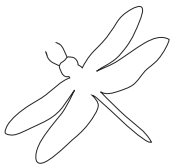
Chapter 1. GREEN SUN MACHINES & CREEPY CRAWLY THINGS



Welcome to the Cheadle Center for Biodiversity and Ecological Restoration!

This is the home of Kids in Nature (KIN) and we help to take care of the environment for students of all ages - and that includes you. This is the 14th year of KIN.
We hope you're ready to explore and have fun!
Today we're going to learn about flower and insect structure; different types of flowers and their pollinators; and seeds and seed dispersal mechanisms. We're also going to learn how to use some equipment that will help us explore all of these topics.

Focus Questions

Why do some plants produce flowers?

What is a pollinator?

What equipment do you think will be useful on your journey of exploration?

Challenge Words

Listen for these words during your visit. If you hear them and know the definition, be sure to tell us.

An **exoskeleton** is the hard outer structure, such as the shell of an insect or crustacean, that provides protection or support.

Photosynthesis is the process by which plants use carbon dioxide, water and light energy from the sun and convert it into sugar and oxygen. Photosynthesis takes place in plant cells inside of special organelles called chloroplasts.

Something that is **symmetrical** is the same on opposite sides of a dividing line; having two identical halves.

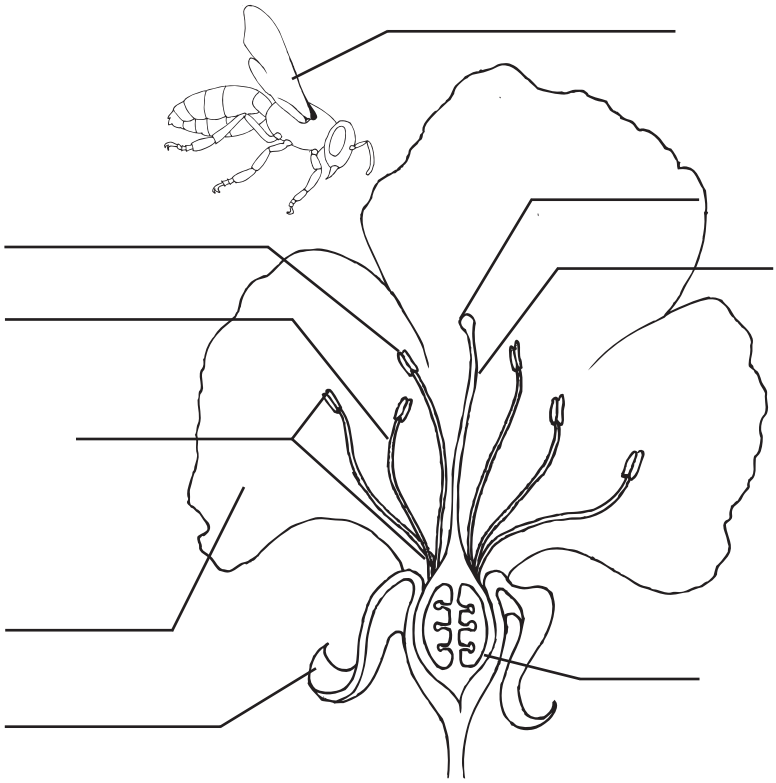
FLOWER POWER

LEARNING ABOUT FLOWER PARTS

1. Label the picture below using the word bank.

WORD BANK

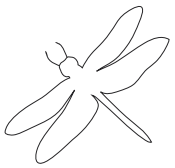
Ovary: contains egg cells
Filament: supports anther
Anther: makes pollen
Stigma: sticky on top to trap pollen
Style: pollen travels through this structure to reach the ovary
Pollinator: an organism that brings pollen to the flower
Petal: often brightly colored to attract pollinators
Sepal: surround and protect the flower bud
Stamen: filament and anther



2. Choose one of the flowers on the table - draw, label and color your flower (make sure your flower fills the space below).

FLOWER POWER

LEARNING ABOUT FLOWER PARTS



3. Why are flowers different shapes, sizes and colors? Circle one.

a. So that they can look nice in a vase
b. So that they can attract pollinators
c. So that they look good in our gardens

4. Look at the flowers on the table. How many are symmetrical?

_____

5. Why do some plants produce pollen?

_____

_____

_____

6. Why do some plants produce nectar?

_____

_____

_____

7. Choose 2 flowers. What flowers do you have?

a. _____

b. _____

8. Measure the flower size in centimeters. Use the ruler on the back cover of the journal.

a. _____cm

b. _____cm

9. Measure the length of the stamens and record the measurements below.

a. _____cm

b. _____cm

PLANT POLLINATORS

FUN FACTS

Little darling
The honey possum from Australia has grasping feet and a prehensile tail (a tail that can grip). This combination allows it to easily hang from branches. While hanging upside down, it searches for flowers and uses its extremely long tongue to drink nectar from the flower. The possum's face gets dusted with pollen while it's eating and the pollen is brushed off on the next flower it visits. In this way, the honey possum is both a unique animal and an excellent pollinator.

An unusually large pollinator
The black and white ruffed lemur lives on the island of Madagascar and is the main pollinator for a tree called the traveler's palm. The lemur uses its hands to pull the flowers apart as it searches for nectar. Pollen is transported to the next traveler's palm tree flower on the snout of the lemur. Lemur means ghost in Latin. What do the people of Madagascar think about lemurs?

As light as a penny
Hummingbirds have good eyes and a poor sense of smell. They are attracted to bright red, yellow and orange flowers with little or no odor. Hummingbirds weigh a little more than a penny. Their hearts beat 1,200 times each minute and their wings beat 70 times each second, which means they have to eat several times their body weight everyday to have enough energy to survive.

PLANT POLLINATORS

FUN FACTS

Not so scary
Bats are very important pollinators. They visit large, pale flowers, with a strong fruity fragrance that open at night. Three hundred species of fruit depend on bats for pollination, including mangos, bananas and guavas.

Sweet and spicy
Difficult to believe, but beetles pollinate 88% of flowering plants worldwide. They have a great sense of smell and are attracted to flowers with sweet, spicy and fermented smells.

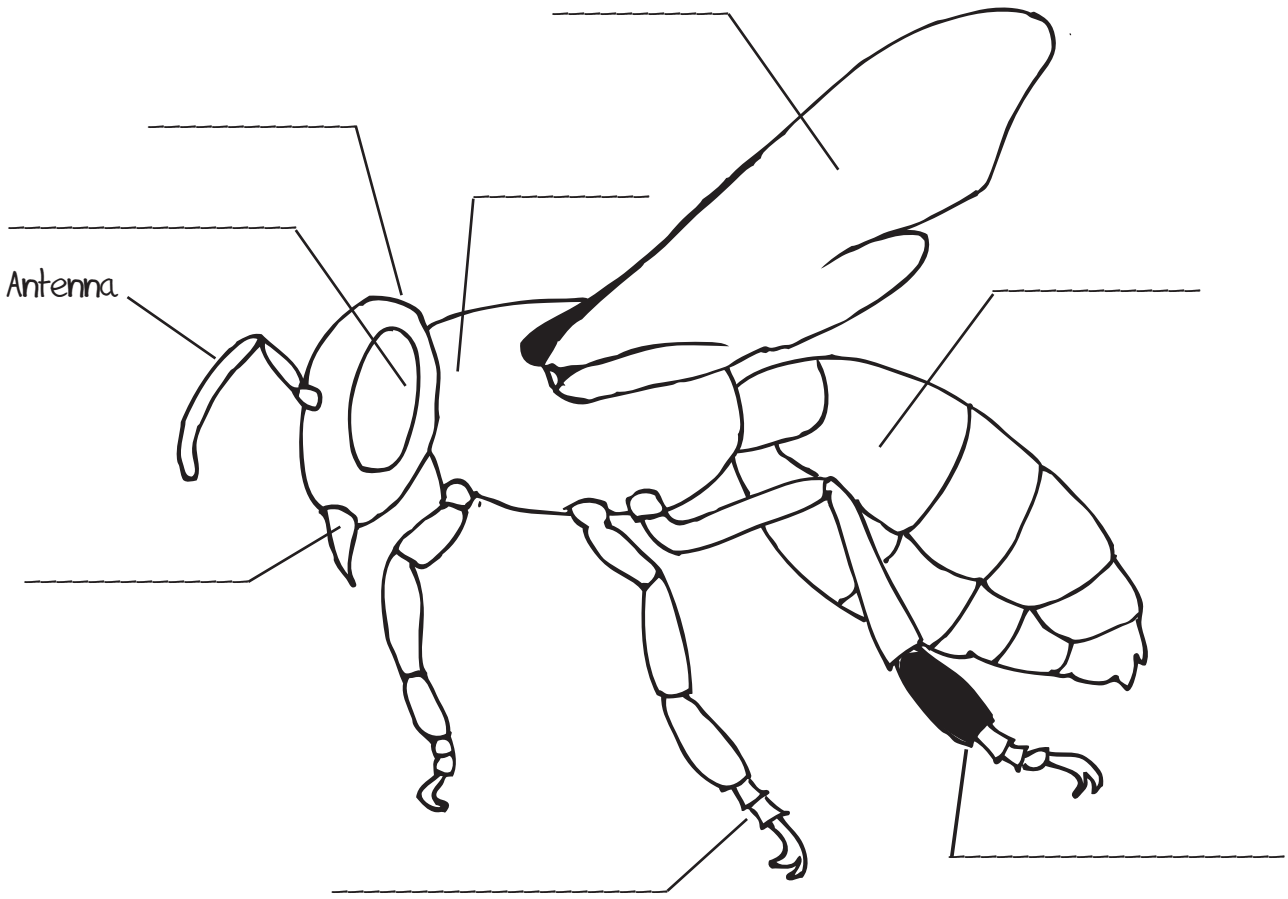
Stinky flowers
Some pollinators like the carrion-eating beetle and flesh flies are attracted to flowers that have an unusual perfume. Carrion flowers like the *Amorphophalus titanum* smell like decaying meat.

Humble honey bee
Although native to Europe, the honey bee is responsible for pollinating crops all over the world. Approximately a third of human food production depends on insect pollination and most of this is done by the humble honey bee.

AMAZING INSECTS

INSECT ANATOMY

Label the parts of the bee using the word bank.

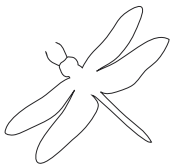


WORD BANK

Antenna: used for feeling, hearing and smelling
Head: first section of body
Thorax: middle section of body
Compound eye: an eye made up of lots of small simple eyes
Jointed legs: made up of 5 different parts
Wings: enable insect to fly
Abdomen: rear section of insect body
Proboscis: used for feeding
Exoskeleton: protective covering
Pollen basket: holds pollen

AMAZING INSECTS

INSECT ANATOMY



1. How many pairs of legs do insects have? _____

2. List the three main body sections.
a.
b.
c.

3. Which is the largest group of insects - beetles, butterflies, flies or ants?

4. Is this an insect? a. Yes b. No

5. Why are insects important?

6. In the space below, draw, color and label your own insect – make sure it has:

a. Three body sections (head, thorax and abdomen)

b. Six jointed legs

c. Two antennae

d. Compound eyes

e. Wings are optional

AMAZING INSECTS

FUN FACTS

Flying First
When the dinosaurs were alive 300 million years ago and before birds could fly, insects developed wings and dragonflies with huge wings (3 ft across) took to the skies.

It's Chilly!
Since insects are ectotherms (get heat from their surroundings), they often need to raise their body temperature before they can fly. To do this, they shiver, similar to the way you and I would shiver on a chilly day.

Tasty Toes
Most butterflies have taste buds on their feet. Butterflies can be found on every continent except Antarctica.

Awesome Antennae
Insects don't have noses and instead use feathery feelers or awesome antennae to smell. The male silkworm moth can smell a female moth 2.5 miles away.

It's Dark in Here
Some cave dwelling crickets use their extraordinarily long feelers – five times the length of their bodies to find food, water and sometimes each other.

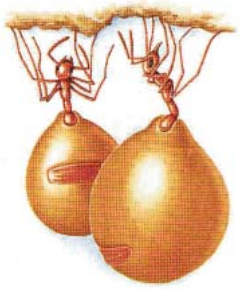
Illustrations by Mark Iley, Julie Anderson and John Hutchinson, Eye Witness Juniors, Amazing Insects

AMAZING INSECTS

WHAT'S ON THE MENU?

Different insects like to eat different things:
Leaves, hair, wood, blood, fruit, dung, pollen, nectar…. Mmmmmm!

Dung beetles lay their eggs in a ball of poop and when the eggs hatch, the larvae have yummy dung for their first meal.



Honeypot ants are like living pantries. They store food in their abdomens and feed other ants in the colony when food is scarce. Sometimes their bellies get so full they can no longer move around and must hang from the roof of the nest.

Butterflies and moths have feeding tubes (proboscis) like straws that they use to drink nectar. When not in use, the proboscis is coiled under their heads.

I Taste Yucky!
Some insects disguise themselves so that they don't get eaten. Other insects use bright coloring to warn potential predators. Don't Eat Me!

Stinkbugs have bright red spots to warn predators that they taste really bad and if an enemy comes too close, the stinkbug releases a stinky smell that will take the enemy's appetite away.

Illustrations by Mark Iley, Julie Anderson and John Hutchinson, Eye Witness Juniors, Amazing Insects

SEEDS AND SEED DISPERSAL

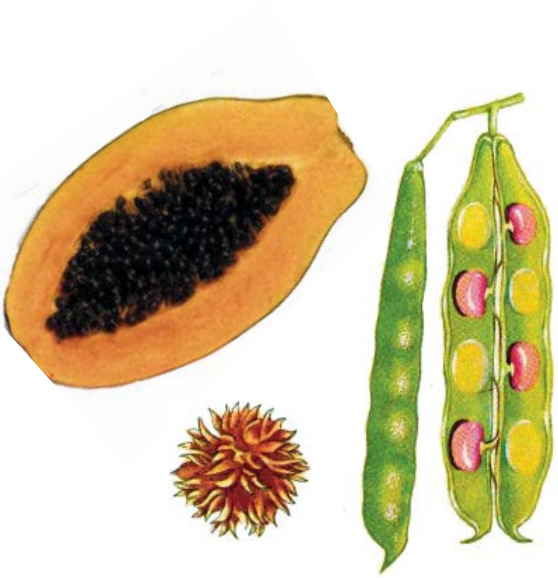
HOW & WHY SEEDS TRAVEL

1. Why do some plants produce seeds?

_____

_____

_____



2. Name any 3 methods of seed dispersal.

_____

_____

_____

3. Imagine you are a seed that is dispersed by a monkey. Describe what kind of seed you would be? OR Describe and draw a seed that may be dispersed by water.

_____

_____

_____

_____

4. If you were a plant that used wind to disperse your seeds, do you think it would help if you were tall or short? Explain why?

_____

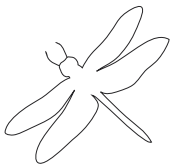
_____

_____

_____

SEEDS AND SEED DISPERSAL

HOW & WHY SEEDS TRAVEL



5. Why is it important for plants to disperse their seeds?

_____

_____

_____

_____

6. Try to find out why fire is important to some plants and more importantly to the seeds they produce. (Here's a hint- pine trees)

_____

_____

_____

_____

7. Look at some of the foods you eat at home and see if you can find the seeds, ex. watermelon, cucumber, oranges, grapes, squash, beans, tomatoes etc.

EQUIPMENT DISCOVERY

GETTING READY FOR YOUR JOURNEY

Dominant Eye

- Hold your arms out in front of you.
- Make a triangle by overlapping the space between index finger and thumb with the same space on your opposite hand.

- Look at an object through the triangular opening made by your hands.
- Focus on the object, not your hands.
- Now close one of your eyes. If you still see the object with your left eye open, you are left eye dominant. If you still see the object with your right eye open, you are right eye dominant.
- Why might it be important to know which eye is dominant? Certain sports and activities such as archery, darts, photography and bird watching require accurate aim.

Binoculars

1. Label the parts on the binoculars.

WORD BANK

Eyecup
Adjustment ring
Lens barrel
Objective lens
Eyepiece lens
Focusing ring

EQUIPMENT DISCOVERY

GETTING READY FOR YOUR JOURNEY

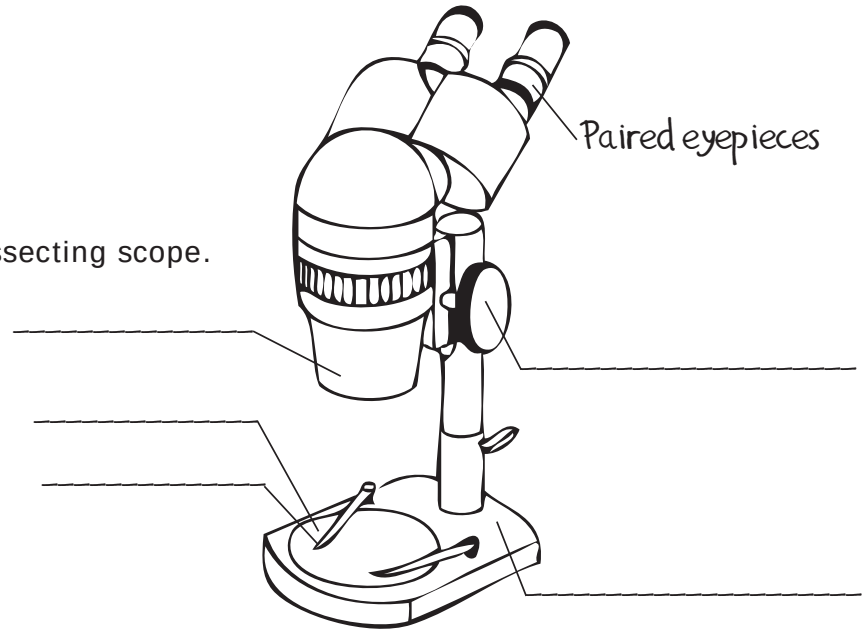
Hand Lens

1. Which eye is your dominant eye? _____

2. How many different ways can you use a hand lens? _____

Dissecting Microscope

1. Label the parts of the dissecting scope.



WORD BANK

Objective
Stage
Paired eyepieces
Focus wheel
Foot and stand
Clip

2. Where should you place an object to be viewed? _____

3. To see fine detail on an object what do you need to adjust?_____

4. If no natural light is available, what would you need to use in order to view an object under the dissecting microscope? _____

THE METRIC SYSTEM

GETTING READY FOR YOUR JOURNEY

The **Metric System** is a standardized system of measurement used by **scientists world-wide**. It was introduced into the United States in 1866. The units of measure with which you will need to become familiar are listed below:

mm = millimeter (about the thickness of a dime)
cm = centimeter (about the width of your fingernail)
m = meter (about the height of your teacher's desk)
km = kilometer (there are about 8 city blocks in a kilometer)

The **Imperial Measurement System** was introduced in 1824 and was used throughout the world. By the late 1900's, many countries had moved away from this method of measurement and had adopted the **Metric System**. However, in the United States, we use both systems of measure. Many trades people such as **carpenters, bricklayers and mehanics** use the imperial system. Below are some of the units of measure with which you will need to be familiar:

in (") = inch (slightly larger than the diameter of a quarter)
ft (') = foot (the size of a standard 12 inch ruler)
yd = yard (about the height of a door handle when measured from the bottom of the door)
mi = mile (almost 12 city blocks)

Converting Measurements

Metric		Imperial
1 millimeter (mm)		0.03937 in
1 centimeter (cm)	10 mm	0.3937 in
1 meter (m)	100 cm	1.0936 yd
1 kilometre (km)	1000 m	0.6214 mile

Imperial		Metric
1 inch (in)		2.54 cm
1 foot (ft)	12 in	0.3048 m
1 yard (yd)	3 ft	0.9144 m
1 mile	1760 yd	1.853 km

THE METRIC SYSTEM

GETTING READY FOR YOUR JOURNEY

Let's do some measuring...

