3

Science Standard 3.3.a.

Supports ELA Standard: Writing 3.2.3.

Visual Aids

California Education and the Environment Initiative

Structures for Survival in a Healthy Ecosystem

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Initiative Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency

California Natural Resources Agency

California State Board of Education

California Department of Education

Department of Resources Recycling and Recovery (CalRecycle)

Key Partners:

Special thanks to **Heal the Bay,** sponsor of the EEI law, for their partnership and participation in reviewing portions of the EEI curriculum.

Valuable assistance with maps, photos, videos and design was provided by the **National Geographic Society** under a contract with the State of California.

Office of Education and the Environment

1001 I Street • Sacramento, California 95814 • (916) 341-6769

http://www.CaliforniaEEI.org

© Copyright 2011 by the California Environmental Protection Agency

© 2013 Second Edition

All rights reserved.

This publication, or parts thereof, may not be used or reproduced without permission from the Office of Education and the Environment.

These materials may be reproduced by teachers for educational purposes.

Contents

Lesson 1 Structures That Help

1 What Are Structures For? . . . 3

Lesson 2 When Structures Are Not Enough!

2 Low Desert . . . 4
3 Ocotillo Plant Structures: Page 1 . . . 5
4 Ocotillo Plant Structures: Page 2 . . . 6
5 Alpine Gold Plant Structures: Page 1 . . . 7
6 Alpine Gold Plant Structures: Page 2 . . . 8
7 Chamise Plant Structures: Page 1 . . . 9
8 Chamise Plant Structures: Page 2 . . . 10
9 Chinese Houses Plant Structures: Page 1 . . . 11
10 Chinese Houses Plant Structures: Page 2 . . . 12
11 Coast Redwood Plant Structures: Page 1 . . . 13
12 Coast Redwood Plant Structures: Page 2 . . . 14
13 Joshua Tree Plant Structures: Page 1 . . . 15
14 Joshua Tree Plant Structures: Page 2 . . . 16
15 Lodgepole Pine Plant Structures: Page 1 . . . 17
16 Lodgepole Pine Plant Structures: Page 2 . . . 18
17 Purple Needlegrass Plant Structures: Page 1 . . . 19
18 Purple Needlegrass Plant Structures: Page 2 . . . 20
19 Single-Leaf Pinyon Plant Structures: Page 1 . . . 21
20 Single-Leaf Pinyon Plant Structures: Page 2 . . . 22

Lesson 3 Do Animal Structures Guarantee Survival?

21 Merriam's Kangaroo Rat Animal Structures: Page 1 23
22 Merriam's Kangaroo Rat Animal Structures: Page 2 24
23 Banana Slug Animal Structures: Page 1 25
24 Banana Slug Animal Structures: Page 2 26
25 Desert Tortoise Animal Structures: Page 1 27
26 Desert Tortoise Animal Structures: Page 2 28
27 Mountain Bluebird Animal Structures: Page 1 29
28 Mountain Bluebird Animal Structures: Page 2 30
29 Pacific Rattlesnake Animal Structures: Page 1 31
30 Pacific Rattlesnake Animal Structures: Page 2 32
31 Pika Animal Structures: Page 1 33
32 Pika Animal Structures: Page 2 34
33 Pronghorn Antelope Animal Structures: Page 1 35
34 Pronghorn Antelope Animal Structures: Page 2 36
35 Tule Elk Animal Structures: Page 1 37
36 Tule Elk Animal Structures: Page 2 38
37 Western Bluebird Animal Structures: Page 1 39
38 Western Bluebird Animal Structures: Page 2 40
39 Greetings from the Low Desert 41

Lesson 4 Plants, Animals, and People

40 What Do These Have in Common? 42
41 Pollen 43
42 Bees 44

Lesson 5 Building a Hummingbird Habitat

43 Animals Helping Plants 45
44 What Anna's Hummingbirds Need: Page 1 46
45 What Anna's Hummingbirds Need: Page 2 47

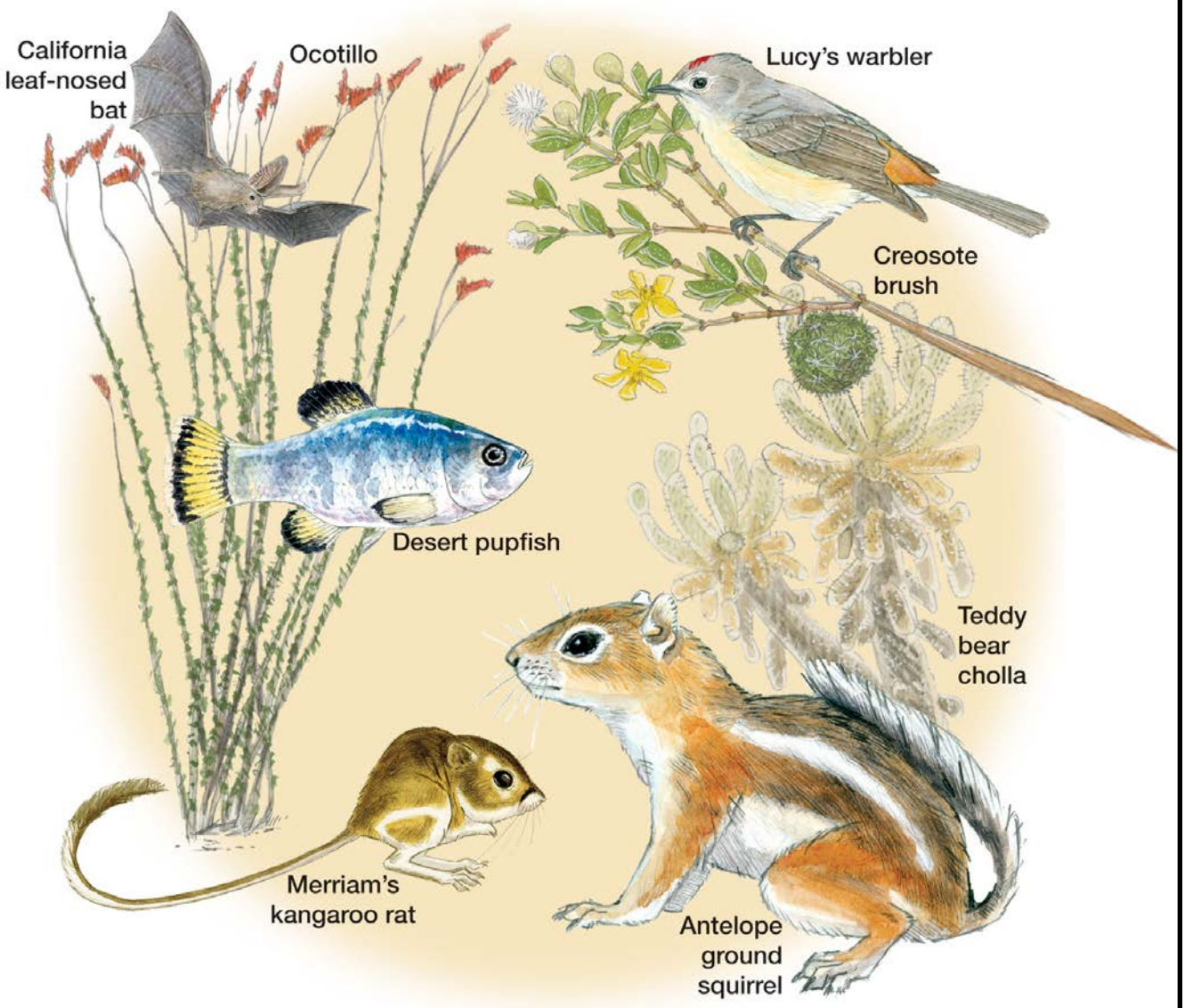
VA #1 What Are Structures For?

Plant or animal: _____

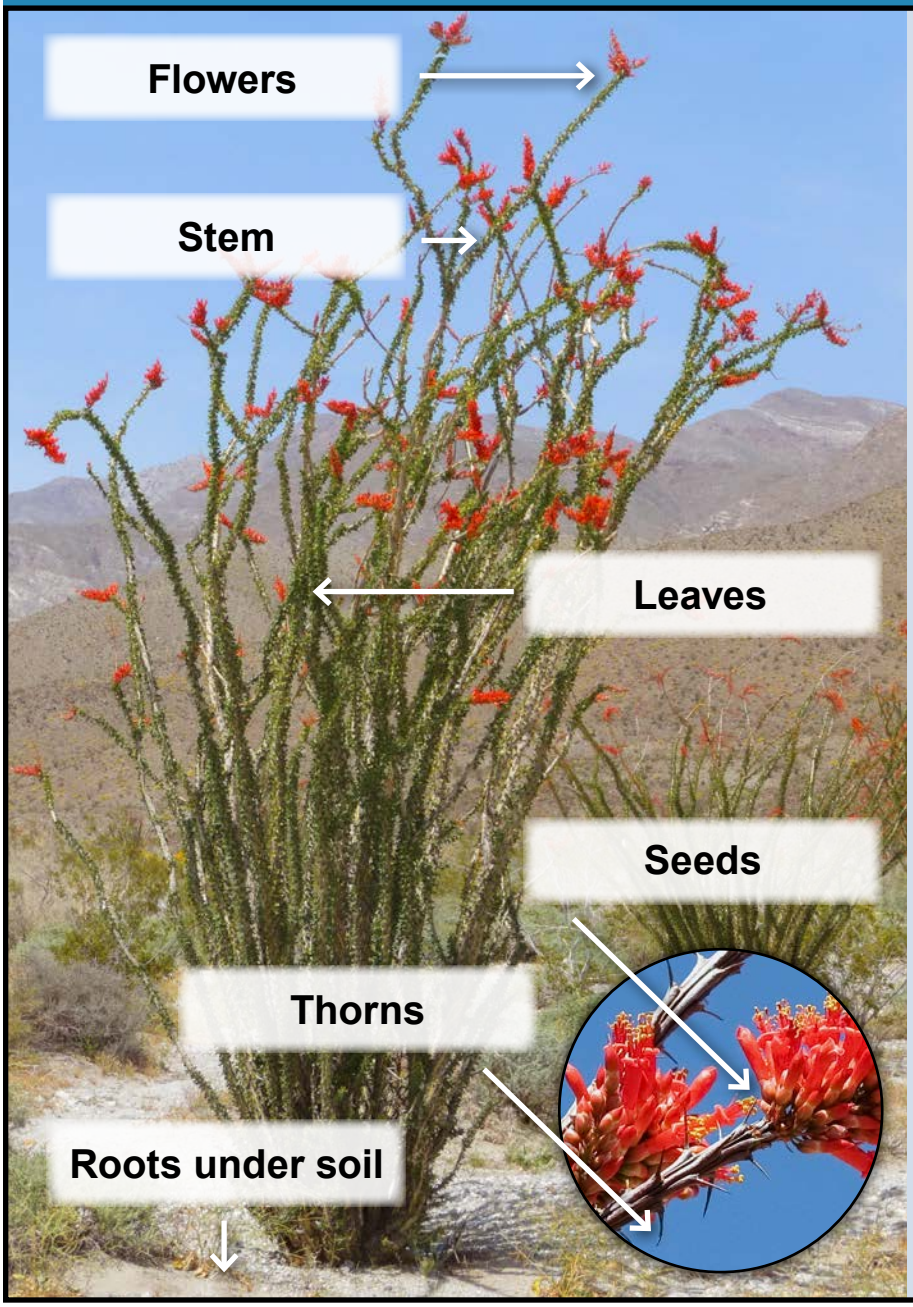
Structure: _____

Use of Structure	Resources from the Environment	How structure helps plant/animal use the resource to survive	What if the environment cannot provide the needed resource?

VA #2 Low Desert



VA #3 Ocotillo Plant Structures: Page 1



After a long time without rain in the low desert, the ocotillo plants lose their leaves. Their strong, straight stems take in light from the Sun to make food for the plant. When rain falls, new leaves sprout quickly. Red flowers bloom at the tips of stems. Hummingbirds drink the flowers' nectar and carry pollen.

VA #4 Ocotillo Plant Structures: Page 2

Flowers: Bright red flowers attract bees and birds. Pollen helps the plant reproduce.

Leaves: Leaves help the plant make food so it can be healthy, grow, and survive.

