USDA

United States Department of Agriculture

Farm Service Agency

Natural Resources Conservation Service

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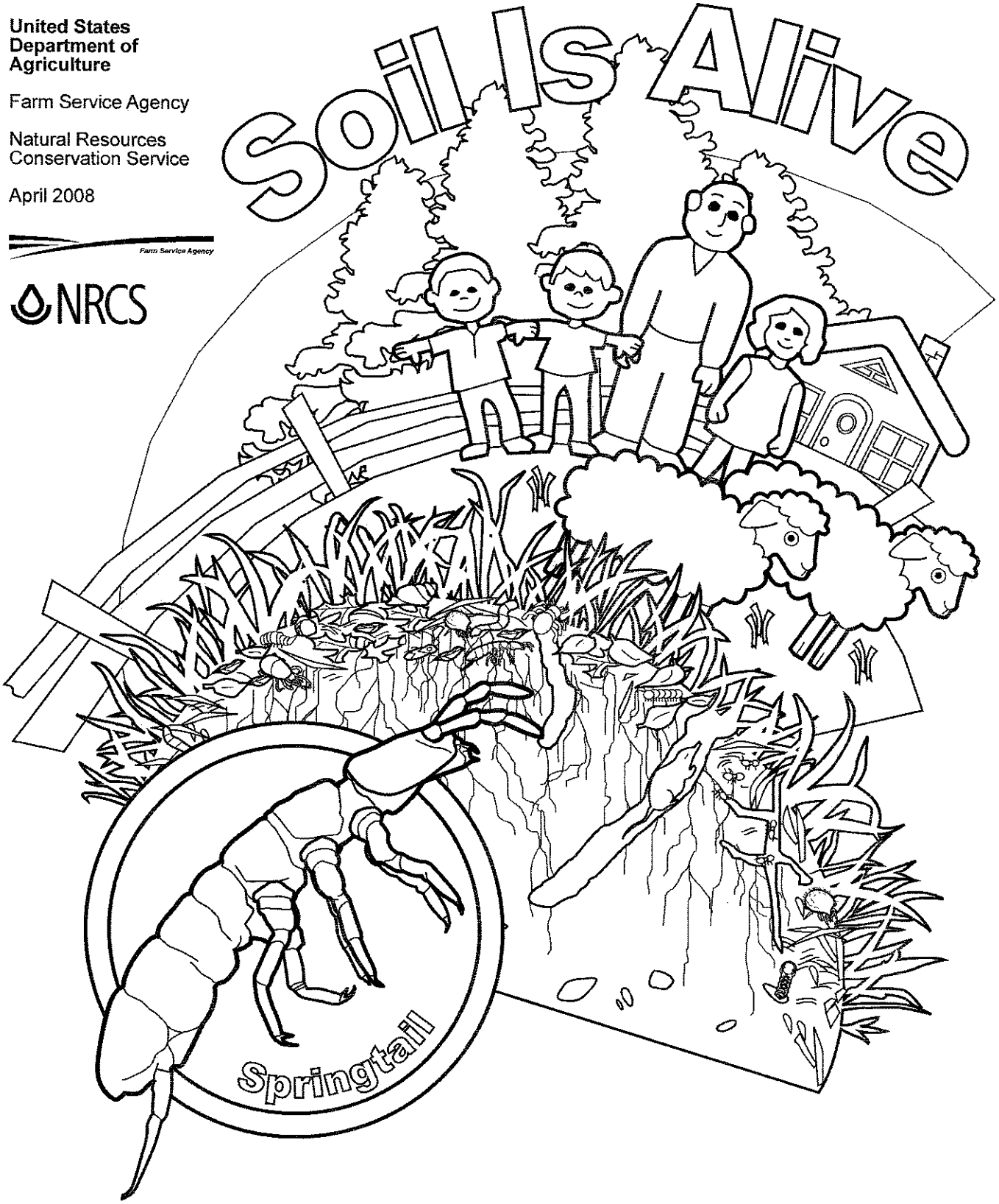
Farm Service Agency

NRCS

Soil Is Alive



Helping People Help the Land

What Makes Soil Alive?

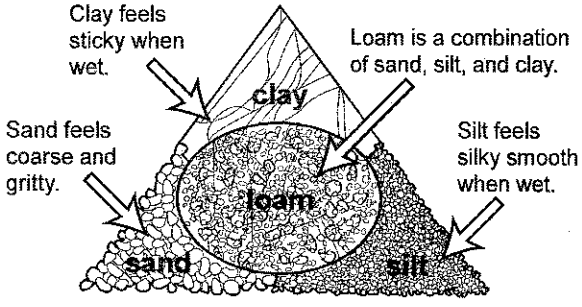
We can all see things that live ***on*** the soil such as plants, animals and people, but did you know there are a lot of things that live ***in*** the soil? Things living in the soil are called soil organisms. Some organisms are big enough to be seen with your eyes, other organisms are so small they can only been seen with a magnifying glass or a microscope. The job of the organisms is to keep the soil healthy. "Springtail" is one of the soil organisms that help keep soil alive and healthy. We will follow Springtail throughout this activity book as he explores the soil beneath his feet, bugs, storing carbon and mineral matter in the soil, and painting with soil.