How tall are you? Measure your height in inches. _____ in

Now convert that to centimeters. _____ in x 2.54 = _____ cm

Measure your index finger in centimeters. _____ cm

Now convert that to inches. _____ cm ÷ 2.54 = _____ in

Measure the length of your pencil in inches. _____ in

Now convert that to centimeters. _____ in x 2.54 = _____ cm

Measure the thickness of a quarter in millimeters. _____ mm

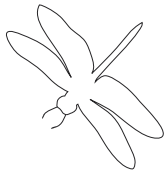
Now convert that to centimeters. _____ mm ÷ 10 = _____ cm

What did you see?

What did you learn?

What did you do?

What did you hear?



Chapter 2. My Garden Notebook

Shoots, Stems and Leaves

Why are plants important?
There are over 300,000 different plant species on earth. Plants are unique because they produce their own food. Do you know how they do that?
Plants use energy from the sun to produce sugar by a process called **photosynthesis.** Plants produce much of the oxygen in the air around us and without oxygen, humans and other animals would not survive. Humans and other animals depend on plants for so many different reasons. How did you use plants today? Think about the different ways and list them below.

1. _____ 2. _____ 3. _____

Focus Questions

What do plants need to grow?

How do humans use plants?

How do plants change with the seasons?

What parts of the plant are underground?

Challenge Words

Listen for these words during your visit. If you hear them and know the definition, be sure to tell us.

Deciduous plants lose their leaves when it is too hot, dry or cold
Evergreen plants keep their leaves throughout the year
Annual plants germinate, flower, produce seed and die within a year
Perennial plants live for 2 or more years
Angiosperms are plants that have flowers and produce fruits that contain one or more seeds
Gymnosperms are plants that have seeds, but no flowers. The seeds are in cones or cups.
Monocots have one cotyledon or seed leaf
Dicots have two cotyledons or seed leaves

GREEN SUN MACHINES

PHOTOSYNTHESIS

Plants are producers

Plants make their own food through a process called **photosynthesis**. If you were a hungry plant, you could make your own food!

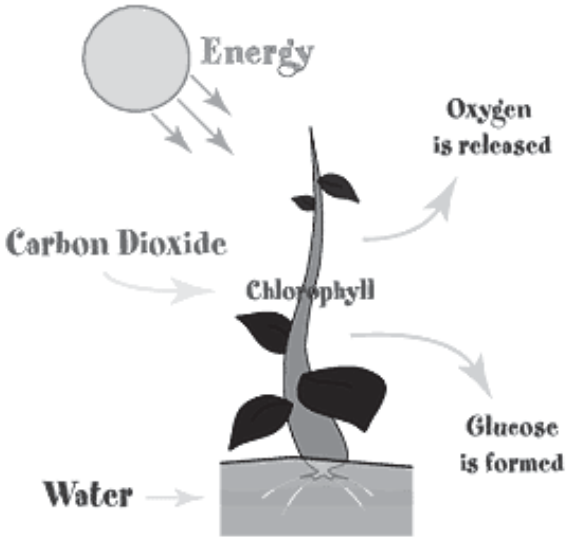
What would you need to make your own food?

Sunlight
Plants absorb sunlight through their leaves. Leaves contain a green chemical called chlorophyll that absorbs sunlight.

Water
Plants take up water through their roots. Water travels from the roots to the stem through system of tubes and then upward to the leaves.

Carbon Dioxide
Carbon dioxide is a natural gas we create when we breathe. Plants use the carbon dioxide that we exhale to help make their food.

Soil
Soil is made up of minerals (rocks, sand, clay, and silt), air, water and organic (plant & animal) material.



Photosynthesis

How plants make food with sunlight, water, and carbon dioxide.

Plants use the energy from sunlight to change water and carbon dioxide into sugar. The sugar is food for plants and gives plants energy to grow. The process plants use to make food using sunlight, water, and carbon dioxide is called **photosynthesis**.

The process of photosynthesis can be represented by the equation below.

Water + carbon dioxide $\xrightarrow{\text{Sunlight}}$ **sugar + oxygen**

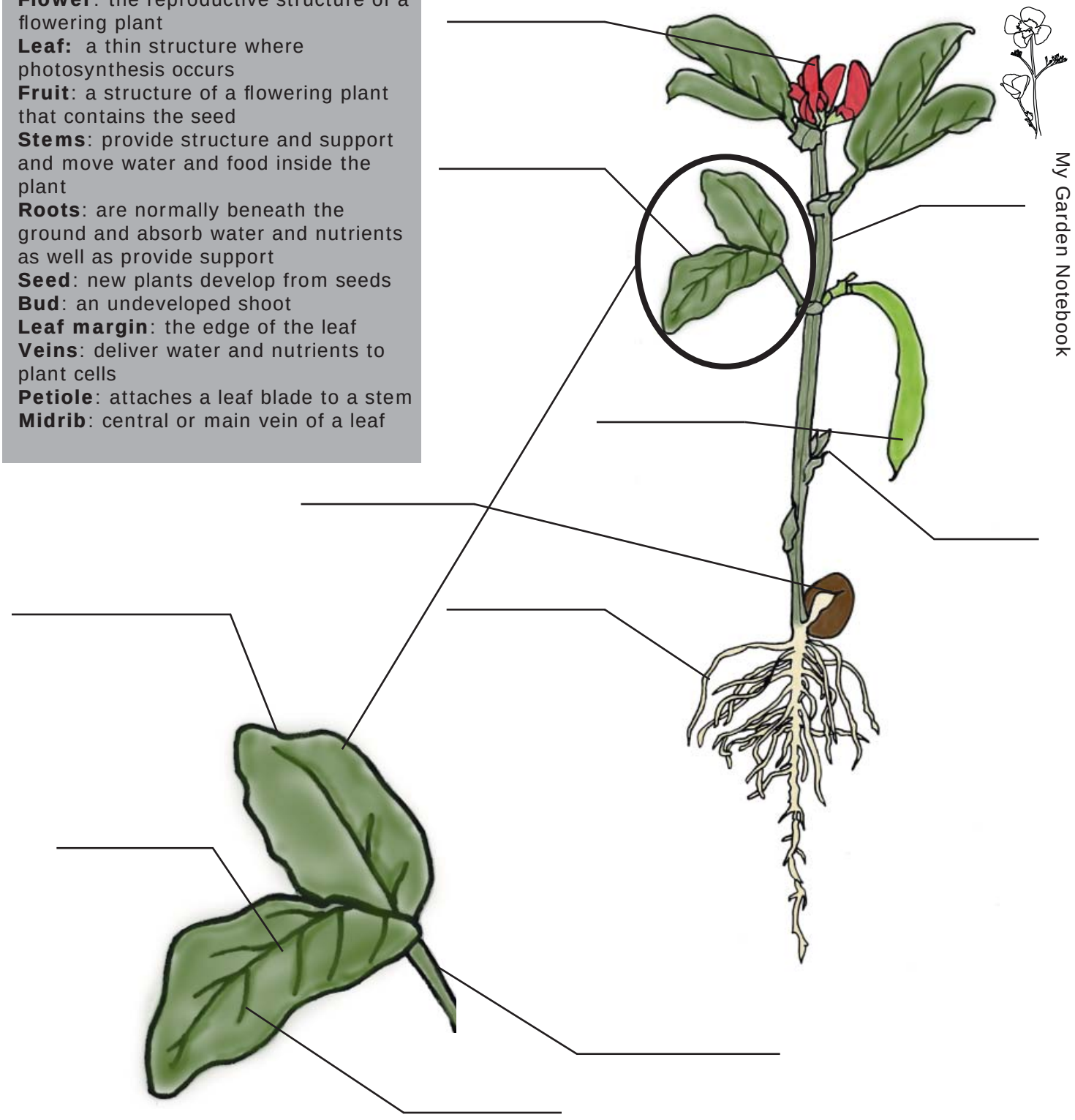
PLANT MORPHOLOGY - ANGIOSPERMS

LEARNING ABOUT PLANT PARTS - DICOTYLEDONS

Label the bean plant diagram below using the word bank

WORD BANK

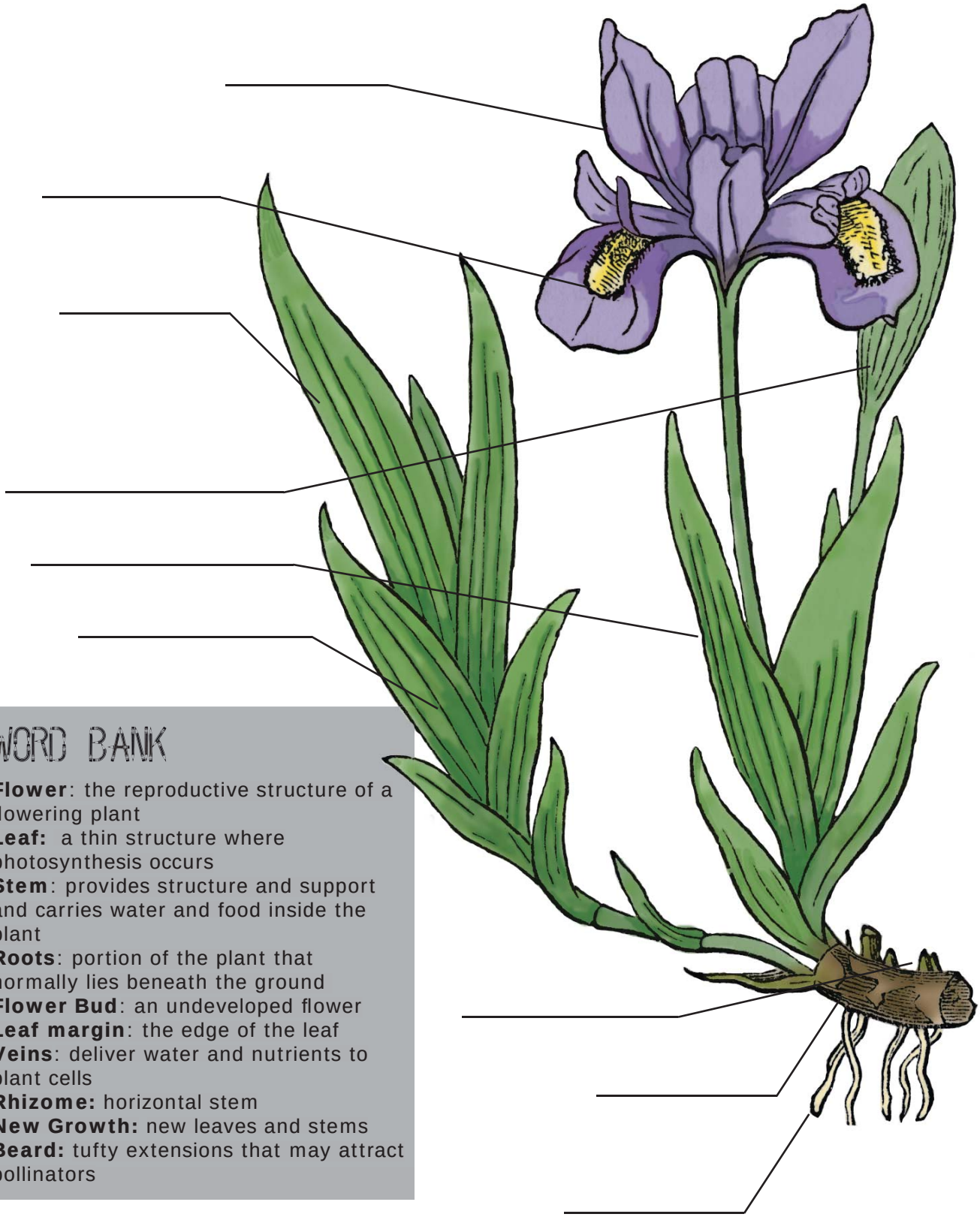
Flower: the reproductive structure of a flowering plant
Leaf: a thin structure where photosynthesis occurs
Fruit: a structure of a flowering plant that contains the seed
Stems: provide structure and support and move water and food inside the plant
Roots: are normally beneath the ground and absorb water and nutrients as well as provide support
Seed: new plants develop from seeds
Bud: an undeveloped shoot
Leaf margin: the edge of the leaf
Veins: deliver water and nutrients to plant cells
Petiole: attaches a leaf blade to a stem
Midrib: central or main vein of a leaf



PLANT MORPHOLOGY - ANGIOSPERMS

LEARNING ABOUT PLANT PARTS - MONOCOTYLEDONS

Label the iris diagram below using the word bank



WORD BANK

Flower: the reproductive structure of a flowering plant
Leaf: a thin structure where photosynthesis occurs
Stem: provides structure and support and carries water and food inside the plant
Roots: portion of the plant that normally lies beneath the ground
Flower Bud: an undeveloped flower
Leaf margin: the edge of the leaf
Veins: deliver water and nutrients to plant cells
Rhizome: horizontal stem
New Growth: new leaves and stems
Beard: tufty extensions that may attract pollinators

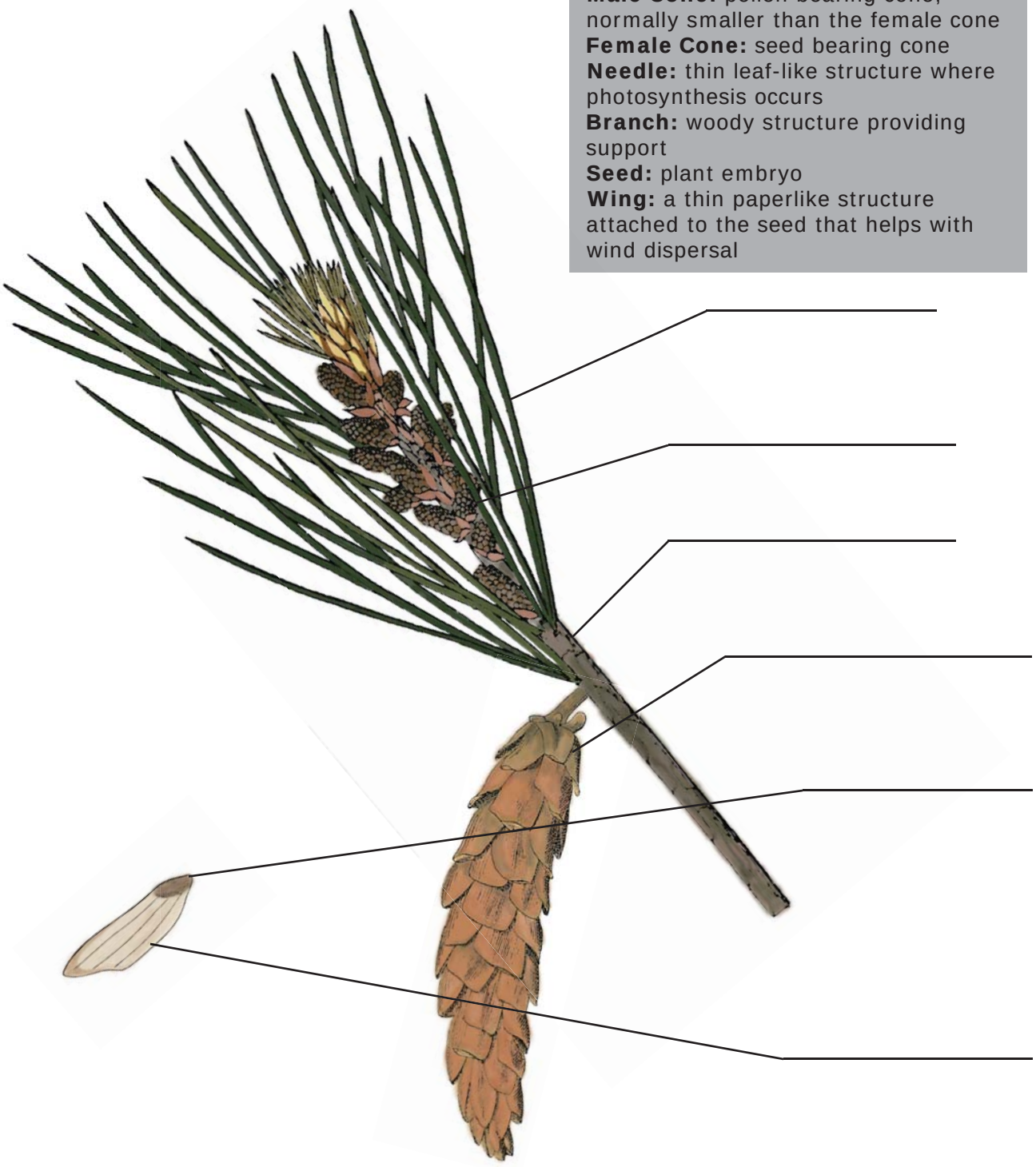
PLANT MORPHOLOGY - GYMNOSPERMS

LEARNING ABOUT PLANT PARTS - CONIFERS

Label the pine branch diagram below using the word bank

WORD BANK

Male Cone: pollen bearing cone, normally smaller than the female cone
Female Cone: seed bearing cone
Needle: thin leaf-like structure where photosynthesis occurs
Branch: woody structure providing support
Seed: plant embryo
Wing: a thin paperlike structure attached to the seed that helps with wind dispersal



PLANT TAXONOMY

HOW DO SCIENTISTS IDENTIFY PLANTS?

What is plant taxonomy?