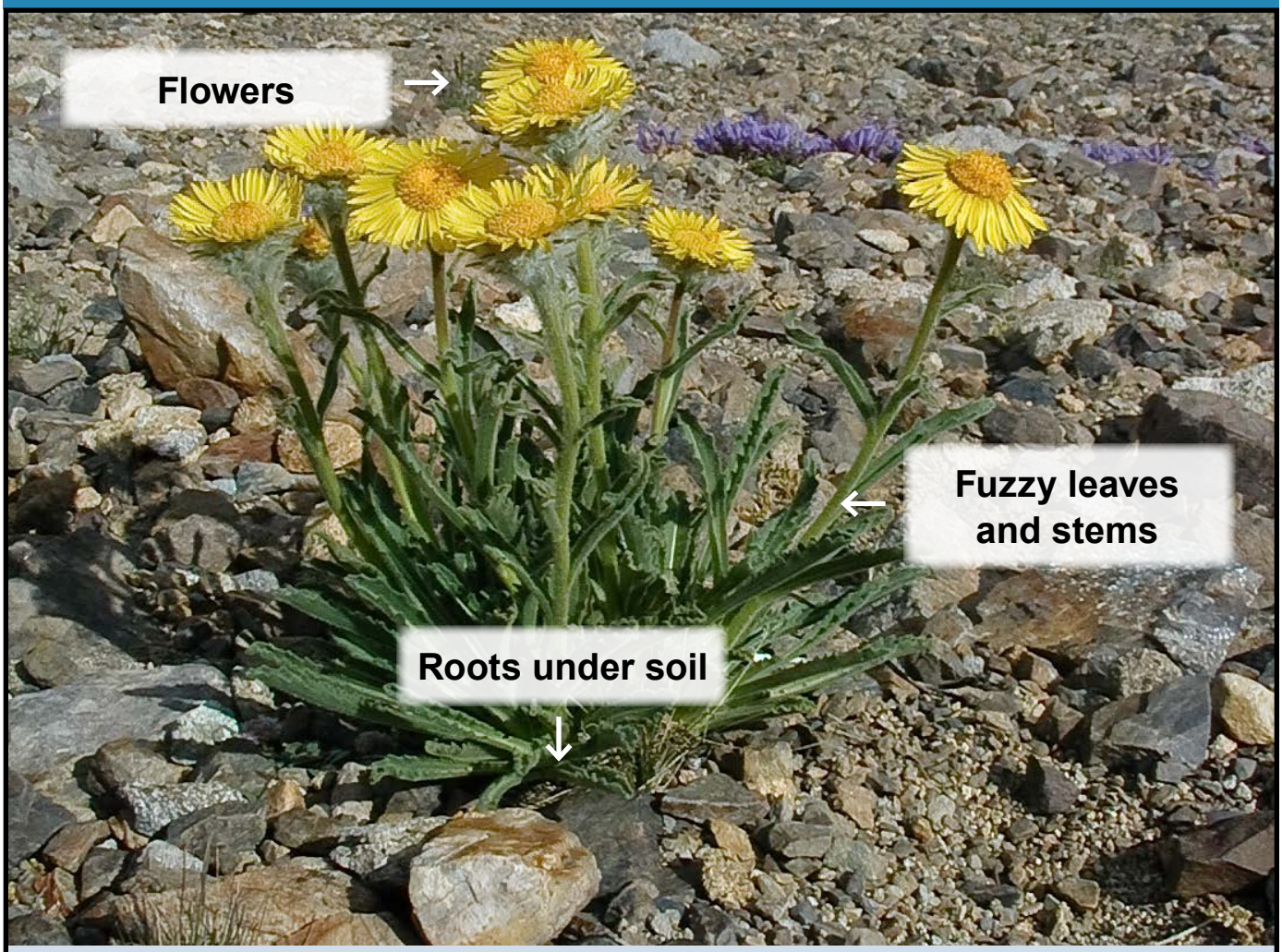
Roots: Roots collect water and nutrients from below the surface to help the plant survive and grow.

Seeds: Seeds sprout and become new plants. They are so light that the desert wind carries them.

Stems: Stems help the ocotillo live and grow by moving water and nutrients. They can make food when the plant has no leaves.

Thorns: Thorns keep animals from eating the plant's leaves and stems so the plant can survive.

VA #5 Alpine Gold Plant Structures: Page 1



Alpine gold towers above other wildflowers in the highest rocky places. Hairy stems and leaves help the plant hold in the little water that is available there. This helps the plant live, grow tall, and produce many large flowers.

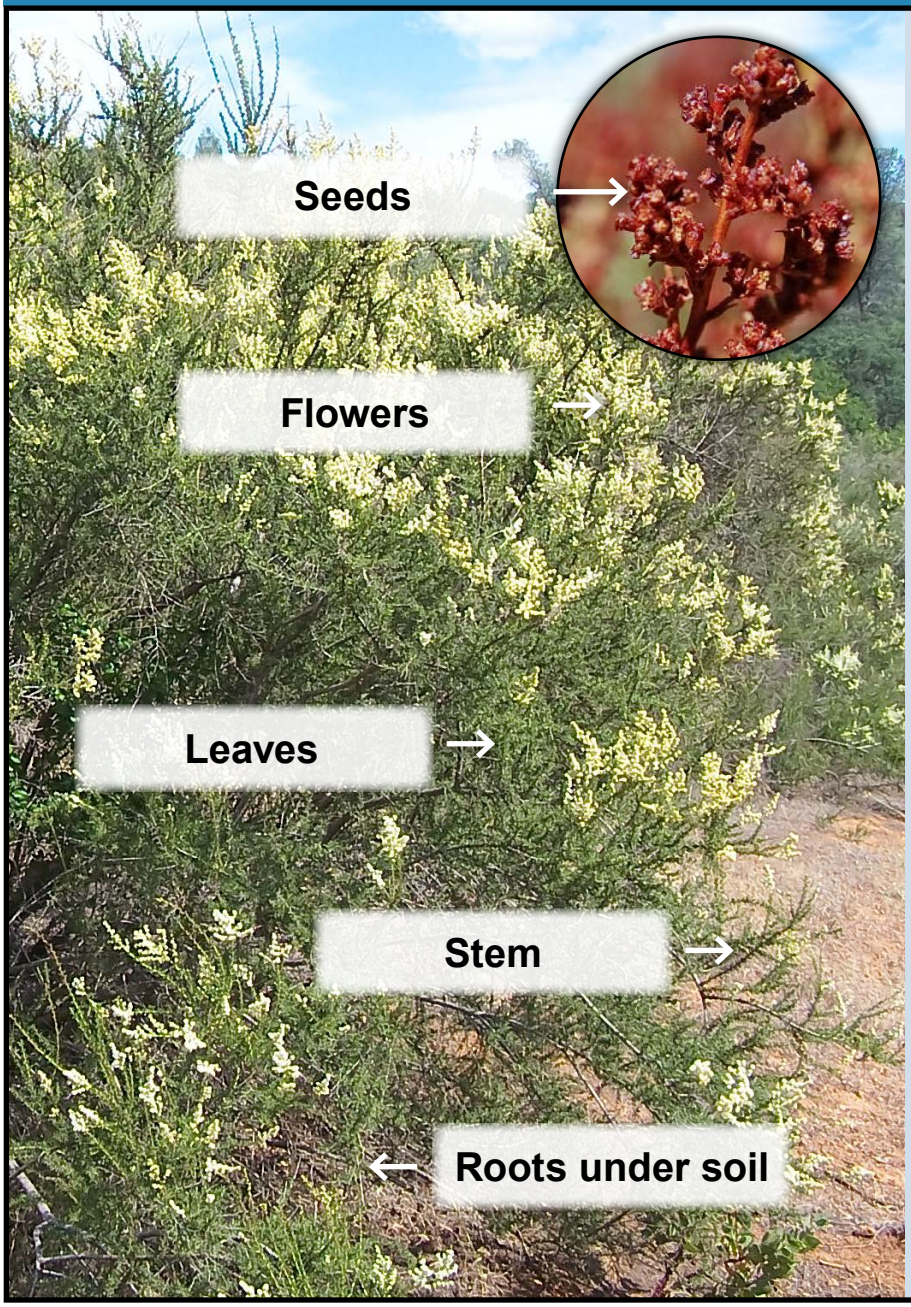
VA #6 Alpine Gold Plant Structures: Page 2

Flowers: Big, bright flowers attract insects to carry pollen so that the plant can make plenty of seeds to reproduce.

Fuzzy leaves and stems: Fuzzy hair on leaves and stems protect them from the drying wind and strong sun. That protection helps the plant survive.

Roots: A long main root grows between cracks in rock. It can find water deep underground, helping the plant grow and survive.

VA #7 Chamise Plant Structures: Page 1



Chamise structures help it grow and survive in hot, dry chaparral, where fires occur often. A huge underground root system collects hard-to-find water. Leaves hold water in, and flowers store their own supply. The sticky resin in leaves and branches easily catches fire. Fire helps this plant reproduce by cracking seed coats so that new plants can germinate. New sprouts grow out of the top of the roots, too. Ash adds nutrients so new plants can grow.

VA #8 Chamise Plant Structures: Page 2

Flowers: Small flowers can draw water from the stem. Flowers can store their own supply of water. Flowers turn from white to brown as they dry out.

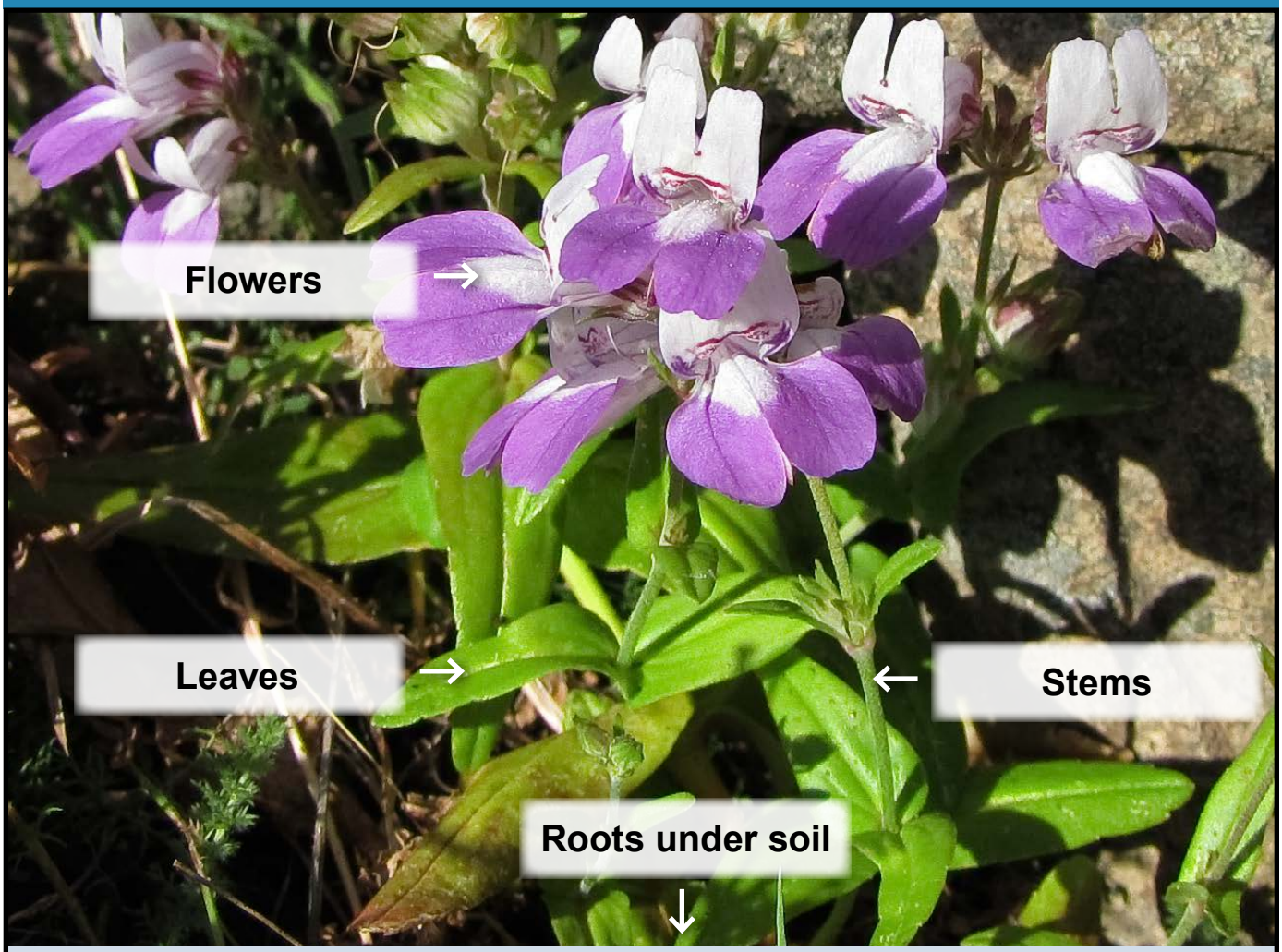
Leaves: Needle-like leaves have a waxy coating that holds in water for survival.

Roots: Roots spread out and downward to find water for survival.

Seeds: Most seeds have hard coats. When fire burns, it opens the seeds so they can reproduce.

Stems: Chamise plants have many scratchy branches that keep grazing animals away, helping the plant to survive. Branches, bark, and leaves can drop off in hot summers, which saves water.

VA #9 Chinese Houses Plant Structures: Page 1



Chinese houses grow best in rich, moist soil in the shade of oak trees. The leaves are large. They can capture sunlight even in the shade of a tree. These wildflowers reproduce so well that they may cover a whole hillside in purple. They attract the endangered checkerspot butterfly.

VA #10 Chinese Houses Plant Structures: Page 2

Flowers: Masses of purple flowers attract many bees to carry pollen.

