Scientists estimate that there are many thousands of animal pollination partners, ranging from invertebrates (animals without backbones) such as bees, butterflies, wasps, flies, and beetles to vertebrates (animals with backbones)such as birds, bats, and other mammals. In North America, most of the pollinators are insects like bees, butterflies and beetles, or vertebrates like hummingbirds and bats. But elsewhere in the world pollinators can be primates (like lemurs), Australian possums, arboreal (tree-dwelling) rodents, or even reptiles like the gecko lizard.

The animal pollinators carry the pollen in different ways. Vertebrate pollinators like birds or bats carry pollen in their feathers or hair. Although invertebrates like bees and butterflies lack hair, they have something just as suitable for carrying pollen: bristles situated on their legs, head, and other body parts. Honeybees have tiny baskets on their legs for carrying pollen back to the hive. When butterflies use their long proboscis, or nectar-gathering appendage, to sip nectar from tubular flowers, they get peppered involuntarily with pollen on the proboscis or the head.

Plants use various techniques to attract their particular animal partners. Flowers are actually cleverly designed reproductive organs that incorporate all kinds of lures. The petals, for example, may serve as a landing platform for a visiting insect. When a bee lands on the lower petal of a snapdragon, its weight causes a stamen to swing down and dust the bee with pollen. Petals of many plant species even have lines or other marks that guide the pollinator to the nectar.

Another type of lure is aroma. A flower's scent must appeal to its pollinator. Many people appreciate the sweet smell of honeysuckle on a midsummer night. At that time, it's at its strongest to draw the honeysuckle's pollinators: nocturnal moths who "smell" with their feathery antennae. While most flowers have a sweet, pleasant fragrance, there are exceptions. One example is the Rafflesia flower, whose "rotten meat" aroma, which is offensive to most humans, is precisely what attracts its pollination partner: the fly.

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Plant structures, too, are designed to attract specific pollinating partners. The Queen Anne's lace flower places its nectar right at the base of its tiny flowers where pollinators with a short proboscis (nectar-gathering appendage) such as honeybees, ants, wasps, flies, and beetles can reach it when they crawl on the flower. On the other hand, bumblebees, butterflies, and moths have long proboscises, which enable them to reach nectar in less accessible places. For example, the long shape and curve of the columbine flower complements the long tongue of a bee, butterfly, or hummingbird. By concealing the nectar deep within its trumpet-like blossoms, the columbine prevents animals who are not its pollination partners from taking the nectar and transferring any pollen.

Plants also use colors to attract their ideal animal pollinators. Hummingbirds often, but not always, are attracted to red flowers. As it turns out, red flowers are typically loaded with carbohydrate-rich nectar, which provides almost instant energy for the fast-moving hummingbirds. Insect pollinators see color differently than we do because they are sensitive to ultraviolet (UV) light. UV light makes the reproductive areas of some flowers stand out. To human eyes a buttercup appears as a uniform yellow, but to a bee's eyes the flower's center (where the reproductive structures are) is darker because it reflects UV light. Bees are also attracted to blue and violet flowers. Flowers pollinated by animals who search for food at night are often pale so they'll be visible.

Through natural selection, a process in which living things become better adapted to their environments, some plants have evolved to match a particular animal pollinator. While this may be efficient because the pollinator will always visit the right species, it can also be dangerous for both partners should one or the other become extinct.

On a worldwide scale, animals pollinate more than three-fourths of the staple crop plants that people eat. Scientists estimate that one out of every three bites of food we take is the result of a successful animal-plant pollination system. For instance, consider a hamburger or hotdog with "the works": ketchup, relish, mustard,

and onions. Several different bee species pollinated the flowers of the plants that produce these condiments: tomatoes, cucumbers, mustard seed, and onions. Other bees were responsible for the side dishes. For example, hardworking bees pollinated the potato plant that eventually became potato chips and French fries. And for dessert, an endless variety of ice cream flavors, such as strawberry, chocolate, and vanilla, is also the result of successful plant-animal partnerships. A world without pollinators, and thus without flowers, and so many types of food, would bea poor world indeed!

Objectives

- Interpret the links between pollination and food production.

Materials

- Copies of Activity Page 2. (see Required Materials)
- Pens or pencils.

Subject

- Science

Procedure

Required Materials

Activity Page 2

pollinated plants that appears at the top of the page.

3. Tell your students that they have chosen a hamburger or hot dog from the grill. Explain that they can now choose what they will have with their hamburger or hot dog. Remind them that this is the bee-free barbecue and that the foods listed under "Plants Pollinated by Bees" won't be available. These include tomatoes, onions, cucumbers, lettuce, oil for frying potatoes, oranges, lemons, limes, mustard seed, cacao bean used in making chocolate, vanilla, almonds, watermelon, and apples.

4. Have your students select the items on the checklist that they could not have at the bee- free barbecue. After they've eliminated the bee-pollinated items from the list, have them describe the meal that would remain.

5. Conclude the lesson by asking your class to decide whether the availability of bee-pollinated food items is worth the risk of getting stung by a bee in their lifetimes.

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