

Answers to Workbook exercises

Chapter 22

Exercise 22.1 Acid rain and wildlife in Canadian lakes

- a The low pH could be caused by acid rain. This could be produced when fossil fuels are burnt, releasing sulfur dioxide into the atmosphere. This dissolves in water droplets in clouds and reacts to form sulfuric acid, which falls to the ground as rain with a lower pH than normal. (Students may also suggest that it could be caused by the kind of rocks on which the lake is lying and the type of soil around it. Peaty soils, for example, tend to contain acids, which are carried into the lake as water drains through them.)
- b The fish-eating birds are most common in habitat with lakes with a pH of around 6.5. They are not common in habitat where lakes with low pH, and only very small amounts (less than 10%) of the available habitat contain lakes with a pH of less than 5. This is because fish are unable to live in such acidic water. There are often large concentrations of aluminium ions in acidified lakes, washed out of the nearby soils by the acid rain. Aluminium ions affect the functioning of the fish gills, and may kill young fish.
- c The divers are more common in lakes with a low pH than in lakes with a higher pH. This could be because there is more food for them in these lakes, perhaps because the plants and invertebrates that they eat do well in these waters. Another possibility is that they might compete for nesting sites with fish-eating birds; these are less common in habitat with lakes with low pH so there would be more nest sites available for the divers. Students might also come up with other answers.
- d The answer will depend on the student's suggestion in c above. Look for an outline of

an experiment that makes clear what variable is changing and what is being measured, perhaps also with some mention of the control of other variables.

Exercise 22.2 Eutrophication

- a Plants need nitrogen-containing ions (such as ammonium or nitrate) to make proteins. They need proteins to build new cells, and therefore for growth. The soil in the field may be deficient in nitrogen-containing ions, which would limit the growth of the crop. The farmer therefore gets higher yields by adding these ions to the soil.
- b i Through their root hairs, by active transport. Energy, provided by respiration in the root hair cells, would be used to move the ions into the cell against the concentration gradient.
- ii xylem
- c i The population of algae rises rapidly just downstream of where the fertiliser flowed into the river. This is because algae can use the nutrients (nitrates and ammonium ions) in the fertiliser for growth. Further downstream, there are fewer nutrients because they have been used by algae upstream. The population size therefore decreases with the distance downstream.
- ii Many of the algae die. The population of bacteria rises because they can feed on the increased quantity of dead algae. These bacteria use up the dissolved oxygen in the water in respiration. This decreases the quantity of oxygen. Fish need oxygen to respire, so in the area where oxygen levels are low they either die or move away.

Exercise 22.3 Fertiliser experiment

Look for the following features in the plan.

- ◆ A clear statement that amount of fertiliser (the independent variable) will be changed, with at least five different values being used, including a control with no fertiliser.
- ◆ A clear statement that crop yield (the dependent variable) will be measured; some idea of exactly how this will be done (e.g. measure the mass of grain or fruit produced per plant, or per unit area of the field) and when it will be done.
- ◆ A clear statement about all the variables that will be controlled, and how this will be done (e.g. do the experiment in a laboratory and keep temperature, water availability, light, etc. the same for all the plants, with an outline of how these will be kept constant; or do the experiment in the field and grow all in the same type of soil with the same amount of shade or shelter).
- ◆ A clear statement about how many repeats will be done, and how mean results will be calculated.
- ◆ An outline result chart, with headings, showing how results will be recorded.

Exercise 22.4 Introduced species in New Zealand

- a They have wings, so could fly across the oceans separating New Zealand from the nearest land.

- b Flight allows birds to escape predators. Predators are therefore a selection pressure which gives birds that can fly a greater chance of survival and reproduction. However, where there are no predators, there are fewer advantages in being able to fly, and there may be disadvantages. For example, birds that can fly use more energy than birds that cannot, and need to grow strong flight muscles, and may need more food. Birds that do not have wings, do not have these energy costs and may be better able to survive and reproduce, passing on their alleles for winglessness to their offspring. Over time, this process of natural selection will result in the whole population having no wings.
- c In all three areas, the number of seedlings in the areas where rats were trapped were greater than in the areas where they were not trapped. (Credit reference to comparative numbers of seedlings in any trapped and untrapped area.) Removing rats would therefore be expected to increase the population, as more seedlings would survive and grow into adult palms.