Soil is a living thing – it is very slowly moving, changing and growing all the time. Just like other living things, soil breathes and needs air and water to stay alive. Healthy, living soil provides us with our everyday needs. Not only the obvious things such as food, grass, plants and trees but also some not-so-obvious things like medicines, paint, paper, ink, chalk and shampoo just to name a few.

Soil Sprouts Life

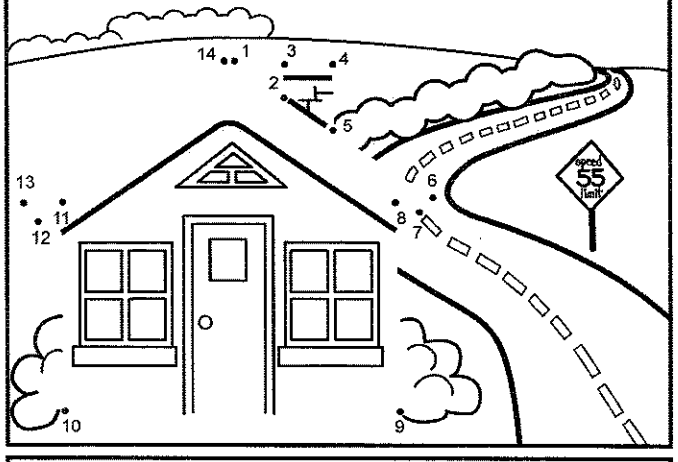
Soil supports all kinds of living activities. It nourishes crops that we use for food and trees that we use for building materials. Wildlife and livestock survive by eating plants that grow on the soil. We build houses and roads on top of the soil.

soil textures

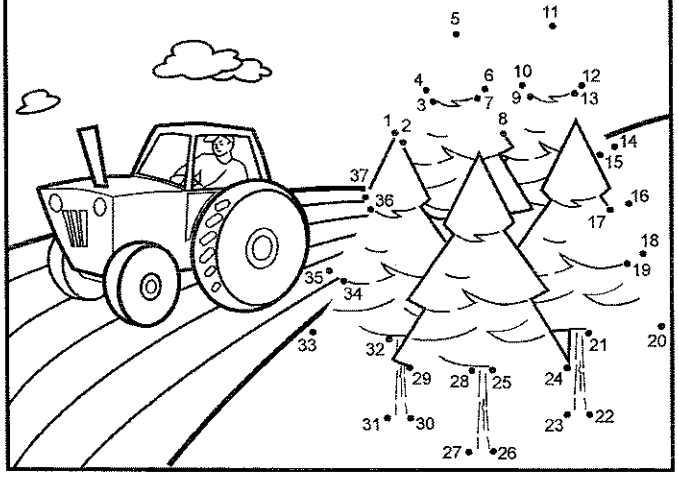


A different type of soil is written in each picture box. Connect the dots to see the type of activity for which that soil is well-suited.

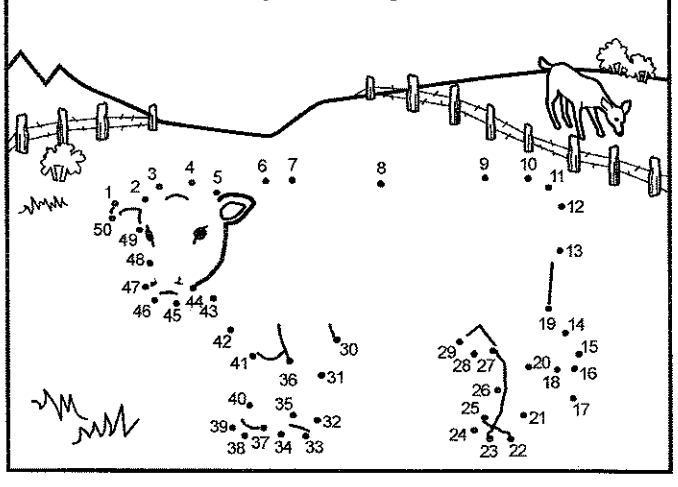
gravely or sandy soil



loamy organic soil



steep or stony soil



Right Beneath Your Feet

When you look at soil can you see the different layers? These layers in the soil are called soil horizons.