Taxonomy is the science of classifying organisms such as plants. **Taxonomy allows us to find, describe, identify, classify and name plants** and the person who does this is a **Plant Taxonomist.**

To begin to classify plants, we need to start at the beginning. There are 6 kingdoms of living organisms on earth: **Animals, Plants, Fungi, Protists, Archaebacteria and Eubacteria**.
The **Plant Kingdom** is further divided into **Division, Class, Order, Family, Genus** and **Species**. As we learn to classify plants, we will mainly use the terms family, genus and species. Look at the example for *Sisyrinchium bellum* (Blue-eyed Grass) below.

Kingdom	*Plant*
Division	*Angiosperm*
Class	*Monocot*
Order	*Asparagales*
Family	*Iridaceae*
Genus	*Sisyrinchium*
Species	*bellum*

Sisyrinchium bellum

When we think of plants, we might think of flowering plants like daffodils and roses, but there are lots of different plants:

Bryophytes

Liverwort

Moss

Pteridophytes

Fern

Horsetail

Angiosperms

Monocot

Dicot

Gymnosperms

Conifer

Gingko

Cycad

One other very important thing you should know before you become Junior Taxonomists is that the language used to name plants is **Latin**. Latin is a very old language and was used to name plants as early as the 17th century. A plant name is binomial (2 parts). The first part is the genus and the second part is the species. Here is an example:

Part 1 ***genus*** ***Sisyrinchium - sys is from Greek and means pig***

- rynchus means snout (roots consumed by swine)

Part 2 ***species*** ***bellum - bellum means pretty or handsome***

If we put it all together, it might read pretty plant with roots that pigs eat.

What tools do Plant Taxonomists use?

- **Hand lens**
- **Microscope**
- **Plant press**
- **A dichotomous plant key** contains a series of questions and each question is a choice between two characteristics. The identity of the plant is determined through a process of elimination. An example might be green leaves or yellow leaves. There is a simple example of a dichotomous key below

You're going to become a Junior Plant Taxonomist, so you need to know how to use a dichotomous (2 branched) key. Choose one of the plants and use the dichotomous key below to work out the plant's name.

1.a) Leaves simple 2

b) Leaves compound 3

2. a) Flowers yellow with brown center ..... *Encelia californica*

b) Flowers yellow with yellow center ..... *Venegasia carpesioides*

3. a) Flowers white to blue/purple ..... *Lupinus bicolor*

b) Flowers yellow with a red tip ..... *Acmispon glaber*

Helpful hints for using a dichotomous key

- Notice there are 3 steps used to identify 4 organisms
- There should always be one less step than the number of organisms identified in a key
- Always read both options
- Be sure you know the meaning of the terms given, never guess

PLANT PORTRAITS

PLANTS IN MY GARDEN

Deciduous plants

- A **deciduous** plant is one that loses its leaves for several months each year when the weather becomes too hot, dry or cold.
- The leaves usually turn brown and dry before they drop because the nutrients that are stored in the leaves return to the plant's stems.
- When the weather becomes favorable and the rainy season begins, deciduous plants begin to grow and produce new leaves.

California Sunflower
Encelia californica

Canyon Sunflower
Venegasia carpesioides

Blue Elderberry
Sambucus nigra

California Aster
Corethrogyne filaginifolia

California Figwort
Scrophularia californica

California Fuchsia
Epilobium canum

California Rose
Rosa californica

Deerweed
Acmispon glaber

Golden Yarrow
Eriophyllum confertiflorum

PLANT PORTRAITS

PLANTS IN MY GARDEN

Deciduous plants

Monkeyflower

Mimulus aurantiacus

Mugwort

Artemisia douglasiana

Seacliff Daisy

Malacothrix saxatilis

Snowberry

Symphoricarpos albus

Gooseberry

Ribes amarum

PLANT PORTRAITS

PLANTS IN MY GARDEN

Evergreen Plants

Evergreen plants are shrubs and trees (with woody stems) that keep their leaves throughout the entire year.

Black Sage
Salvia mellifera

California Sagebrush
Artemisia californica

Coffeeberry
Frangula californica

Coyote Brush
Baccharis pilularis

Honeysuckle
Lonicera subspicata

Lemonade Berry
Rhus integrifolia

Toyon
Heteromeles arbutifolia

PLANT PORTRAITS

PLANTS IN MY GARDEN

Herbaceous Plants

- An **herb** (pronounced “erb”, the “h” is silent) or **herbaceous** plant (pronounced “herb-ay-shus”, the “h” is pronounced!) is any plant with soft, flexible stems that are not rigid and woody.
- Herbs don’t need to produce strong, stiff stems and branches because they never grow to be very large.

California Poppy

Eschscholzia californica

Blue-eyed Grass

Sisyrinchium bellum

Miniature Lupine

Lupinus bicolor

Narrow-leaf Milkweed

Asclepias fascicularis

Hummingbird Sage

Salvia spathacea

Morning Glory

Calystegia macrostegia

PLANT PORTRAITS

PLANTS IN MY GARDEN

Grasses

- **Grasses** are fast-growing herbaceous plants that have long, narrow "strap-like" leaves.
- If you look closely at a grass leaf, you will see tiny ridges and grooves running along its length. These are the veins of the leaf where food and water are transported.

California Barley

Hordeum brachyantherum

Blue Wildrye

Elymus glaucus

Giant Rye

Elymus condensatus

Purple-needle Grass

Stipa pulchra

MY GARDEN NOTEBOOK

PLANT ADOPTION PAPERS

Name of your school: _____

Choose a plant in your school garden that you'd like to adopt

What plant family does your plant belong to? _____

What is the common name of your plant? _____

What is the scientific name of your plant? Remember there are 2 names - genus & species i.e. *Sisyrinchium bellum*

_____

Using the word bank to help you, complete the following section

Describe your plant *(color, smell, texture, height, width)*

Describe your plant's environment *(soil texture, soil color, invertebrates, sun or shade)*

WORD BANK

Your Plant

Color: green, grey-green, blue-green, silvery
Smell: aromatic, pleasant, stinky
Texture: glossy, smooth, hairy, waxy, soft, prickly, thorny, spiny

Your Plant's Environment

Soil Texture: sandy, clay, muddy, loamy, dry, wet, dusty, stoney
Soil Color: yellowish, brown, grey, dark, light
Invertebrates: beetle, aphid, fly, spider, worm, caterpillar, bee, butterfly, moth, wasp
Sun or Shade: sunny, shady, cool, warm, bright, damp

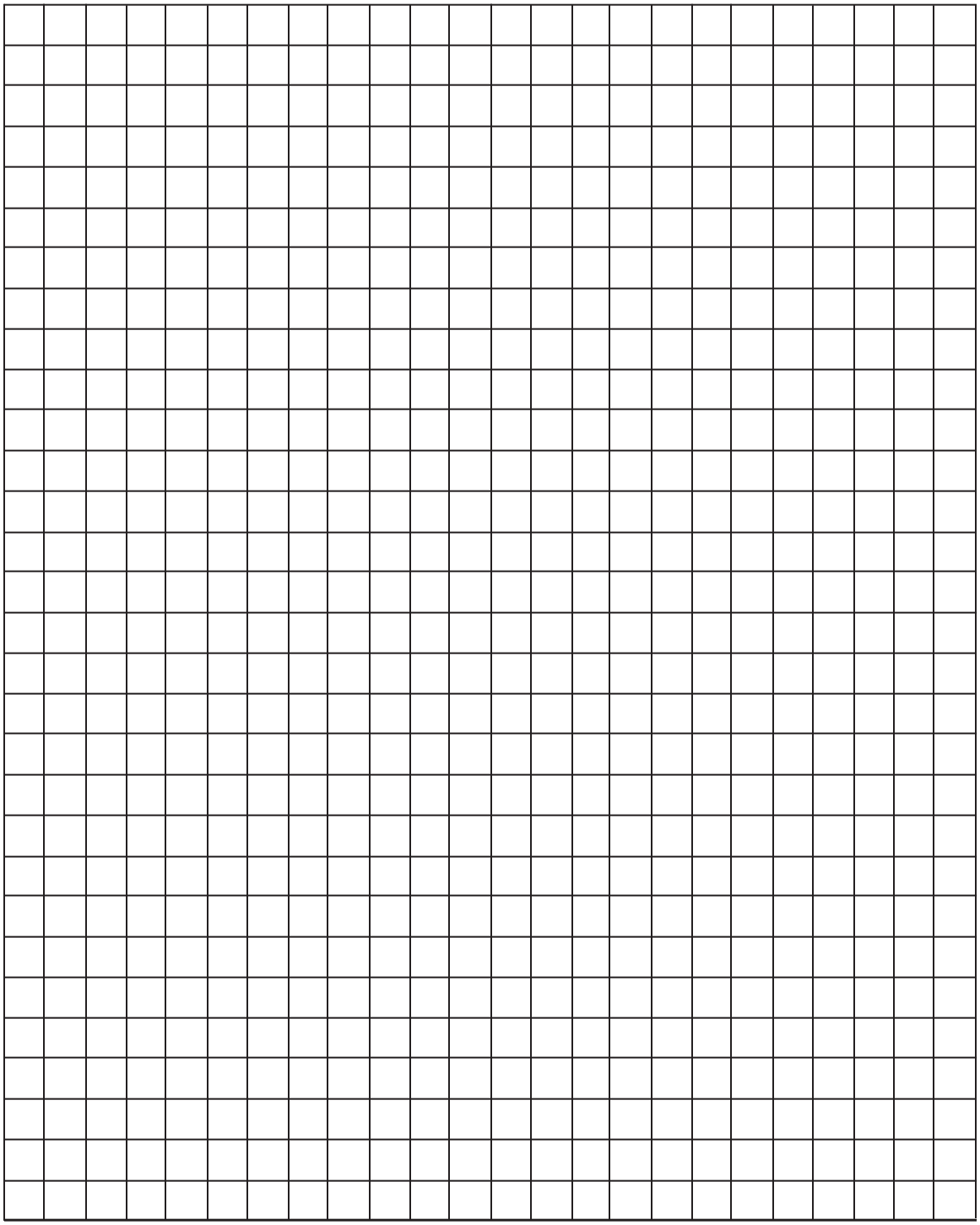
MY GARDEN NOTEBOOK

DRAW YOUR PLANT

Draw a diagram of your plant. Remember to label the parts. (leaf, bud, flower, stem, roots, fruit)

MY GARDEN NOTEBOOK

PLOT YOUR PLANT



What is the area of your garden? Area = length x width _____ m^2

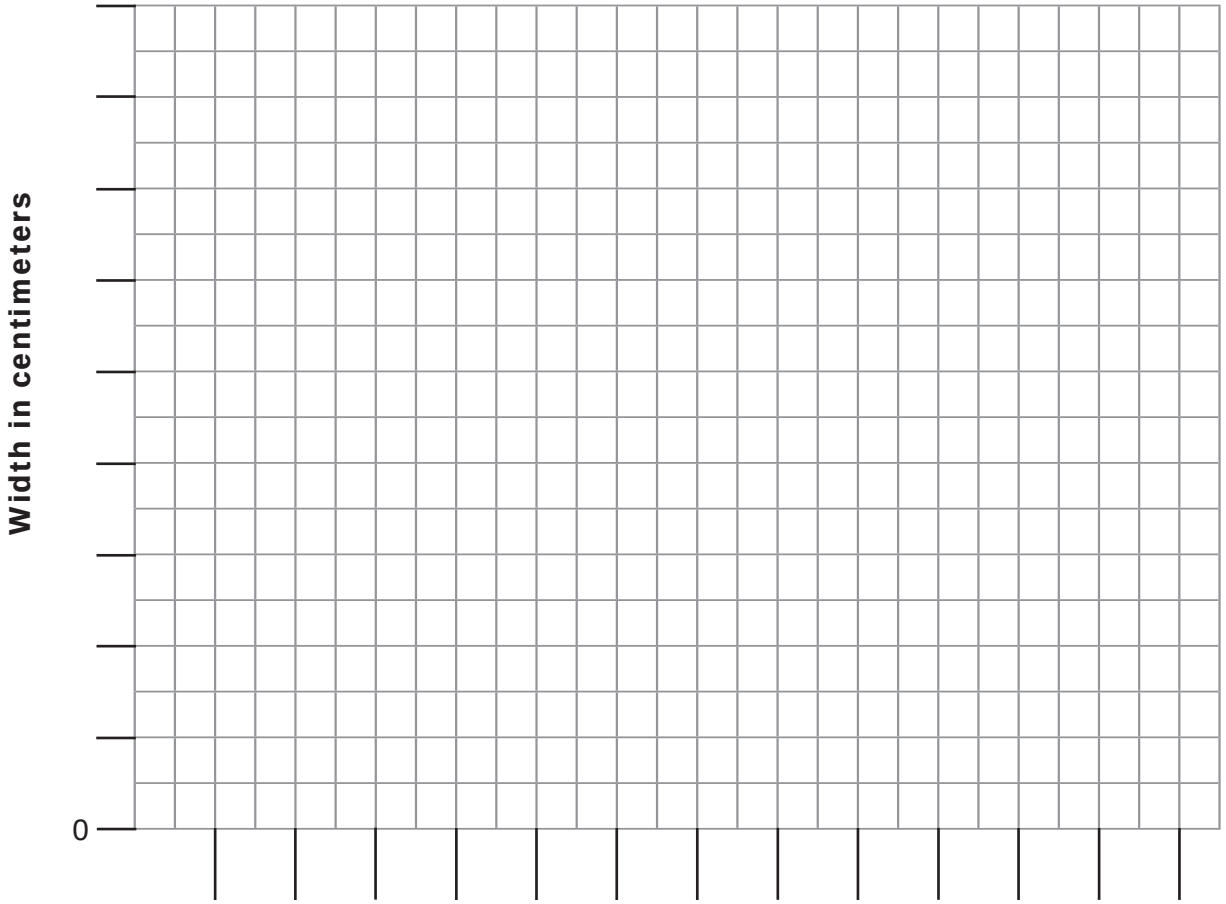
What is the perimeter of your garden? Perimeter = 2x length + 2x width

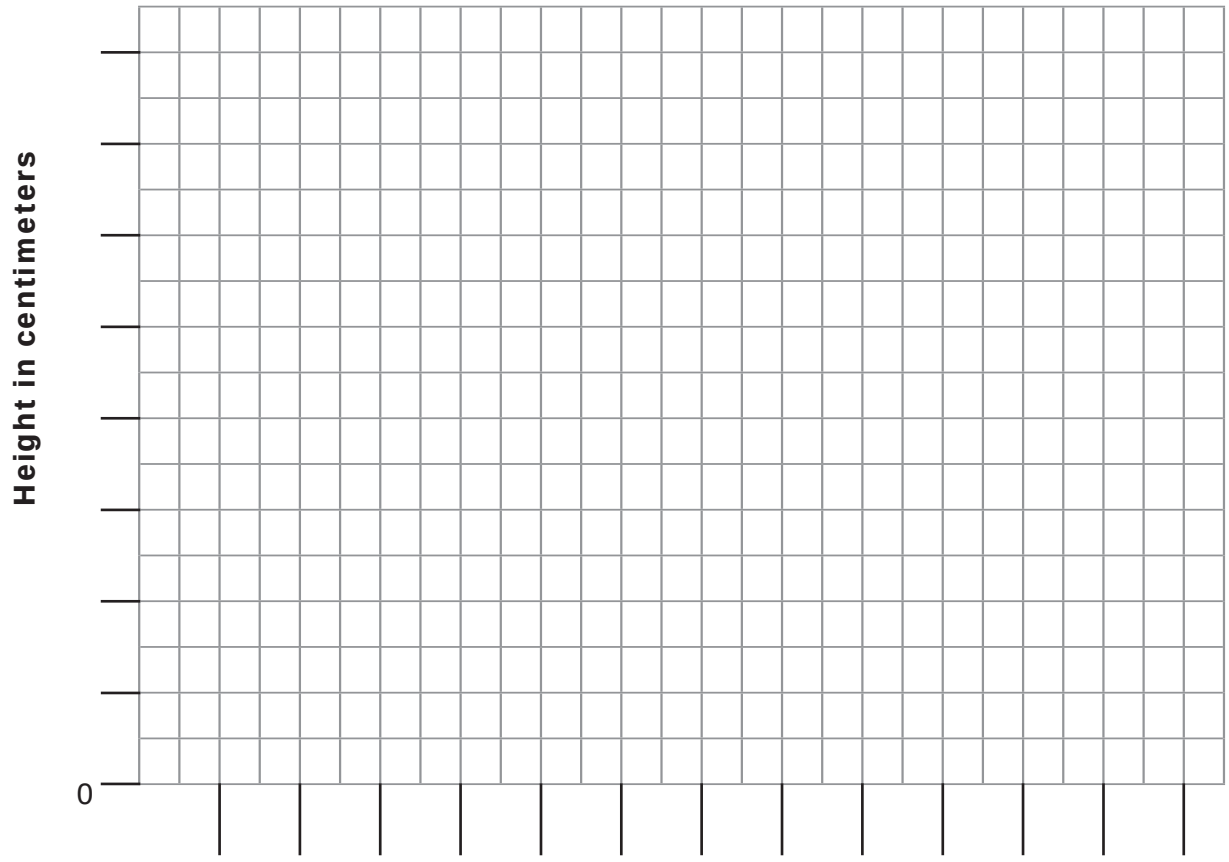
_____ cm

Draw the position of your plant in the garden and approximate how much area it covers.

_____ cm^2

You will measure the height and width of your plant several times during the year and plot the results below.





What did you see?

What did you learn?

What did you do?

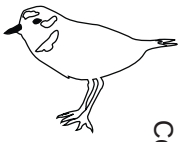
What did you hear?

Chapter 3. LIFE ON THE BEACH

EXPLORING COASTAL HABITATS

Welcome to the Coal Oil Point Reserve (COPR)!

A wide variety of coastal and estuarine (where the tide meets a river) habitats are protected at Coal Oil Point Reserve, including coastal dunes that support a large variety of dune plants. In the heart of the reserve is Devereux Slough, a seasonally flooded tidal lagoon that dries out in the summer to form salt flats and extremely salty ponds and channels. Thousands of migratory birds visit throughout the year and a number of rare species (Snowy Plover, Globose Dune Beetle, Wandering Skipper) make COPR their home.



Coal Oil Point Reserve

Focus Questions

What do you think plant adaptation means?

If a species is listed as threatened or endangered, what does that mean?

What is a slough?

Why are sloughs important?

Challenge Words

Listen for these words during your visit. If you hear them and know the definition, be sure to tell us.