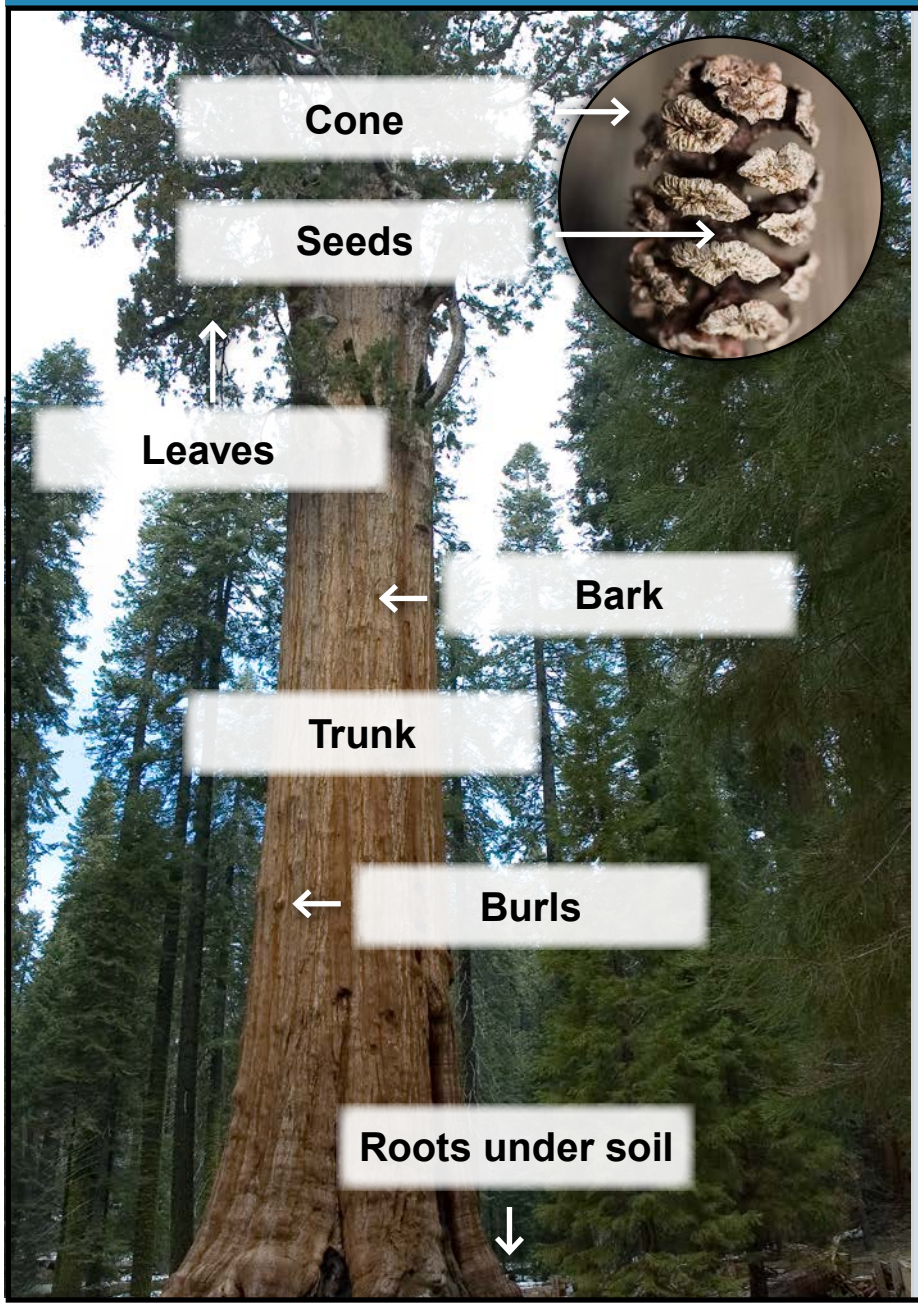
Leaves: The leaves are large. They can capture sunlight even in the shade of a tree. This plant lives and grows in moist soil.

Roots: Roots spread out and downward to find water for survival.

Seeds: Large numbers of flat seeds fall onto the ground. The next spring, many new plants grow in place of the parent plant.

Stems: Stems are the part of the plant that holds up other structures such as the leaves and flowers. Stems carry water and nutrients up through the plant.

VA #11 Coast Redwood Plant Structures: Page 1



California's northern coast is one of the few places in the world that provides coast redwoods what they need to survive, grow, and reproduce. Coast redwoods need plenty of water, which the foggy ocean air and heavy winter rains provide. The trees need sandy soil. Their seeds and burls have kept redwoods reproducing here for 20 million years!

VA #12 Coast Redwood Plant Structures: Page 2

Bark: Reddish bark, up to 1 foot thick, protects the tree from fire and insects.

Burls: Grow on trunks of redwoods that are stressed. New sprouts can grow out of burls. They can draw on the old tree's roots for water and nutrients. This is another way redwoods can reproduce.

Cones: Small cones grow at the tips of top branches. Wind pollinates them so the tree can reproduce. In fall, the cones dry out and open, and the seeds fall out.

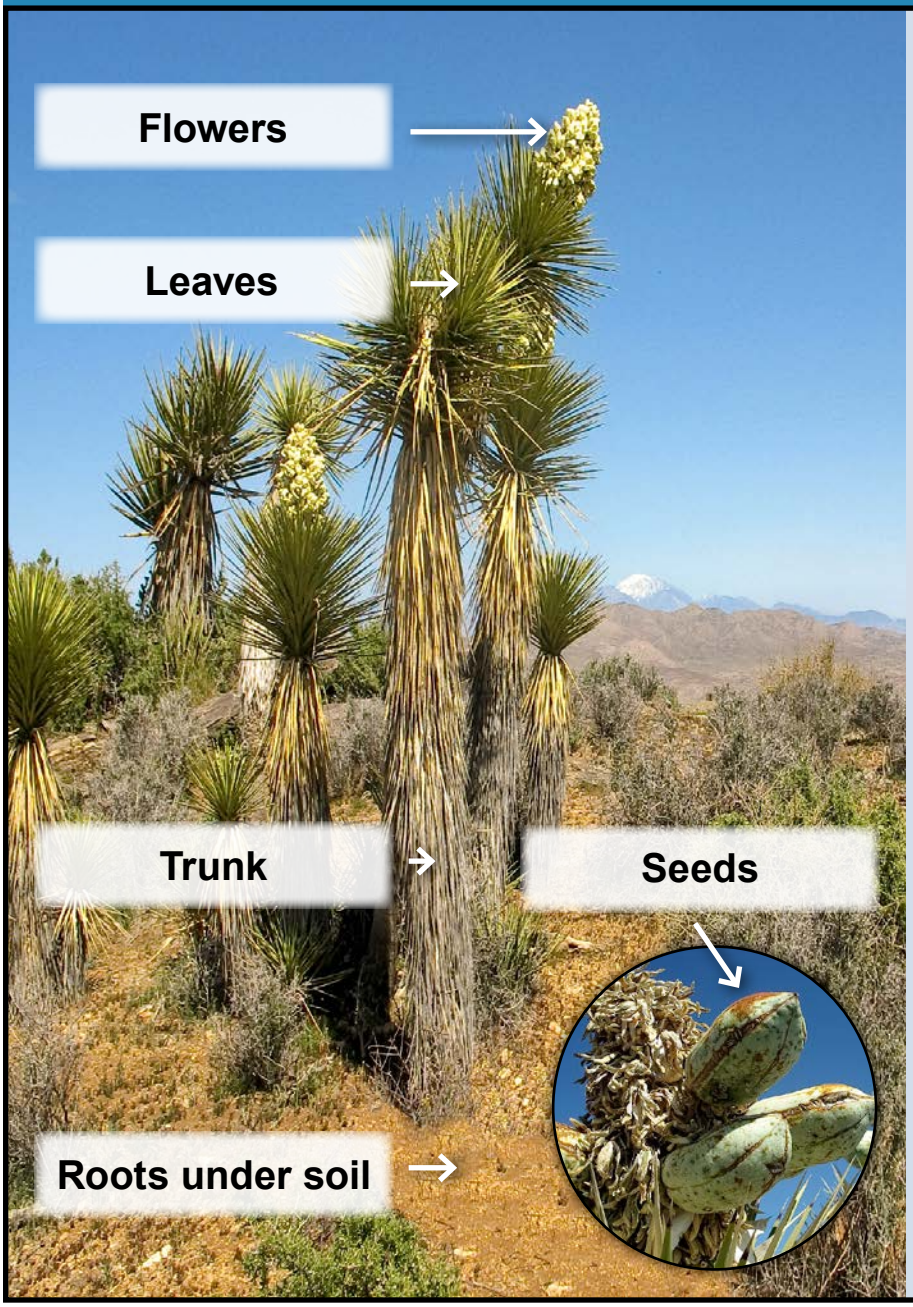
Leaves: Round needles at the top drop moisture from fog and rain to the roots. Flat needles below soak in sunlight.

Roots: They do not grow deep. They collect water dropped from the leaves. The roots grow around other redwood roots.

Seeds: About 20 speck-sized seeds are in each cone. "Wings" on each seed can carry them far from the parent tree. Millions of seeds are made by one redwood each year; a few will become new trees.

Trunk: The trunk of a redwood can grow more than 300 feet tall and 15 feet wide.

VA #13 Joshua Tree Plant Structures: Page 1



The unusual Joshua tree grows only in the high desert's sand and gravel. The tree's structures are made to collect and save water. Yet to survive, grow, and reproduce, the tree must get things from its habitat. It makes new branches only after it has flowered. It flowers only after a winter freeze has prepared the branch end and spring rains come. The flowers make seeds only if the yucca moth pollinates them. Seeds germinate only if rain falls. With the resources it needs from its environment, a Joshua tree can live more than 500 years.

VA #14 Joshua Tree Plant Structures: Page 2

Flowers: When bunches of flowers open at night, their strong scent attracts yucca moths (the Joshua tree is a type of yucca) that carry pollen. In years with little rainfall, the tree does not form flowers.

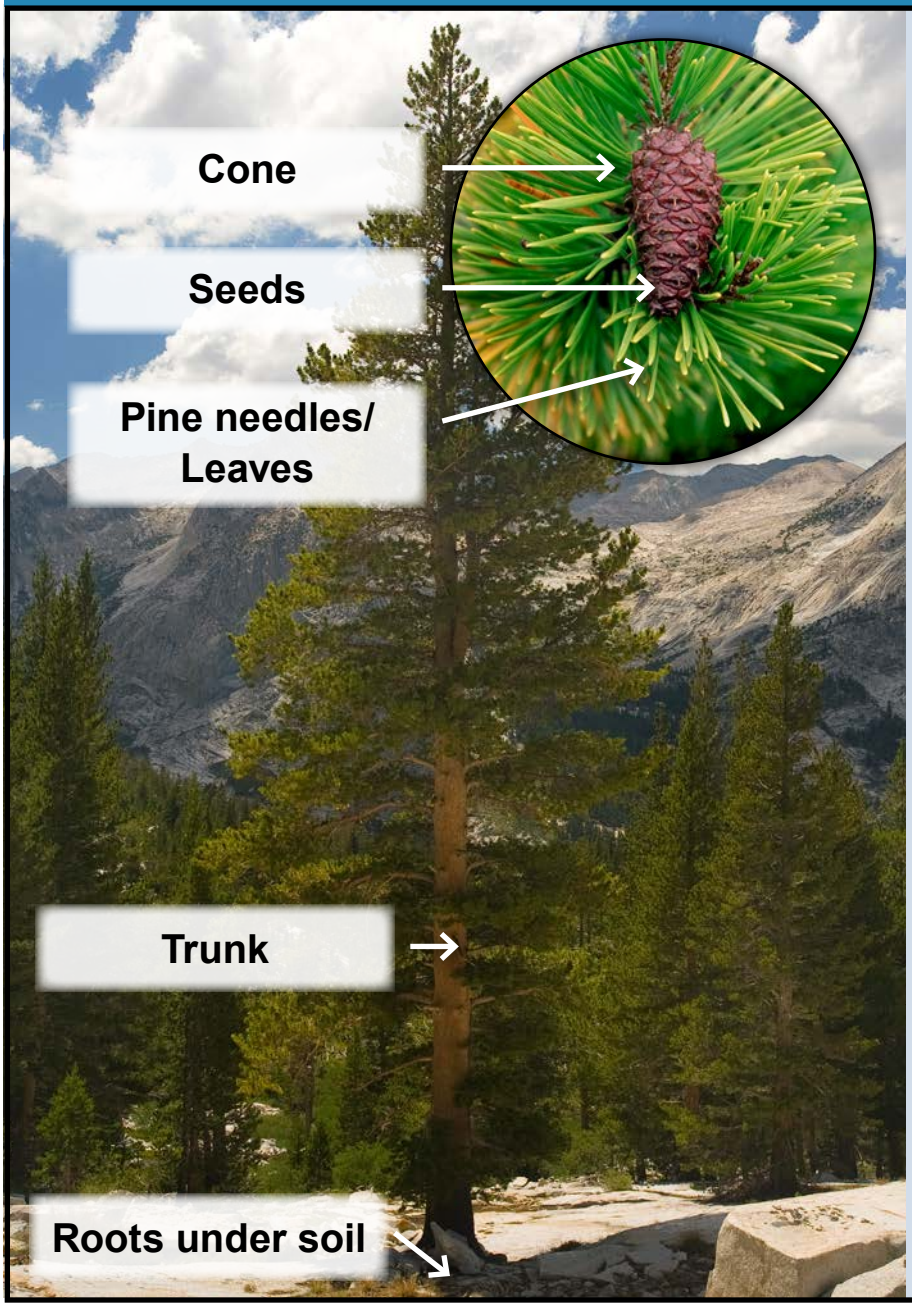
Leaves: Sword-like leaves shoot rainwater down toward the roots. A waxy coat helps leaves keep water inside.

Roots: Shallow roots take in water before it drains into the sandy soil. Roots spread out up to 36 feet to help support the plant. Deep roots store water for the plant to use when there is no rain.

Seeds: Dried fruit drops and rolls in the desert wind or is carried by animals to a different place. When rain provides water, the many flat seeds inside the fruit may start a new grove of Joshua trees.

