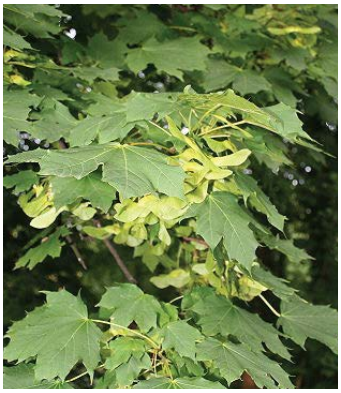
Wrap-up and Discussion

Understanding the process of adaptation and seed dispersal is critical as students continue to build on their knowledge of plants and the environment. Ask students for examples of real plants that use each dispersal mechanism and how they've developed to be successful. Possible answers include:



Gravity: fruit tree

- Key features: This method usually occurs in fruits after they ripen. As they grow, the fruits become heavy, until eventually they reach full maturity and fall off the tree. Seeds are contained within the fruit, which will either break open upon hitting the ground or roll away from the parent tree after it drops. In many cases completing the process of seed dispersal requires additional spreading by animals that eat the fallen fruit[1].
- Successful because: Dispersal by gravity requires no additional external factors to occur, and as such is not weather or animal dependent. Because seeds do not travel very far, it is likely that they will land in an area near the parent tree, which has already been shown to provide the correct conditions required for successful plant growth. As such, gravity-dispersed seeds do not need to be produced in large quantities as the chance of germination success is likely to be high[2].

Wind: maple tree, dandelion

- Key features: Seeds must be light and feature accessory structures that allow them to travel in the wind. For seeds that carry through the air, feather-like "parachutes" (like those found atop a dandelion seed) are effective as they allow the seed to be carried long distances. Seeds that drift to the ground do not need to be carried as far, and will often have wing-like structures called samaras (like a maple key) that help to guide them as they fall[3]
- Successful because: This method of dispersal is weather dependent, but requires very little force to occur (students will certainly remember blowing on dandelion heads and watching hundreds of seeds spread far into the distance!). Because there is much less control on the spread of wind-dispersed seeds, plants that rely on this mechanism must produce seeds in large quantities to ensure germination success[4].

Water: water lily, coconut

- Key features: Dispersal by water occurs in plants that live in water (like the water lily), or that grow near water (like a coconut). Seeds must have a tough or waxy outer coating to prevent them from becoming waterlogged, and they are usually buoyant to allow them to travel long distances[5].
- Successful because: Seed dispersal in water is necessary for aquatic plants. The water lily, for example, produces a fruit that is buoyant and floats down current until eventually it sinks and germinates when it reaches the floor. This method helps guarantee the water lily's success as it ensures it stays in water (which is important as it can't grow elsewhere)[6].

Animal: berries, common burdock (or "bur" plant)

- Key features: Animal dispersal can occur after an animal eats a seed or fruit and passes it in its excrement. This occurs with many species of birds that eat berries and pass their seeds, and typically relies on seeds that are contained within fleshy, nutritious fruits[7]. Alternatively, seeds can catch in the feathers or fur of animals incidentally – anyone with a dog who has run through a field and come out covered in burs knows this strategy all too well! These seeds are housed in accessory structures that stick to fur or feathers and can have a Velcro-like appearance[8].
- Successful because: Dispersal by animal vectors is an example of directed dispersal, in which seeds are more likely to end up in a location that is favourable for their germination[9]. Seeds will be excreted or dropped in areas that are frequented by the animals necessary for their dispersal, which helps ensure that new generations of plants also have access to these important dispersers[10]. In some cases, dispersal by animals can also help protect seeds from predators. This occurs with dispersal by ants that consume the seed coat of certain seeds but leave the seeds intact to germinate underground, away from the birds that would otherwise eat them[11].

Did you know? Ring-tailed lemurs like Animal Ambassador Cosmo aren't just important for seed dispersal, they also play a role in the pollination of the trees they like to hang out in! Pollen gets trapped in their fur and spread between flowers as they bounce between branches looking for food.

Additional Discussion Questions and Activities

Why is it important for seeds to disperse at all? Possible answers include:

- The environment that the parent plant is growing in might have changed, and now seeds can disperse and have the chance to grow somewhere more favourable
- Too many seeds growing in the same area means too much competition between plants for resources (water, soil nutrients, etc.), which ultimately lowers survival

How did you determine what features were important to make your seeds successful? Possible answers include:

- Seeds that dispersed via gravity needed to be heavy when ripe
- Seeds that travelled by wind needed wing-like structures
- Seeds that were waterborne required a protective waterproof coating or shell
- Seeds that were spread by animals needed to be attractive to their specific vector

What do you think you could have done to improve your seeds? Possible answers include:

- Seeds that travelled by air could have been lighter (remove some of the Styrofoam from the base seed)
- Seeds that were waterborne could have been more buoyant (make lighter or add air sacs)
- Seeds that were spread by animals could have been more attractive to a wider variety of animals to increase their potential for pick-up and dispersal (more Velcro, or brighter in colour if they were to be ingested)

Take it to the Next Level (optional)

Take students outside (or ask them to complete the activity at home) and go on a hunt for seeds. Challenge students to find as many different types of seeds that they can, and facilitate a discussion on what the most likely dispersal method for these seeds would be, given their features.

NEED FOR SEED!

Teacher's Activity Guide

Use this guide to facilitate a discussion on the Key Concepts below prior to leading the Classroom Activity.