An **amphipod** is a small crustacean such as a Beach Hopper.

A **lagoon** is a shallow body of water often separated from a sea by sandbars or coral reefs.

Beach wrack refers to the piles of seaweed, terrestrial plants and animal remains that wash ashore.

A **sand dune** is sand hill or sand ridge formed by the wind.

Habitat is a place where an organism is normally found.

Information and photos from coaloilpoint.ucnrs.org.
Activities modified from Mike Collins, Cabrillo High School

WHAT'S ON THE MENU

BEACH HOPPER RESEARCH

Beach hoppers can jump over 60 times their body length. If you find a beach hopper and it is 1.5 cm long, approximately how far would it be able to jump?

1.5 x 60 = _____ cm

How tall are you?_____ cm

If you could jump 60 times your height, how far would you be able to jump?

_____ X 60 = _____ cm
your height in cm

How many feet does that equal? Hint: 1cm = 0.3937 in

cm X 0.3937 in = _____ in, which equals _____ ft

Research Question

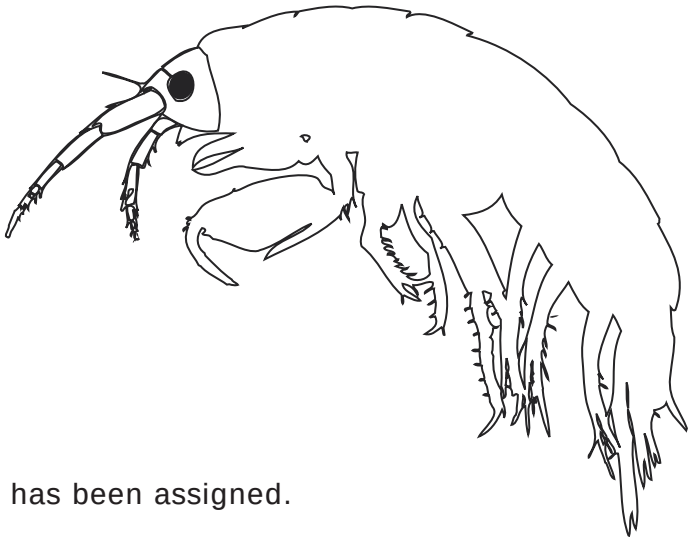
If you were a hungry Beach Hopper (an amphipod), where would you look for food? Choose one:

A. Not under seaweed
B. Under fresh seaweed
C. Under wilted seaweed
D. Under slightly dry seaweed
E. Under dry seaweed
F. Under very dry seaweed

We're going to figure out which answer is correct by doing an experiment.

MATERIALS

Pencils
Shovel
Container (to hold sand)
Sieve
Magnifying jar



Method

Examine the pile of kelp your group has been assigned.

Lift up the pile of kelp and take a shovel full of sand from underneath.

Put the sand into the container.

Count the Beach Hoppers and as you count them, lift them out of the sand and let them hop away.

Record the total number of Beach Hoppers you count and write the results on the recording table on the next page.

WHAT'S ON THE MENU

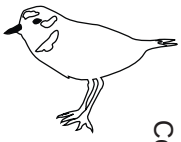
BEACH HOPPER RESEARCH

Recording Table

Record your information in this table.

Group Name	Kelp Condition	# of Beach Hoppers
	No kelp	
	Fresh	
	Wilted	
	Slightly Dry	
	Dry	
	Very Dry	

*Be sure to share your results with the other groups when you return to school



Data Graph

Graph Your Results on the graph paper below.

Beach Hopper Kelp Condition Preference

Number of Beach Hoppers (write in units)

0 Beach Hoppers

Fresh | Wilted | Slightly Dry | Dry | Very Dry

Kelp Condition

Coal Oil Point Reserve

SAND DUNES

DUNE FORMATION

How are Sand Dunes Created?

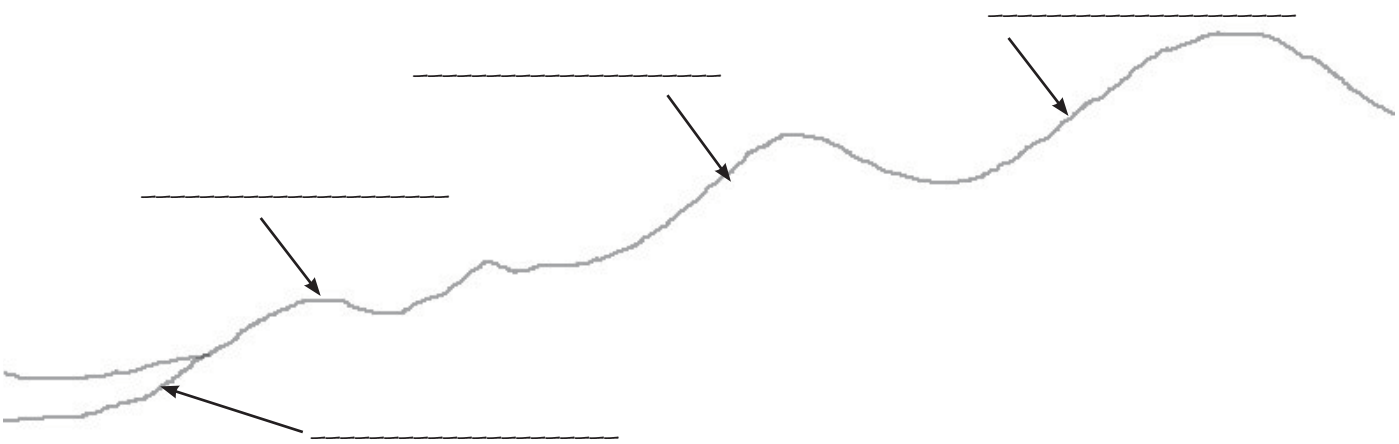
When wind blown sand is caught by dune plants and settles into mounds, embryo sand dunes are formed. Gradually the winds continue to add sand and blow the dunes inland, where they grow in size, and continue to collect sand.

Dunes are continually changing. Waves, wind, plants, weather, and trampling by people all have an impact on dune shape. Dunes are a fragile ecosystem and are rare in this part of California.

Label the parts of the beach using the word bank above.

WORD BANK

Embryo dune - the first dunes to develop and stabilized by plants.
Fore dune - embryo dunes join together to form foredunes.
Back dune - as plants grow and bacteria colonize the dune, it becomes more stable.
Ocean - body of saline water.



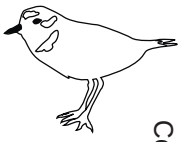
Draw one of the plants you found growing on the sand dunes.

SAND DUNES

SURVIVING LIFE ON THE DUNES

What environmental conditions shape the beach?

How do you think this beach might change from summer to winter?



Plant Adaptations

Plants often have **adaptations** (special features) that help them to grow in different areas.

Plants that live on beaches have special **adaptations** that allow them to tolerate salt, drying winds, and intense sunlight.

Look at the different parts of the beach. Do you see more plants close to the water or farther away, in the dunes?

Underline or circle all of the plant **adaptations** that plants living on these dunes might have.

Hairy leaves	Tall and skinny
Long roots	Seeds that float
Grow low to the ground	Gray leaves
Small leaves	Short roots
Sticky	Big shiny leaves

SAND DUNES

PLANT CHECKLIST

Check the box next to the species you saw during your visit at Coal Oil Point Reserve.

☐ 

Sea Rocket
(Cakile maritima)

☐ 

Beach Saltbush
(Atriplex leucophylla)

☐ 

Red Sand Verbena
(Abronia maritima)

☐ 

Beach Primrose
(Camissoniopsis cheiranthifolia)

☐ 

Beach Bur
(Ambrosia chamissonis)

☐ 

Bush Lupine
(Lupinus arboreus)

☐ 

Coyote Brush
(Baccharis pilularis)

☐ 

Buckwheat
(Eriogonum parvifolium)

THE LIFE OF THE SNOWY PLOVER

A THREATENED SHOREBIRD

Western Snowy Plover

Charadrius alexandrinus nivosus (Scientific name)

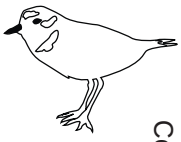
What are Western Snowy Plovers?

Plovers are a shore bird, which means that they live near the shore of coastal or inland waters. There are even two separate groups of Western Snowy Plovers – the coastal and the inland populations. We will be studying the coastal population of the Western Snowy Plover. These birds are found on the Pacific Coast of the United States and Mexico.

A Threatened Species

In 1993, the Western Snowy Plover was declared "threatened" under the Endangered Species Act.

- The Endangered Species Act is a law.
- It helps protect animals that are threatened or endangered.
- An **endangered** species is a plant or animal that might become extinct.
- A **threatened** species is a plant or animal that may become endangered soon.



Coal Oil Point Reserve

Indentifying a Plover

The plover is a small bird with a short neck and a slender, dark bill. It has pale brown plumage (feathers) on its back, a pale brown on the top of its head (cap) and white underparts. During the breeding season, the plumage changes and dark patches appear on the forehead, under the eyes, and on the neck. Male breeding plumage patches are black and female patches can be dark brown or black.

Western Snowy Plover
Normal Plumage

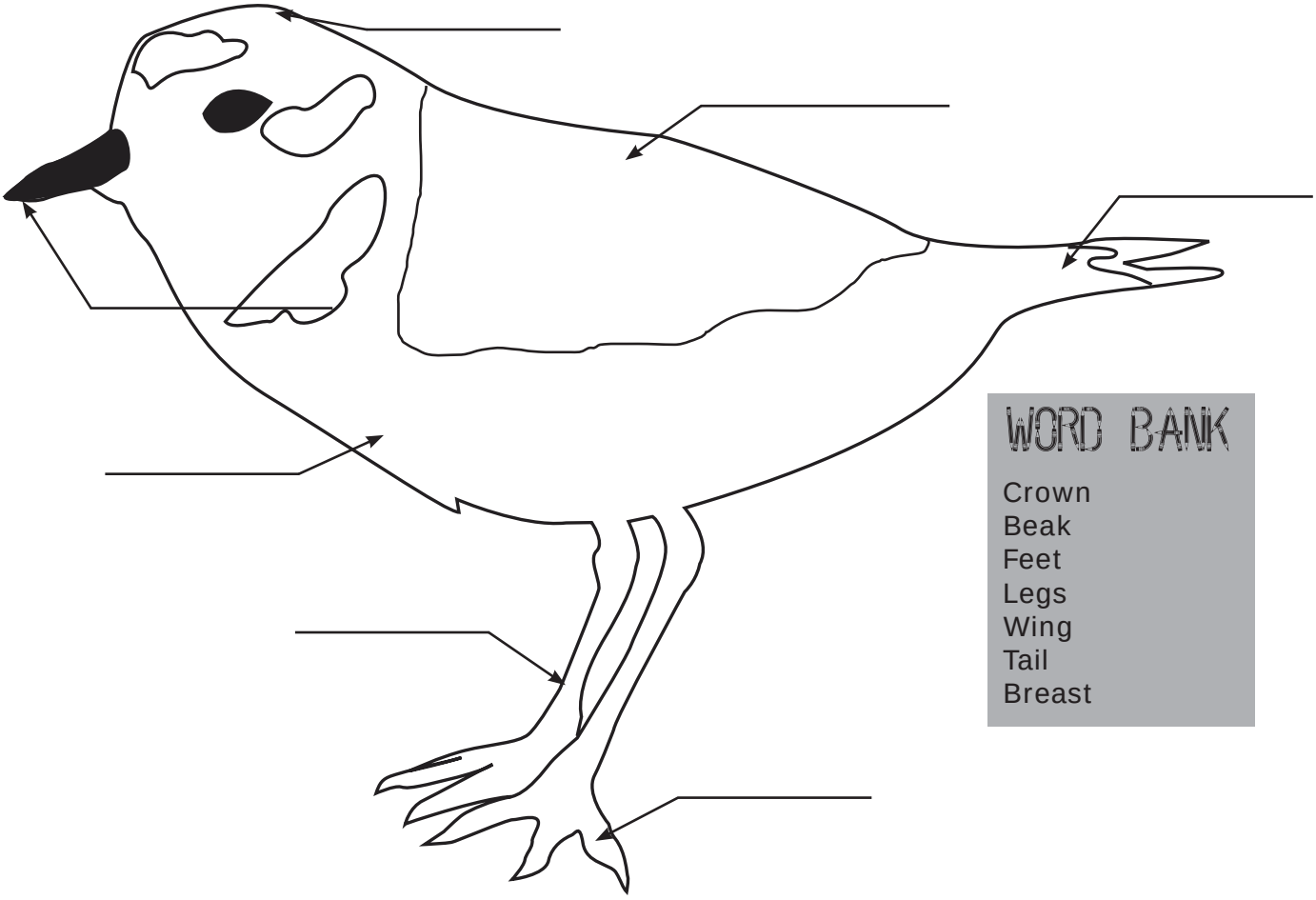
Western Snowy Plover
Breeding Plumage

THE LIFE OF THE SNOWY PLOVER

ACTUAL SIZE OF A WESTERN SNOWY PLOVER

This drawing is the actual size of the Western Snowy Plover. It is about 6 inches in length.

Color and label the snowy plover in breeding plumage.



WORD BANK

Crown
Beak
Feet
Legs
Wing
Tail
Breast

This is a picture of a Snowy Plover chick – it's about the size of an oreo cookie!

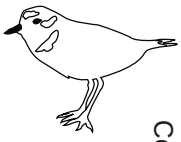
THE PLOVER'S NEIGHBORHOOD

PAUSE, LOOK, RUN AND PECK

Habitat
A habitat is the natural home for a plant or animal. Four elements must be present in a habitat: **space, shelter, food, and water**.

Space
Snowy Plovers live on flat sandy beaches, such as dunes, open coastal beaches, the mouths of streams (where streams flow into the ocean), and at nearby ponds.

Shelter
Snowy Plovers make scrapes – small dips in the sand they use as a nest. They need protection from predators and wind, so they will often nest around driftwood or small grasses and plants. Their scrapes are usually lined with shells or rocks.



Food
Snowy Plovers eat insects (such as flies and beetles) and other beach invertebrates (such as small crabs and Beach Hoppers). They forage for food along the strip of sand exposed to air at low tide and submerged at high tide (intertidal area) and in kelp piles (kelp wrack). Plovers use a pause, look, run, and peck technique to catch prey.

Plover Trivia!

Describe the space that Snowy Plovers prefer for a home.

What is the name of the Snowy Plover's nest?

What do Snowy Plovers enjoy eating?

THE PLOVER'S NEIGHBORS

SHOREBIRD IDENTIFICATION

Knowing how to identify the Western Snowy Plover from other birds is important. Can you identify and lwrite in the name of the different shorebirds? Use the information on the next page to help you.

1. _____

2. _____

3. _____

4. _____

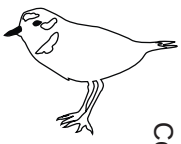
THE PLOVER'S NEIGHBORS

SHOREBIRD IDENTIFICATION

Use the decriptions below to identify the birds pictured on the previous page.

Semipalmated Plover (*Charadrius semipalmatus*)
The Semipalmated (partly webbed feet) Plover has darker plumage on its back and head than the Snowy Plover. It also has a band across its entire chest and another that connects its eyes to its beak. During the summer breeding season those bands turn black, and it also develops a black band across its forehead just above the white band. It has a short orange and black beak.

Least Tern (*Sterna antillarum*)
The Least Tern has a white underside, gray back, and a black edge on its wings. During the summer breeding season, it has a white forehead, a black head cap, and a yellow bill with a black tip. In nonbreeding season it has a white head cap, black strips from the eyes to the back of the head, and a black bill. The California least tern is an **endangered species**.



Killdeer (*Charadrius vociferous*)
Killdeer have a brown back and wings and white undersides. The head cap is brown, and they have a white forehead and eyestrip around a distinctive red ringed eye. They have two black bands across the chest, one band over the forehead and one around the long thick beak.

Sanderling (*Calidris alba*)
Sanderlings are most commonly mistaken as Snowy Plovers by beach visitors. They are bigger in size and have darker legs and longer beaks. Plumage is speckled gray, pale brown and white and turns to a red brown during breeding season with a white underside. They use their beaks to forage for food under the wet sand and will run back-and-forth as the waves come in and out.

FEATHERED FRIENDS

BIRDS YOU MIGHT SEE AT COAL OIL POINT

Check the box next to the species you saw during your visit at Coal Oil Point Reserve.

☐ 

Black-bellied Plover
Pluvialis squatarola

☐ 

Least Sandpiper
Calidris minutilla

☐ 

Dunlin
Calidris alpina

☐ 

Western Gull
Larus occidentalis

☐ 

Willet
Tringa semipalmata

☐ 

Sanderling
Calidris alba

☐ 

Snowy Plover
Charadrius alexandrinus

☐ 

Marbled Godwit
Limosa fedoa

FEATHERED FRIENDS

BIRDS YOU MIGHT SEE AT COAL OIL POINT

☐

Black Turnstone
Arenaria melanocephala

☐

Great Blue Heron
Ardea herodias

☐

Turkey Vulture
Cathartes aura

☐

Brown Pelican
Pelecanus occidentalis

☐

Mallard
Anas platyrhynchos

☐

Long-billed Curlew
Numenius americanus

☐

Killdeer
Charadrius vociferus

☐

Whimbrel
Numenius phaeopus

FURRY FRIENDS

ANIMAL TRACKS YOU MIGHT SEE AT COAL OIL POINT

Below are the approximate sizes of animal tracks you might see at Coal Oil Point.

