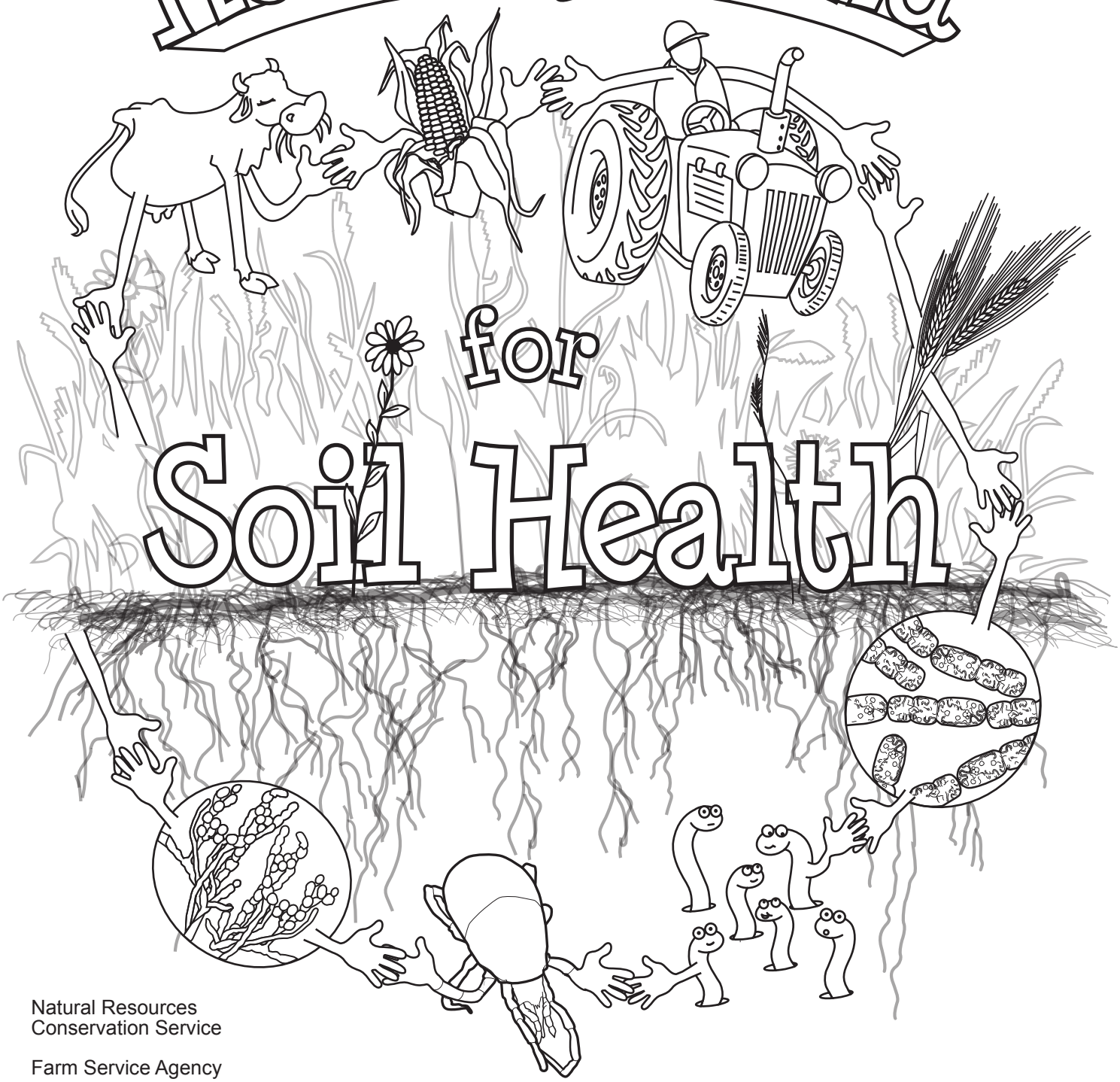
USDA

United States Department of Agriculture

Hand-in-Hand for Soil Health



Natural Resources
Conservation Service

Farm Service Agency

April 2014

Helping People Help the Land

Where does soil come from?

Soil is the upper layer of earth in which plants grow. Soil is needed to grow food for animals and humans. But where does soil come from? How is it made?

Soil formation begins with large rock, minerals and humus. Humus is decayed plants and animals. After thousands of years, wind, water and organic material break down the surface rock into smaller pieces or particles. These small particles form a thin layer of soil.

As soil particles lay on top of each other, they begin to form layers. These layers are called horizons. You can see the various horizons when you dig a hole.

Soil horizons

The O horizon is the top layer. It is made up of plants that have fallen onto the ground (called litter) and keeps the soil very healthy. The plant litter breaks down or decomposes into nutrients that make the soil healthier and form the next layer.

