



Ag@School

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The entire earth—every ecosystem, every living plant and animal—depends upon soil. It is a complex mixture of minerals, air, water, and organic matter (living organisms and decaying remains of once-living plants and animals). Farmers know that on average it takes 500 years to create an inch of topsoil, so they understand the importance of taking good care of the soil. After all, every day is Earth Day for agriculture!



Today's Children... **Tomorrow's Leaders**

soil, n. the top layer of earth suitable for growing plants





Farmers are Environmentalists

Farmers were environmentalists long before it became popular to be one. Farmers care about **natural resources** because their business depends on them. They work at keeping water and soil clean and healthy because they will eventually pass the farm on to their children.

Good **conservation** practices are part of a sustainable agricultural system. Sustainable agriculture is growing food, fiber and forestry products that are:

- 1) Environmentally friendly now and in the future:
- 2) Profitable enough to keep farmers in business:
- 3) Acceptable to society.

Think and Discuss:

Why is conservation important to a farmer?

Why must farmers make a profit?



Farmers and ranchers provide habitat for 75% of our nation's wildlife. Trees on farms and ranches provide shelter for birds and many animals. Fish and waterfowl live in the freshwater streams that run through farmland. Many animals survive winter by eating crop residue left in the fields after harvest.

Sustainable Agriculture:

Using technology and resources to keep farms profitable, improve human lives, yet respect the environment.

SUSTAINABLE AGRICULTURE

American agriculture is the most earth-friendly in the world. Our farmers know they need to be friends of the land, soil and water. Why? If they treat the earth well, it will be able to keep giving back... and not just for us today, but for future generations too.

Sustainable agriculture meets the needs of today but does not use up resources for the future. It must be:

- Environmentally friendly; taking care of the soil so it will remain productive now and in the future
- Profitable enough to keep farmers in business
- Able to improve the quality of life for farmers and all of society

Both conventional agriculture and organic agriculture can be sustainable.



Organic food is produced without using fertilizers made with synthetic ingredients, genetically engineered seeds, or synthetic pesticides (but natural pesticides and mineral salts can be used).

Organic food accounts for just over 6% of total sales in Washington. Organic production certainly meets the first condition of sustainability being environmentally friendly. Organic food is usually more expensive than conventionally produced food. It needs to be because it is often more expensive to produce organic crops due to more labor involved. The majority of organic foods are higher cost fruits and vegetables. It is easier to farm organically on smaller farms, or with established fruit trees or vines that do not require annual planting.

Sustainability does not mean raising crops without the benefit of commercial fertilizers, pesticides or biotechnology.

Large-field crops like grains are less likely to change to organic because there is not enough profit to pay for the extra labor, while growing fewer bushels, and losing a year of production when producing green manure.

Remember to be sustainable, farmers have to make enough money to stay in business.

It is true that organic production does not use synthetic (man-made) fertilizers. If we went to only organic production, we would have to produce the necessary nitrogen (the main plant nutrient) by either:

- Converting 1/3 of all crop land into green manure production (where crops are plowed down into the soil). This is a great method for improving the soil and adding nitrogen, but it takes that land out of production for that growing season (and perhaps for a second year in dryland Eastern Washington in order to build up enough soil moisture for a grain crop).
- Or increasing the number of cattle to produce the manure necessary to replace synthetic fertilizer. The US currently has 97 million head of cattle; we would need to add another billion head. Can some of them stay in your backyard?



Isn't organic food better?

The answer is more about varieties and handling than production systems. Locally grown food (whether organic or conventional) may indeed taste better. Characteristics that make fruits and vegetables ship well, process easily, or extend the shelf-life may come at the expense of flavor and texture. Buying from local growers gives you the chance to try varieties of red, juicy strawberries, flavorful tomatoes, and carrots with more vitamin A.

Pollination

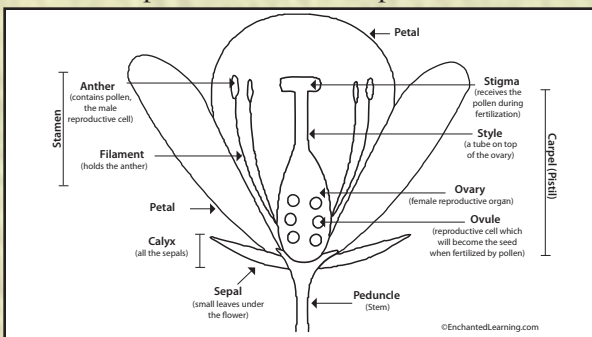
Pollination is the transfer of pollen from an anther to the stigma in flowering plants and it starts the production of seeds, or fruits that contain seeds.