5 Toes

No Thumb

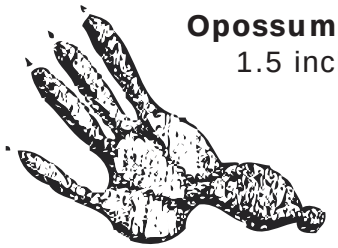
Skunk Front
2 inches

Skunk Back
3 inches

Raccoon
4 inches

Thumb

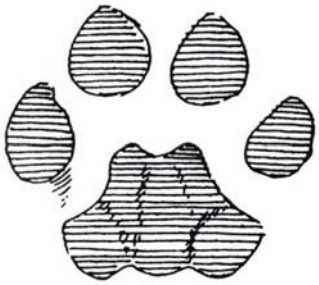
Opossum Front
1.5 inches



Opossum Back
2.5 inches

4 Toes

Round - Cat Family



Cougar
3 inches

Bobcat
2 inches

Oval - Dog Family

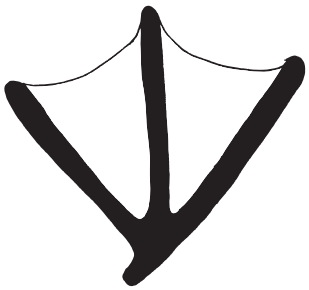
Gray Fox
1.5 inches

Coyote
3 inches

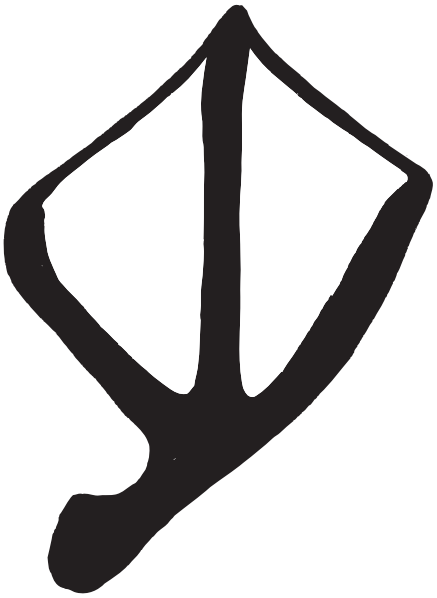
FEATHERED FRIENDS

BIRD TRACKS YOU MIGHT SEE AT COAL OIL POINT

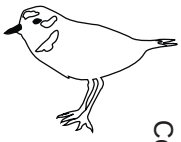
Below are the approximate sizes of bird tracks you might see at Coal Oil Point.



Duck
3 inches



Pelican
6.5 inches



Heron
7 inches

Killdeer
1 inch

Turkey Vulture
4 inches

Plover
less than 1 inch

Coal Oil Point Reserve

NATURE JOURNAL

BEACH HABITAT TREASURES

Treasure Hunt

Let's see what treasures we can find on the beach…..
Choose 2 objects you found on the beach and bring them back to your group.

Choose your favorite object

Draw the object you found. Do you know what it is?

Name of Object: _____

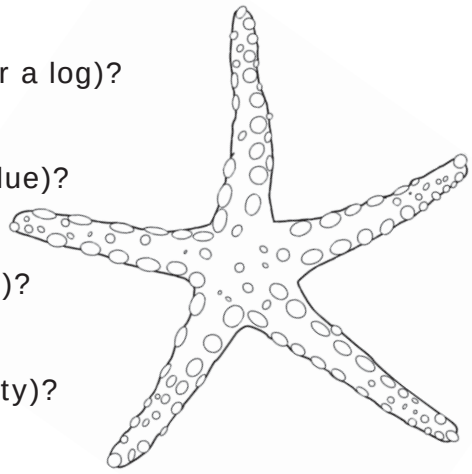
Describe Your Object

Where did you find it (for example: near the water, under a log)?

What does your object look like (for example: smooth, blue)?

What does your object feel like (for example: rough, soft)?

What does your object smell like (for example: fresh, salty)?



Measure Your Object (use the ruler on the last page of your journal)

How wide is your object at the widest part? _____ cm

How wide is your object at the thinnest part? _____ cm

How long is your object? _____ cm

NATURE JOURNAL

BEACH HABITAT TREASURES

Now we're going to explore other parts of the beach habitat using some other senses:

Close your eyes and listen to the sounds around you. List 2 sounds you can hear.

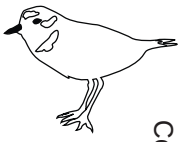
1. _____ 2. _____

What do you think is making those sounds?

Close your eyes again and breathe deeply, smelling all of the different smells around you. List 2 of the smells.

1. _____ 2. _____

Where are the smells coming from?



Coal Oil Point Reserve

Open your eyes and look around you. List 5 things you can see (for example: trees, birds, clouds).

1. _____ 2. _____ 3. _____

4. _____ 5. _____

Draw something you have seen at the beach today in the box below.

ALL SEAWEEDS ARE ALGAE, BUT NOT ALL ALGAE ARE SEAWEEDS

Describe the algae you found. Where on the beach did you find it, what's the color, shape, smell, size and texture of your seaweed?

_____

_____

_____

_____

_____

All seaweeds can be divided into 3 categories: Red, Green and Brown

Red Seaweed
Rhodophyta

Green Seaweed
Chlorophyta

Brown Seaweed
Phaeophyta

What is the scientific name for seaweed? _____

How does seaweed make food? _____

What other organism uses this process? _____

Most seaweeds need to attach themselves to a surface of rock, sand or mud. What structure allows them to do this? _____

ALGAE FACTS

Did you know that.....

Marine plants (which include seaweed) contribute between 70 and 80 percent of oxygen in the atmosphere.

Some seaweed can grow up to 24 inches a day.

Seaweed has been around for 3 billion years.

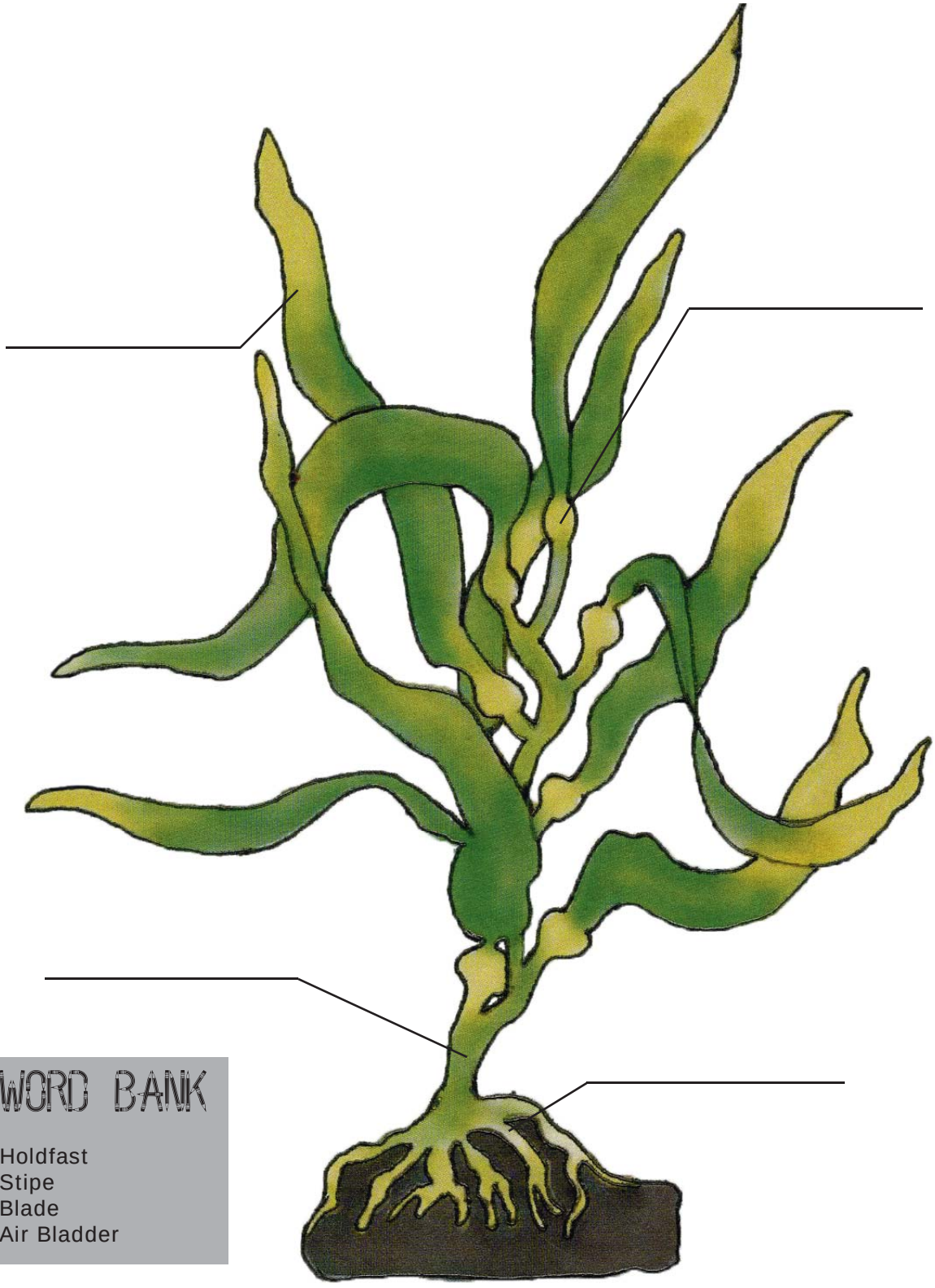
Seaweed is packed full of vitamins and minerals.

Sea otters tangle themselves up in seaweed so that they can eat and sleep without being washed away.

What type of forest grows under water?

ALGAE STRUCTURE

Using the word bank below. Label the different parts of the seaweed.



WORD BANK

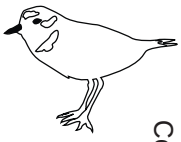
Holdfast
Stipe
Blade
Air Bladder

When do you use seaweed?

Many of the products we use on a daily basis contain ingredients extracted from seaweed.

- **Carrageenan** is extracted from red algae and is used to stick or bind food together.
- **Alginate** comes from brown algae and is used to make water-based products thicker or creamier.
- **Beta carotene** is extracted from green algae and is used as a natural food coloring and also helps to prevent cancer.

Based on the information above, circle all of the items that you think might contain seaweed.



What did you see?

What did you learn?

What did you do?

What did you hear?

Chapter 4. AN OCEAN VIEW OF THE WORLD

EXPLORING THE COASTAL ZONE

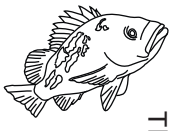
Welcome to the Marine Science Institute (MSI)!

Our focus is the "coastal zone," the land and ocean that occurs along the coast of California and the Santa Barbara Channel Islands. You will get to see and touch sea creatures that are found right here in our front yard!

The Research Experience & Education Facility, better known as the REEF, is MSI's teaching aquarium and a really neat place to learn all about marine science.

Don't be surprised if you get a little wet as we explore our world through the wonders of water and ecology. So, let's dive in…

Focus Questions



Why are oceans important?

What is the coastal zone?

What is a wetland?

Challenge Words

Listen for these words during your visit. If you hear them and know the definition, be sure to tell us.

Convection currents are caused by movement of water or air due to uneven heating in the environment.

Biodiversity refers to the different kinds of living things found in a specific habitat, ecosystem or the entire planet.

Biotic means related to life or living organisms. Example: plants, animals.

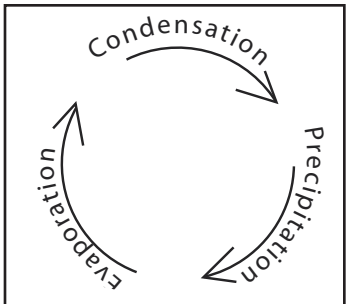
Abiotic means not alive, non-living factors that affect living organisms. Example: water, temperature, light, etc.

THE MAGIC PLANET

THE WORLD, WEATHER AND WATER

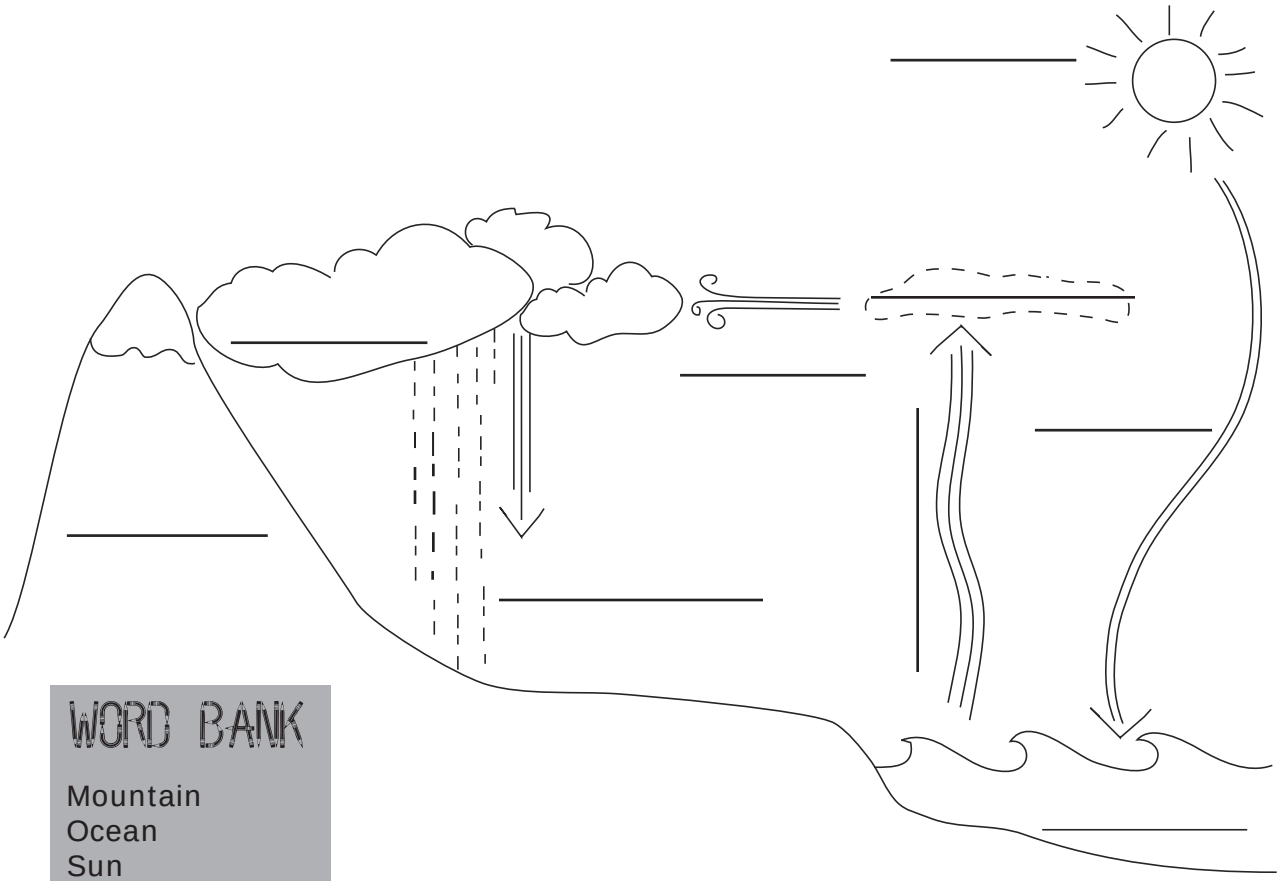
We are going to use one of the COOLEST pieces of modern technology, the Magic Planet ®, to explore the relationship between weather and abiotic cycles.

Things that go around are called CYCLES!
How many kinds of cycles can you think of?



Ex. Water Cycle

Below is a diagram of the water cycle. Use the word bank below to label the parts of the water cycle.

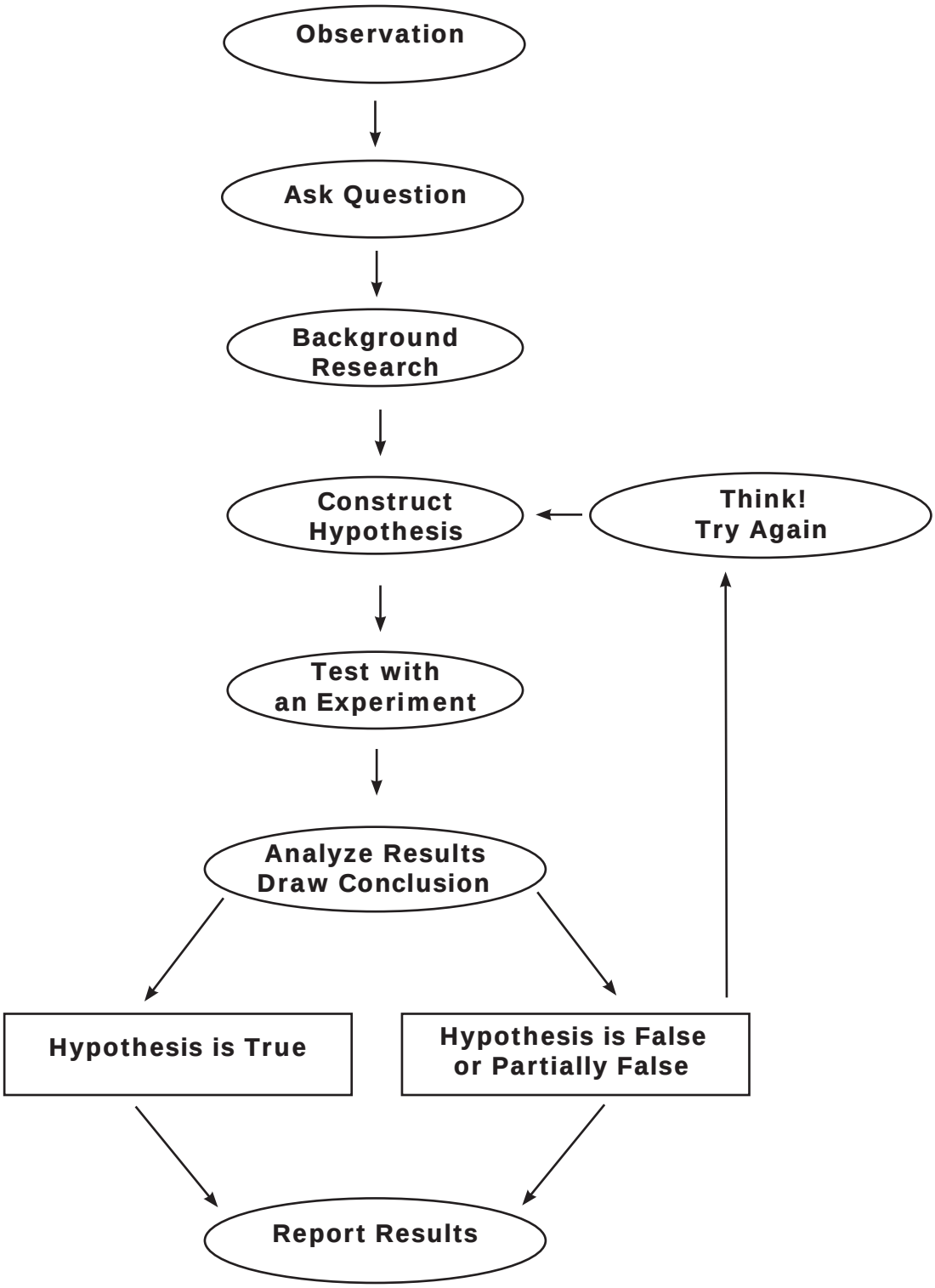


WORD BANK

Mountain
Ocean
Sun
Clouds
Wind
Light/Heat
Evaporation
Condensation
Precipitation

HYDRO-LOGIC

AN INTRODUCTION TO THE SCIENTIFIC METHOD



HYDRO-LOGIC

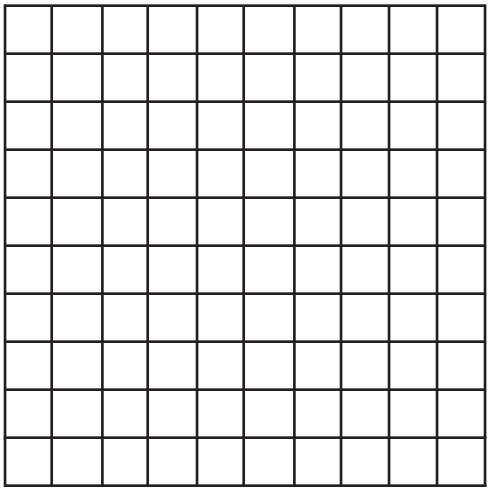
DATA COLLECTION AND ANALYSIS

What is a Wetland?

