

Unit	Trout Biology
Lesson	3.2 Understanding the trout life cycle
Essential question	What behaviors have trout developed to adapt to their environment?
Objective	Students will be able to describe and explain the various trout life cycles.
Key words	Species, hybrid, subspecies, salmonid, redd, milt, alevin, fry, anadromous, spawn, endangered species
Related Standards	
NGSS standard	HS-LS4-4
AP Env Sci topic	
IB Biology topic	D3.1
IB ESS topic	2.1
Suggested sequence of learning activities	<ol style="list-style-type: none"> 1. Starter quiz/prior knowledge check 2. Direct instruction (if traditional) or classroom discussion (if flipped). Slides here. 3. Students identify presentation topics (individual or pairs). Instructions and model presentation here. 4. Students research and create presentations (continued as homework?) 5. Students present to class 6. Individual exit ticket/comprehension check
Assessment	Exit ticket/comprehension check
Possible modifications	<ul style="list-style-type: none"> • Give a keyword list (with or without definitions already included) to students before or during class • Be intentional about student groupings (eg. heterogeneous skill levels) • Provide list of subspecies to choose from rather than have students identify their own
Resources required	Digital distribution or showing of student presentation instructions and model presentation
Starter questions	<ol style="list-style-type: none"> 1. What is the definition of a species?

<p>Concepts covered in lesson</p>	<p>The biological definition of a species is a group of organisms that can mate and produce fertile offspring. In the system of scientific classification, first proposed by Carl Linnaeus in 1758, each species is given a two word Latin name with the first word (capitalized and italicized) identifying the genus and the second word (lower case and italicized) identifying the species. For example, the rainbow trout is <i>Oncorhynchus mykiss</i>. In the real world it is more complicated as closely related species can interbreed, producing offspring that are called hybrids that can be fertile. In addition, within species there can be geographically isolated populations called subspecies that have significantly different physical and genetic characteristics adapted to the local environment, while still being within the same species as other populations. Subspecies can be given a third Latin name after the species name. Examples of that include the redband trout (<i>Oncorhynchus mykiss gairdneri</i>) and the Little Kern River golden trout (<i>Oncorhynchus mykiss whitei</i>).</p> <p>There is debate about what constitutes a species compared to a subspecies. In addition, the classification for trout species, and indeed all animal and plant species, changes as new information becomes available, particularly genetic information. Taxonomists (scientists who classify species) attempt to have classifications match evolutionary history as closely as possible.</p> <p>Salmonid is a category of species in the family <i>Salmonidae</i> that encompasses closely related trout, salmon, char, grayling, whitefish, lenok and taimen. Just within trout, salmon and char, there are as many as 120 recognized species.</p> <p>All salmonid species share some general life history characteristics. They breed in freshwater streams, usually in gravel beds in flowing water. With her tail, the female removes sediment and digs a shallow nest in the gravel called a redd. When ready, she lays her eggs in the redd and then a male fertilizes the eggs by spreading milt containing his sperm over the eggs. The female then covers the eggs with a layer of gravel and will sometimes guard the redd to prevent the eggs from being eaten by predators, including other trout. Depending on the species and the location, trout spawn at different times of year. Generally brook and brown trout spawn in the fall, rainbow and cutthroat trout spawn in the spring and salmon can spawn at all times of the year depending on the latitude and local climatic conditions.</p> <p>Depending on the species, water temperature and other factors, eggs hatch between 4 and 20 weeks later. The fish are then in the alevin stage and still have a yolk attached to their bodies for up to five weeks</p>
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	<p>providing nutrients for rapid growth. After the yolk is absorbed, the fish are called fry and live in the river eating small pieces of detritus and insects. As they get larger, trout and salmon consume larger aquatic insects, terrestrial insects like grasshoppers or ants that fall in the river, small fish (including other trout), frogs and crayfish. Salmonids continue to grow throughout their lifespan which depends on the species and the local conditions, but can range from three years for brook trout in small streams to over 60 years for lake trout in a large lake.</p> <p>Salmonids are all migratory species. Some populations migrate to different parts of a river during different parts of their life. Others migrate from rivers to a lake and back. And others, such as salmon and sea-run trout, migrate to the sea during much of their adult life to take advantage of the large amounts of food available in the ocean. A life cycle that includes migration to and from the ocean is known as anadromous. All Pacific salmon species follow this pattern:</p> <ul style="list-style-type: none"> ● hatch in rivers and live for a year or two getting bigger ● travel downstream to the sea and spend most of their life in the ocean ● return to the river in which they were hatched to spawn (lay or fertilize eggs) and then die <p>Atlantic salmon have a similar life cycle, but can spawn multiple times.</p> <p>Some trout species are very local and are threatened by environmental factors such as habitat loss, invasive species and warming waters due to climate change. The Endangered Species Act of 1973 lays out legal protections for endangered species and tasks the U.S. Fish and Wildlife Service with developing and executing a recovery plan for all listed species. For example, bull trout which live in rivers and lakes in the far north of the continental U.S. and need very cold water are listed as “threatened.”</p>
Slide presentation	Link here
Activity	Digital distribution or showing of student presentation instructions and model presentation
Exit ticket questions	<ol style="list-style-type: none"> 1. What are the basic life stages of a salmonid? 2. What is the evolutionary advantage of a salmon migrating to and from the ocean? <p><u>Answers:</u></p> <ol style="list-style-type: none"> 1. Lay eggs in river, hatch into alevin with yolk sac, grow into fry and

	<p><i>then into adults, lay eggs again (migrate to ocean or lake if available)</i></p> <p>2. <i>To take advantage of the food sources in the ocean to get large (and be able to lay many eggs)</i></p>
<p>Extension questions/activities/resources</p>	<p>Good video on Pacific salmon life cycle here.</p> <p>Have students research how salmon spawning runs provide nutrients to the plants and other organisms surrounding streams. Good intro video on this here.</p> <p>Have students research how salmon fishing is regulated in Alaska and evaluate if they think it is sustainable or not.</p> <p>Consider participating in the Trout in the Classroom (or Salmon in the Classroom) program from Trout Unlimited. Students will see the trout life cycle from egg to fry in a classroom tank and then release the trout in a stream. Details here.</p>