How does pollination work?

It all begins in the flower. Flowering plants have several different parts that are important in pollination. Flowers have male parts called **stamen** that produce a sticky powder called **pollen**. Flowers also have a female part called the **pistil**. The top of the pistil is called the **stigma**, and is often sticky. Seeds are made at the base of the pistil, in the **ovule**.

For pollination to occur, pollen must be moved from an



pollination. Self-pollination means that an individual flower on a plant stem can pollinate itself, or other flowers on the same individual plant stem. Wheat, other grains, and most grasses are self-pollinators.

When pollen from a plant's stamen is transferred to a different plant's stigma, it is called **cross-pollination**. The plants must be of the same species. For example, only pollen from a daisy can pollinate another daisy. Pollen from a rose or an apple tree would not work.

How does pollen from one plant get moved to another?

About 80% of plant pollination requires the help of other living, moving creatures such as insects, birds, or bats, to transfer pollen from one plant to another.

When animals such as bees, butterflies, moths, flies, and hummingbirds pollinate plants, it's accidental. They are not trying to pollinate the plant. Usually they are looking for food, either the sticky pollen or a sweet **nectar** made at the

base of the petals. When feeding, the animals accidentally rub against the stamens and get pollen stuck all over themselves. When they move to another flower to feed, some of the pollen can rub off onto this new plant's stigma.

What about the other 20% of plants, how are they pollinated?

Some plants, especially grasses, most conifers, and some deciduous trees, are pollinated by wind. Plants that are not self-pollinators, but need to be pollinated by wind often have long stamens and pistils to enable pollen grains to be blown from one plant onto another. Since they do not need to attract animal pollinators, they can be dull colored, un-scented, and have small or no petals since no insect needs to land on them. There are also a small number of water plants that rely on water movement for pollination.



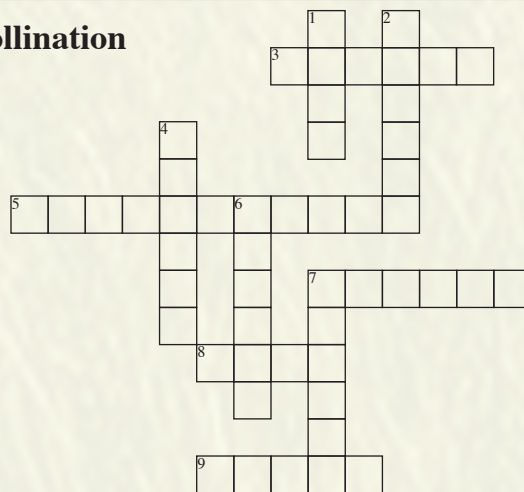
<http://youtu.be/ge3EM8AE>
RV0?list=FLAdHP75YXIMQOBLeYBWC4JA

Thanks to the University of Illinois for the information on this page.

Why we should care about pollinators?

- One out of every 3 bites of food we eat is courtesy of a pollinator.
- Birds and other animals are even more dependent upon fruits and seeds than we are.

Pollination



Across

- Sweet fluid in flowers
- Pollen reaching the stigma
- Male reproductive cells in plant
- Important pollinators; produce honey
- Female reproductive cells in plant

Down

- Created when pollen fertilizes ovule
- Male plant parts
- Top of pistil
- Part of stamen producing pollen
- Female plant parts

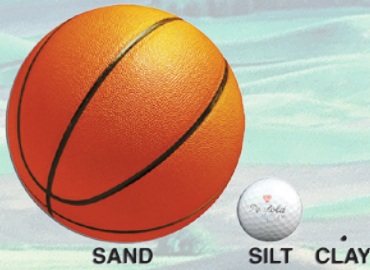
THE SOIL IS ALIVE

One cup of soil may hold as many bacteria as there are people on earth! That's over 6 billion. There are also nearly 300 million protozoa, and hundreds of millions of yeast, spores, fungus, and nematodes. Soil is also home to arthropods, worms, and burrowing animals.