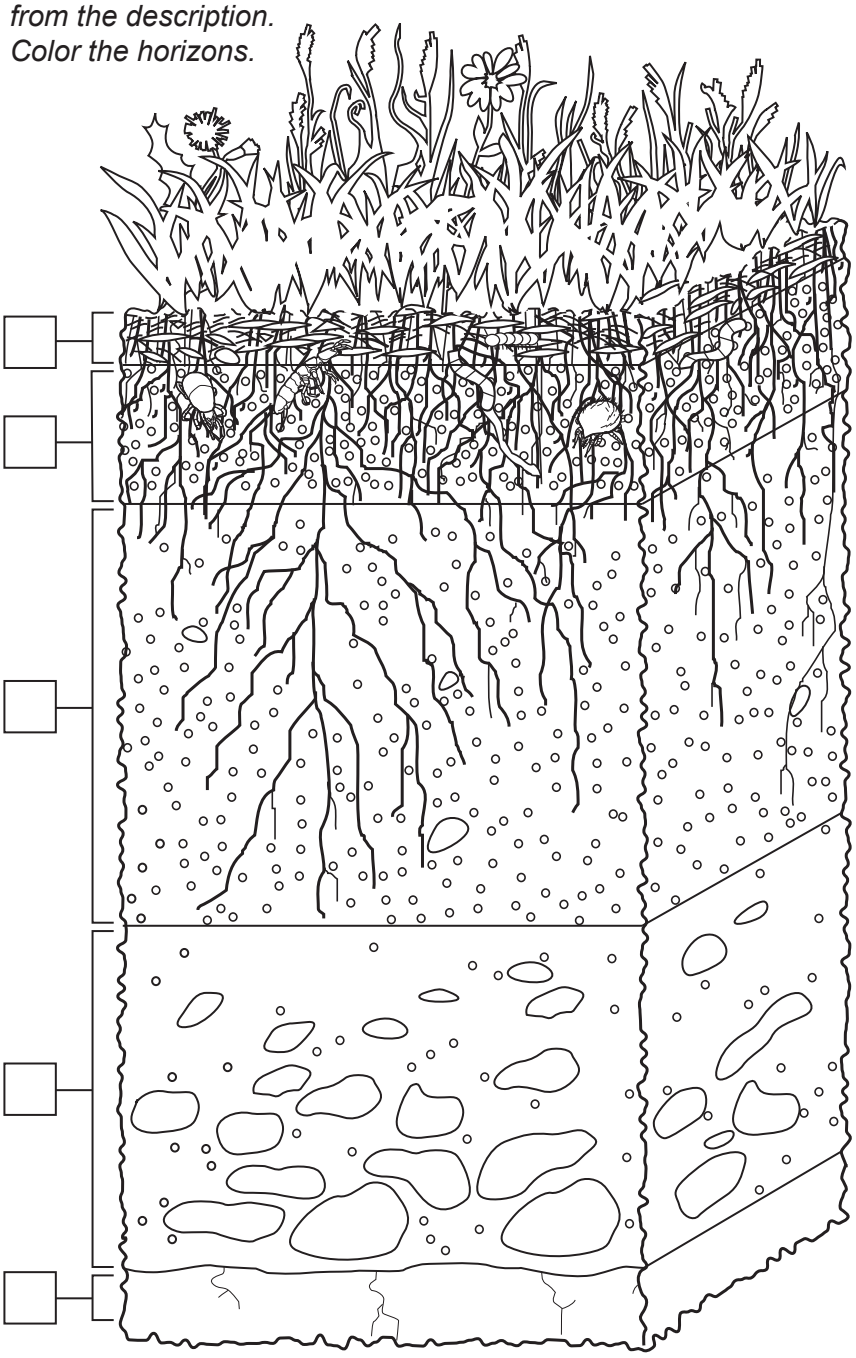
The A horizon is the living layer. This layer is also called the topsoil and is where the roots of plants grow best. It is also where bacteria and fungi live that make the soil able to grow plants and hold water.

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 made from 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 made by parent material that is created from weathered rock.

The D horizon is the bedrock that lies beneath the soil. In some places this can be quite near the surface and in others it is very, very deep.

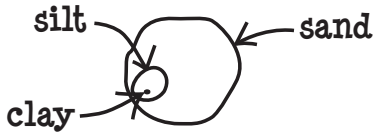
Next to each horizon, put the letter that matches from the description.
Color the horizons.