Although wetlands are often wet, a wetland might not be wet all year. Wetlands are the link between the land and the water. They are transition zones where the flow of water, the cycling of nutrients, and the energy of the sun meet to produce a unique ecosystem characterized by water, soils, and vegetation, making these areas very important features of a watershed. **A watershed is an area of land drained by a river, river system or other body of water.** Using a watershed-based approach to wetland protection ensures that the whole system, including land, air, and water resources, is protected.

In California, we have lost approximately 90% of our wetlands to human development. The San Francisco Bay Area makes up 90% of what is left. Color in the % of wetlands remaining in California.

Can a wetland be restored?



What are some of the things we need to think about when restoring a wetland?

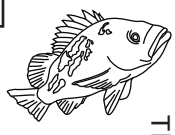
We are going to use different types of dirt (also known as substrate) and water to do a laboratory experiment to answer these questions! On the next page is a data table that we will use along with the scientific method to see if we can answer the question: which substrate (soil, sand, peat or clay) makes the “best wetland?”

HYDRO-LOGIC

DATA COLLECTION AND ANALYSIS

Wetland Soil Data

Substrate	Immediate Observations	Observations	Water Collected (ml)	% Water Held by Substrate	Best Wetland
sand					
peat					
clay					
soil					



Conclusion

Which substrate (soil, sand, peat or clay) was best at holding water?

SEE SEA CREATURES

LEARNING ABOUT LIFE UNDERWATER

Life in the Santa Barbara Channel

Because of our geography and the ocean currents that flow through the Santa Barbara Channel, we have some of the MOST awesome sea creatures right in our front yard.

One of the species you will see today is the giant kelp. **Giant kelp** (*Macrocystis pyrifera*) forests are located at the land-ocean margin in temperate (mild climate) regions of both the northern and southern hemispheres. This leads to very high biodiversity (lots of different plants and animals)!

Species Checklist

Explore the REEF and learn about the ocean from algae to zooplankton! Check the box next to the species you saw during your visit at the touch tanks.

☐ 

Giant kelp
Macrocystis pyrifera

☐ 

Rockfish
Sebastes spp.

☐ 

Garibaldi
Hypsypops rubicundus

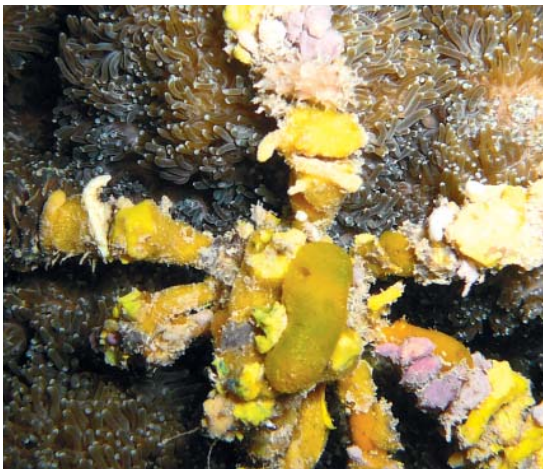
☐ 

Swell Shark
Cephaloscyllium ventriosum

SEE SEA CREATURES

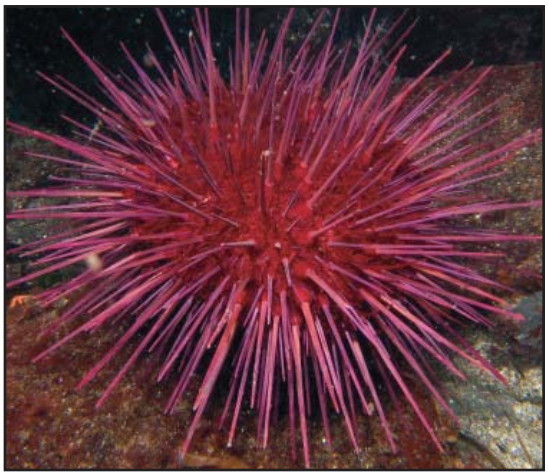
LEARNING ABOUT LIFE UNDERWATER

Spiny Lobster
Panulirus interruptus



Decorator Crab
Loxorhynchus spp.

Sea Stars
Pisaster spp.



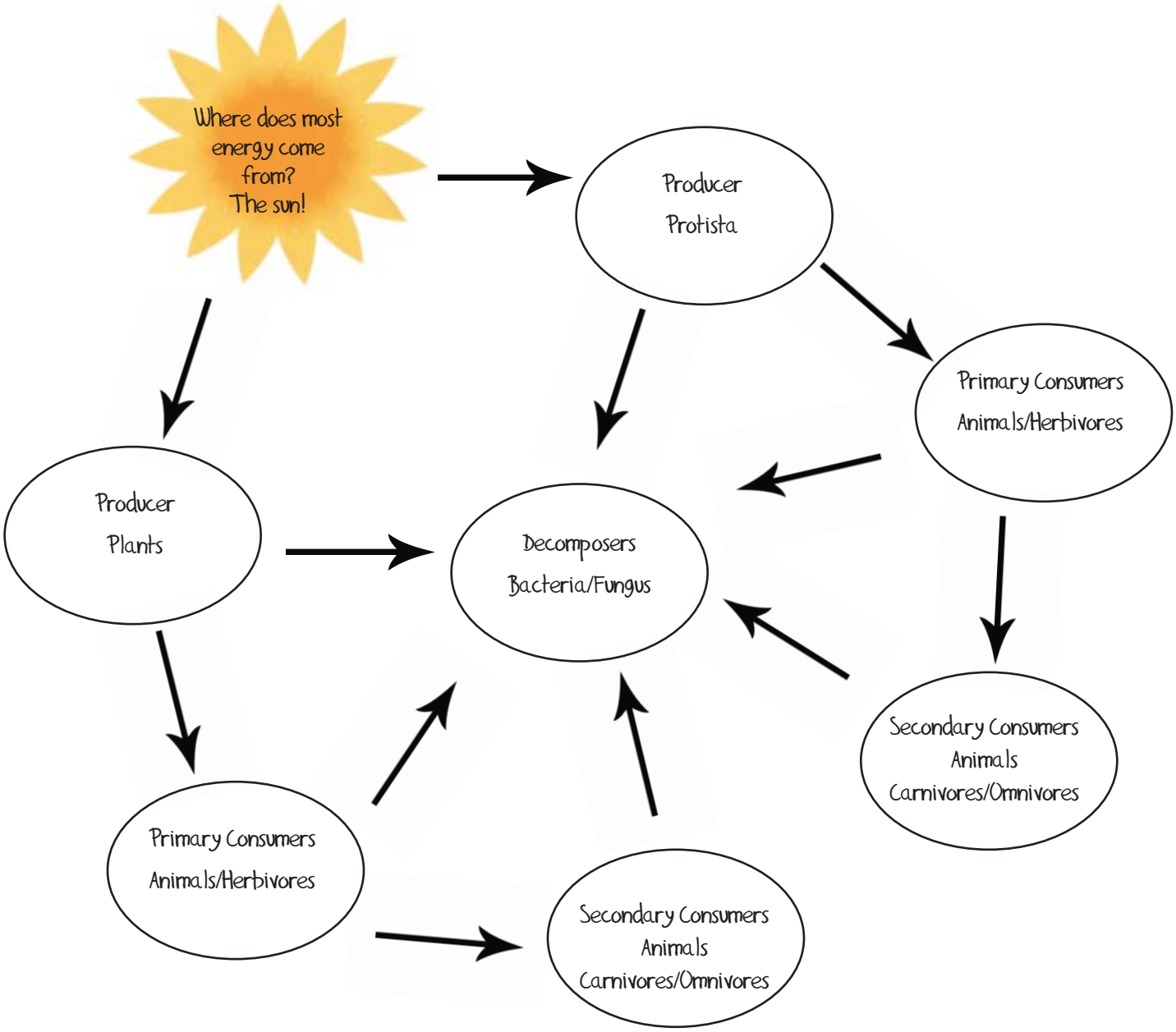
Sea Urchin
Strongylocentrotus spp.

Two-Spot Octopus
Octopus bimaculatus

Red Abalone
Haliotis rufescens

ENERGY AND MATTER

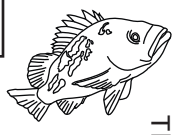
AN OCEAN FOOD WEB



NATURE JOURNAL

REFLECTING ON YOUR OCEAN EXPERIENCE

Draw a picture of your favorite sea creature at the REEF and describe why you like it.



Write down your thoughts about the ocean.

The ocean makes me feel...

I like the ocean because...

What did you see?

What did you learn?

What did you do?

What did you hear?

Chapter 5. WATERSHEDS & FOOD WEBS

HOW WETLANDS SUPPORT BIODIVERSITY

Welcome to the Storke Wetland, at UCSB!

Why are wetlands unique and valuable places?

Wetlands play an important role for insects, birds, humans and other animals. Most animals need freshwater during their lives and can't live in areas without this resource. Humans learn to recognize the value of wetlands when heavy rains flood homes built on areas that were once wetlands or near wetlands. Wetlands located near oceans play one of their most important roles when they help filter out pollution, trash, and silt from water before it flows into the ocean.

Focus Questions

What do birds that live in wetlands eat?

What kinds of plants can grow in water?

Why are salty soils hard for plants to grow in?

Challenge Words

Listen for these words during your visit. If you hear them and know the definition, be sure to tell us.

A **food chain** refers to the flow of energy from one organism to the next. For example, a green plant, a leaf-eating insect and a hungry bird form a simple food chain.

A **food web** is an interconnected web of food chains.

A **bioswale** is a wide man-made drainage ditch containing plants that filter stormwater and runoff before it flows to the ocean.

Osmosis is the passage of liquid from a weak solution to a concentrated solution across a semi-permeable membrane.

A **wetland** is a lowland area, like a marsh or swamp, that is saturated with water.

Plant Adaptations

Storke Wetlands

Look around you at the patterns of plant distribution in this wetland. Subtle differences in water depth, duration of flooding and soil salinity create plant community mosaics which reflect the adaptations of plants to their particular environment.

Plants need sunlight, fresh water, oxygen and nutrients to grow; insufficient amounts of any of these resources can create stressful conditions. Over the annual cycle the changes in salinity and water saturation are immense. Since they cannot move, plants must be able to withstand the most stringent conditions.

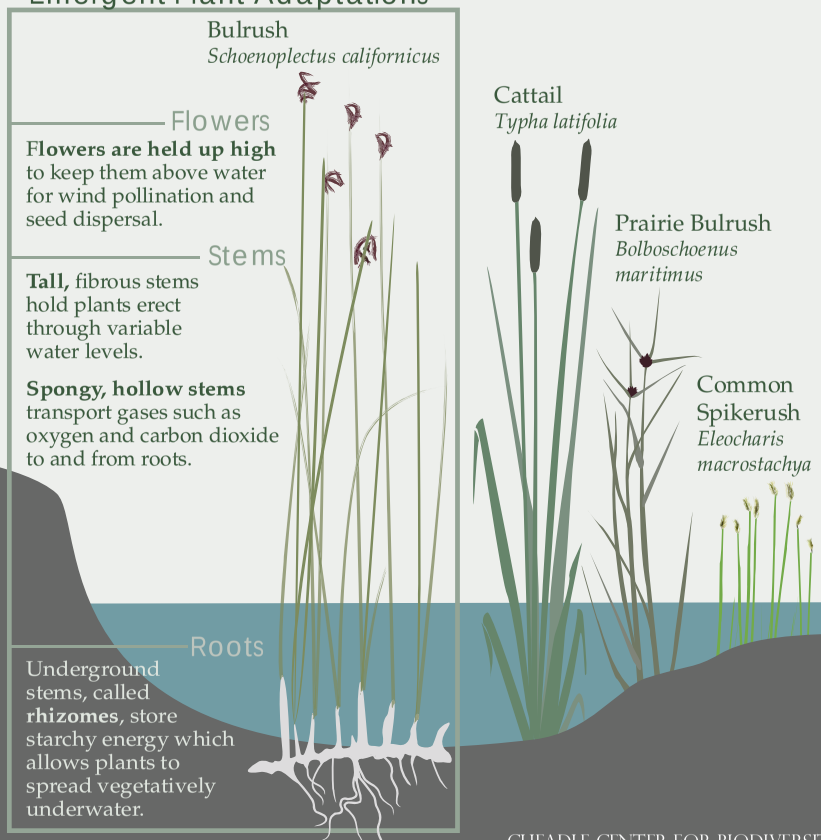
Storke Wetland, a part of the Goleta Slough, has been cut off from ocean tides by berms and a tide gate since the 1930s, yet salty or "saline" conditions persist due to their long history of tidal influence. Saline soils are stressful because salts can become concentrated in the plants and have toxic effects on cell function. Below are examples of plants that have adapted to these extreme conditions.

Emergent Wetland Plants

Adaptations to Saturated Soils

Wetland plants often grow in dense, clay soils. These wet soils are devoid of oxygen. Roots require oxygen; however, wetland plants have evolved adaptations to enable gases to transfer from the air down to the roots. Some wetland plants have floating leaves and stems that rest on the water surface, but "emergent plants" grow straight up out of the water and can handle changing water depths. These plants must have sufficiently rigid stems to hold the flowers and fruits above the water for wind pollination and seed dispersal, while also having spongy channels for carrying oxygen to the roots. Plant populations expand by extending underground stems or by dispersing seeds to wetland edges where the correct balance of light, oxygen and water exists.

Emergent Plant Adaptations



Flowers

Flowers are held up high to keep them above water for wind pollination and seed dispersal.

Stems

Tall, fibrous stems hold plants erect through variable water levels.

Spongy, hollow stems transport gases such as oxygen and carbon dioxide to and from roots.

Roots

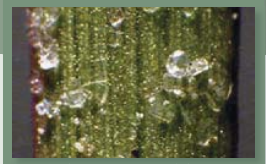
Underground stems, called **rhizomes**, store starchy energy which allows plants to spread vegetatively underwater.

Salt Marsh Plants

Adaptations to Extreme Saline Conditions

When plants grow they take in water through their roots and lose water through leaf transpiration. In salt marshes, salts flow into plants during water uptake and become concentrated during transpiration and evaporation. High salt levels interfere with cell function. For this reason, these plants must reduce water loss to keep the salt diluted, so they often develop water conserving adaptations like those found in desert plants. These adaptations include succulent leaves and stems, waxy coatings, and small or vertically-held leaves which help reduce transpiration. Other adaptations allow plants to excrete salt.

Salt Extrusion



Salt grass is able to actively move salts out of living cells. (Note salt crystals above.)

Salt Grass
Distichlis spicata

Adaptation: Excess salt is secreted out of the leaves through salt glands.

Pickleweed
Salicornia virginica

Adaptation: Excludes salts from roots; retains water in succulent stems.

Spearscale
Atriplex triangularis

Adaptation: Waxy, vertical leaves reduce water loss.

Alkali Heath
Frankenia salina

Adaptation: Small, gray reflective leaves reduce loss of fresh water.

Plant Community Mosaic

This cross-section illustrates how 1 to 2 foot differences in water depth can create very different environments to which just a few plants are adapted. These wetland plants have evolved novel ways to handle salts, flooding and drought.

CCBER

WETLAND FUNCTIONS

1**. Absorbs rainwater – like a sponge**
What happens when you pour water on concrete compared to soil?

2. **Reduces flooding**
What flows faster?
Water that flows over concrete or water that flows through a wetland? Why might this happen?

3. **Filters out silt, nutrients and pollution**
What happens to the dirty water when it goes through a wetland compared to flowing through a pipe? Why is this important?

4. **Supports life**
Make a list of living organisms that use the wetland.

UCSB Storke Wetland

5. **People enjoy wildlife, exploring, views, clean air and water**
What do you enjoy about this place?

