

Unit	Stream Ecology
Lesson	I.3 Measuring biodiversity
Essential question	What is the significance of biodiversity in an ecosystem?
Objective	Students will be able to use a dichotomous key to identify macroinvertebrates and calculate a biotic index.
Key words	Biodiversity, indicator species, macroinvertebrate, dichotomous key, biotic index
Related Standards	
NGSS standard	HS-LS2-2
AP Env Sci topic	2.1
IB Biology topic	A4.2, D4.2
IB ESS topic	3.1
Suggested sequence of learning activities	<p>Classroom-based lesson:</p> <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. Classroom biotic index activity using cut out paper images to identify macroinvertebrates and calculate a biotic index 4. Individual exit ticket/comprehension check <p>Additional field-based activity for a subsequent class (if visit to stream is possible):</p> <ol style="list-style-type: none"> 5. Streamside biotic index activity to collect and identify macroinvertebrates in a stream and calculate a biotic index
wAssessment	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)

	<ul style="list-style-type: none"> ● Reduce/increase the number of macroinvertebrates to identify
Resources required	<p>Classroom-based activity: copies of activity materials (see teacher instructions here)</p> <p>Field-based activity: one kick net for the class, a shallow tray or ice cube tray and copies of activity materials for each group</p>
Starter questions	<ol style="list-style-type: none"> 1. Why do you think biodiversity is important? 2. How would you measure biodiversity?
Concepts covered in lesson	<p>Biodiversity is a measure of the richness of species living in an ecosystem which includes the range (variety) of species and the abundance (number) of species. Ecosystems that are more biodiverse are more likely to recover from disruptions because there are more relationships between species. For example, if a predator species has many different prey species to eat, there are other options if the population of one prey species decreases.</p> <p>An indicator species is one that can be used to assess a specific environmental condition. The presence or absence of an indicator species can indicate something about an ecosystem. For example, if a certain species is very sensitive to pollution, its presence in an ecosystem means the ecosystem is not polluted. This is often easier than direct measurement of the ecosystem itself. For example, trout need cold, clean water so the presence of trout indicates a healthy stream. Another example is that lichen is sensitive to air pollution so its presence indicates clean air.</p> <p>A biotic index is a technique of assessing and quantifying the health of an ecosystem. The steps of a calculating a biotic index are:</p> <ul style="list-style-type: none"> ● Collect a sample of organisms from an ecosystem ● Identify and list the species found ● Assign each species a value based on its pollution-tolerance ● Calculate a summary score based on those values which can be used as a relative measure quantifying the health of the

	<p>ecosystem</p> <p>Macroinvertebrate is a general term for large (can be seen with the naked eye) organisms without a backbone like insects, worms and shellfish that are found in a stream. They generally live at the bottom of a stream and can be sampled with a kicknet. The macroinvertebrates are identified, with certain species being pollution-tolerant and others are pollution-intolerant. The relative abundance of each type of macroinvertebrate can be used to calculate a biotic index for the stream. A dichotomous key is a chart with a series of yes/no questions that allows you to narrow down the identification of a species.</p>
Slide presentation	Link here
Activity	<p>Classroom biotic index activity teacher instructions here.</p> <p>If field trip to a stream is possible, Streamside biotic index activity teacher instructions here.</p> <p>Student worksheet (same for classroom and streamside) here.</p>
Exit ticket questions	<ol style="list-style-type: none"> 1. Why is a stonefly an useful species to indicate stream health? 2. If you do not find any alderflies in your stream, does that mean the stream is polluted? <p><u>Answers:</u></p> <ol style="list-style-type: none"> 1. <i>Because it is intolerant to pollution so its presence indicates an unpolluted stream.</i> 2. <i>Not necessarily, they might not be present for another reason besides the presence of pollution.</i>
Extension questions/activities/resources	<p>Interesting (but long-30 minute) video on measuring biodiversity on a coral reef here.</p> <p>Simpson's Index of Biodiversity is relevant. Good Khan Academy video here.</p>

	Have students look into what are the most biodiverse freshwater ecosystems and why and what are the threats to those ecosystems.
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