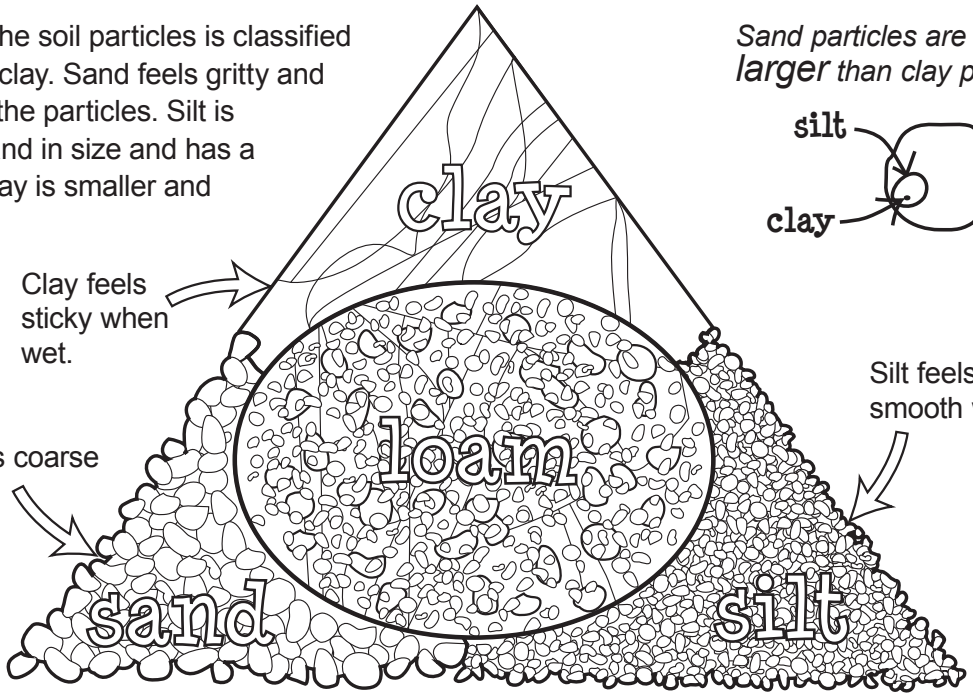


Soil textures

The texture of the soil particles is classified as sand, silt or clay. Sand feels gritty and is the larger of the particles. Silt is smaller than sand in size and has a smooth feel. Clay is smaller and feels sticky.

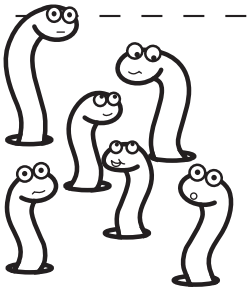
Sand particles are ***much larger*** *than clay particles.*





Loam is a combination of sand, silt and clay.

Make your own earthworm farm



Materials Needed

1. 2 earthworms (collect from dark-colored moist soils)
2. One or two dishpans or deep containers
3. Soil to fill the containers
4. Dry plant material.

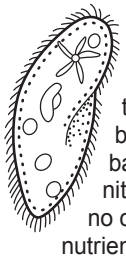
Steps

1. Fill one or two dishpans or deep containers with soil. Do not use peat and do not use soil with much sand—it's rough on the worms' skin. The soil should be kept moist, but not soggy. Moisten the soil slowly if needed. It's a good idea to punch a drain hole in the dishpan to make sure no water stays at the bottom of the pan.
2. Add earthworms. Put the earthworms on the surface of the soil in one pan. The other pan can be used to see what happens to the soil without earthworms. Be sure the worms get plenty of darkness every day so they can work at the surface. If the container has clear sides, keep it covered most of the time to prevent algae growth. The sides can be uncovered briefly each day or for a whole day every once in while. Caution: A sick worm can infect and kill the whole bunch. Avoid this by removing dead worms quickly (if possible), and by starting with healthy worms. They should be plump, quick-moving and show no physical damage.
3. Sprinkle dry plant material on the surface. Use dry leaves, grass clippings or plant material from your yard or a nearby field. Make a single thin layer, leaving some soil visible. If you use two pans, be sure both have the same type and amount of material.
4. Watch what happens. Once a day, for at least a week, take a look in the pan to see if anything changes. Look for burrow openings, worm poop, and the disappearance of plant material. The worms will bury the plant material in the soil and also mix the soil.

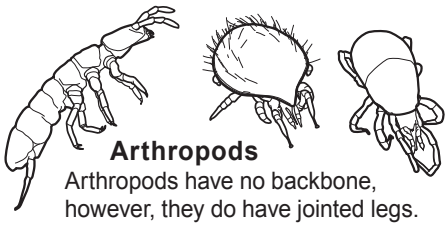
Journey into the soil

Want to journey into the soil? Let's explore what's underground.

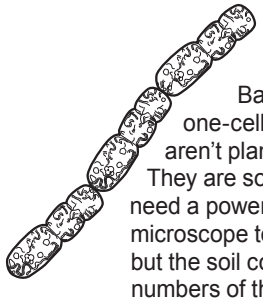
Fungi
Fungi are simple plants that don't have chlorophyll (the green stuff) that allows other plants to make their food from the sun. Fungi have many filaments or threadlike fibers found on plant structures in the soil such as roots.



Protozoa
Protozoa are tiny animals that mainly feed on bacteria. When they eat bacteria, they release nitrogen (a chemical that has no color or smell) and other nutrients (plant food) to use.



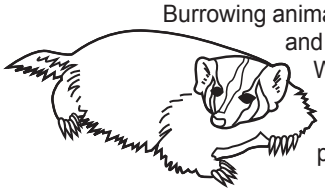
Arthropods
Arthropods have no backbone, however, they do have jointed legs. Soil arthropods include ants, termites, spiders, mites, centipedes, millipedes and many other critters. You would probably call them bugs. They stir up the soil so that it gets more air. They chew up dead plants into tiny pieces so fungi and bacteria can rot them. They are also a food source for larger soil animals.