Trunk: Made up of many fibers, the trunk pulls up water like a sponge. That helps the tree survive and grow. Although it grows only half an inch a year, the trunk with branches can reach a height of 40 feet.

VA #15 Lodgepole Pine Plant Structures: Page 1



Lodgepole pines can thrive in the Mixed Evergreen and Conifer Forest habitat's rocky soil and snow. Some pines survive more than 600 years! Most of their growth occurs after the snow melts in spring. Their long, strong trunks made perfect poles for Native Californians' lodges. The trunks make perfect telephone poles. In a year, one tree can make 20,000 seeds, ready to produce new trees. This pine tree's cones need extreme heat (such as from a forest fire) to open and release the seeds.

VA #16 Lodgepole Pine Plant Structures: Page 2

Cones: This pine tree's cones need extreme heat (such as from a forest fire) to open and release the seeds. In the warm summer, the cones open so that seeds can germinate.

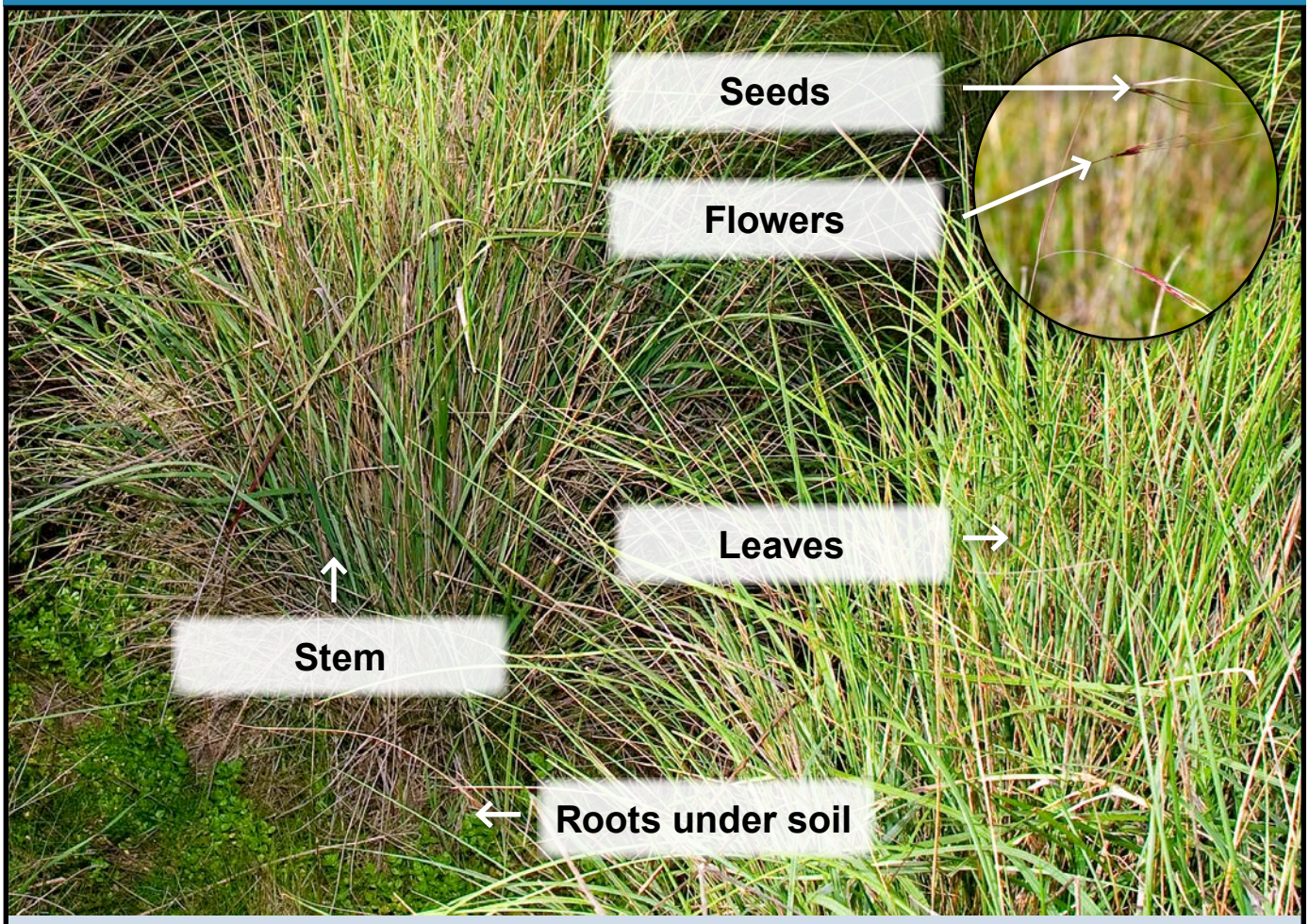
Leaves: The leaves on a pine tree are called "needles."

Roots: Spreading roots collect water (mostly melted snow) from the ground.

Seeds: Long, broad "wings" carry seeds on the wind to new places to reproduce.

Trunk: The lodgepole pine's straight trunk grows to 100 feet tall. Tall trees get more sunlight, enabling them to make food to survive and grow even taller.

VA #17 Purple Needlegrass Plant Structures: Page 1



Purple needlegrass, a native plant, still waves on sunny slopes in California's grasslands. Growing in separated bunches helps it survive drought and fire. The plant's spreading roots help it survive and soak up winter rains to grow. Its needlelike seeds can drill into hard clay soil to reproduce. A purple needlegrass plant can live hundreds of years.

VA #18 Purple Needlegrass Plant Structures: Page 2

Flowers: Small flowers with fuzzy tops open to let out pollen as they dry. Wind carries the pollen, so the plant does not need to attract animals to reproduce.

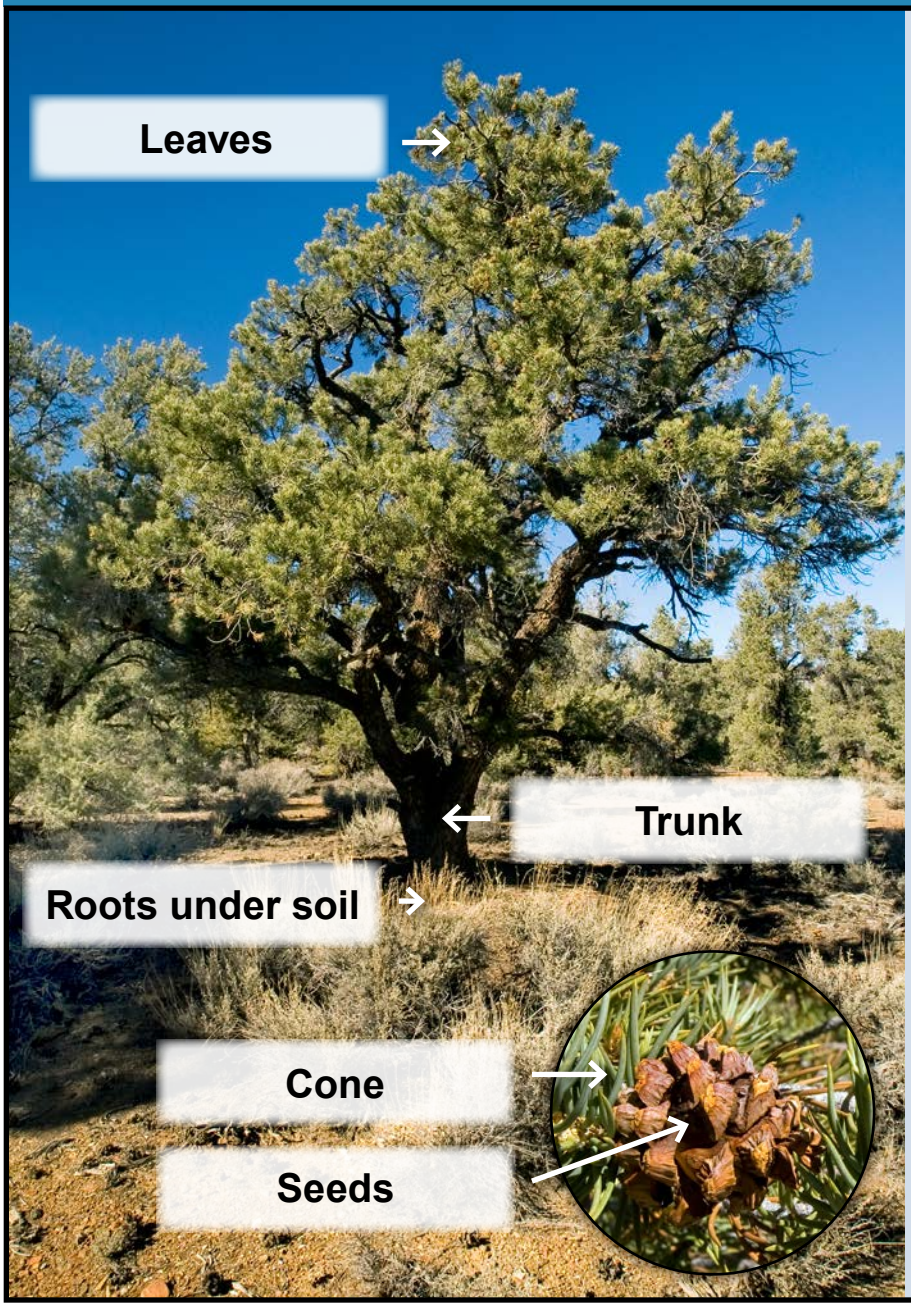
Leaves: Tough leaves stay green most of the year to make food for the plant to live and grow.

Roots: Roots grow to be 18 feet long. They hold down soil. They also hold water, which helps the plant survive drought and fire.

Seeds: Seeds that look like a needle with thread help this plant reproduce. The wind carries the “thread.” The “needle” drills into the soil.

Stems: Strong stalks grow up to 2 feet tall. They hold up the flowers in the wind that sweeps the grasslands.

VA #19 Single-Leaf Pinyon Plant Structures: Page 1



The single-leaf pinyon lives on ridgetops where water is scarce and summers are hot and dry. The tree's roots take in water, and the trunk helps store it. Since winters are cold, the tree grows for only a short time in spring and fall. Long-lasting evergreen needles save nutrients for these times of growth. A pinyon grows slowly and may take a century to make a full crop of seeds. However, its pine nuts feed many animals in the pinyon-juniper woodland. These animals help pinyons reproduce in many new places.

VA #20 Single-Leaf Pinyon Plant Structures: Page 2

Cones: Wind carries the pollen to form cones. Cones open and drop to the ground releasing seeds, helping pinyons reproduce.

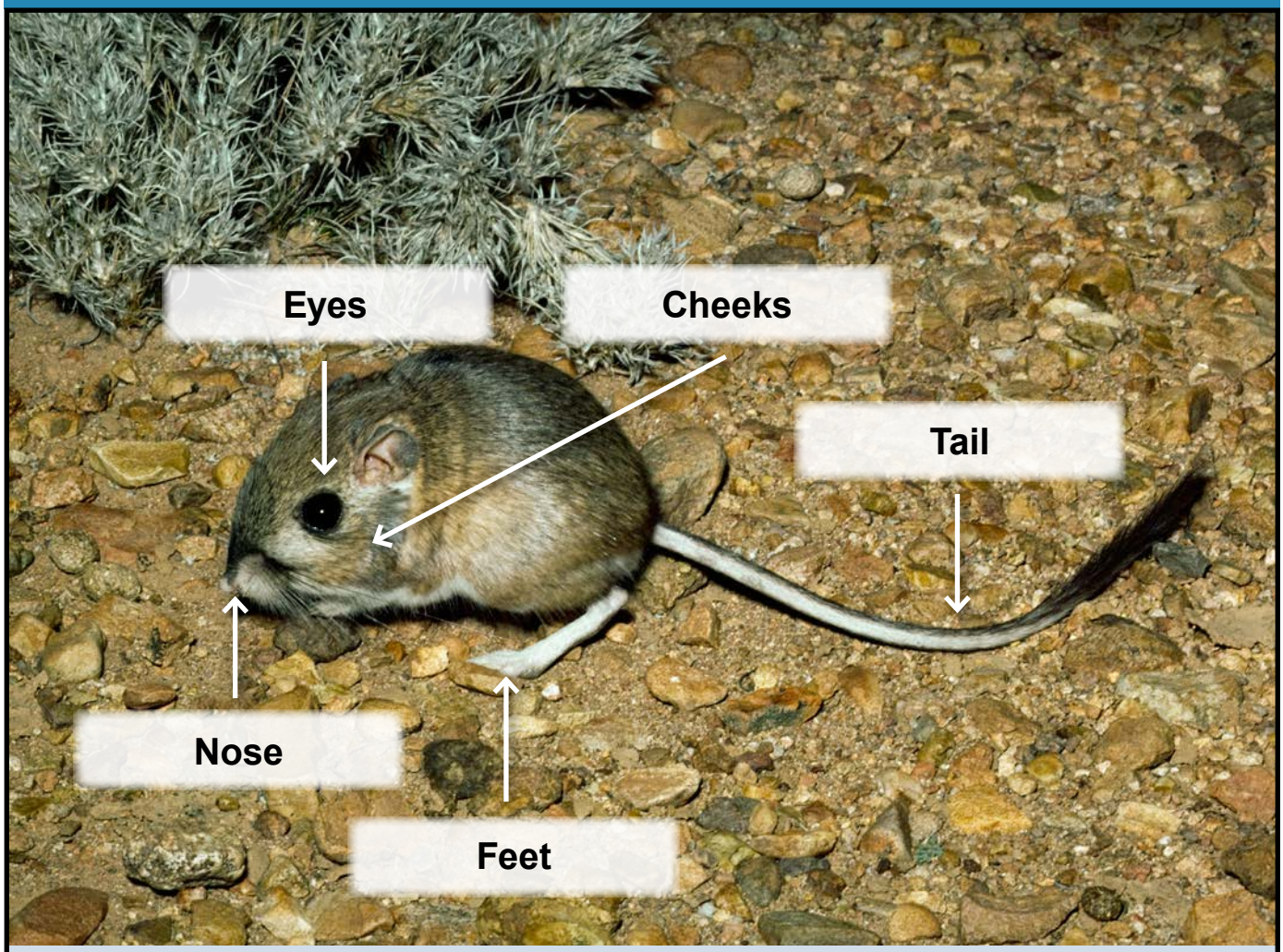
Leaves: The needles live a long time. This saves nutrients the tree can use to grow and reproduce.