IT ALL BEGINS

Natural resources fit together like puzzle pieces on earth. Caring for soil and water helps us to produce food today, and in the future.

3 Basic Soil Particle Sizes



CAN YOU DIG IT?

Soils are made of three basic particles called sand, silt, and clay. The difference in size between the three would be like comparing a basketball (sand), a golf ball (silt), and the tip of a ballpoint pen (clay). Soils from different locations vary in their amounts of each of the three particles. The amount of each type of particle is important because that determines the capacity of the soil to hold water and air. In the Columbia Basin soil can be very sandy whereas near Mica, WA the soil is nearly all clay. In fact, there is a business in Mica that uses the soil to make bricks.

Ideally soil is:

- 45% particles (sand, silt, and clay)
- 5% organic matter (dead plants and animals)
- 50% empty space (pores) with half filled with air, and half filled with water

Without decayed organic matter (**humus**), the soil loses its capacity to retain the water and air that soil organisms need.

TOPSOIL
SUBSOIL 1
SUBSOIL 2
BEDROCK 1
BEDROCK 2



Fill in the blanks with the correct response.

1. The sun provides _____, _____ provides nutrients _____ by plant roots.
2. Healthy _____ provides nutrients _____ by plant roots.
3. People, crops, animals, industry, aquatic _____ supply.
4. Trees and crops use carbon dioxide and _____ making the _____ healthier.

Grazing Benefits Animals and Soil Alike

Beef is one commodity that is produced in all 39 of the counties in Washington State.

Cattle and other grazers such as sheep and goats are able to utilize land that is not useful for growing crops. This land may be too steep, too rocky, or even too wet to grow other crops. Grazers convert solar energy (in the form of grass and other plants) into nutritious high-protein foods for the human diet.

Some of the many environmental benefits of well-managed grazing land are: plant growth is promoted, soil erosion is reduced, brush is controlled, and at the same time the ground is fertilized with manure. Grazers can clear excess vegetation from forest undergrowth which reduces the fuel load for wildfires.

Grazing along streams removes excess plant matter that would otherwise decompose into the water (think about how water in a vase of flowers looks and smells after a few days). Grazing animals are also used in cities to control overgrowth. Well-managed grazing utilizes land which is not good for growing crops and it can also improve the water quality and habitat for fish and wildlife.



SOIL CONSERVATION



With help from science, farmers have developed conservation practices that reduce soil loss. The movement of soil from one place to another by wind or water is called **erosion**. Erosion can occur anywhere but is usually worse in places that are steep or where there are no plant roots to hold the soil in place. Stopping erosion is important because it can take hundreds of years for nature to replace just one inch of good topsoil.

One conservation practice is planting windbreaks. Another conservation method includes farming with the contour of the land and planting strips of crops across hillsides (these

methods slow down the gravity flow of water). Another is **conservation tillage**. To stop erosion many farmers now use equipment and methods that use less tillage. When land is tilled (plowed or cultivated), soil particles are exposed to wind and water erosion. The more times a farmer disturbs the soil, the finer the particles become and the worse the erosion potential. Following harvest, crop residue is left in the field and often the field is not disturbed until it is time to plant the next crop. The roots hold the soil in place. Less tilling means fewer tractor trips across the fields using less fuel therefore less air pollution from dust and machine exhaust.

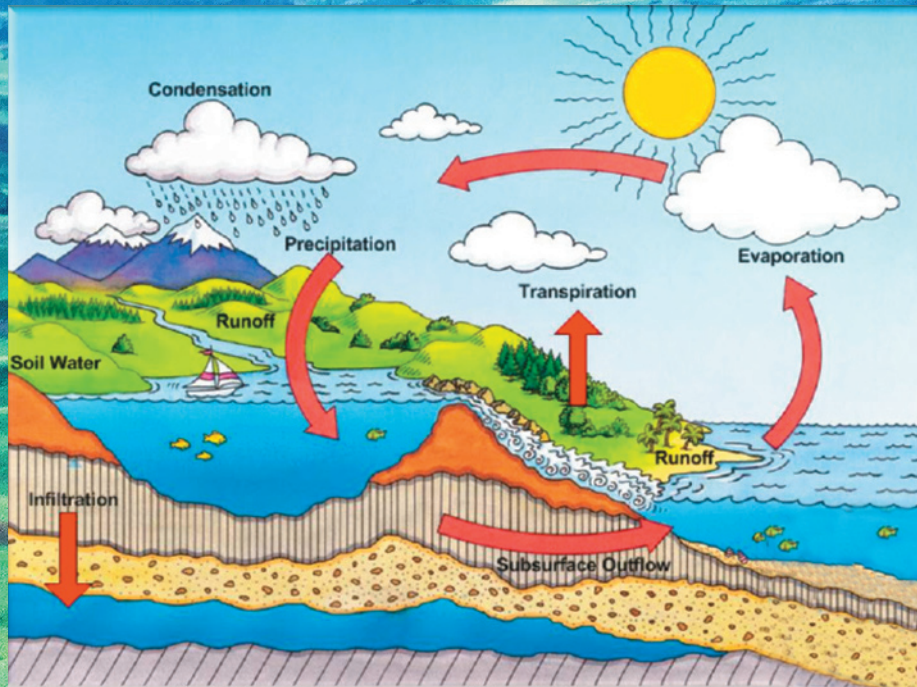
INS WITH...