The **O horizon** is the top layer. It is made up of plant litter and keeps the soil very healthy. The plant litter decomposes into nutrients that enrich the soil and form the next layer.

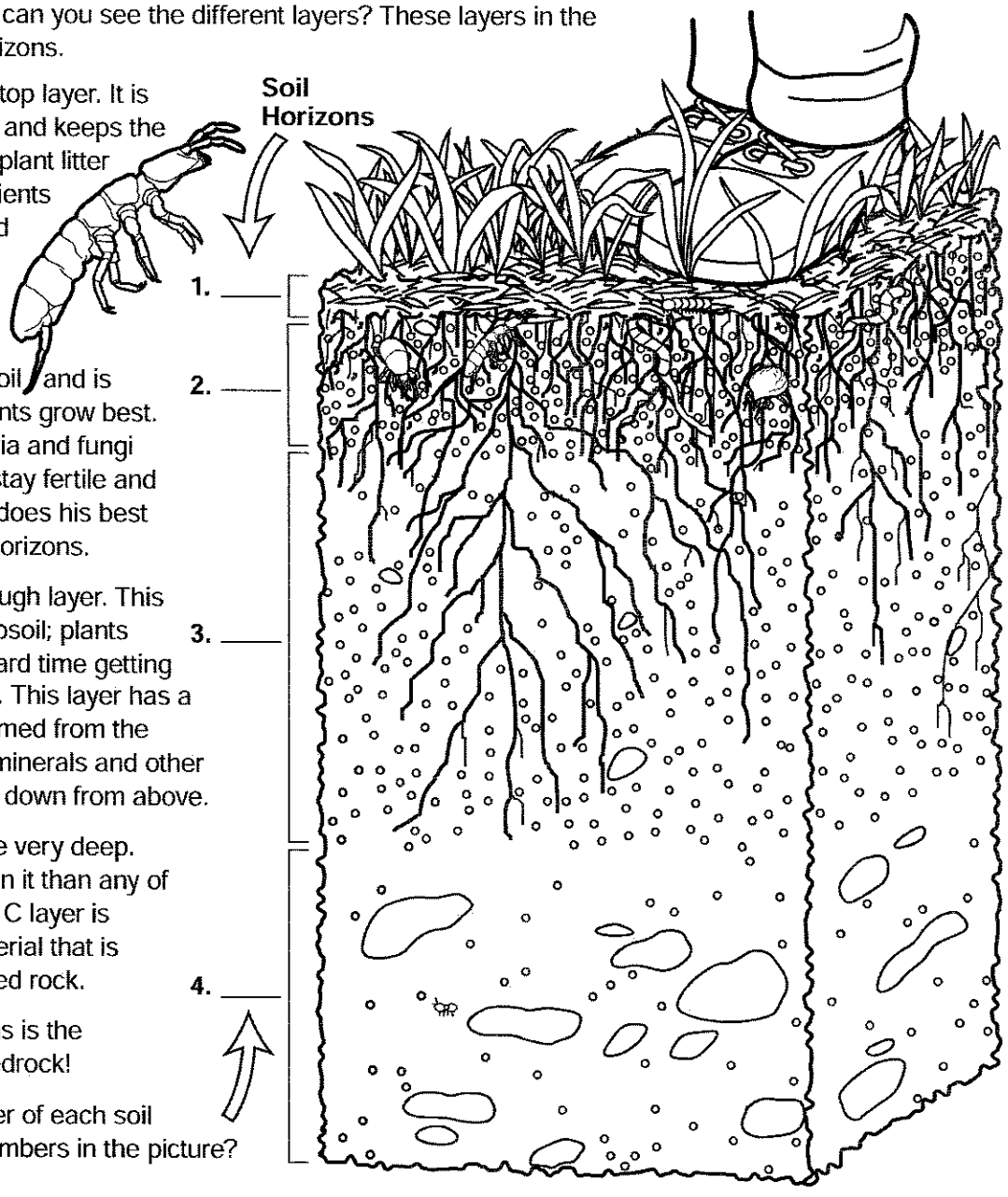
The **A horizon** is the living layer. This layer is also called the topsoil and is where the roots of plants grow best. It is also where bacteria and fungi live that help the soil stay fertile and hold water. Springtail does his best work in the **O** and **A** horizons.

The **B horizon** is a tough layer. This layer is also called subsoil; plants and animals have a hard time getting through the B horizon. This layer has a lighter color and is formed from the accumulation of clay minerals and other compounds that seep down from above.

The **C horizon** can be very deep. It has less living stuff in it than any of the layers above. The C layer is formed by parent material that is created from weathered rock.

Below the soil horizons is the hardest layer of all: bedrock!

Can you write the letter of each soil horizon next to the numbers in the picture?