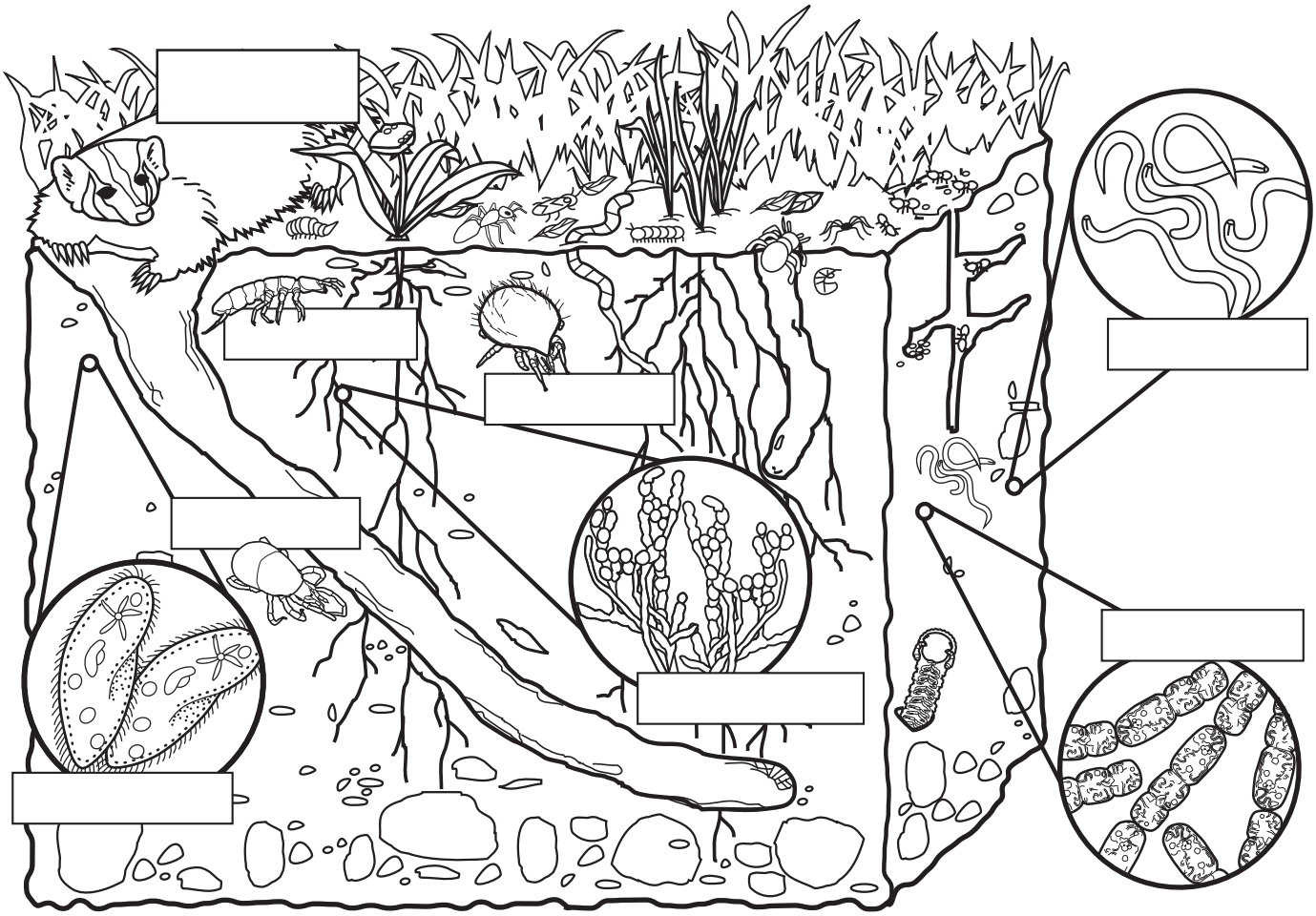
Bacteria
Bacteria are tiny, one-celled critters that aren't plants or animals. They are so small that you need a powerful microscope to see them, but the soil contains huge numbers of them.

Nematodes
Nematodes are tiny roundworms that are common in grassland soils. They help provide nutrients for plants and also help mix up the soil.

Burrowing Animals
Burrowing animals like prairie dogs, ground squirrels and badgers like to dig holes in the soil. When the animals dig holes, it helps mix the soil and allows rainwater to enter the soil. This helps feed the plants and also helps prevent flooding.



Color and name the soil "workers" in the picture below.

