TOPIC
1.4

How does reproduction contribute to the variety of life on Earth?

Imagine a living thing so large that it covers almost 1000 hectares. That's an area that would hold more than 1700 football fields. This photo shows a *very* tiny part of the world's largest known organism: a type of honey mushroom (*Armillaria solidipes*) that lives in the Blue Mountains of Oregon. The vast majority of this huge fungus lies beneath the ground surface. Only small portions of it, like this, are visible to the eye. The parts that we see are actually the reproductive structures of the fungus, called fruiting bodies, which produce and release spores.

Key Concepts

- Asexual reproduction results in many genetically identical offspring in a short amount of time.
- Sexual reproduction results in genetically varied offspring.

Curricular Competencies

- Make observations aimed at identifying your own questions about the natural world.
- Assess risks and address ethical, cultural, and/or environmental issues associated with proposed methods of investigation.
- Critically analyze the validity of information in secondary sources, and evaluate the approaches used to solve problems
- Contribute to care for self, others, community, and world through individual or collaborative approaches.

Starting Points

Choose one, some, or all of the following to start your exploration of this Topic.

1. **Identifying Preconceptions** What type of reproduction do you think the fungus described in this Topic introduction uses? Review your understanding of ideas related to reproduction to support your answer.
2. **Applying** Generate a list of the top 10 largest living organisms on Earth. How does your list change if you include organisms from Earth's past? Use at least three reliable sources to support your decisions.
3. **Considering First Peoples Perspectives** How does sexual reproduction involve transformation that ensures diversity in species?

Key Terms

There is one key term that is highlighted in bold type in this Topic:

- genetic variation

Flip through the pages of this Topic to find this term. Add it to your class Word Wall along with its meanings. Add other terms that you think are important and want to remember.

CONCEPT 1

Asexual reproduction results in many genetically identical offspring in a short amount of time.

In 2016, a huge population of algae—an algal bloom—formed along the west coast of North American (**Figure 1.24**). Plant-like algae reproduce mainly asexually. Blooms occur when conditions such as temperature and nutrient availability enable algae to multiply quickly.

Algal blooms can pollute shellfish, making them toxic. First Peoples have always used careful observation to make sure clams and other shellfish are safe to eat. They check the colour of the water and watch to see if animals like crows and mink eat the clams safely.

Advantages of Asexual Reproduction

Asexual reproduction provides a number of advantages.

- Only one parent is needed. Since there is no need to find a mate, the organism can start to reproduce as soon as it is ready and conditions are suitable.
- The process occurs quickly. As a result, each organism can produce many offspring.
- The formation of mature offspring takes a short amount of time. As a result, offspring can start to reproduce soon after being produced.
- The offspring are genetically identical to the parent. As long as environmental conditions stay the same, offspring are likely to live in and interact with their environment with the same success as their parent.

Figure 1.24 Algal blooms are a common sight along the Pacific coast any time of year but especially in the summer. **Why would algal blooms be especially common in summer?**

A Lack of Genetic Diversity

All of the advantages of asexual reproduction help an organism become established quickly and successfully in the conditions provided by its environment. But what happens if those conditions change?

For example, many farms that grow food crops use plants that are produced by asexual reproduction (**Figure 1.25**). New plants can be grown quickly and in large numbers when they are produced this way. The plants, and the food that comes from them, also have predictable qualities that consumers expect. However, what can happen if there is no rain for a long time, or if the plants are invaded by a disease-causing organism (**Figure 1.26**)? Because all the plants are genetically identical, they will all respond the same way—they will become diseased and may die.

The lack of diversity within a population means all individuals in the population are equally vulnerable to change. Sometimes these changes can cause an entire population to be wiped out.

Figure 1.25 Apples are one kind of crop plant that is grown using techniques that rely on asexual reproduction.

Figure 1.26 If the conditions change or a disease occurs, it may cause a crop to die or the yield of produce to be severely reduced.

Activity

Reflecting on Advantages and Disadvantages

Choose a species of organism you have learned about that reproduces asexually. Describe a situation in which asexual reproduction is an advantage for that organism. Then, describe a condition in which its lack of genetic diversity is a disadvantage.

Before you leave this page . . .

1. Describe one advantage and one disadvantage of asexual reproduction.

CONCEPT 2

Sexual reproduction results in genetically varied offspring.

Activity

Family Features

Think back to what you learned about gametes and sexual reproduction. Use this to explain why people have some features that are similar to those of their family members and yet they remain unique individuals.

genetic variation variation in the DNA sequences of each individual of a species

There is variation in the genetic make-up of humans and all other species. **Genetic variation** makes members of a species unique due to small differences in the DNA sequences of each individual. These differences result from sexual reproduction.

