K): The physical exchange of oxygen between the gaseous phase (atmosphere) and dissolved phase (water). K increases nonlinearly with warmer air and/or water temperatures and channel roughness/complexity.

Atmospheric oxygen: Oxygen in the gaseous phase (O_2). Atmospheric oxygen makes up approximately 21% of the air we breathe.

Autotrophic respiration: Respiration (oxygen consumption) by autotrophs (plants). Autotrophic respiration increases with gross primary production. Gross primary production minus autotrophic respiration is net primary production.

Benthos: The stream bottom.

Dissolved organic carbon: organic matter that can pass through a 0.7 μm pore-size filter. Sources of dissolved organic carbon in streams and rivers can include leachates from soils, vegetation, algae, and human/animal waste.

Dissolved oxygen: Oxygen in the dissolved phase in water.

Ecosystem respiration (ER): Autotrophic and heterotrophic respiration (oxygen consumption). ER can increase nonlinearly with gross primary production, nutrient concentrations (nitrogen and phosphorus), organic matter availability, and temperature.

Gross Primary Production (GPP): The conversion of water and carbon dioxide to glucose (food) and oxygen in the presence of light. GPP can increase nonlinearly with light, nutrient concentrations (nitrogen and phosphorus), and temperature.

Heterotrophic respiration: Respiration (oxygen consumption) associated with the decomposition of organic matter. Bacteria, fungi, and animals are responsible for heterotrophic respiration.

Hyporheic zone: The zone below and adjacent to the stream channel (e.g., below flood plains and islands) where surface water mixes with groundwater. The hyporheic zone often is an area where a substantial fraction of ecosystem respiration occurs.

Particulate organic carbon: Organic matter that cannot pass through a 0.7 μm pore-size filter. Forms of particulate organic matter present in streams and rivers can include vegetation, wood, algae, and human/animal waste.