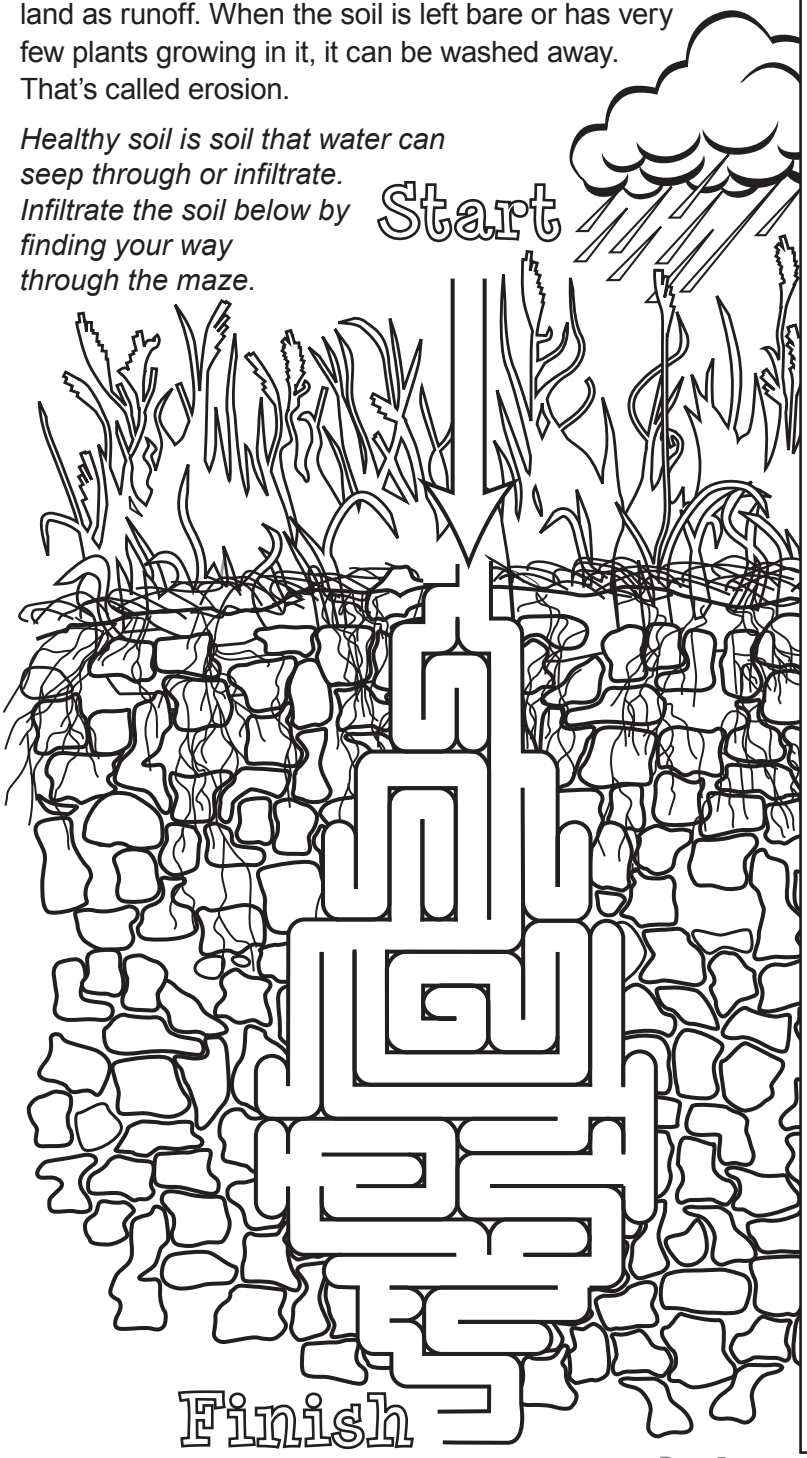


How does water act in the soil?

Water and soil go together hand-in-hand. Water has a downward entry into the soil. This is called infiltration. Infiltration is an indicator of the soil's ability to allow water to move into and through the soil. The soil temporarily stores water, making it available for roots to drink, plant growth and habitat for soil organisms.

When water is supplied at a rate larger than the soil's infiltration capacity, the extra water moves down across the land as runoff. When the soil is left bare or has very few plants growing in it, it can be washed away. That's called erosion.

Healthy soil is soil that water can seep through or infiltrate. Infiltrate the soil below by finding your way through the maze.

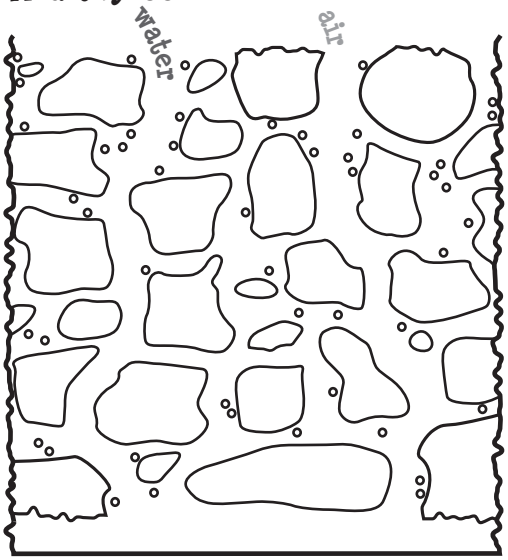


Compaction

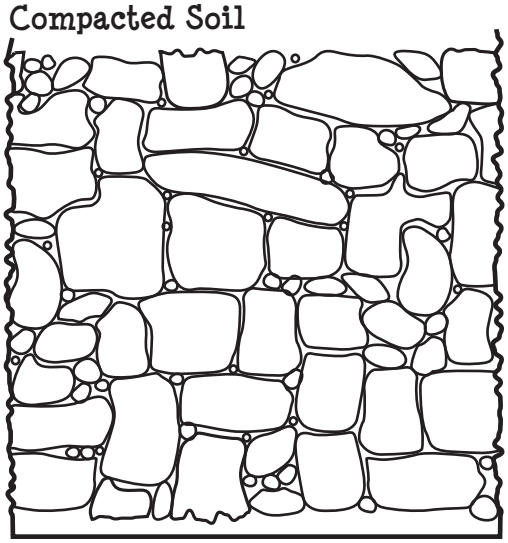
Over time, farming can cause a compaction layer to form in the soil. This is a layer that is packed tightly together by the weight of tractors driving over it, making it hard for water or plant roots to get through. Compaction can form soil crust, which are bumps on the soil surface. Soil crust is a sign of poor infiltration.