This is true even for people within the same family. The brothers and sisters shown in **Figure 1.27** look similar, but they are not copies of each other. Each sibling inherited half their DNA from each parent, but they did not inherit the same DNA. Different DNA means that each offspring has a different set of features. Over many generations, as new people contribute their DNA to a family, a greater diversity of individuals within that family develops.

Figure 1.27 Although members of this family share similar traits, their different genetic material makes them unique individuals.

The Value of Genetic Diversity

Because of genetic variation, there are slight differences among individuals within a population. If the environment changes, some individuals within that population might now be less successful in living and reproducing. They may even die. Others may have certain features that enable them to live in the new conditions more easily. Genetic diversity may allow at least some individuals to survive. If surviving members of the population reproduce, their genetic information is passed on—and a new generation lives on.

Disadvantages of Sexual Reproduction

Despite the value of genetic diversity, there are disadvantages to sexual reproduction.

- The search for a mate might expose individuals to predators, disease, or harsh environmental conditions. This can delay reproduction and an organism's ability to become established in its environment.
- Fewer offspring tend to be produced. This means it takes longer for a population to grow, even under suitable conditions.
- Offspring often take longer to reach maturity before they can produce sex cells and reproduce themselves.
- In many cases, offspring require a substantial amount of time and energy to raise until they are independent from the protection of one or both parents.

Extending the Connections

The Many Faces of Biodiversity

The term *biodiversity* refers to the variety (diversity) of all species of living things, the genetic information stored in their cells, and the environments in which they live and interact. In other words, biodiversity has three components: species diversity, genetic diversity, and ecosystem diversity. Find out how the interactions and relations among these components result in Earth's rich and diverse life.

Before you leave this page . . .

1. Describe one advantage and one disadvantage of sexual reproduction.

Connect to Investigation 1-J on page 72

Biology Connections

Obstetrician

Veterinarian

Arborist

What kinds of jobs are there for people interested in the reproduction of living things?

Food Technologist

Animal Behaviourist

Midwife

Is the wail of a newborn baby music to your ears? Midwives hear this "music" on a regular basis as part of their job to observe, educate, and care for women and their babies throughout pregnancy, labour, and birth.

Horticulturist

As the green thumbs of the scientific world, horticulturist use their knowledge of plant reproduction and cultivation to help farmers grow better crops and landscapers create beautiful parks.

Pathologist

While pathology is literally "the study of disease," many people in this profession consider themselves detectives. They investigate cells for clues to identify diseases that affect people, other animals, or crops.

Questions

1. What other jobs and careers do you know or can you think of that involve the reproduction of living organism?
2. Research a job or career related to Unit 1 that interests you. Explain what attracted you to it. What kinds of things do you have to know, do, and understand for this job or career?

Check Your Understanding of **Topic 1.4**

QP Questioning and Predicting PC Planning and Conducting PA Processing and Analyzing E Evaluating
AI Applying and Innovating C Communicating

Understanding Key Ideas

1. Using a table or other format of your choice, summarize the advantages and disadvantages of asexual reproduction. PA C

2. Explain the meaning of the term *genetic variation*. What might cause a lack of genetic variation in a species, and how might this affect the species' ability to survive? PA C

3. How does sexual reproduction lead to variations in the genetic diversity seen in a family over the course of many generations? QP

Connecting Ideas

4. Plants are very successful organisms that can be found in just about every environment. How does their ability to reproduce both asexually and sexually contribute to this success? QP PA

5. Is reproduction required for the survival of an individual? Is reproduction required for the survival of a species? Explain each of your answers. QP

6. The length of time between fertilization and the birth of an offspring is called the gestation period. Gestation periods can vary a great deal. The gestation period for a mouse is 21 days. For humans it is 266 days, and elephants require about 600 days—almost two years. Fertilization cannot occur during pregnancy. Explain why a long gestation period is a disadvantage of sexual reproduction. C QP

7. Is one type of reproduction is better than another, or are they equal? Support your answer with valid reasons. PA C

Making New Connections

8. The white-coated Kermode or Spirit Bear of B.C.'s north coast is sacred to First Peoples and celebrated more generally as the province's official animal. It is a subspecies of black bear. About 1 out of every 10 bears has white or cream-coloured fur. QP PA E AI C

a) Explanations for the white colouring from a First Peoples perspective include stories told by the Tsimshian Peoples. Find out about these stories. What do they communicate about the Spirit Bear?

b) Explanations for the white colouring from a Western science perspective include information that comes from fields of genetics and population studies. Find out about this information. What does it communicate about the Spirit Bear?

c) In what ways are First Peoples and Western science accounts similar? In what ways are they different? In your opinion, how significant are the differences?