Edible Soil Recipe

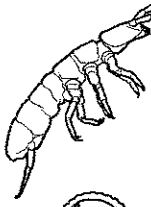
You can make edible soil with food that looks like all the different soil horizons. What you will need: Clear cup, cookies, vanilla pudding, chocolate pudding, and sprinkles

1. Place a whole cookie at the bottom of the cup. The cookie symbolizes the bedrock found under the soil.
2. Crumble up a cookie or two and drop the pieces on top of the whole cookie. The crumbled pieces symbolize the C horizon and parent material.
3. Spread vanilla pudding over the cookies. The light pudding symbolizes the B horizon and the subsoil.
4. Spread the chocolate pudding over the vanilla. The dark pudding symbolizes the A horizon and all the nutrients found in topsoil.
5. Drop the sprinkles on the top. The sprinkles symbolize the O horizon and the plant litter above the topsoil.

Bugs in the System

Let's take an even closer look at the soil. An area that includes the soil and all living and nonliving things within it is called a soil ecosystem. If you look at soil under a magnifying glass, you'll find some tiny critters that are part of a healthy soil ecosystem. They help keep the soil alive and growing. Some of them are especially wanted by farmers and ranchers to make their soil better for growing plants. Springtail and others like him are good for the soil because they chew up litter like dead grass and leaves into small pieces that bacteria and fungi can decompose. Decomposition means the pieces are broken down so small they become part of the soil. The decomposed plant and animal material is called organic matter and it is one of the major components of soil.

See if you can find these critters in the soil ecosystem picture. Put a circle around the ones you find or color them YELLOW for YES, they are wanted in the soil.



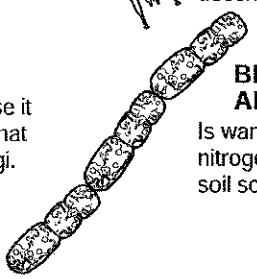
Springtail
Is good for the soil because they release nutrients plants need and eat diseases caused by fungi.

Mold
This fungus decomposes plant litter and returns nutrients to the soil.

Shredder Soil Mite
Shreds a lot of litter for bacteria and fungi to decompose.

Millipede
This bug is good for the soil because it is a shredder.

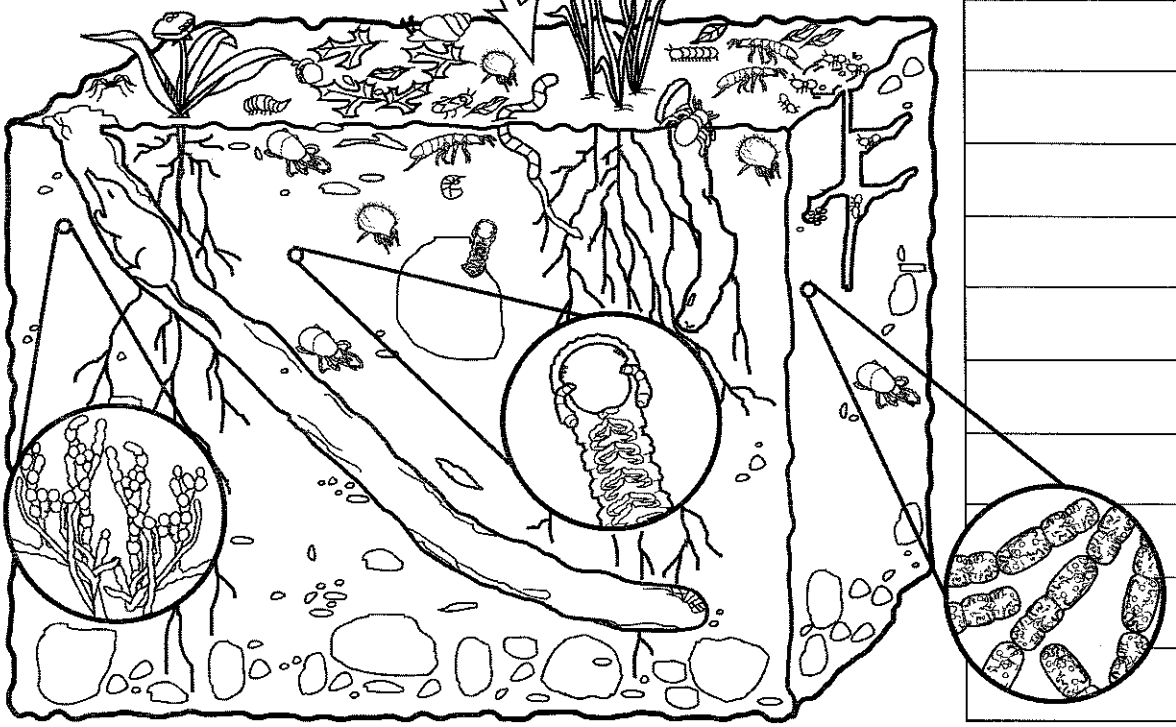
Predatory Soil Mite
It is called predatory because it hunts other soil organisms that eat helpful bacteria and fungi.