Key Concept One: Adaptation
Key Concept Two: Pollination
Key Concept Three: Seed Dispersal

Activity cheatsheet
Student worksheet and example answers
Dispersal cards

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Key Concept One: Adaptation

Adaptation is the process by which organisms develop traits that help them survive in their environments[12]. Because these traits make the organism more successful, they are passed down from generation to generation until they become a common characteristic of the species as a whole. Flowers have developed adaptive traits that help increase their chances of being pollinated, like the bright petals that attract bees, and their seeds have also developed adaptive traits that help ensure their successful dispersal.

Adaptations come in many forms: they may be structural, with physiological traits developing in the organism, or they may be behavioral, in which an organism develops a behavior that increases its survival and reproductive success. Most adaptations are the result of a random genetic mutation that occurs in response to a change in an organism's environment, and if this mutation by chance improves the success of that organism it will continue to be passed down into future generations[13].

In some cases, an adaptation is so significant that it leads to the development of an entirely new species. The Stickleback fish, common in freshwater lakes across North America, is sometimes recognized as two distinctive species after it developed structural adaptations that helped improve its ability to catch prey in different regions of the lake. The fish that live near the water's surface have become slimmer and faster to help them catch the plankton that filters through the open water, while their bottom dwelling counterparts are larger and better able to swim through the dense vegetation on the lake's floor[14].

Many plant and pollinator species have coevolved to develop adaptations that are mutually beneficial. Bees prefer to pollinate plants that are bilaterally symmetrical (can be divided into only two identical halves) because this shape provides a "landing pad" that guides the bees towards the nectar[15]. It also conceals the nectar in a location that can only be accessed by a bee-shaped body, which prevents it from being eaten by wasps and other insects[16]. This preference creates a strong pressure on plants that are bee-pollinated to develop this general shape. In turn, the specific shape of a flower and the location of its pollen creates selection pressures for the bee that favour the development of traits that increase their access to this critical resource[17].

Key Concept Two: Pollination

Pollination is the process that occurs when pollen from the male part (anther) of one flower is transferred to the female part (stigma) of another flower, causing seeds to develop. Pollen grains are small and light and can be transferred between plants by insects, animals, or simply carried in the wind. Pollinators are attracted to flowers since their nectar provides an important source of food, and it is during their feeding that the pollinator comes into contact with the pollen grains it will then transfer as it travels between plants. Pollination is a critical step in a plant's lifecycle – without it, plants wouldn't be able to make seeds and reproduce[18].

Key Concept Three: Seed Dispersal

After pollination occurs and seeds have been produced, these seeds need to travel to a location where they can grow. The primary mechanisms through which seed dispersal occurs include:

- Gravity: The simplest form of seed dispersal, in which seeds will fall from the parent tree once developed. Seeds don't usually have any additional features to help with their dispersal.
- Wind: Seeds drift through the wind after they've matured and are released from the tree. Seeds typically have accessory structures to help carry them in the wind.
- Water: Seeds will travel along a body of water until they reach a favourable spot for germination
- Animal: Animal vectors transfer seeds after ingestion or incidental contact

Did you know? Earth Rangers Animal Ambassador Dora loves her fruit! The black and white Tegu will eat berries and seeds, dispersing them later in her droppings.

NEED FOR SEED!

Activity Cheatsheet

**The materials and features listed below are only suggestions,
and students are encouraged to be as creative as possible when designing their seeds!**

Dispersal method: Gravity

Suggested materials: Cardboard, heavy items

Key features: This dispersal method usually occurs with fruits, so students will effectively be making their "seeds" into fruits. They should be heavy to simulate a ripened fruit ready to drop from a tree, and they might be brightly coloured for attracting animals which usually completes the dispersal process in seed-bearing fruits.

Dispersal method: Wind

Suggested materials: Tissue paper, string, lightweight items

Key features: Accessory structures to help the seed carry in the wind (eg. parachute, wings). Students may also remove parts of the Styrofoam ball to make the seed lighter.

Dispersal method: Water

Suggested materials: Wax paper, additional items that would help a seed float

Key features: Seeds should have a waterproof coating, and students should attempt to make them buoyant. They can remove parts of the Styrofoam to make the seed lighter, or they can add air-filled accessory structures (like wax paper sacks – akin to water wings for seeds) to help the seeds float.

Dispersal method: Animal

Suggested materials: String, pipe cleaners, Velcro, additional items that would look appetizing for dispersers or sticky for fur/feathers

Key features: Seeds that are dispersed after ingestion should look appetizing to the animals that might eat them – they can be brightly coloured or big and juicy! Seeds that are spread by animal contact should use Velcro or pipe cleaners to stick to fur or feathers.

NEED FOR SEED!

Student Worksheet

Name: _____

The dispersal method our group drew from the Dispersal Cards was: _____

1) What was your goal when creating your seed, and how did you choose to change your basic seed to make it an effective disperser?

_____

_____

2) What materials did you use to adapt your seed to the dispersal method your group chose?

_____

3) Why did you choose these materials?

_____

_____

4) If you could have used any supplies you wanted, in addition to the ones provided, what would you have chosen? How would they have made your seed better?

_____

_____

5) What type of ecosystem do you think your seed would do well in?

_____

_____

6) Based on its dispersal method and the features you gave your seed, what type of plant do you think your seed came from, and why? Think about what the plant might look like and how its design or adaptations might affect the dispersal of its seeds. Use the back of this worksheet to draw your plant!

_____

_____

YOUR SEED IS DISPERSED... BY WIND!

YOUR SEED IS DISPERSED... BY WIND!

YOUR SEED IS DISPERSED... BY WATER!

YOUR SEED IS DISPERSED... BY WATER!

YOUR SEED IS DISPERSED... BY GRAVITY!

YOUR SEED IS DISPERSED... BY GRAVITY!

YOUR SEED IS DISPERSED... BY ANIMALS!

YOUR SEED IS DISPERSED... BY ANIMALS!

References and additional resources

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