er like puzzle pieces to sustain life
d water resources allows farmers
n the future.



ct resource:
_____ which plants need to grow.
es nutrients and minerals that are taken up
atic life, and recreation all must share the
a and produce oxygen,
healthier for people.

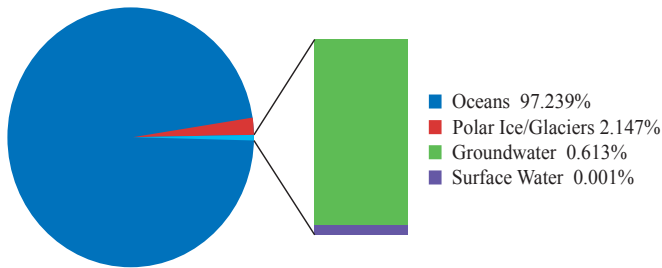
Water—The Most Common Material on Earth



<http://youtu.be/vYBjPE0wekw>

Total Water on Earth

Remember that about 70% of the earth is covered by oceans and those oceans hold more than 97% of all the water. Just over 2% of the water is frozen in glaciers. That means that less than 1% of the earth's water is available for drinking, and most of that is groundwater. The very thin purple line at the bottom of the bar to the right of the pie chart represents all the combined water in lakes (0.017%), the atmosphere (0.001%) and rivers (0.00001%)



The water cycle is the circulation of the earth's water in a never-ending process. The heat from the sun causes (1) water from the ocean, streams, lakes, and even plants to evaporate. As the water vapor rises, it is cooled by the upper air. Cold air cannot hold as much water vapor as warm air so (2) water vapor condenses into water droplets and creates clouds. The wind carries clouds over the land and (3) water falls back to earth as precipitation.

Water is Life!

All living things (plants, animals, humans) must have water to survive. **The amount of water on earth stays the same. It is never 'used up', but continues to move through the water cycle.** However, the water in a specific location can change in amount or form, sometimes we have a drought and sometimes we have extra snow or rain. A growing human population puts pressure on available water.

Condensation: The process of water vapor in the air turning into liquid. As water vapor rises it cools and becomes liquid again. These droplets form around dust particles in the air and become clouds.

Evaporation: Changing from a liquid or solid state to a vapor or gas. Only pure water evaporates. Substances like salt and minerals are left behind when water evaporates.

Groundwater: Water which has seeped below the earth's surface and is held there in the underlying sand and gravel. Water bearing layers are called **aquifers**. In Washington, 2/3 of the people get their drinking water from aquifers.

Percolation: The movement of water into soil through pores, holes and cracks.

Precipitation: Rain, snow, hail, sleet, dew, and frost.

Transpiration: Water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface through leaf pores.

Irrigation Water Benefits Fish



Any water used for irrigation of crops that is not absorbed by growing plants moves as groundwater back to streams and rivers. This water returns more slowly and at a much cooler temperature than water left in the stream. Cool, clean water entering rivers in summer and late fall is very good for fish!



A VERY "FRUITFUL" STATE

WASHINGTON IS A TOP PRODUCER OF APPLES, PEARS, SWEET CHERRIES, RED RASPBERRIES AND CONCORD GRAPES.