Blue-Green Algae
Is wanted for fixing nitrogen from the air in soil so plants can use it.

Soil Ecosystem

Earthworms move soil from lower strata up to the surface and move organic matter from the soil surface to lower layers.



What else do you see in this soil ecosystem?

Soil: The Carbon Catcher!

Carbon sequestration is a fancy way of saying carbon storage. Carbon dioxide is a gas that may contribute to global warming if released in the air. Storing carbon can help keep our planet cool.

In Montana, farmers, ranchers, and foresters help keep carbon out of the air by planting crops, maintaining healthy grasslands, and planting trees. Farmers help store carbon because the roots of their crops put carbon into the ground. When its harvest time, farmers can practice "no-till" or leaving the stumps and roots of the old crops in the ground. Plowing or tilling the ground releases the carbon into the air.

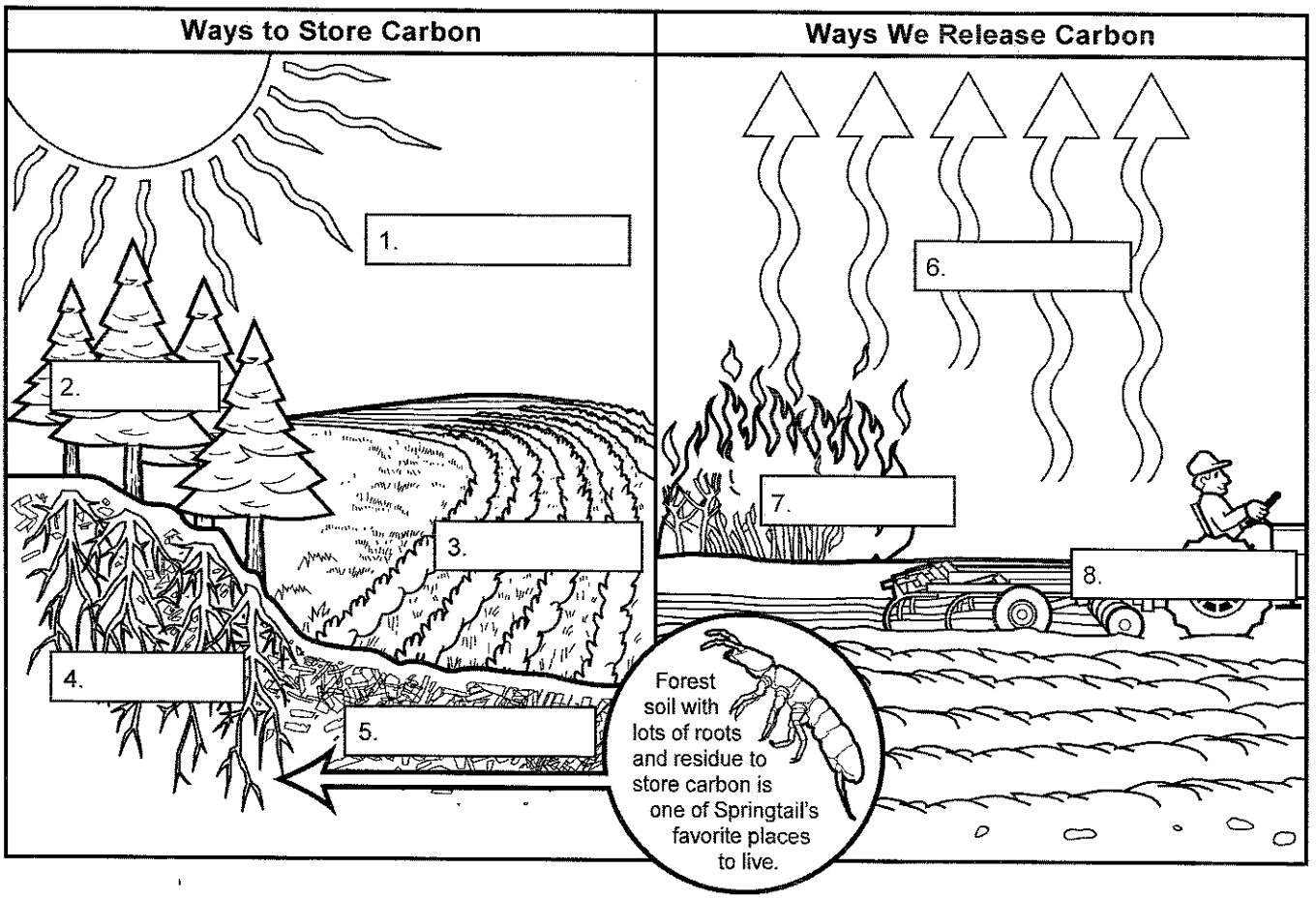
Ranchers help store carbon because the grass their livestock depend on adds carbon to the soil through vast root systems that stretch for miles. Because rangeland is the largest portion of Montana's agricultural land, ranchers must be careful because overgrazing can cause soil compaction and prevent carbon from entering the soil.