TAKE Action

Make a Difference

How can we deal with invasive species?

Many species have been introduced to North America, either on purpose or by accident. In some cases, these invasive species compete with native species for resources such as food, water, sunlight, and shelter. Often, the invasive species is able to out-compete native species. As a result, they reproduce more often and more successfully. Over time, the native species may die out or become at risk of doing so.

Spotted knapweed (*Centaurea biebersteinii*) was introduced into North America from Europe in the late 1800s. It is very difficult to remove.

Parrot's feather (*Myriophyllum aquaticum*) is an aquatic garden plant that can grow to become so dense that it chokes out other aquatic plants. It can also cause pools of standing water, which is the preferred environment for mosquitos to breed.

Developing An Invasive Species Attack Plan

Your task is to develop and carry out a public awareness campaign about how to prevent the introduction or spread of invasive species. Research the different invasive species in your region, how they were introduced, and how their reproductive strategies have helped them get established. Find out how they affect your region and ways that governments and communities have been dealing with this issue.

Here are some questions to consider when developing your plan.

- Who will your target audience be: people in your neighbourhood? students in your school? anyone else?
- What type of plan will you propose? For example, one idea is to develop an information bulletin that can be distributed. What other ideas do you have?
- What information do you need to find and provide? For example, what safety precautions should people take if they come across an invasive species?
- How will you get people to participate?
- How will you assess the success of your plan?

Analyze and Evaluate

1. Do you consider your plan a success? What is your evaluation based on?
2. Describe any challenges you had with developing or running the plan. What would you do differently if you were to run such a campaign again?

Apply and Innovate

3. Suppose your local town or community council has heard about the plan you developed and is thinking about expanding it. They have asked you to present the information in a meeting with council members. Develop a presentation for the council that informs them about the issue and how your plan can be expanded to reach a wider audience.

Even plants and animals, such as the American bullfrog (*Lithobates catesbeianus*), which started as pets or aquarium plants, have become invasive species by being released into the environment.

The largemouth bass (*Micropterus salmoides*) is native to eastern North America, but it is an invasive species in many lakes and rivers in B.C. Its presence has caused severe reduction in the numbers of native fish.

INVESTIGATION
1-J

GUIDED INQUIRY

Advantages and Disadvantages of Sexual and Asexual Reproduction

Skills and Strategies

- Questioning and Predicting
- Planning and Conducting
- Processing Information
- Evaluating
- Applying and Innovating

What You Need

- computer with Internet access
- print resources, as needed

There is a wide range of strategies that organisms use to reproduce. In this investigation you will study two organisms that have different reproductive strategies and identify the advantages and disadvantages of each.

Question

What are the advantages and disadvantages of how an organism reproduces?

Procedure

1. Your teacher will provide a list of organisms that reproduce sexually, asexually, or both asexually and sexually. You and your partner should choose two organisms that reproduce differently.
2. Do research to find out about the reproductive strategies of each organism that you chose.
3. As part of your research, find out answers to the following:
   - What are the physical characteristics of the organism (for example, is it a prokaryote or eukaryote; single-celled or multicellular; complex or simple body structure)?
   - What type of environment does the organism tend to live in?
   - What mating behaviours are associated with reproduction?
   - What type of reproduction does it undergo? If fertilization occurs, how and where does it occur? Are the offspring clones of the parent or is there genetic variation?
   - If an organism can reproduce both sexually and asexually, under what conditions does it perform each type?
   - What is the gestation period, and what are the stages of zygote development to form offspring?
   - How many offspring are in each reproductive cycle, and how many reproductive cycles within a year occur?

4. Develop a plan for how you will research the topic, and how you will collect and organize the information about it. Choose a format for presenting the information to the class.
5. Have your teacher approve your chosen organisms, research plan, and presentation format.
6. Carry out your plan once your teacher has approved it.
7. Present the information to the class.

Analyze and Interpret

1. In a table format, list the advantages and disadvantages of each reproductive strategy.
2. Describe how the reproductive strategies are similar and how they are different.

Conclude and Communicate

3. Provide your reasons for deciding which feature of an organism's reproductive strategy is an advantage or a disadvantage.
4. Do you think one reproductive strategy is better than the other? Provide reasons that support your opinion.