Try to infiltrate the healthy soil. Use one color to draw water moving through the soil, and use a different color to draw air moving through the soil. Then try to infiltrate the compacted soil.

Healthy Soil

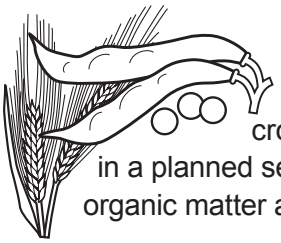


Compacted Soil

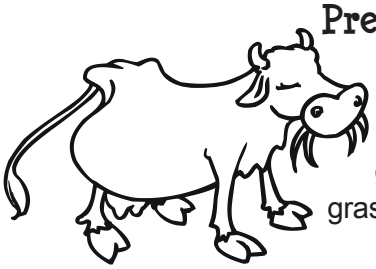


Keeping soil healthy

We benefit from the soil daily. In fact, farmers and ranchers spend their lives using soil to grow nutritious crops for food. There are many ways to keep soil healthy. NRCS encourages four practices to help improve soil health—no-till, crop rotation, cover crops and prescribed grazing. All of the practices help farmers and ranchers keep their soil healthy.

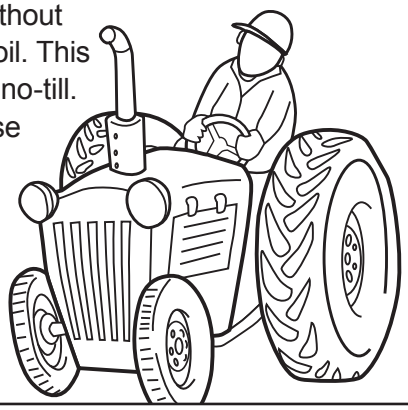


Crop Rotation. Crop rotation is growing different crops on the same piece of land in a planned sequence. Rotations increase organic matter and reduce soil erosion.

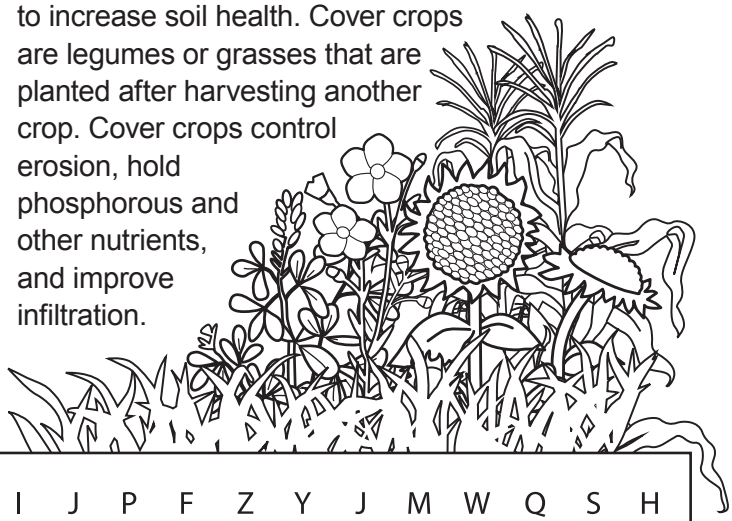


Prescribed Grazing. Prescribed grazing is controlling when and how much animals graze to accomplish grass management goals.

No-Till. In order to grow crops, farmers usually work the soil. They can do this by traditional plowing or using a system for planting crops without plowing up the soil. This method is called no-till. When farmers use no-till practices they plant their crops with machinery that hardly disturbs the soil.



Cover Crops. Cover crops are also used to increase soil health. Cover crops are legumes or grasses that are planted after harvesting another crop. Cover crops control erosion, hold phosphorous and other nutrients, and improve infiltration.