Foresters help store carbon by planting trees and managing forests. Every year, a tree adds a new tree ring; this is another layer of carbon that the tree stores. By reducing hazardous fuels, foresters can also prevent forest fires. Forest and range fires release the carbon stored by trees and grasses into the air.

Soil is a great carbon catcher because it holds the roots of crops, grasses, and trees and also catches their fallen residue like leaves and pine needles. Over time, the soil stores more and more carbon keeping the air clean and free of carbon gases. Now that's cool!

Can you help make better air by labeling the different parts of the picture with the following words:

gases | trees | roots | plowing | organic matter | no-till | healthy air | fire



Minerals Matter

What color is soil? It's not all just brown. Look closely and you will see some different colors. The color of the soil depends on what it's made of. Soil with lots of organic matter usually looks brown or black. Other colors like yellow, red, or white come from the mineral matter component of the soil.

Black/Dark Brown
Soil that has high organic matter content and nutrients for plants.

Yellow or Gold
Soil from certain sandstones.

Light Brown
Clay soils with low organic matter content. Soils formed mainly in materials left from ancient sea beds.

Red
Soil with high iron content.

White or Cream
Soil with high amounts of lime or formed in wind-blown silty material.

All these words have something to do with soil color. Find and circle them in the word puzzle.

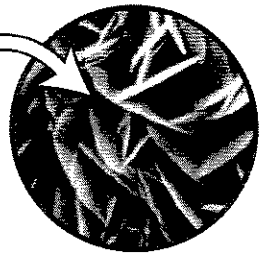
MINERAL
BLACK
ORGANIC
YELLOW
SANDSTONE
BROWN
CLAY
RED
IRON
CREAM
LIME
SILTY

K	L	S	I	L	T	Y	O	S	P
E	I	B	L	A	C	K	A	A	K
I	M	P	Y	E	L	L	O	W	S
A	E	U	V	B	A	S	D	J	O
B	I	R	O	N	Y	K	V	G	R
R	Q	R	E	D	E	M	S	T	G
C	R	E	A	M	Y	S	P	V	A
S	A	N	D	S	T	O	N	E	N
M	I	N	E	R	A	L	Y	N	I
T	O	C	C	B	R	O	W	N	C

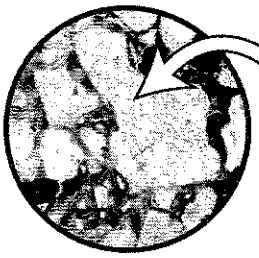
Under the Microscope

These soil photos were taken through a microscope. What color do you think each soil might be? Write the color next to the photo.

When iron crystalizes in soils, it can look like this under the microscope.