Roots: Roots can reach deep down or far out to get water and nutrients. This helps the pinyon tree survive and grow.

Seeds: Cones hold brown seeds. People and other animals eat the seeds, called pine nuts. Some animals carry them and bury them in other places, starting new trees.

Trunk: The trunk's wood can store water to help the plant survive in drier times.

VA #21 Merriam's Kangaroo Rat Animal Structures: Page 1



Getting water—and keeping water in the body—is key to survival in the dry low desert habitat. Without water, no animal can grow, mature, and be healthy enough to reproduce. Merriam's kangaroo rats can get water from the seeds they eat. They do not lose water by sweating or panting.

VA #22 Merriam's Kangaroo Rat Animal Structures: Page 2

Eyes: Big eyes help the kangaroo rat see at night to stay safe from predators, such as owls.

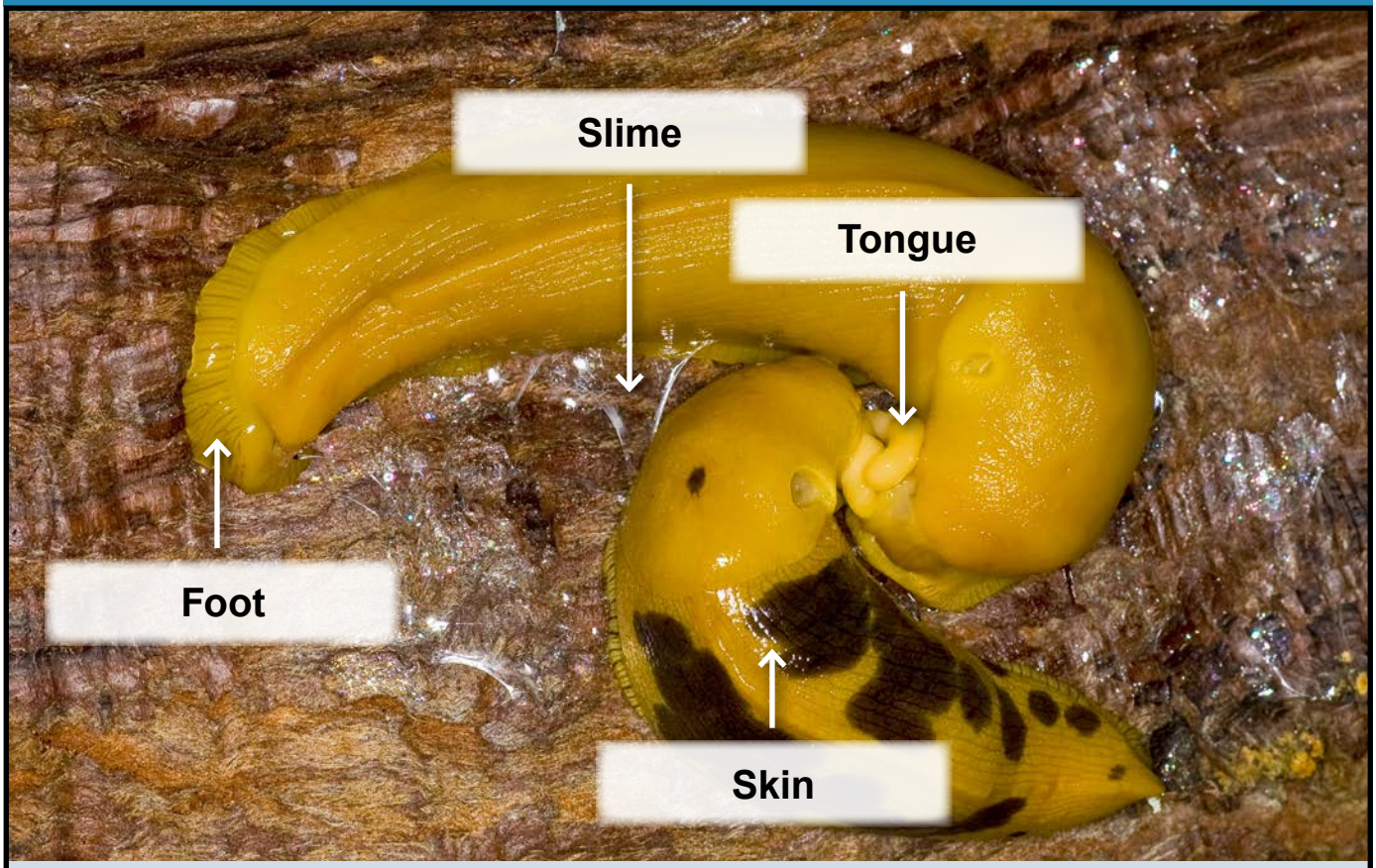
Cheeks: In fur-lined pouches in its cheeks, the kangaroo rat can carry seeds to its burrow. Food helps the animal survive, grow, and reproduce.

Feet: Using its large back feet with hairy soles, the kangaroo rat can jump 9 feet or kick sand in predators' faces. Short front feet dig a burrow, where this animal stays safe and cool. The kangaroo rat's feet help the animal survive.

Nose: As the kangaroo rat breathes out, its nose pulls water from the air. Keeping more water in its body helps the animal survive.

Tail: A long tail helps the kangaroo rat balance as it hops away from predators to survive.

VA #23 Banana Slug Animal Structures: Page 1



Banana slugs are small next to giant coast redwoods, but the slugs play a big part in north coastal forests. Their tongues with “teeth” help break down fallen redwoods, putting nutrients back into the soil. The slug uses its “foot” to move and secretes slime to slide along the forest floor. The slime also helps the slug avoid being eaten. The slug’s skin gets water from the foggy ocean air and the rich, moist soil in this environment, enabling the animal to survive.

VA #24 Banana Slug Animal Structures: Page 2

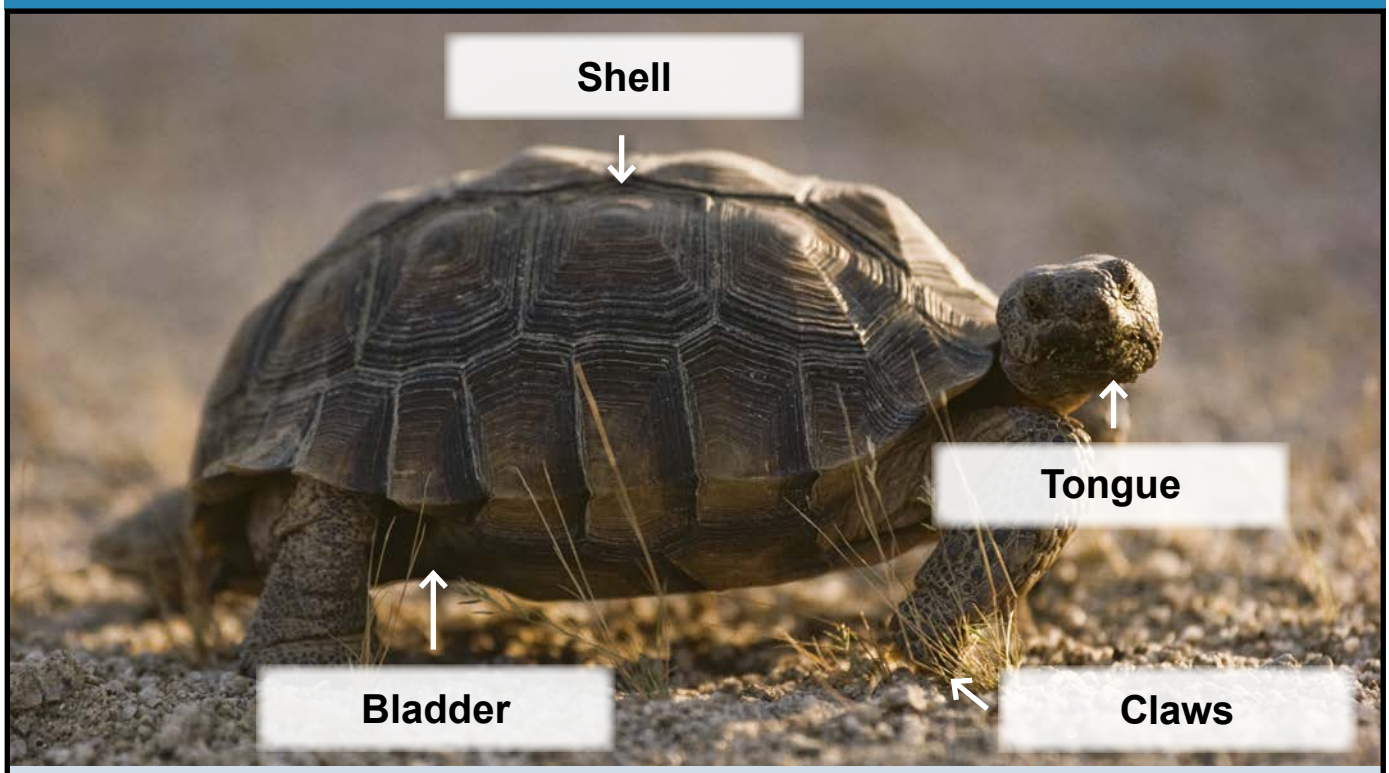
Foot: Like other snails, the banana slug uses its “foot” to move. The animal has to move to find dead plants and animals to eat, so the foot helps a slug survive.

Skin: The banana slug breathes through its moist skin. Slime on the skin pulls moisture out of the air or soil so that the slug can survive.

Slime: Slime drives away animals that do not like the way it feels. It also makes it easier for the slug to move. This helps the banana slug avoid being eaten so that it can survive.

Tongue: Rows of sharp “teeth” grind up food—dead plants. This helps the banana slug survive and grow until it can reproduce.

VA #25 Desert Tortoise Animal Structures: Page 1



The desert tortoise survives summer heat of 120° F (49° C) and winter cold and snow in the high desert by using thick claws to burrow underground. After spring rains, the tortoise's large tongue pushes plants that store water in their leaves and flowers into the animal's toothless mouth. Since the desert may get only four inches of rain a year, the tortoise's bladder stores all the water it drinks and gets from eating plants. The tortoise must survive and grow for 15 to 20 years before it is big enough to reproduce. The animal can live as long as 50 to 80 years.

VA #26 Desert Tortoise Animal Structures: Page 2

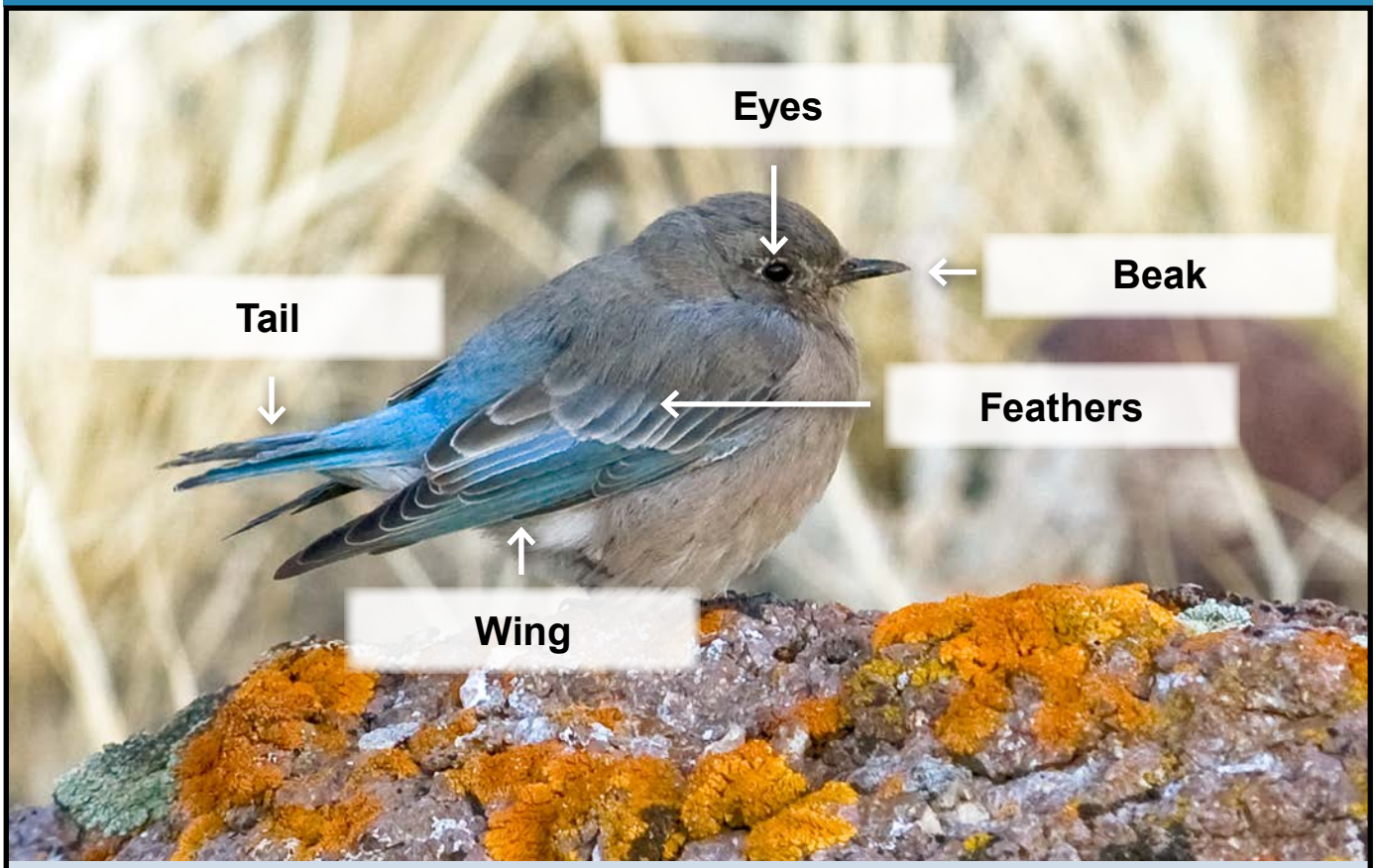
Tongue: A large tongue pushes grass and cactus fruit into the animal's mouth. This food helps the tortoise survive and grow.