FOOD WEB

THE CHAIN OF LIFE

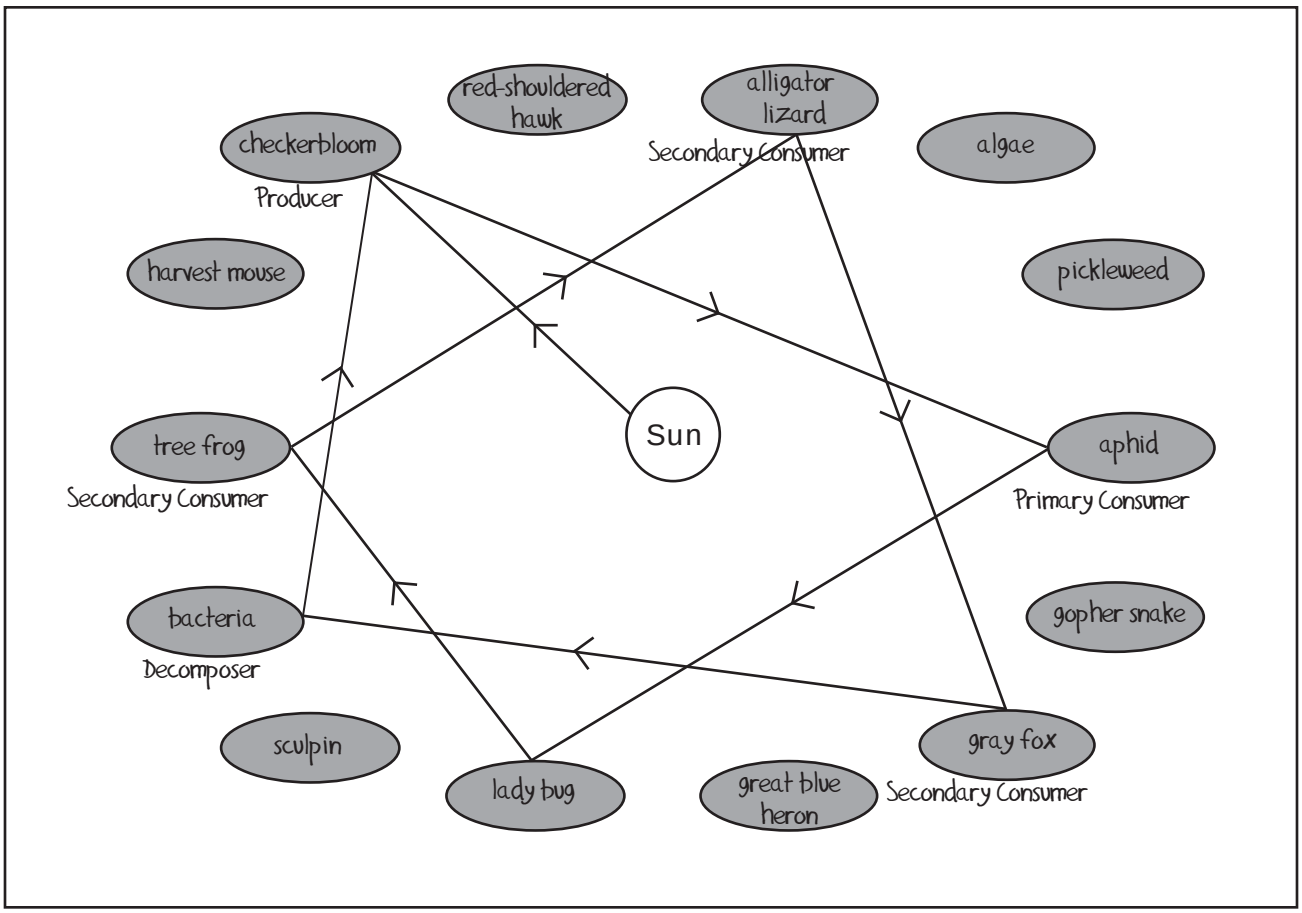
Most organisms rely on other organisms for food. Food is a link between nearly all organisms. Using the sun, water and nutrients, plants produce food that is carried through the links in a **FOOD WEB.**

The main **Food Web Roles** are defined below:
PRODUCERS are green plants that use the sun's energy to produce sugar and oxygen through photosynthesis.
PRIMARY CONSUMERS only eat plants, which are producers. Primary consumers are **herbivores**.
SECONDARY CONSUMERS eat primary consumers, they are carnivores or omnivores.
DECOMPOSERS break down dead plant and animal material into nutrients for producers.

FOOD WEB ROLES

Producers: checkerbloom, pickleweed, algae
Primary Consumers: aphid, sculpin, salt marsh harvest mouse
Secondary Consumers: gray fox, gopher snake, great blue heron, red- shouldered hawk
Decomposers: bacteria, fungi

Look at the example of a food chain below:
Starting at the sun, create 2 more food chains to complete a food web. Using the Food Web Roles Box above, label each species with the correct food web role.



PLANT ADAPTATIONS

SURVIVING EXTREME WATER AND SALT

1. What do plants need to grow? Circle the correct answers:

Chocolate Air Soda Water Oil Salt Jell-O Nutrients Sunlight

Can they get too much...? If plants get too much of any of the things they need, they have a hard time growing and must adapt to their environment.

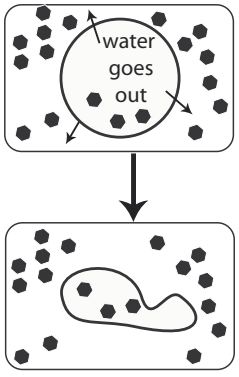
All plant roots need air to grow. In a wetland, plant roots are underwater. Only plants adapted to getting air to their roots can grow successfully in wetlands.

2. Compare the cross section of the marsh plant (rush) with an upland plant (shrub) and draw them below.

3. How do the marsh plants solve the problem of too much water?

Marsh Plant	Upland Plant

Fighting Osmosis. Salt draws water out of cells through a process called osmosis. See diagram to the right. (hexagons = salt crystals)



Plants growing in very salty environments, such as a salt marsh, need to avoid losing too much water. They can do this using different **plant adaptations**.

4. How can they solve the problem of having too much salt? Describe or draw for the following species.

Pickleweed (*Salicornia virginica*)	Saltgrass (*Distichlis spicata*)

What did you see?

What did you learn?

What did you do?

What did you hear?

Chapter 6. BALANCE IS THE KEY TO A HEALTHY STREAM

Welcome to Arroyo Hondo Preserve!

Our visit to Arroyo Hondo will take us back in time…to early California, when the Barbareno-Chumash civilization inhabited this beautiful canyon, known as "the jewel of the Gaviota coast," over 5,000 years ago!

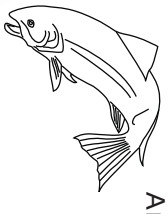
Arroyo Hondo canyon is a "watershed" and its health is important for many species, including the Steelhead Trout, who take an incredible journey that begins—and often ends—at Arroyo Hondo.

Be prepared: Wear sturdy shoes and long pants with long socks to deter ticks and keep an eye out for poison oak. Bring water to drink, be quiet and watchful as we explore, and be respectful of the plants and animals that live in the Arroyo Hondo canyon.

Focus Questions

How do you know if a creek, stream, or river is healthy?

What is a watershed?



Challenge Words

Listen for these words during your visit. If you hear them and know the definition, be sure to tell us.

An **invertebrate** is an animal lacking a backbone, or vertebral column.

Riparian habitat is the narrow strip of land that borders creeks, rivers or other bodies of water.

The different stages that occur in a plant or animal's lifetime, from the time it is a fertilized egg to maturity, when it is able to reproduce is known as the **lifecycle**.

NATURE'S DRAIN

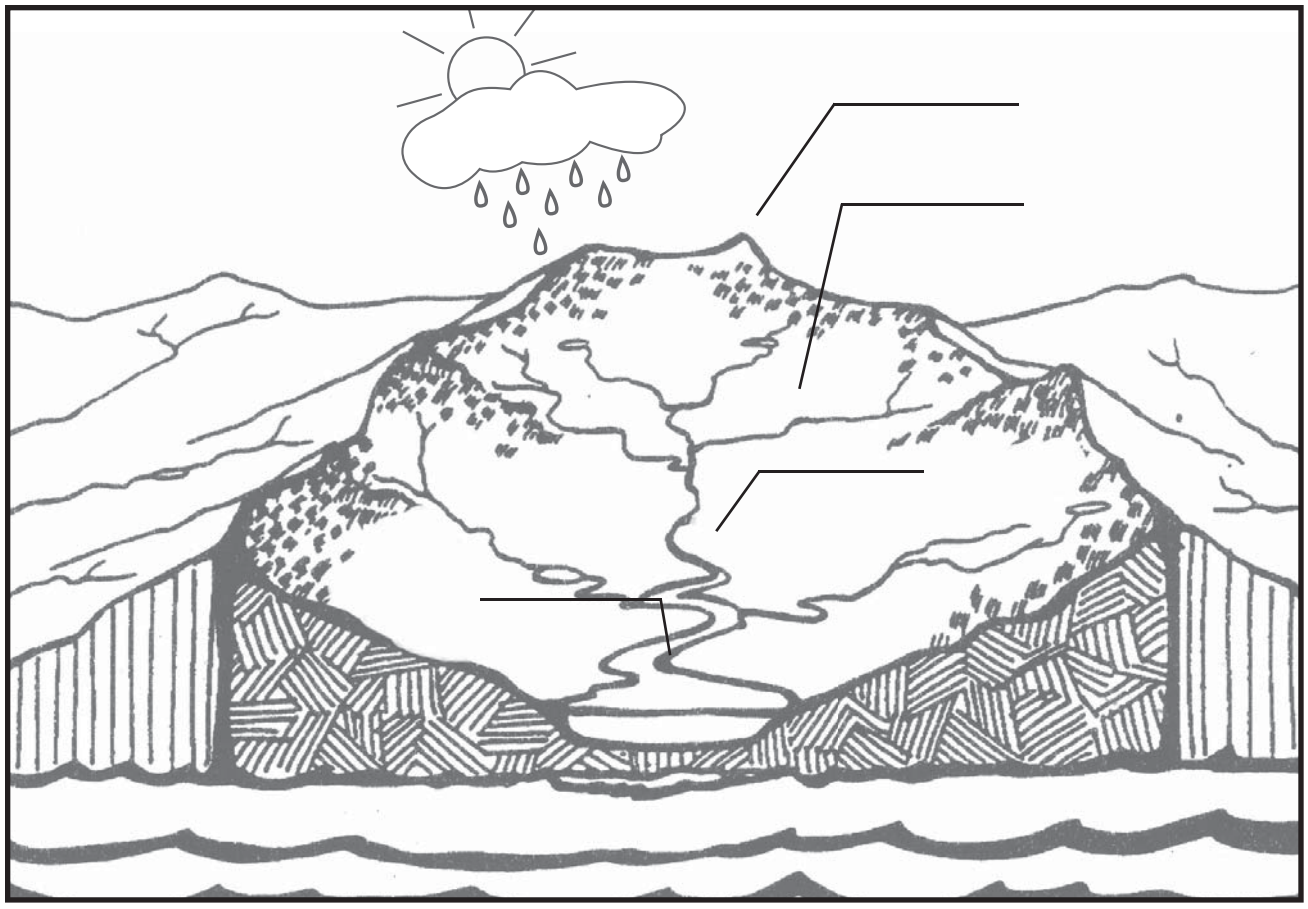
THE PARTS OF A WATERSHED

A watershed or drainage basin is an entire area or region drained by a river and its tributaries. All runoff is eventually conveyed to the same outlet such as the estuary at Arroyo Hondo.

Watershed facts:

- **Almost half (48.7%) of the worlds land drains into the Atlantic Ocean.**
- **The continental U.S. can be divided into 2,110 watersheds.**
- **Hills, ridges, mountains and other high points define the boundaries of a watershed.**
- **Every stream, river or tributary has an associated watershed.**

In the watershed picture below, you can see the different parts, or reaches of the river. The river begins at the top boundaries of the watershed. The upper reaches or tributaries are small, fast flowing streams that empty into the main stem of the river. Fresh water meets with salt water in the estuary, where the river flows into the ocean.



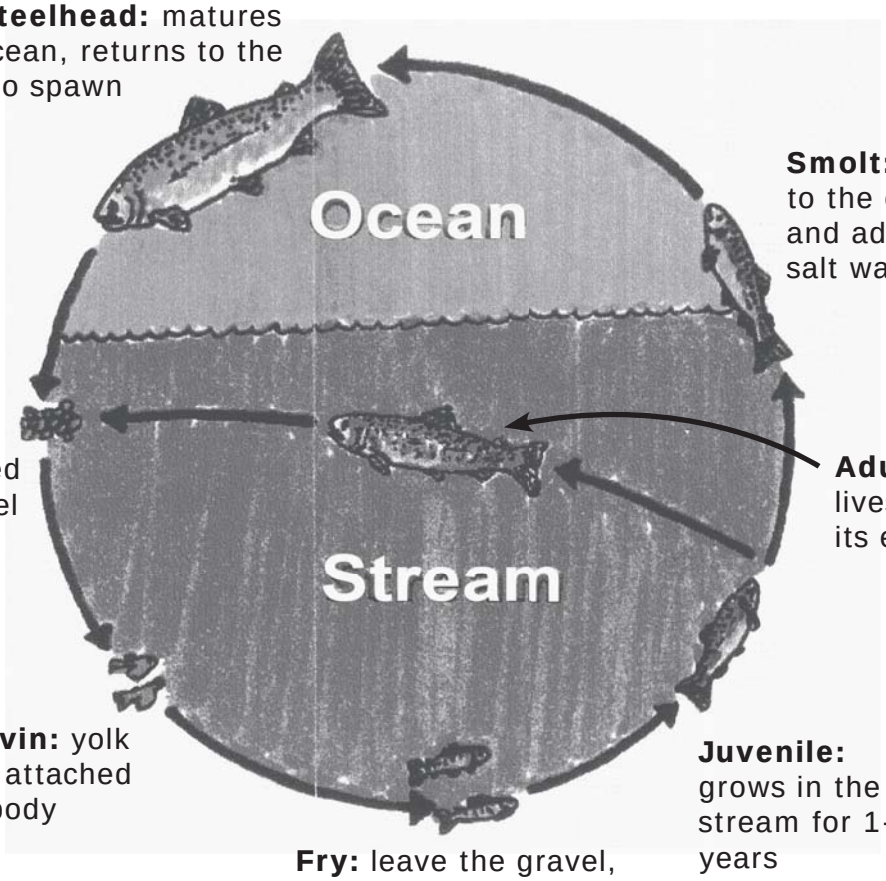
Please label the watershed above using the word bank.

WORD BANK

Watershed boundary
Tributaries
Main river stem
Estuary

STEELHEAD LIFECYCLE

FROM EGG TO ADULT



Adult Steelhead: matures in the ocean, returns to the stream to spawn

Smolt: swims to the ocean and adjusts to salt water

Eggs: deposited in stream gravel

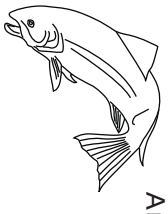
Adult Rainbow: lives in the stream its entire life

Alevin: yolk sac attached to body

Juvenile: grows in the stream for 1-3 years

Fry: leave the gravel, swim and catch food

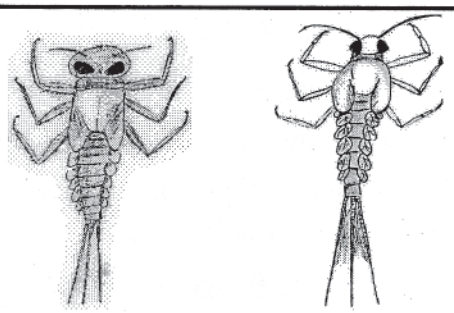
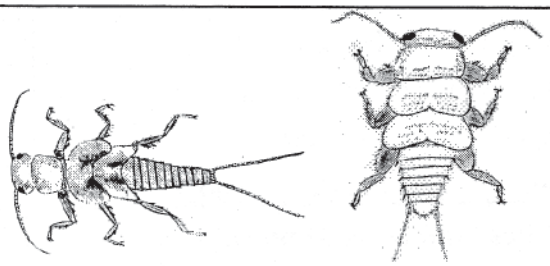
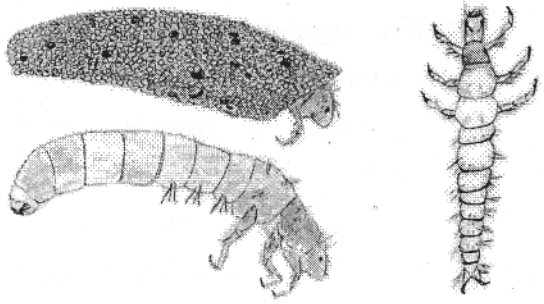
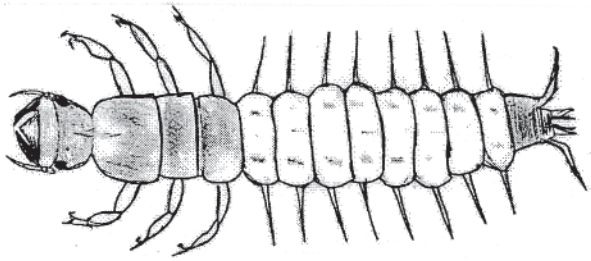
Draw one of the stages in the Steelhead lifecycle in the box below.



INVERTEBRATE PICTURE KEY

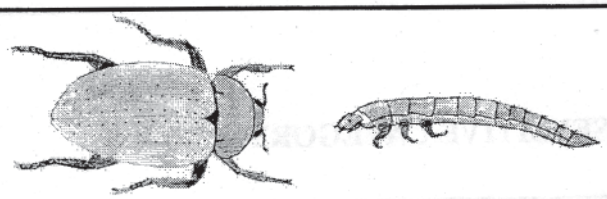
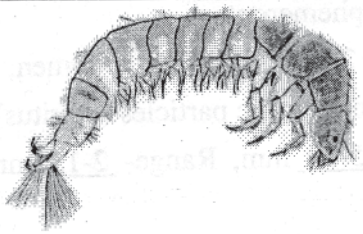
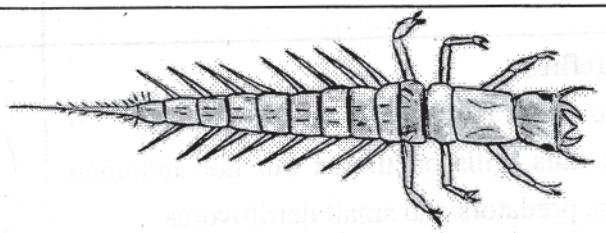
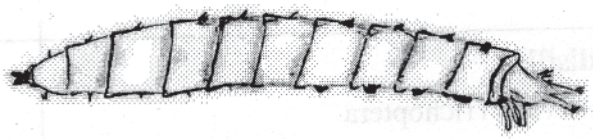
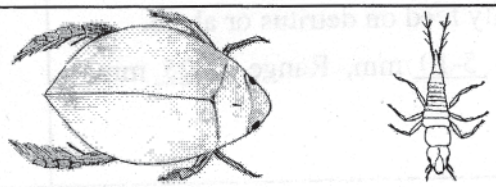
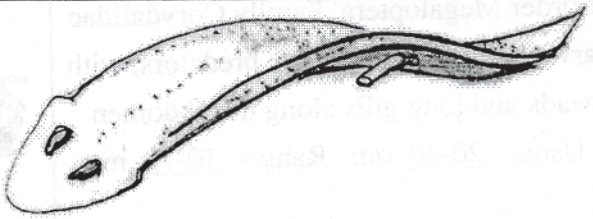
These creatures only live in streams that are very clean and have no pollution.

I. SENSITIVE CATEGORY

Mayflies Insect order Ephemeroptera Usually have 3 tails, gills on abdomen, and feed on algae or organic particles (detritus). Size: Usual- 5-10 mm, Range- 2-15 mm	
Stoneflies Insect order Plecoptera Two tails, gills on thorax but not abdomen. Large predators and small detritovores. Size: Usual- 10-20 mm, Range- 5-30 mm	
Caddisflies Insect order Trichoptera Usually construct a case but may be without, and commonly feed on detritus or algae. Size: Usual- 5-10 mm, Range- 2-25 mm	
Hellgrammites (fishflies or dobsonflies) Insect order Megaloptera, Family Corydalidae The larvae are large and active predators, with dark heads and long gills along the abdomen. Size: Usual- 20-30 mm, Range- 10-70 mm	

These creatures survive in water with a little pollution.

