Making Connections to the Natural World
People are inextricably connected to the plant world. We nourish our families with fruits and vegetables, clothe our bodies with cotton, build homes of wood for shelter, and tend gardens for sustenance and leisure. Yet many of the essential links between people and plants are easily overlooked in our increasingly urbanized world. When purchasing aspirin, few people realize its origin in the bark of the white willow. Most of us do not think about the ecological and economic links between coffee growers and the rainforest when sipping our favorite blend. Who considers plant pests, diseases, or crop sustainability when shopping for a new cotton shirt? With increasing pressure placed upon natural resources, it is critical to raise awareness about our impact and dependence on these resources. And chocolate is an example that not only connects the natural and social worlds, but is interesting and engaging for students.
What is the source of chocolate?
Chocolate is made from the seeds of a rainforest tree called *Theobroma cacao* (kah KOW). Cacao trees have flourished in Central and South America for thousands of years, long before people knew what luscious possibilities they held.

Wild cacao trees grow up to 30 feet (9 meters) tall beneath a canopy of taller trees. The canopy trees protect cacao from the intense tropical sun, wind damage, and moisture loss. The cacao tree requires specific conditions to thrive, which is why it grows only within a band approximately twenty degrees north and south of the equator. The understory of the rainforest provides a delicate balance of rain, shade, humidity, nutrients, and protection from the wind that is critical to the tree’s survival.

The cacao tree is very different from the deciduous North American trees with which students are most familiar. The cacao tree’s flowers grow directly on the lower trunk and branches, a pattern called cauliflory. This strategy increases the flower’s chances of being pollinated by the tiny flies that live and breed in the rainforest debris surrounding the tree. These tiny flies, called midges, are drawn to the moist leaf litter and rotting cacao pods on the forest floor. This decaying debris creates ideal conditions for midges to live and breed—and it’s conveniently located near the flowers they pollinate.

Cacao trees need soil rich in nitrogen and other nutrients, thus the debris surrounding the base of the tree serves another important function—recycling nutrients back to the tree. Decaying plants and animals rotting on the forest floor support a lively growth of fungi. This fungi, in turn, help cacao trees absorb nutrients from the soil. The roots of the cacao tree soak up these nutrients, along with rainfall, from the soil and leaf litter. Stretching across the shallow rainforest soil, the roots also anchor the cacao tree and help prevent soil erosion.
Animals, too, have an important interdependent relationship with cacao. Monkeys, rodents, birds, and many other animals live near cacao trees. With their teeth, bills, or claws, these creatures break into cacao pods to eat the sweet pulp inside. Although cacao seeds are packed with nutritious oils, starches, and proteins that provide the energy a seedling needs to grow, they also contain caffeine and theobromine, giving them a bitter taste. This bitter taste discourages animals from eating cacao seeds and causes them to spit out the seeds. This is an important element of the tree’s seed dispersal strategy. Cacao trees rely entirely on these animals to spread their seeds along the rainforest floor to start the next generation of trees. Without the intervention of these animals, the pods stay on the tree and rot. The animals’ interaction with the cacao seeds is a critical component of the seeds’ survival and growth into new trees.

Many birds inhabit the branches of cacao and its canopy trees. Some birds migrate from the north and spend the winter in the branches of cacao trees, while others live year-round in the trees that tower over the cacao in the rainforest. In 1996, in the canopy trees above a Brazilian cacao plantation, scientists discovered a previously unknown bird. They named it the pink-legged graveteiro (grah vah TAY roh). The pink-legged graveteiro and many other canopy dwellers may lose their homes due to habitat loss. A fungus called witch’s broom threatens cacao trees in Brazil, and lumber companies harvest canopy trees from rainforests all over the world.

**Growing cacao**
Cacao farming has changed little since prehistoric times. Because the pods grow directly off the trunk and branches of the tree, machines are not a viable means of harvesting. Instead, farmers must harvest cacao pods and prune the trees by hand. Pods are sliced from the tree with a machete or a small blade, gathered into net bags, then split open so the pulp-covered seeds can be piled up and fermented. The pulp heats up and disintegrates during the chemical process of fermentation, which is critical to developing the chocolate flavor. Farmers then dry the seeds in the sun on rooftops, tables, or large mats. Some farmers use drying machines to speed up this process. Finally, farmers pack the cacao seeds and ship them to brokers, markets, and factories that will turn them into cocoa powder, cocoa butter, and chocolate.
Growing cacao is not the most lucrative business for farmers. First, cacao trees don’t produce seeds until they are three to five years old. Second, cacao trees grown in sunny, open areas may produce a higher yield for a while, but are prone to pests, molds, and diseases that can wipe out an entire crop. Finally, cacao farmers are dependent on market prices, which are usually very low. Like other agricultural products, cacao experiences highs and lows in the world market. A rise in consumer demand or a decrease in cacao production drives prices up. But when farmers grow more cacao than consumers will buy, cacao prices fall. Falling prices can devastate a country’s economy when it relies heavily on the sale of cacao.

Prices for cacao peaked in the late 1970s. In response to the high prices, farmers planted more cacao trees. Global cacao production peaked in 1996 at 2.9 million tons. Chocolate’s worldwide popularity has created high demand for cacao farmland affecting thousands of acres of tropical rainforests. Rainforests may be cleared completely to grow cacao, or some tall trees may be left to provide shade for the cacao trees. When rainforests are cleared, what’s left are open, sunny fields with dramatically lower levels of plant and animal diversity. Cacao trees planted in the sun face increased risk from pests and disease, and the soil quickly becomes unproductive without fertilizers.

Today cacao farmers and scientists are working together to find ways to grow cacao sustainably—that is, cacao that will provide steady income for farmers while limiting damage to the rainforest. Planting cacao under the shade of taller trees increases cacao’s lifespan and provides a more diverse habitat for rainforest animals than sunny orchards. When cacao is planted as a buffer on the edge of a rainforest, or in corridors between forest fragments, it can create a habitat for rainforest animals and plants while creating a source of income for people. The shade trees may also produce fruits or nuts, such as Brazil nuts or cashews, which farmers can harvest for extra income.