Soil Health Word Search

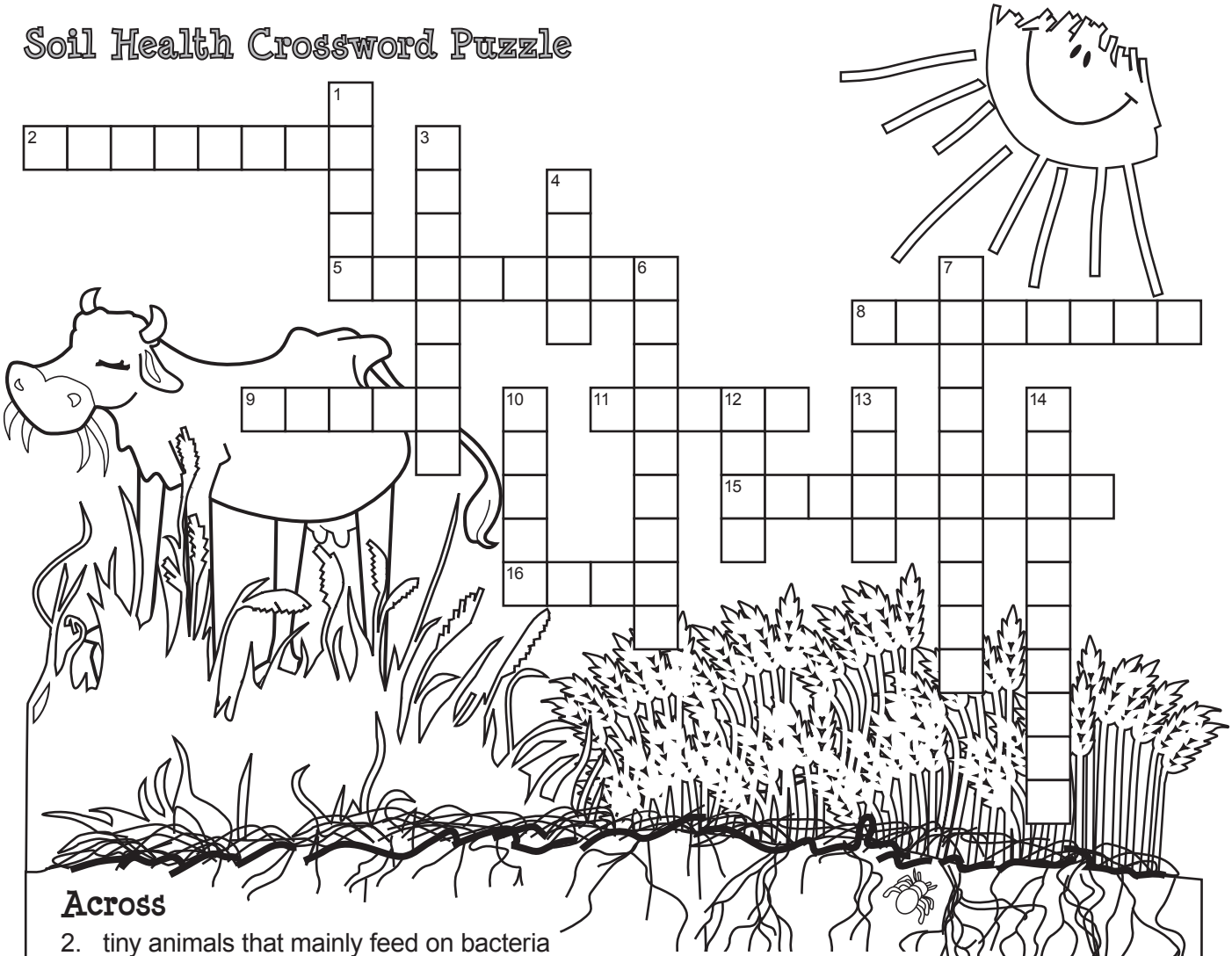
Circle all the words you can find. Hint: all are related to soil health.

BADGER
CLAY
COMPACTION
EROSION
FUNGUS
HEALTHY
HORIZONS
INFILTRATION
MATTER
NUTRIENTS
ORGANIC
PLANTS
PLOWING
ROOTS
RUNOFF
SAND
SILT
STRUCTURE
TEXTURE
TILL
WATER

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

What do you know about soil health?