Bladder: A big bladder stores about one quart of water. This lets the tortoise survive long periods without rain. If the tortoise in frightened, in defense it can release all its stored water.

Claws: Thick claws at the end of strong legs help a tortoise dig a burrow. There, it can stay cool and survive the high heat of summer.

Shell: Bony plates make a dome under which the tortoise can pull its head, tail, and legs. The shell is like a dome. It protects the soft parts of the body.

VA #27 Mountain Bluebird Animal Structures: Page 1



To survive and grow, the mountain bluebird can find plenty to eat, using its beak to pluck acorns and berries from the black oak trees and shrubs in the mixed evergreen and conifer forest. The bird uses its long wings and sharp eyes to hover in the air and snatch insects. The trees are also very important in helping them avoid predators. To reproduce, females look for grasses, pine needles, fur, and feathers to build nests in dead treetops and holes in trees.

VA #28 Mountain Bluebird Animal Structures: Page 2

Beak: The mountain bluebird's narrow beak can pluck berries. It can also snap up insects. Eating these foods helps the bird survive and grow.

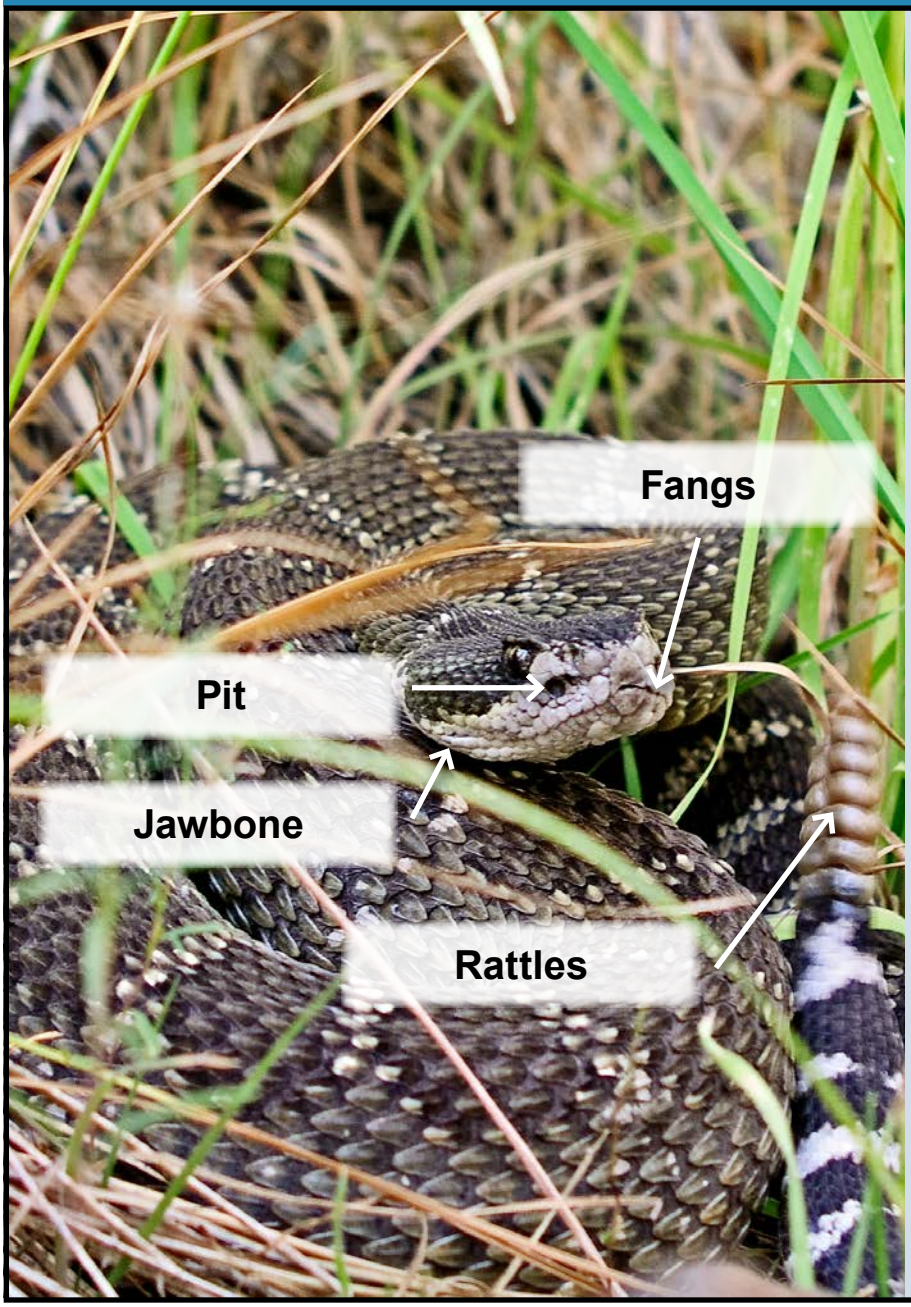
Eyes: The mountain bluebird has sharp eyesight. Because it can spot far-off prey and predators, the animal is better able to survive.

Feathers: The male's bright blue feathers can attract a mate for reproduction. Babies have spotted feathers for camouflage to help them survive.

Tail: The tail helps birds balance while in flight or sitting on a branch.

Wings: With its long wings, the mountain bluebird can hover in the air to catch insects. The ability to catch food helps the bluebird survive.

VA #29 Pacific Rattlesnake Animal Structures: Page 1



Pacific rattlesnakes live under the plants of the chaparral. Pits on the sides of the snake's head help them sense the need to move into the cool shade to survive dry, hot summers. The heat-sensing pits also help the snakes find animals, such as mice and pocket gophers, to eat. Rattlesnakes use fangs to stun their prey. With jaws that let them eat bigger animals, females fatten up so that they can stay in their dens until their babies are born.

VA #30 Pacific Rattlesnake Animal Structures: Page 2

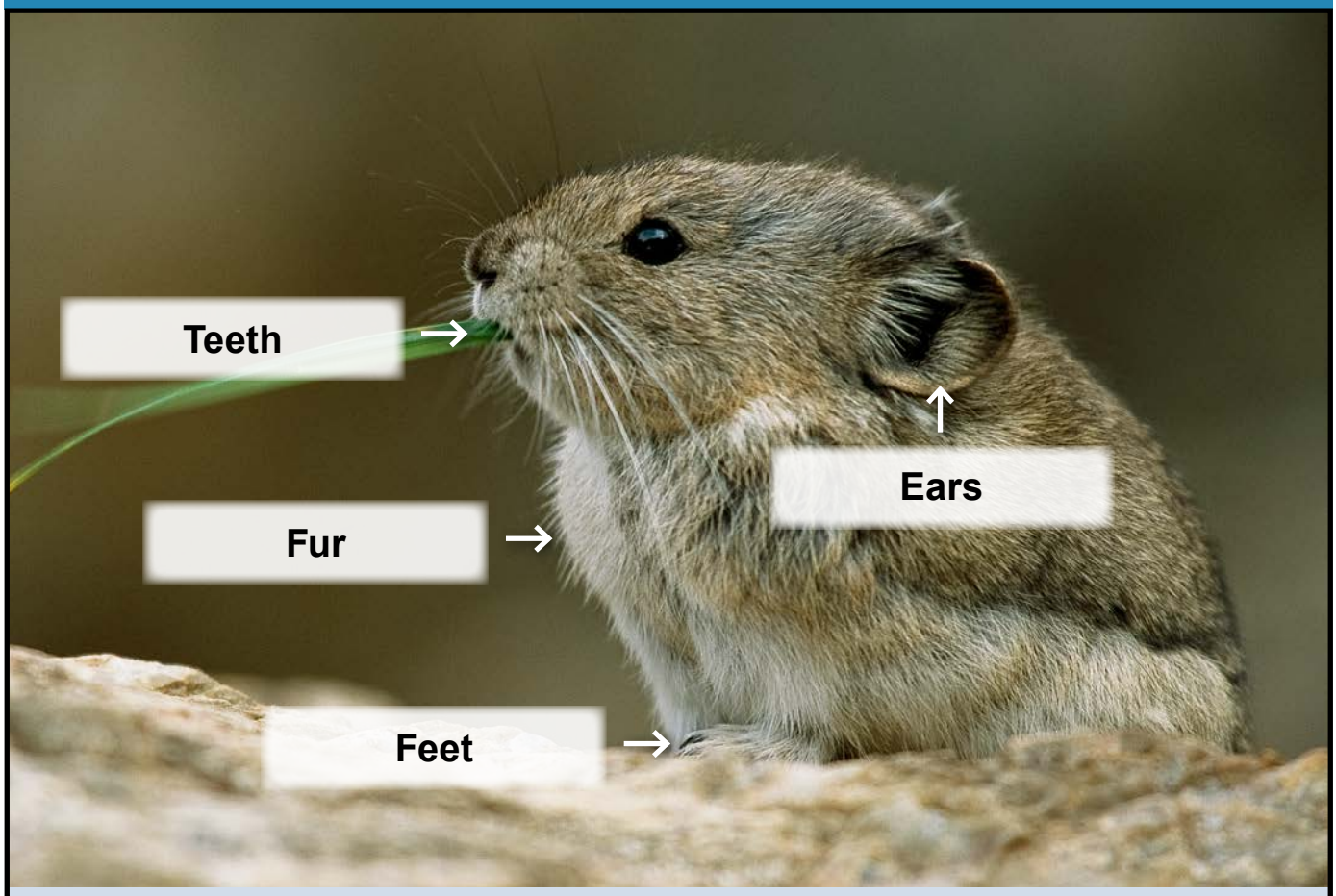
Fangs: Long fangs inject poison into prey. Once the prey stops moving, the Pacific rattlesnake can eat it. With food, the snake can survive, grow, and reproduce.

Jawbone: The snake's jawbone can stretch like a rubber band. It lets the snake eat bigger animals, such as rabbits. This helps females fatten up for a year without eating while they reproduce.

Pits: Pits on both sides of the head sense heat. Pits tell the snake to move into shade to cool off. When the Pacific rattlesnake hunts at night, it uses its heat-sensing pits to find prey. Finding food helps the snake survive and grow.

Rattles: When the Pacific rattlesnake shakes its tail, the rattles scare off predators, helping the snake survive.

VA #31 Pika Animal Structures: Page 1



The pika looks like a short-eared rabbit because it is in the family that includes rabbits. The pika piles wildflowers and grass from alpine meadows among rocks to dry. The animal eats this stored food to survive the cold winter. Under the snow, the pika also scrapes lichen off rocks to eat. The animal's thick fur is so warm that the pika does not have to hibernate.

