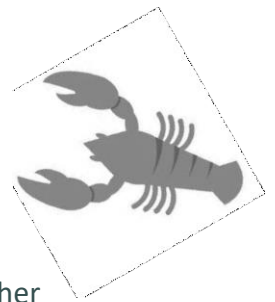


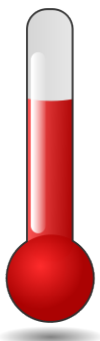


Mystery of the Disappearing Crayfish



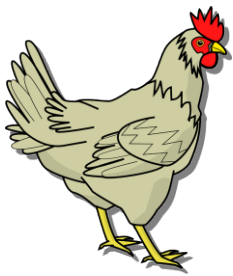
Scenario: Students from Great Lakes School have been studying the crayfish and other macroinvertebrates in Clear Creek, which flows nearby. Classes have enjoyed doing this for many years, but almost every year they find fewer and fewer crayfish and other “macros.” They have contacted local agencies to share their data and find out if there is an explanation for the phenomenon, but the agencies were unaware of the problem. However, through their research and their close observations of the river, the students have gathered these important clues, which could help them solve the mystery of the disappearing crayfish:

- Crayfish and other macroinvertebrates are considered “**indicator species.**” The number of them found in a body of freshwater can indicate the water quality, as measured by many factors, including levels of:
 - **Dissolved oxygen:** aquatic animals need it to breathe; crayfish do best with dissolved oxygen levels of 2 ppm (parts per million) or higher, although they are more tolerant of low levels of oxygen than some other aquatic organisms, such as most fish species
 - **Nutrients:** includes nitrogen and phosphorus that we apply as fertilizer to help plants in our lawns, gardens, and crops to grow; too many nutrients can cause aquatic organisms like algae and bacteria to grow very quickly, and when they die, all the dissolved oxygen can be used up
 - **pH:** the measure of the number of hydrogen ions (which are acidic) in the water compared to the number of hydroxide ions (which are basic)
 - Neutral pH is 7, and crayfish prefer a range of 7.5–8.5. Most aquatic organisms prefer a range of 6.5 (slightly acidic) to 9 (a little basic).
 - Macroinvertebrates are generally quite sensitive to changes in pH.
 - **Sediment:** loose sand, clay, silt and other soil particles that settle on the bottom of a body of water
 - Sediments can build up to unhealthy levels when erosion increases on riverbanks and in the surrounding watershed.
 - Sediments can also be stirred up by rapidly flowing water and human activities.
 - **Toxic substances:** pollution such as ammonia, metals, and oil-based products
 - **Temperature:** amount of heat energy contained in a substance (such as water or air); more oxygen can dissolve in cooler water and be available for animals to breathe
 - **Turbidity:** clarity (clearness) of the water; clearer water is generally healthier
 - **Bacteria** such as fecal coliform, *E. coli*, and enterococci



- **More clues the students have gathered:**

- The sewer system has sometimes been overwhelmed during big storms in recent years. At those times, large amounts of untreated sewage flows into Clear Creek.
- There has been a lot of development in the area recently, including many new buildings and parking lots. Native plants, such as trees and willows, have been removed from riparian areas (those near rivers and streams). This includes many areas along Clear Creek near the school.
- Student tests in the river have found that water temperatures have been getting warmer in recent years.
- Many people who live near the river have lawns that they fertilize and water regularly. The students have also observed homeowners and lawn crews spraying pesticides and herbicides to kill insects and weeds.
- There has been a reduction of shade plants such as trees and shrubs along the river and in some streams that drain into it.
- Many more cars are driving in the watershed now, and there are many more parking lots.
- Some community members have been advocating for the creation of bioswales to reduce stormwater runoff into the rivers and streams.



- A large chicken farm and processing facility is upriver from the school. The students can often smell it, and the students have heard that waste from the facility is being disposed of on the property, which is right next to the river.
- More people are using the river recently for activities such as waterskiing and jet skiing.
- Most climatologists (scientists that study long-term weather patterns) believe that human activities, such as the burning of fossil fuels, are the main cause of the increase in global temperatures over the last century. They expect the trend to continue unless significant changes are made soon. Warmer water will mean less dissolved oxygen for aquatic organisms, such as fish and crayfish.

Your Challenge

Work with your group to develop a plan to conduct additional tests, if necessary, and take action to solve the mystery of the disappearing crayfish.

- Discuss factors that might explain the declines in crayfish and other macroinvertebrates. For example, how might factors, such as possible pollution sources, loss of native plants, and development be affecting water quality and organisms' ability to survive?
- Create a water quality improvement plan to address issues for crayfish and human needs. Include both a visual model and written description of your plan:
 1. Illustrate your ideas on a large sheet of paper, a computer, or tablet. Label the parts of your model.
 2. Explain your plan in detail, in writing. Include details about how your plan will help crayfish and other macroinvertebrates that are so important in aquatic food webs. **Important:** You should also include a discussion of how the success of your plan can be monitored over time. See the "Water Quality Improvement Plan Rubric" for details about how your plans will be assessed.