Soil Health Crossword Puzzle



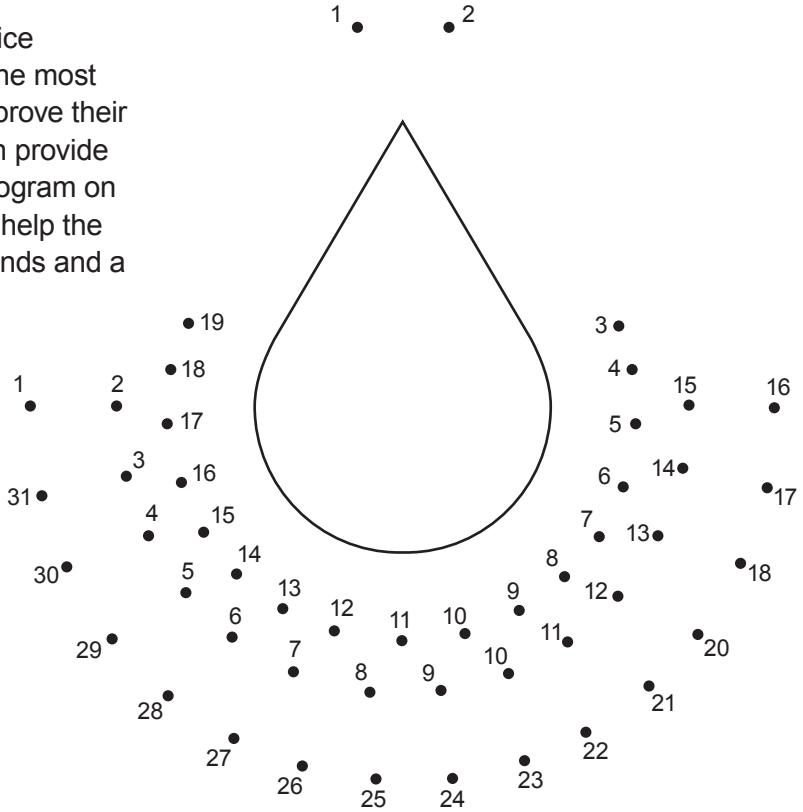
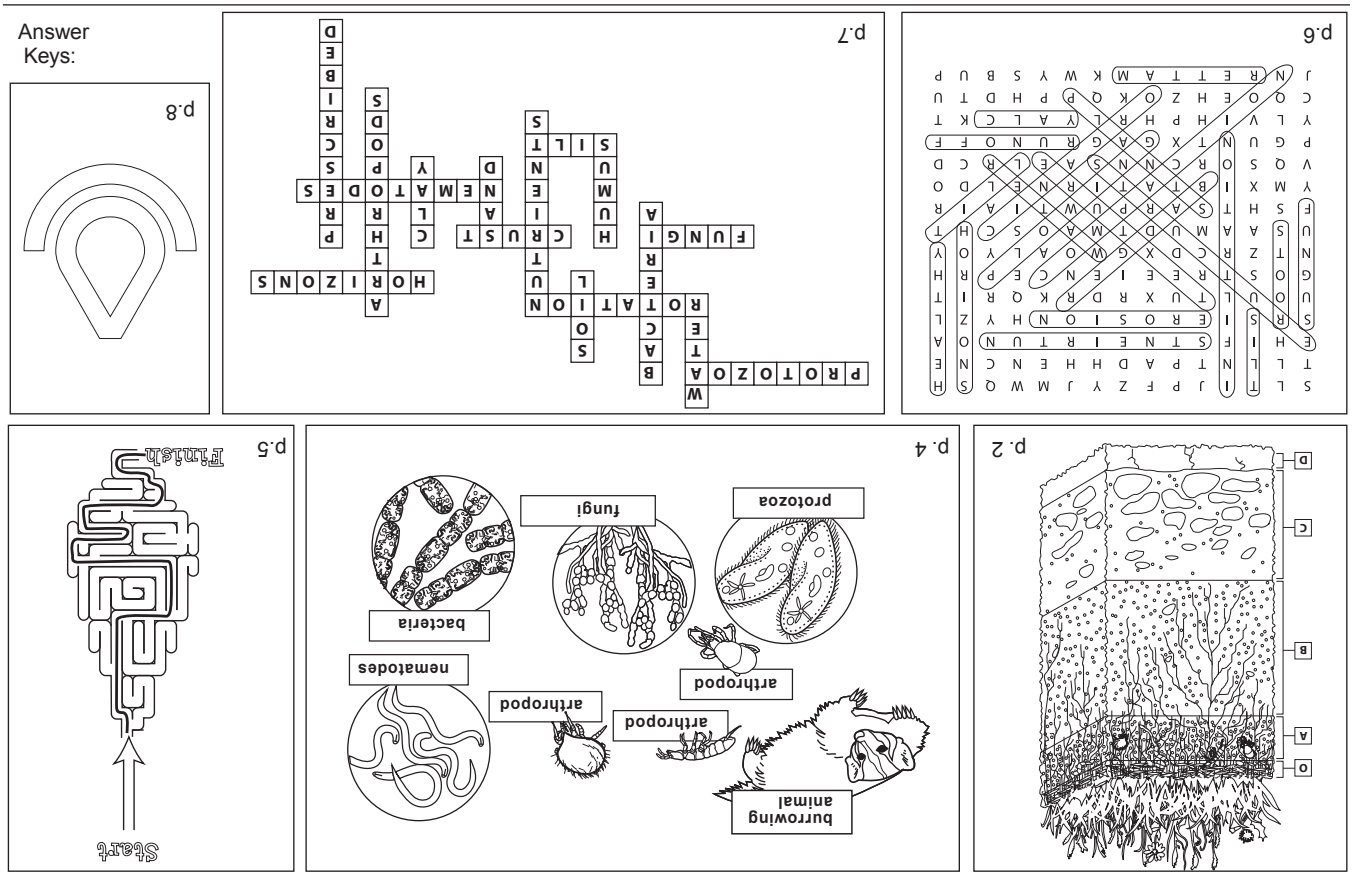
Across

2. tiny animals that mainly feed on bacteria
5. growing various crops on the same piece of land in a planned sequence
8. layers formed from soil
9. simple plants that don't have chlorophyll
11. forms bumps on the soil surface
15. tiny roundworms that are common in grassland soils
16. has smooth texture

Down

1. infiltrates soil
3. tiny, one-celled critters that aren't plants or animals
4. upper layer of earth in which plants grow
6. plant food
7. have jointed legs, no backbone
10. decayed plants and animals
12. feels gritty
13. feels sticky
14. type of grazing that controls when and how much animals graze to accomplish vegetation management goals

So what does NRCS have to do with soil health?

The Natural Resources Conservation Service (NRCS) provides private landowners with the most up-to-date information on how they can improve their soil health. In some cases, NRCS can even provide financial assistance to start a soil health program on their property. NRCS works to help people help the land and through them create productive lands and a healthy environment.

Connect the dots to see the historical Natural Resources Conservation Service symbol.