1. _____



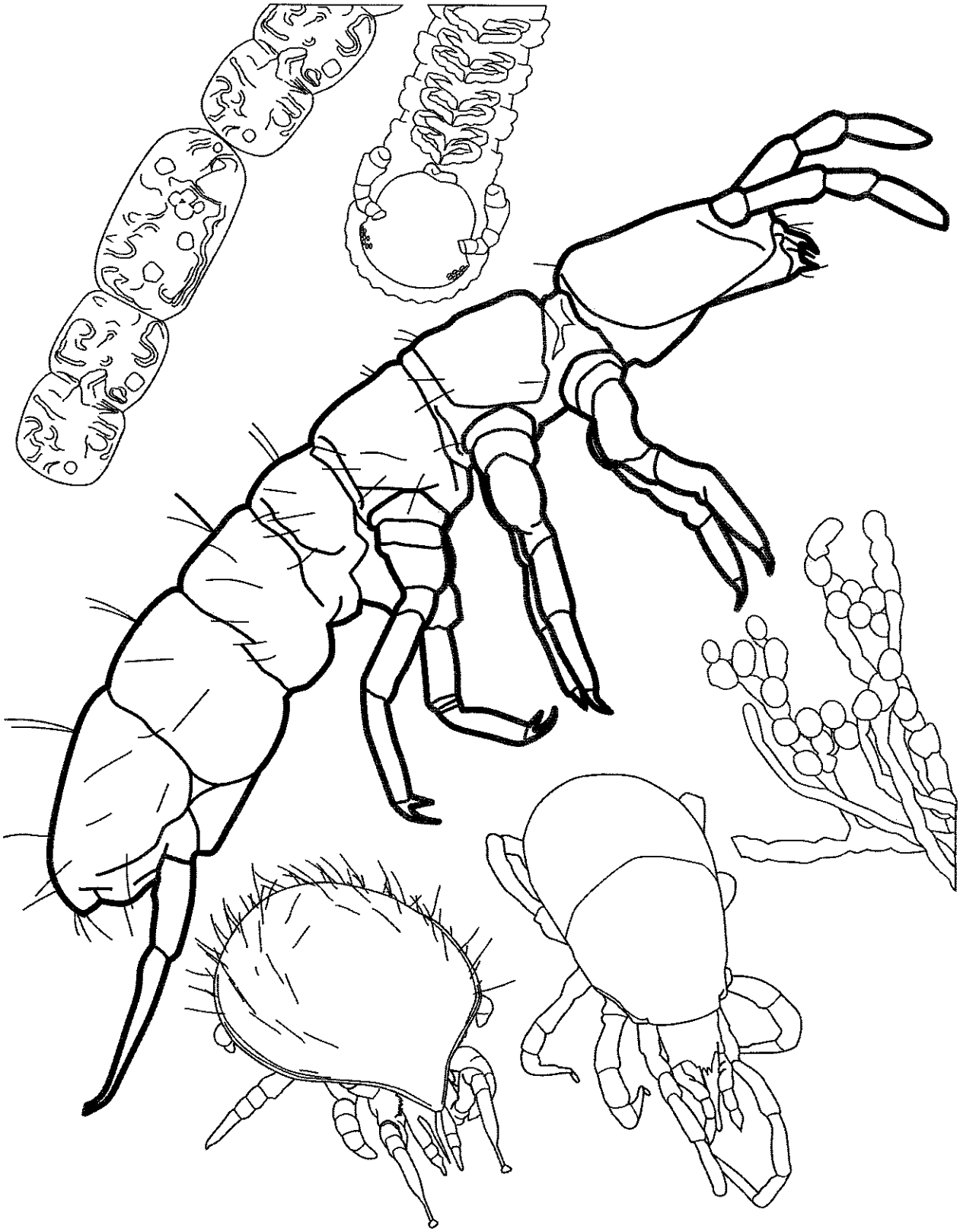
Under a microscope, sand grains look as big as gravel stones.

2. _____

Soil Paint Recipe

1. Prepare soil samples:
   - Collect samples of soils with different colors and textures (about 2/3 cup).
   - Remove grass, rocks, roots, and bugs from the samples you collected.
   - Air-dry the soil samples.
   - Once they are dry, place the soil samples in resealable freezer bags, one for each type of soil.
   - Use a rolling pin to break down the large chunks in each sample.
   - Pour the contents of one bag into a sifter with large mesh.
   - Sift the soil onto a paper plate. Discard the large particles that separate out during sifting.
   - Repeat these steps for each bag of soil.
2. For each soil color, pour the finely sifted soil into a plastic cup, filling them about two-thirds full.
3. Add enough water to each cup to make a batter the consistency of a "mud-brownie." Stir until combined.
4. Add about one teaspoon of acrylic medium (available at arts and crafts stores) to each cup. Stir until smooth. Add more medium if needed.
5. Be careful. Add only a little liquid at a time. If you add too much, the color will be too light in the paintings.

Try out the soil paint you made by painting Springtail in this picture of soil organisms. You can use other paint, crayons, or colored pencils too.