VA #32 Pika Animal Structures: Page 2

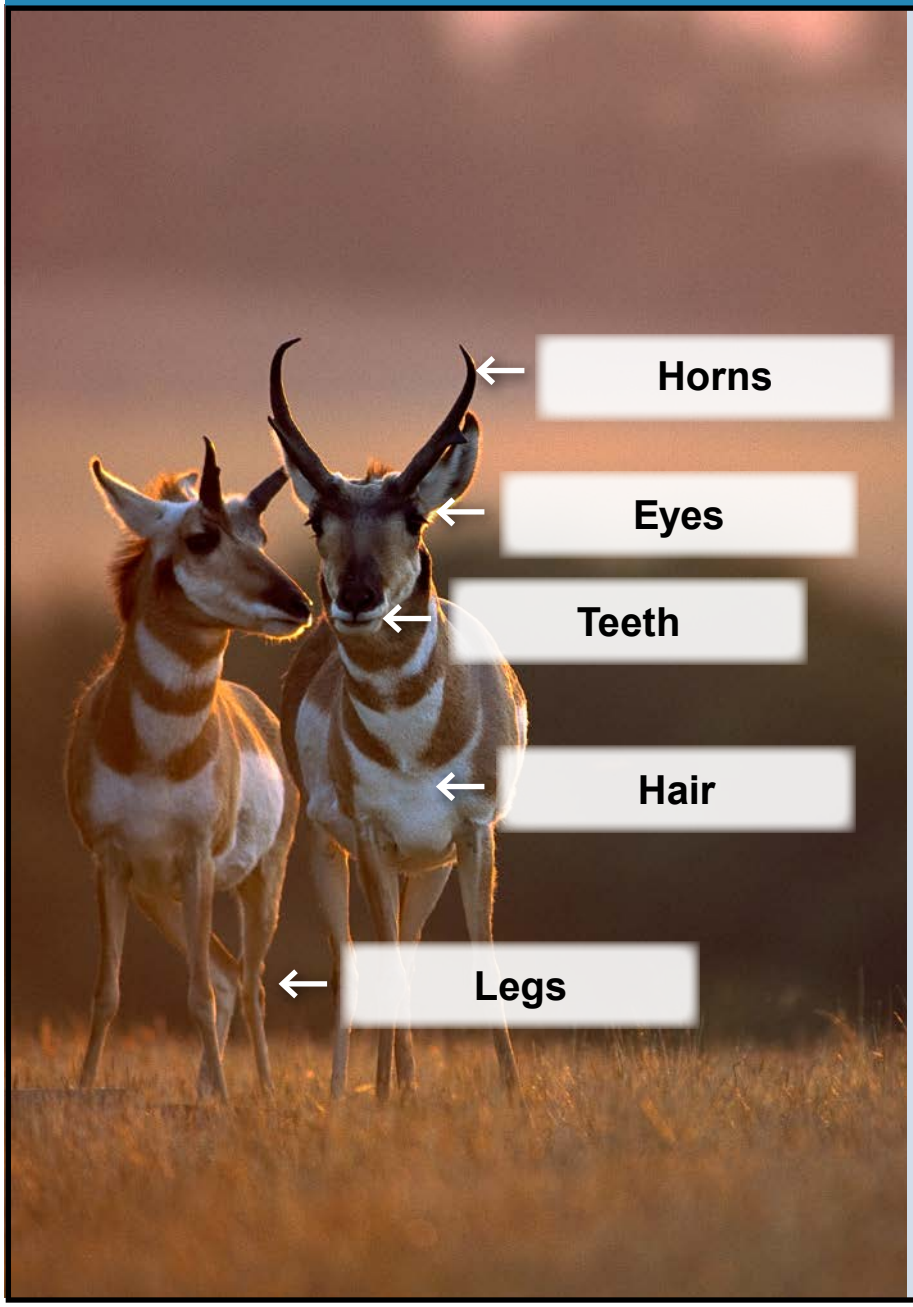
Ears: Rounded ears help the pika hear well. It can hear predators and other pikas' warning cries. This helps the animal survive.

Feet: A pika can run among rocks without slipping. This ability helps the pika escape predators and survive.

Fur: Several layers of thick fur keep the pika's body warm, helping the animal survive cold mountain winters.

Teeth: With its strong front teeth, the pika cuts down wildflowers. It carries them in its mouth to stack and dry. This food helps the pika survive and grow until it can reproduce.

VA #33 Pronghorn Antelope Animal Structures: Page 1



Pronghorns' structures for raising and lowering their hair help them survive the sagebrush scrub's very hot summers and very cold winters. Their teeth can cut and eat sagebrush, the only plant that sticks out above winter snow. Sagebrush gives year-round food to help pronghorns survive and grow. Adult males use their horns to fight each other for a mate so that they can reproduce. Eyes can spot predators while the animal is grazing, and long, strong legs let the pronghorn outrun all predators, making this animal a survivor.

VA #34 Pronghorn Antelope Animal Structures: Page 2

Eyes: Large eyes are set back in the head, so the pronghorn antelope can spot predators while grazing. This helps it survive.

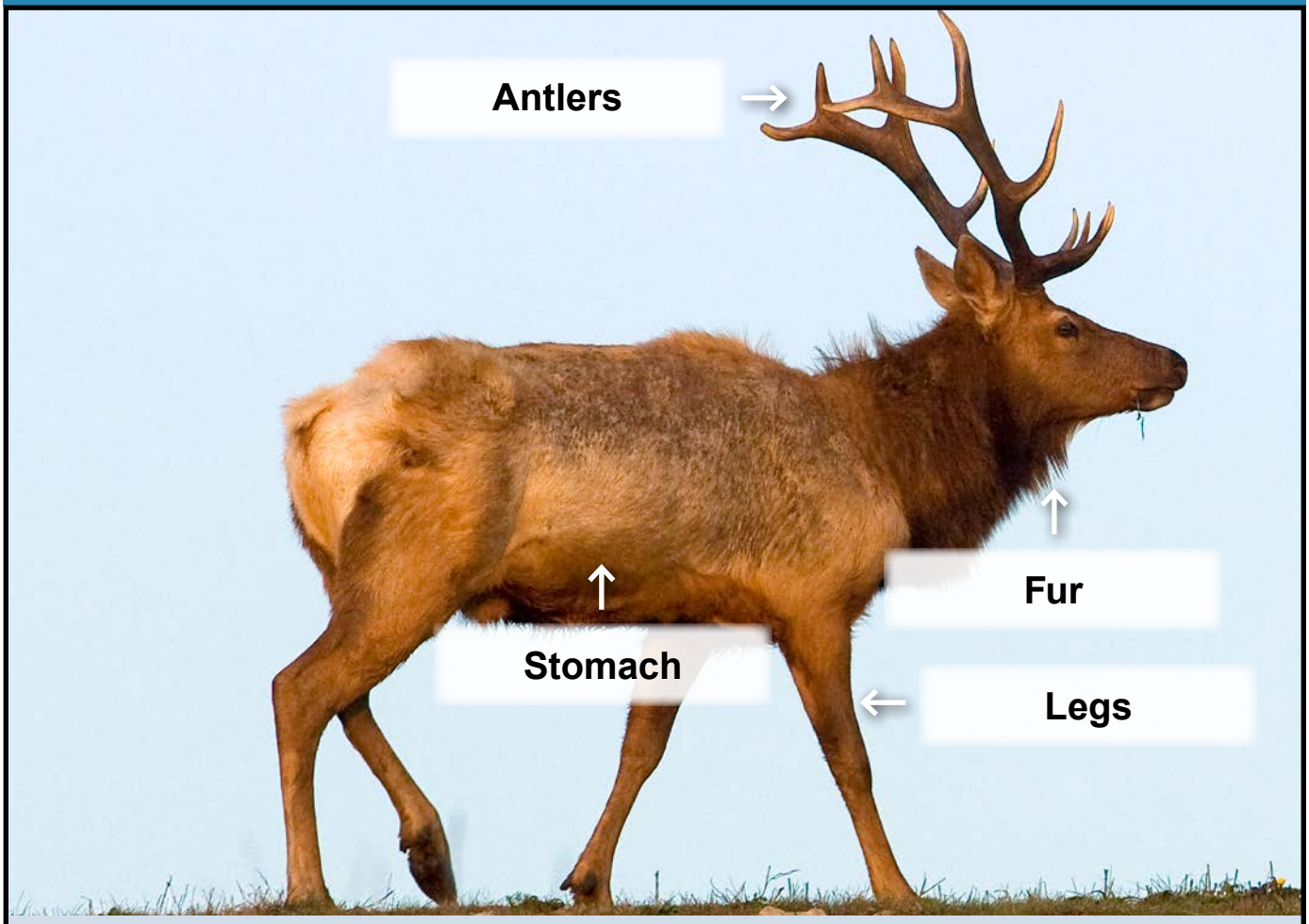
Hair: Special muscles let pronghorns raise hair to cool off during hot summer and to warn others of danger. They can also lower hair to keep warm in cold winters. This helps them survive.

Horns: Males' horns are bigger than females' horns. Males sometimes use their horns to fight for a mate, so the structures are useful in reproduction.

Legs: With its long, strong legs, the pronghorn antelope can run 60 miles per hour. It can run for a long time, too. Its legs enable the animal to outrun predators and survive.

Teeth: Sharp cutting teeth break off sagebrush, grasses, and even cacti. Large, flat teeth grind up the plants. They help the pronghorn antelope get food to grow and survive.

VA #35 Tule Elk Animal Structures: Page 1



Since there is little rain in the grasslands, there may be few water holes and clumps of grass. Tule elks' strong legs help them travel distances to find water and food to survive and grow. The elks' legs also help the animals run and kick to survive predators' attacks. Older males with bigger antlers have a better chance of reproducing.

VA #36 Tule Elk Animal Structures: Page 2

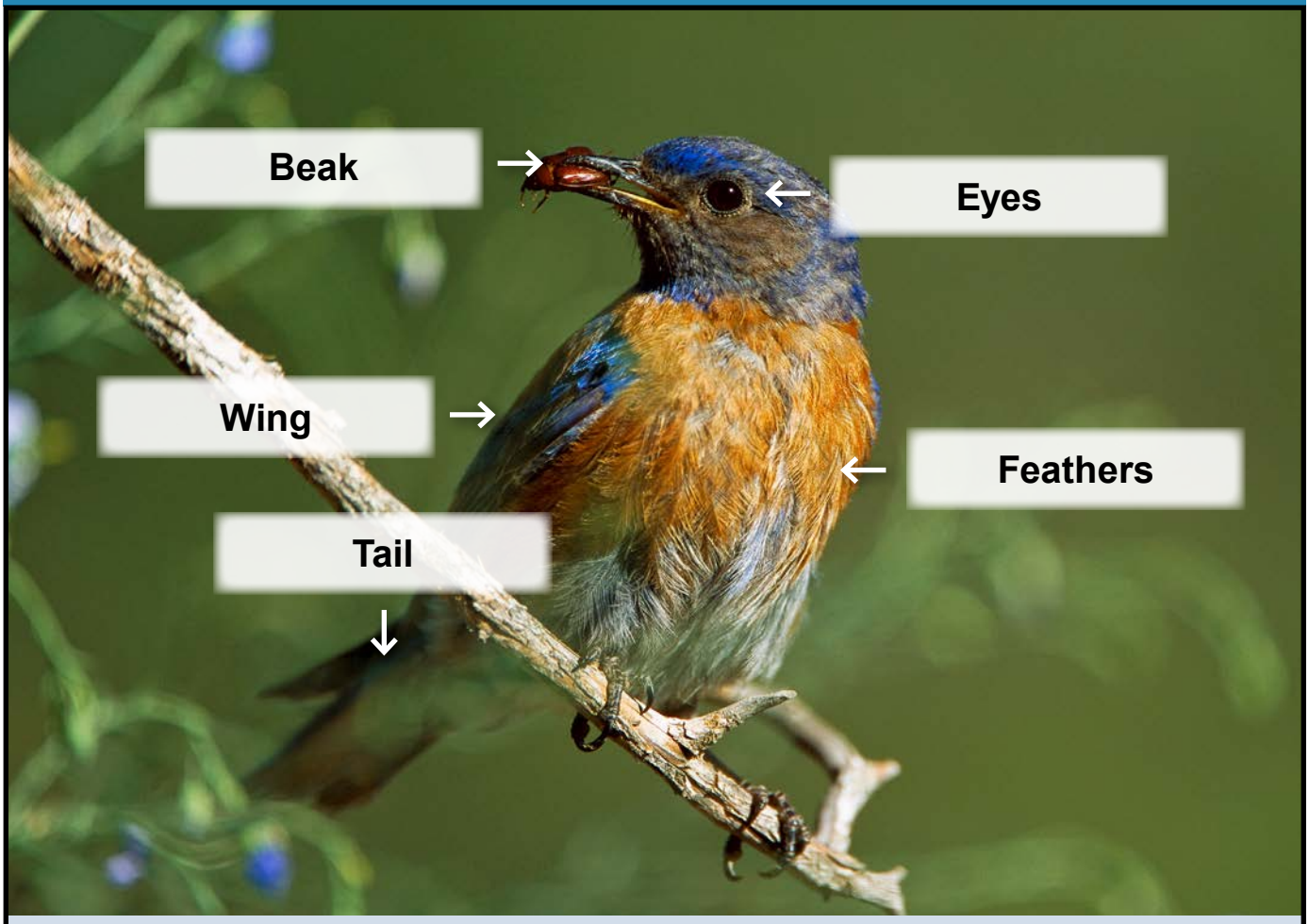
Antlers: Males grow new, bigger antlers each year. They use them to fight for mates and reproduce.

Fur: Winter coats have warm, wooly fur underneath and waterproof hairs on top. This helps tule elk survive the cold fogs of winter.

Legs: On long, strong legs, a tule elk can travel to water holes to drink. It can run away from predators, too. Sharp hooves can kill predators, such as coyotes, with one kick. The tule elk's strong legs help it survive.

Stomach: The four-part stomach allows for more chewing steps to break down tough grasses. This helps the tule elk get the most nutrients for growth.

VA #37 Western Bluebird Animal Structures: Page 1



To survive and grow, the western bluebird finds food on the trees and shrubs in the oak woodlands. The bird uses its long wings and sharp eyes as it hovers in the air and snatches insects. To reproduce, females look for grasses, moss, fur, and feathers to build nests in dead treetops and holes in trees.

VA #38 Western Bluebird Animal Structures: Page 2

Beak: The western bluebird's narrow beak can pick berries. It can also snap up insects. Eating these foods helps the bird survive and grow.

Eyes: The western bluebird has sharp eyesight. It can spot a caterpillar to eat in long grass 50 yards away. Good eyesight helps the bird find food and helps its young eat and survive.