TREE FRUIT



Washington produces 69% of all US apples, but accounts for 90% of all apples exported to other nations. Our slogan "The Best Apples on Earth" certainly describes Washington apples that are shipped to over 60 countries around the world. Washington produces nearly 45% of the pears grown in the US. Thanks to advancements in Controlled Atmosphere (CA) storage technology, fresh apples and pears are available to consumers nearly year-round. The three main tree fruit regions are the Wenatchee Valley, Columbia Basin and Yakima Valley. These areas are ideal because of the mild climate, dry growing season, good soils, and plentiful irrigation water from nearby rivers.



1. Because we produce over half of the U.S. crop of this fruit and ship them world wide, Washington is know as the _____ Capital of the World.

A BERRY NICE PLACE

Berries are grown in many areas of our state but the major production area is the Puget Sound lowlands. The soil and climate there are great for blueberries, strawberries, raspberries and blackberries. Most cranberries are grown in the Willapa Hills region. 60% of America's red raspberries used in processing (quick frozen berries, concentrates, purees and other products) are grown in Washington, most of those in Whatcom County



3. If WA harvests 9,600 acres of red raspberries and the yield is 8,070 pounds per acre, the total harvest will be _____ pounds.

How many tons? _____

STONE FRUIT

No, they don't grow out of rocks! **Stone fruits** have a large, hard seed called a pit. Cherries, apricots, peaches, nectarines, plums and prunes are all stone fruits produced in our state. Weather is very important to a stone fruit grower. Rain and hail can damage the tender fruit and destroy an entire crop in the blink of an eye.

Even gentle rain on cherries is bad. A water drop collects in the dimple where the stem is attached and causes the cherry's skin to split open. This ruins the fruit. If it rains a grower might pay a helicopter to hover over his trees to blow the water off and dry the fruit quickly.



2. Comparing weather across the state, why would most stone fruit be grown in Eastern Washington?

GRAPES

The grape industry has grown to become Washington's 9th most valuable crop. We lead the nation in production of Concord grapes (used for juices and jams) at 42%. We also produce 25% of the nation's Niagra grapes and are second nationally in the production of wine grapes.



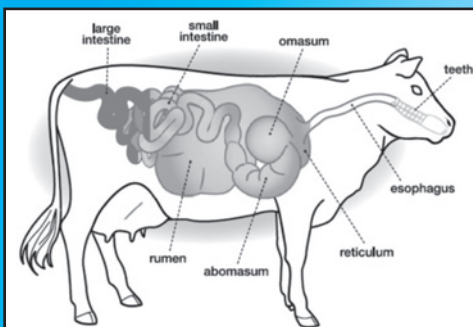
Nearly all our grapes are raised east of the Cascades.



4. Which is your favorite – grape juice, grape jelly, or table grapes? _____

Which one is better nutritionally? _____

The Marvel of Ruminants



The ruminant digestive system
https://cfaitec.org/matrix/lessonplan_print.cfm?lpid=292
California Foundation for Agriculture in the Classroom

Cattle, sheep, and goats and their wild cousins (such as deer and antelope) are all herbivores, which means their diet consists entirely of plants. However, they are also something more: they are **ruminants** (ROO-muh-nintz). Ruminants have a complex digestive system with three chambers before their true stomach, which is like a human stomach. Billions of bacteria live in the largest compartment, called the rumen. These organisms produce substances that digest plant fibers, releasing plant nutrients for use by both the bacteria and host animal. The bacteria use the nutrients for energy and to make more bacteria. The ruminant host uses the freed plant nutrients and the bacteria to meet its nutritional needs.

Cattle and sheep are mostly grazers, which means they mostly eat grasses and with their heads down. Goats prefer to browse, which means they like to eat shrubs and other plants at eye level. All ruminants can browse or graze, depending on what and how much food is available. Ruminants can help make land that is too dry, wet, rocky, or hilly for farming still able to produce food.



Livestock can obtain their own food on rangeland or pasture or food can be provided for them in a paddock or barn. Many beef cattle are on rangeland for at least part of their life. Many dairy cattle have food brought to them because their nutritional needs are so high. Regardless of how food is provided to ruminant livestock, their caretakers must care for the soil, plants, water, and animals properly to protect our environment while producing wholesome and high-quality food for us all.

Did You Know?
Rumen bacteria make vitamins B and K, so ruminants do not need to have them added to their diets.