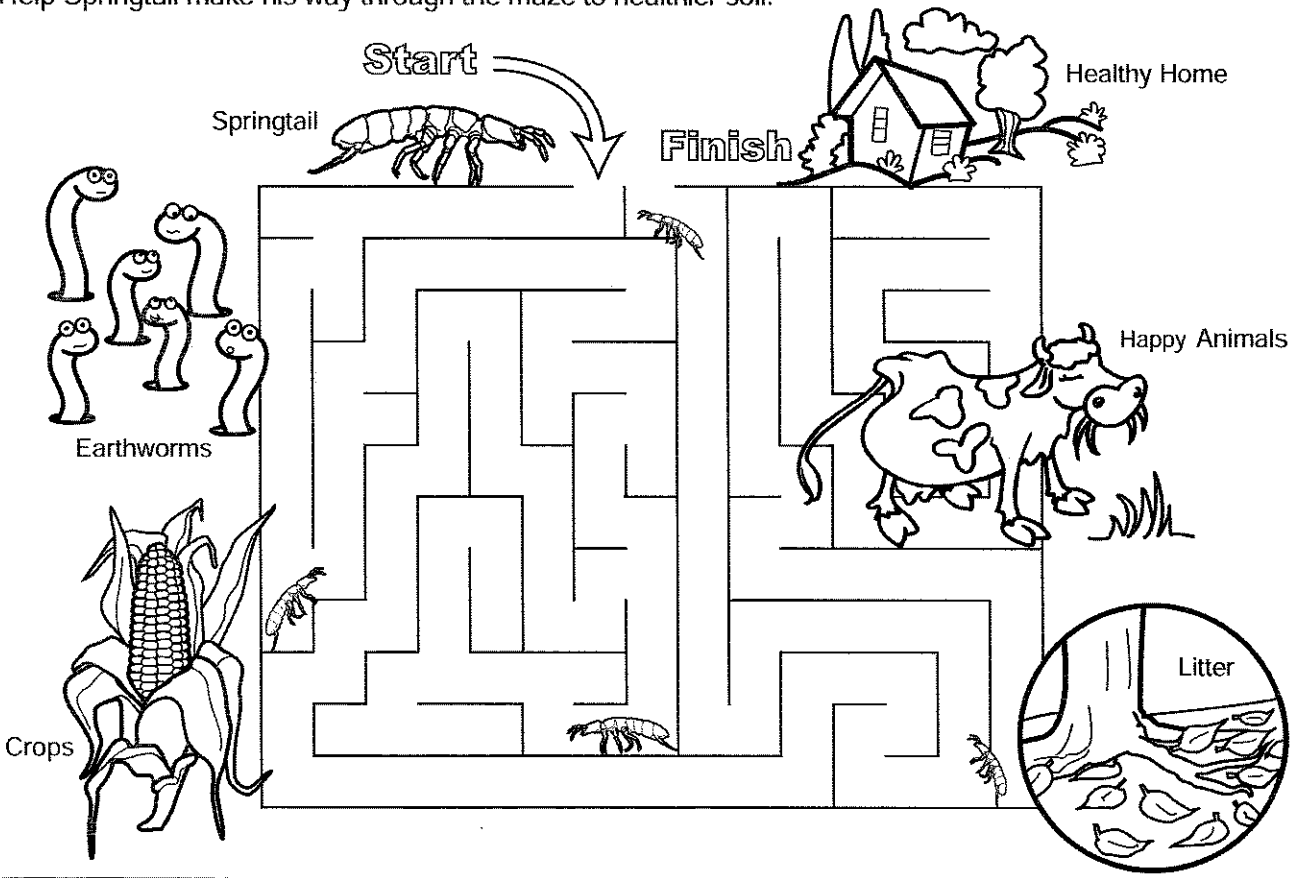


Spring into Action and Keep Soil Alive

Conserving and protecting the soil is the best way to make sure the soil stays alive and healthy. We can all do our part in keeping the soil healthy. When growing crops, we can let the unused parts of the plants return to the soil as organic matter. Our food scraps and grass clippings can be placed into a compost bin and put back into the soil when they are decomposed. We can also grow grass and trees to cover the soil and keep it from eroding (blowing or washing away.) Eroding soil pollutes the air and water and makes them unsafe for all of us to breathe and use.

The Farm Service Agency and Natural Resources Conservation Service are agencies under the United States Department of Agriculture. These agencies help Montana farmers and ranchers conserve soil, water, and energy while providing high quality food, fiber, and wildlife habitat. By practicing what you have learned in this activity book, you too can join Springtail in doing something to keep the soil where we want it to be, "right beneath our feet."

Help Springtail make his way through the maze to healthier soil.



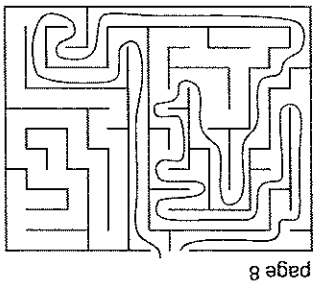
Answer Key

page 6

K	L	S	I	L	T	Y	O	S	P					
E	I	B	L	A	C	K	A	A	K					
I	M	P	Y	E	L	L	O	W	S					
A	E	U	V	B	A	S	D	J	O					
B	I	R	O	N	Y	K	V	G	R					
R	Q	R	E	D	E	M	S	T	G					
C	R	E	A	M	Y	S	P	V	A					
S	A	N	D	S	T	O	N	E	N					
M	I	N	E	R	A	L	Y	N	I					
T	O	C	C	B	R	O	W	N	C					

1. red 2. yellow

page 8



page 3

1. O
2. A
3. B
4. C

page 5

1. healthy air
2. trees
3. no-till
4. roots
5. organic matter
6. grasses
7. fire
8. plowing

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