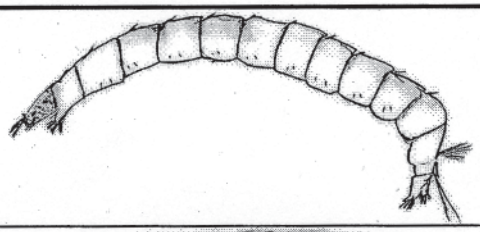
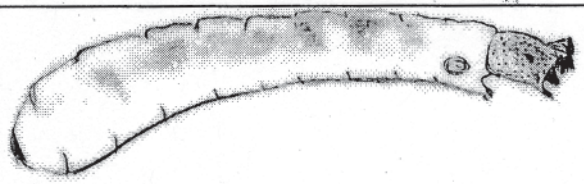
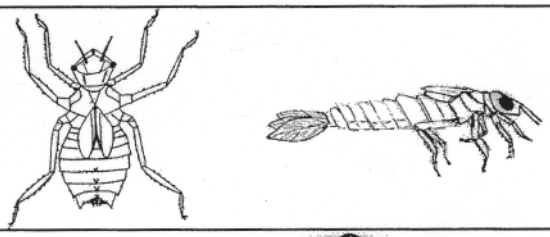
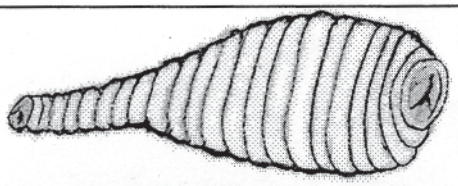
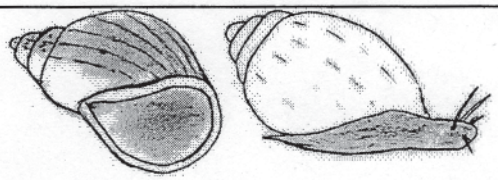
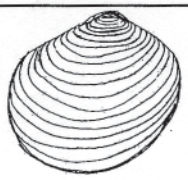
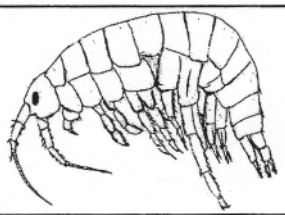
II. INTERMEDIATE CATEGORY

Riffle Beetles Insect order Coleoptera, Family Elmidae Adults & larvae of these small stout beetles are dark brown, and feed on detritus & algae. Size: Usual- 3-5 mm, Range- 2-10 mm	 ADULT LARVA
Net-Spinning Caddisflies Order Trichoptera, Family Hydropsychidae These caddisflies attach their case to rocks and spin a net to capture fine particle food. Size: Usual- 5-10 mm, Range- 3-15 mm	
Alderflies Order Megaloptera, Family Sialidae Medium size predators with gill filaments on the sides and tip of abdomen. Size: Usual- 5-15 mm, Range- up to 25 mm	
Crane Flies (and other Diptera) Insect order Diptera, Family Tipulidae Larvae maggot-like, segmented, gills at hind end finger-like, often feed on detritus. Size: Usual- 5-10 mm, Range- up to 50 mm	
Other Water Beetles (Order Coleoptera) Families Dytiscidae & Hydrophilidae Adults are active swimmers, both adults and larvae are predators or scavengers. Size: Usual 3-10 mm, Range- 2-30 mm	 ADULT LARVA
Flatworms (Class Turbellaria) Order Tricladida (commonly Planarians) No segments, often darker above and lighter below, predators and scavengers. Size: Usual- 5-10 mm, Range- 3-20 mm	

INVERTEBRATE PICTURE KEY

These creatures can survive in water with moderate pollution.

III. TOLERANT CATEGORY

Midges Insect order Diptera, Family Chironomidae Small fly larvae, often feed on fine particles. Size: Usual- 2-4 mm, Range- 1-10 mm	
Black Flies Insect order Diptera, Family Simuliidae Hourglass body-shape, particle filter-feeder. Size: Usual- 4-8 mm, Range- 2-12 mm	
Dragon- and Damselflies Insect order Odonata Stout-bodied predators with extendable jaws. Size: Usual- 10-15 Range- 5-40 mm	
Leeches Class Hirudinea Body flattened, segments & sucker, predators. Size: Usual- 10-20 mm, Range- 5-40 mm	
Snails Class Gastropoda Turban/ spiral-shaped shell, feed on algae. Size: Usual- 5-10 mm, Range- 2-20 mm	
Clams ("fingernail") Class Bivalvia, Family Sphaeriidae Shells speckled black / white, feed on detritus. Size: Usual- 2-5 mm, Range- 2-15 mm	
Scuds ("sideswimmers") Crustacean order Amphipoda White-yellow, flat, many legs, varied food. Size: Usual- 4-8 mm, Range- 2-12 mm	
Segmented Worms Class Oligochaeta Round body many segments, feed on detritus. Size: Usual- 3-10 mm, Range- up to 50 mm	

WATER QUALITY TESTING

IS THE ARROYO HONDO WATERSHED HEALTHY?

Why do we care about STEELHEAD TROUT in the Arroyo Hondo Creek?
Steelhead have very special requirements to survive, so their presence is a sign of a healthy creek and watershed.

Testing the Health of the Creek and Watershed

Steelhead HABITAT requirements

Water temperature _____
(less than 64 degrees F)

Dissolved Oxygen_____
(above 6 parts per million)

Turbidity _____
0-10 Jackson Turbidity Unit (JTU)

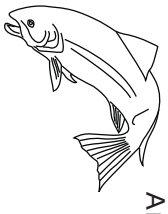
How clear is the water? Check one of the boxes.

Clear (I can see the bottom of the creek) ☐

Clowdy (I cannot see the bottom of the creek) ☐

Other HABITAT requirements for Steelhead

Check those you find.



_____ MOVING WATER to transport food and oxygen

_____ RIFFLES- to provide oxygen for the water

_____ GRAVEL- for redds (nest)

_____ ROCKS and BOULDERS for resting places

_____ ESTUARY for access to the ocean

_____ HIDING PLACES from predators

_____ OVERHANGING PLANTS AND TREES for food and shelter and to keep water cool

Conclusions
Review your results. Is the creek healthy?

REVIEW AND REMINDER

RIPARIAN HABITAT

From your observations, please answer the following questions:

1. What does the Arroyo Hondo watershed provide for the creatures living in or near the creek (riparian habitat)?

2. What organisms did you see in the riparian habitat?

3. Draw your favorite plant or animal found living near the creek.

4. Name at least 2 plants or trees you saw in the riparian habitat. Why are plants and trees important in the riparian habitat?

5. On the Nature's Drain page, color in the riparian habitats (page 84).

REVIEW AND REMINDER

STEELHEAD

You are a Steelhead Trout:

1. What creatures did you find in the creek that you might eat?

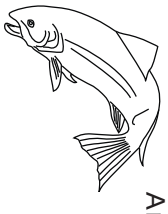
2. What creatures did you find that might eat you?

3. Why is the estuary important?

4. What is the benefit of the new fish passage in the culvert?

5. Why would you like living in the Arroyo Hondo creek? Why not?

6. Draw the Steelhead Trout lifecycle in the box below.



Is the Watershed Healthy?

Do you think the Arroyo Hondo creek is healthy? _____

Why?

Why not?

We hope you had fun during your exploration of the Arroyo Hondo Preserve and saw examples of the roles all animals and plants play in the world in which we live...you included!

Bonus questions

1. What can you do to help keep creeks clean and healthy?

2. What can we do to help take care of our watersheds?

3. If you find a lot of Helgrammites in a stream, what does that tell you about the health of the stream?

4. Why is it important to creatures living in a stream to have plenty of vegetation along the edges of the stream?

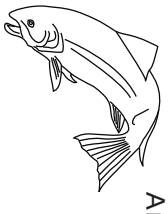
5. Where do the creatures living in a stream get their food?

What did you see?

What did you learn?

What did you do?

What did you hear?



Arroyo Hondo Preserve

Chapter 7. EXPLORING CALIFORNIA'S NATIVE FLORA

Welcome to Santa Barbara Botanic Garden!

The Santa Barbara Botanic Garden is an amazing place. As you walk around, you will see habitats from all over California and these habitats include some of the rarest plant species found on the Central Coast. See if you can find the Redwood Sorrel, some grinding stones that the Chumash used to grind acorns into flour, a turtle (red-eared slider) and a plant that you should never touch (Poison Oak). Notice the different sizes, shapes and textures of plants. Many of the plants you see have special adaptations for the particular habitat in which they live. Most of all, enjoy the garden and come back throughout the year as there is always something new to see.

Focus Questions

Circle the habitat types that you have observed so far on the KIN field trips.

Riparian Oak Woodland Coastal Sage Scrub Redwood Forest

Grassland Kelp Forest Beach Dune Rainforest Chaparral

How can disturbances such as fires or floods affect different ecosystems?

Challenge Words

Listen for these words during your visit. If you hear them and know the definition, be sure to tell us.

A **disturbance** is an event or change in environmental conditions, such as a fire, flood, or storm that causes distinct changes to an ecosystem.

Symbiosis is the close interaction or living together of different organisms. The interaction is usually beneficial to both organisms.

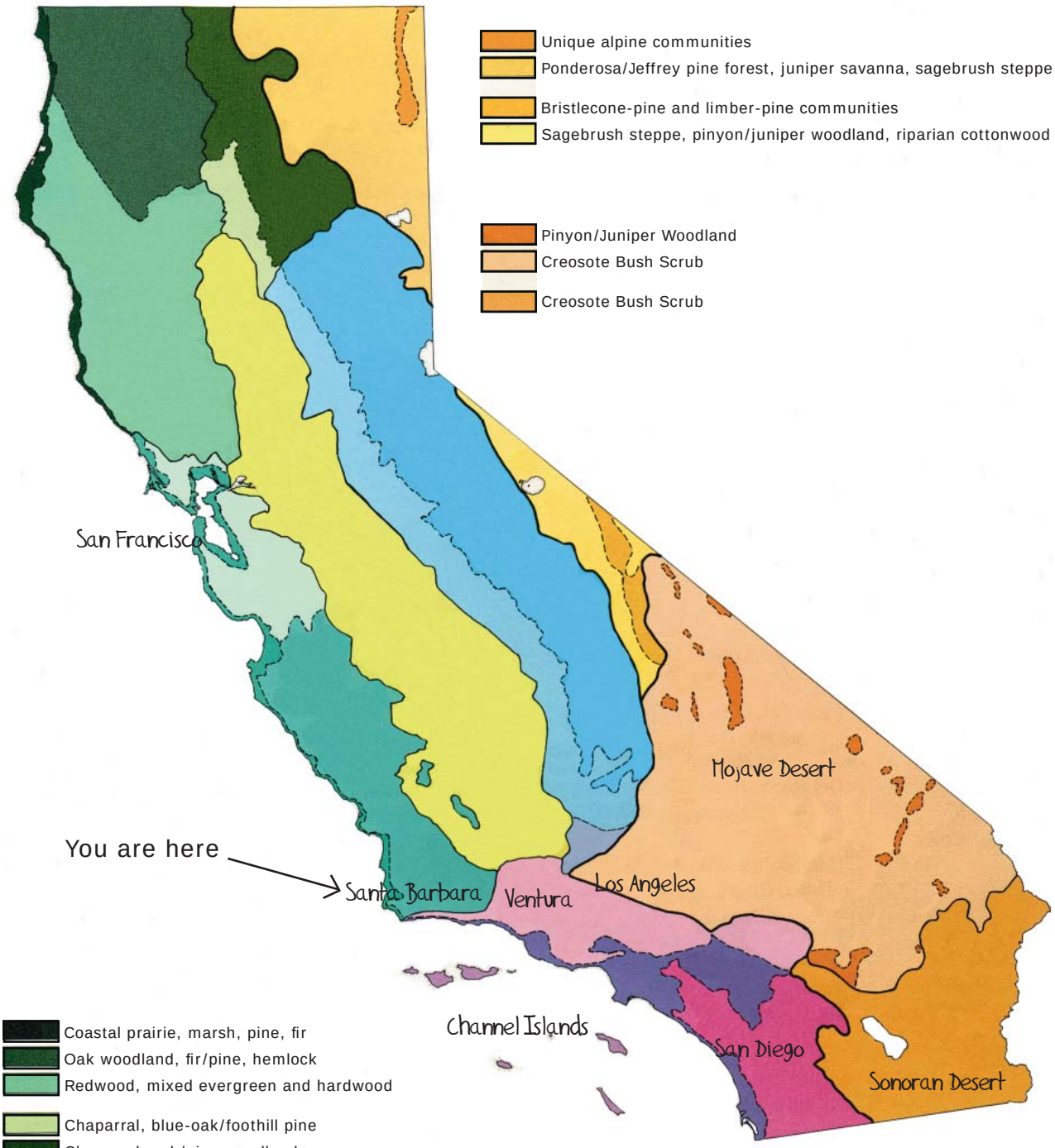
A **pioneer species** is a species that is the first to grow in a new area.

Chaparral habitat is characterized by a Mediterranean climate (mild winters and hot, dry summers) and consists mainly of low growing shrubs.

An **ecosystem** is all of the living organisms existing together in a particular area.

CALIFORNIA'S BIODIVERSITY

WHAT PLANTS GROW WHERE IN CALIFORNIA



ALICE ALGA TOOK A LICHEN TO FREDDY FUNGUS

SYMBIOSIS IN LICHENS

What are lichens?
Lichens are organisms characterized by symbiotic relationships between fungi and algae or bacteria. Since fungi are unable to make their own food, they are often parasites (an organism that lives in or on another organism) or decomposers (an organism that decomposes organic material). Some fungi have developed partnerships with algae or bacteria in which the fungi provides a home for the algae or bacteria in exchange for nutrients.

Fun Facts

Mite

Lichens provide food for many types of animals from deer to mites. Mites are arachnids.

Hummingbird nest

Lichens are used by birds and squirrels for nesting material and provide habitat and camouflage for invertebrates. Look at the hummingbird nest and see if you can spot the lichens.

Lichens growing on a log

Lichens are often pioneer species, the first to grow on a bare spot on a rock, tree, log, or soil.

Lichens growing on a rock

Lichens are mainly decomposers, even breaking down rocks!

ALICE ALGA TOOK A LICHEN TO FREDDY FUNGUS

SYMBIOSIS IN LICHENS

Even More Fun Facts

There are over 15,000 different species of lichens that have been found throughout the world.

Lichens grow very slowly, sometimes less than one millimeter per year!

This lichen is called reindeer lichen...any thoughts on what animal might eat it?

Lichens can grow almost anywhere. They are found on every continent on earth.

1. Find a boulder in the garden. How many different colored lichens can you count?

2. Why can't the fungus and alga live without each other?

Chaparral Habitat

Adapting to Survive in the Dry, Coastal Mountains

A chaparral habitat is a shrub community adapted to conditions with limited rainfall, intense heat, fire, wind, and steep slopes with rocky soils.

Look towards the mountains at the chaparral communities. What kind of environment are the plants living in? What adaptations do you see that the plants might have evolved to survive in these conditions?

Manzanita

Sagebrush

Coast Live Oak

Coyote Brush

Characteristic	**Adaptation**	**Example**
Light Colored Leaves	Reflects sunlight	California sagebrush
Small Leaves		
Woody Stems		
Grayish Leaves		
Spiny Leaves		

IN THE SHADOW OF THE GIANTS

EXPLORING THE REDWOOD FOREST

As you walk down the trail from the meadow toward the canyon floor, take note of the change in light, temperature, and moisture. What do you see and feel?

- Is it warmer or cooler?
- Is it lighter or darker?
- Is it drier or more moist?

The tallest Redwood tree is 379 feet tall.

How tall are you?

How much taller than you is the Redwood tree? 379ft - _____ =

What do you notice about the plants growing under the Redwood trees?

Why don't you see a lot of different plants?

Does sunlight touch any of the Redwood Sorrel (Oxalis) growing under the trees?

If so, what happens to the leaves? Why might this be an adaptation?

WORD BANK

Evergreen plants keep their leaves all year long.
Deciduous plants shed their leaves seasonally.
The **forest canopy** is the uppermost layer of forest habitat formed by the tops, or crowns, of the trees.
The **forest understory** is the lowermost or bottom layer of the forest, we can call it the forest floor.

WHO NEEDS FIRE?

A PLANTS GUIDE TO SURVIVING A FIRE

Let's look for clues....

Do you see any evidence of a fire in the recent past? Write down some of the things you noticed.

Are wildfires always bad? Why? Why not?

What adaptations might plants have that would allow them to survive a fire? Circle the correct answers.

Thick bark	**Fire extinguisher**	**New growth from underground**
A cell phone	**Protected buds**	**Seed germination due to fire**
An ice pack	**Self pruning lower branches**	

A sycamore tree re-sprouting from the burned stump

Plants re-sprouting after a fire

NATURE JOURNAL

RIPARIAN HABITAT

A riparian habitat is the land and plants situated along the banks of a river or stream.

We're going to explore the riparian habitat using some of our senses:

Close your eyes and listen to the sounds around you. List 3 sounds you can hear.

1. _____ 2. _____ 3. _____

What do you think is making those sounds?

Close your eyes again and breathe deeply, smelling all of the different smells around you. List 2 of the smells.

1. _____ 2. _____

Where are the smells coming from?

Open your eyes and look around you. List 5 things you can see (for example: trees, birds, clouds).

1. _____ 2. _____ 3. _____

4. _____ 5. _____

Draw one of the items you listed above.

Write down anything else you would like to remember about this riparian habitat.

NATURE JOURNAL

REFLECTING ON YOUR BOTANIC GARDEN EXPERIENCE

What did you see?

What did you learn?

What did you do?

What did you hear?

Chapter 8. CELEBRATION DAY

Welcome back to the Cheadle Center for Biodiversity and Ecological Restoration!

Congratulations on completing Kids in Nature!

Today we're going to do a bunch of fun things.

You will learn about some of the different types of feathers on a bird's body, different shaped beaks some birds have and the type of food they are adapted to eat. You will also have a chance to see and touch some live birds. Are you ready to hold some reptiles and learn some cool facts about what makes reptiles so unique, like why reptiles have scales and like to bask in the sun?

You will be learning how to make rope using local materials like tule and cattails. The technique used to make these ropes is the same technique used by American Indians. We'll also do some face painting and make clapper sticks, a type of musical instument.

Focus Question

What was your favorite part of Kids in Nature and why?

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