Feathers: The male's bright blue and red feathers help attract a mate so that the birds can reproduce. Babies have spotted feathers for camouflage, helping them survive.

Tail: The tail is short. The tail helps birds balance while in flight or sitting on a branch.

Wings: Wings are long. The western bluebird can hover in the air to catch insects to eat so that it can grow and survive.

VA #39 Greetings from the Low Desert

Instructions: Write a postcard to a friend to tell about the kangaroo rat.

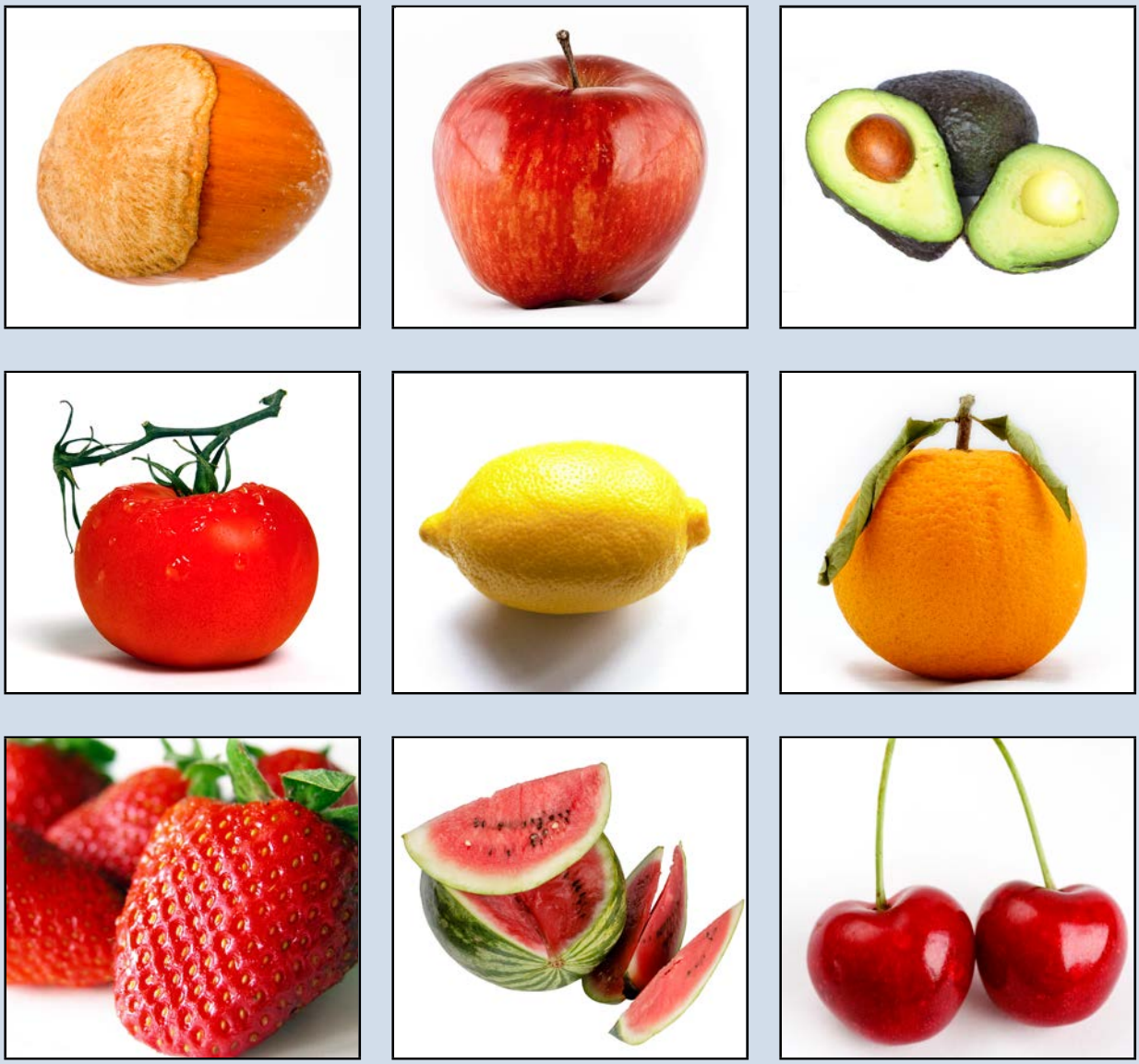
Front of Postcard
Label the structures of the Merriam's kangaroo rat.

Back of Postcard
On the back of the postcard, write a letter telling how one of the kangaroo rat's structures helps it survive, grow, or reproduce in a healthy low desert ecosystem.

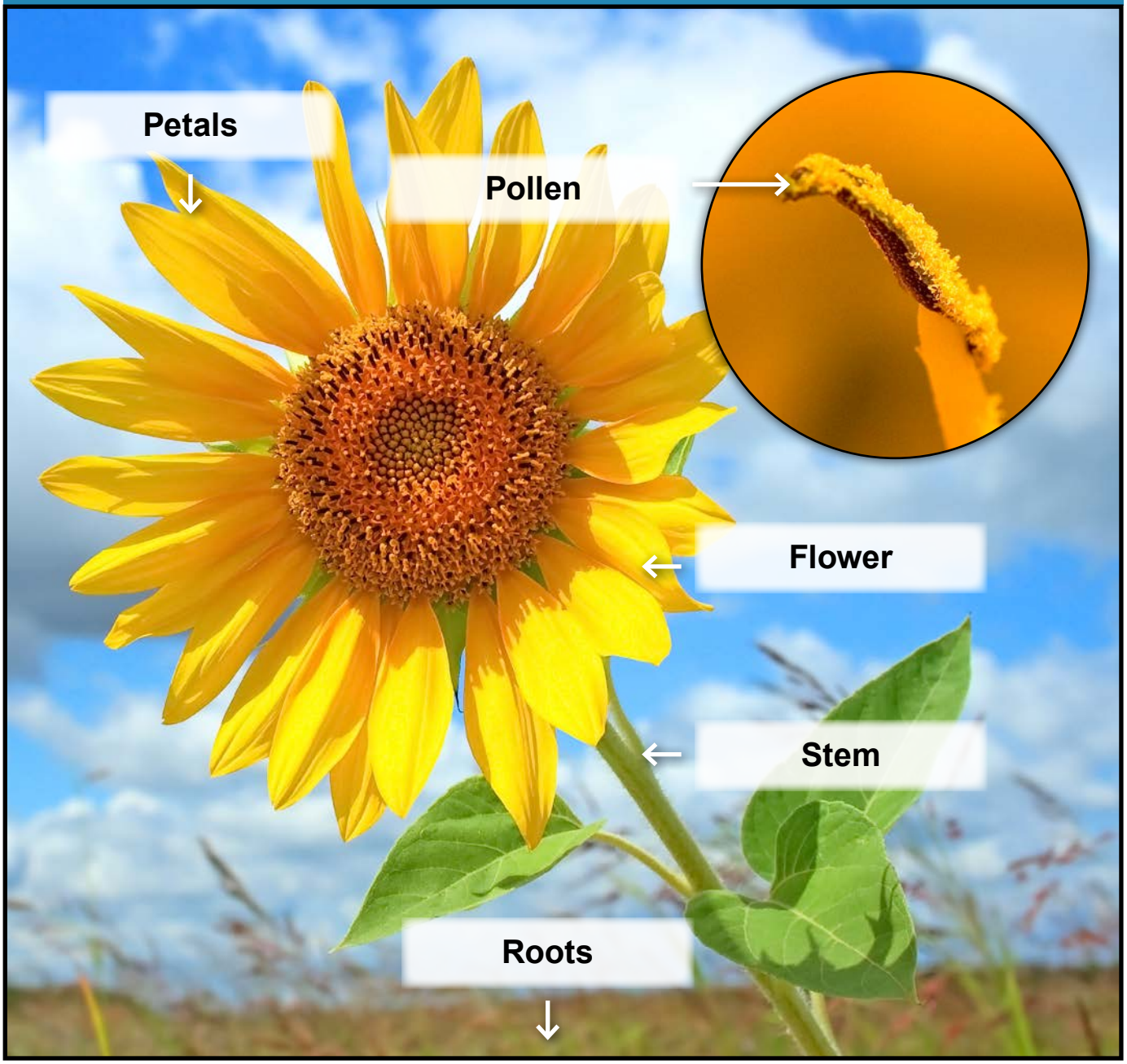
Your postcard should include:

- Date
- Salutation (For example: Dear Evan,)
- Message about one kangaroo rat structure
- Closing (For example: Sincerely, or Your friend,)
- Signature
- Recipient's Address

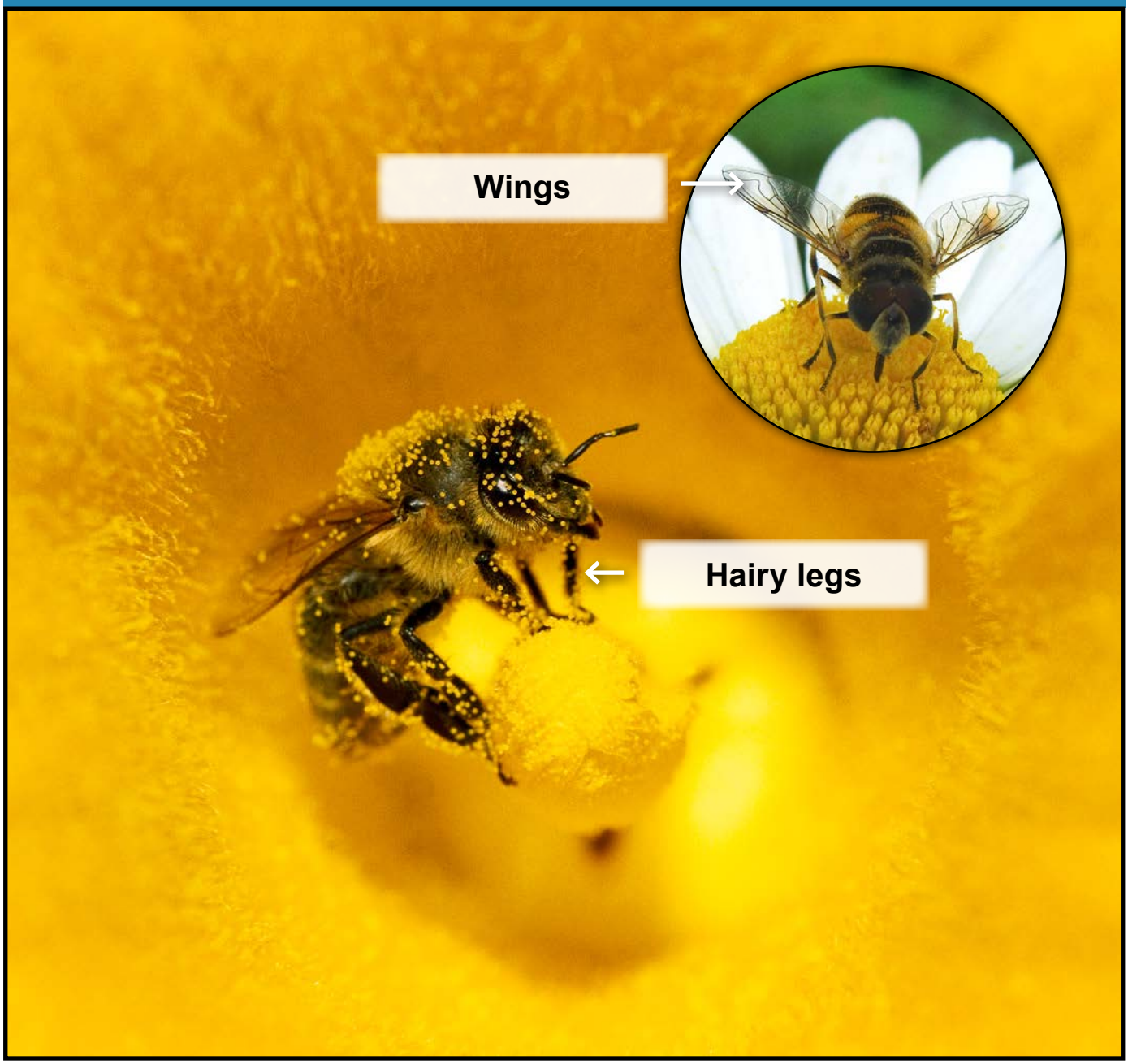
VA #40 What Do These Have in Common?



VA #41 Pollen



VA #42 Bees



VA #43 Animals Helping Plants

VA #44 What Anna's Hummingbirds Need: Page 1

Anna's Hummingbirds

- They live in many places in California.
- They are the largest resident hummingbirds in our state.
- They stay here all year.
- They need many things to grow, reproduce, and survive.

To Grow:

- They need lots of nectar from flowers.
- They like flowers that are brightly colored red and orange.
- They like flowers that are shaped like a tube.
- They need nectar year-round.
- They also eat insects and spiders.
- They need water to drink.

VA #45 What Anna's Hummingbirds Need: Page 2

To Survive:

- They need to wash sticky nectar off their wings. If nectar stays on their feathers, the feathers may fall off.
- They need their water and shelter to be off the ground. This protects them from animals, such as cats.
- They need trees or bushes to perch in. They use trees or bushes for shelter when the weather is bad.
- Pesticides on plants will kill insects, which the birds need for food.

To Reproduce:

- They need to make nests in trees or bushes.
- They need materials, such as leaves, spider webs, and moss to make their nests.

California Education and the Environment Initiative

33aVA

Printed on post-consumer recycled paper