Susan Kerr, DVM, PhD, PAS –
WSU NW Regional Livestock & Dairy Extension Specialist



Weeds - Agriculture's #1 Pest

A **weed** is a plant growing in the wrong place. A rose bush growing on a football field is a weed. **Noxious weeds** are the worst. These weeds are non-native plants that were

introduced into the US through human action. They arrived without the natural enemies that keep them in check in their native lands. They steal moisture, nutrients and sunlight and can be poisonous to both humans and animals. Noxious weeds are so damaging that Washington adopted a weed law in 1881, before we even became a state.



How Do Weeds Travel?

Weeds are able to spread and grow without human help and they are pretty sneaky about spreading their seeds. Seeds travel by wind, water, animals and humans. They stick on cars, boats, shoes, pets and bike tires. Some weed plants can even "throw" their seeds as far as 15 feet.

How Are Weeds Controlled?

Weeds can be controlled by planting other plants to compete with them, by mowing them down, or by introducing insects or diseases to control the plant. Also, farmers carefully and responsibly use chemical herbicides. The best control is achieved by using a combination of all those methods, called Integrated Pest Management.





Earth Day is Every Day for Agriculture!



Earth Day was first celebrated on April 22, 1970, and has been celebrated on the 22nd of April each year since. Farmers and ranchers celebrate the earth every day by protecting and conserving the Earth's resources all year round. Farmers and ranchers know that

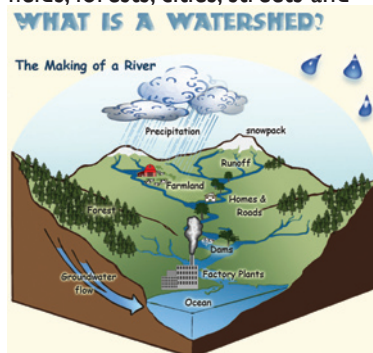
without plants - all humans, animals, and agriculture could not exist. Caring for the environment allows the needed renewable resources to continue to be produced now and into the future.

More than 90% of US farms are operated by individuals or families. Maintaining and improving the environment is necessary to keep the family business going. Today's farmers are restoring wetlands, reducing soil erosion, protecting wildlife, and generating far less waste than ever before. Every day is Earth Day for agriculture!

What is a Watershed?

A **watershed** is the land area that delivers run-off water to the area's lowest point – a stream, river or lake. Small watersheds flow into bigger ones until they eventually reach the ocean. This water travels across and under fields, forests, cities, streets and lawns.

We all live in a watershed and everything we do in our watershed affects its water. Run-off from streets, yards, farms and forests eventually end up in our water.




- Do you live in a watershed?
- Can you think of two actions you might take at home or school to help stop pollution in your watershed?


- _____
- _____

FOOD for THOUGHT


WASHINGTON POTATOES...




Have **MORE POTASSIUM** than a banana




Nutrition Facts	
Serving Size 1 potato (149g/5.3oz)	
Amount Per Serving	
Calories 110	Calories from Fat 0
% Daily Value*	
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 0mg	0%
Potassium 600mg	14%
Total Carbohydrate 26g	9%
Dietary Fiber 2g	8%
Sugars 1g	
Protein 3g	
Vitamin A 0%	Vitamin C 62%
Calcium 2%	Iron 8%
Thiamin 8%	Riboflavin 2%
Niacin 6%	Vitamin B6 10%
Flate 6%	Phosphorus 6%
Zinc 2%	Magnesium 0%



Provide **45%** of your daily **VITAMIN C** needs, which is more than a **TANGERINE**



Have the **EQUIVALENT** amount of **PROTEIN** as half of a glass of milk



Also contain **MORE FIBER** than an equal serving of **OATMEAL** and are one of the top vegetable sources of **VITAMIN B6**

LIBRARY CORNER



The Thing About Bees

A love poem from a father to his two sons, and a tribute to the bees that pollinate the foods we love to eat.

"Sometimes bees can be a bit rude.
They fly in your face and prance on your food."

And yet... without bees, we might not have strawberries for shortcakes or avocados for tacos! Shabazz Larkin's *The Thing About Bees* is a Norman Rockwell-inspired Sunday in the park, a love poem from a father to his two sons, and a tribute to the bees that pollinate the foods we love to eat.

Children are introduced to different kinds of bees, "how not to get stung," and how the things we fear are often things we don't fully understand.