

Unit 5

Water in the Soil and Plants



Watch the video titled 'Water Movement in the Soil'
<https://www.youtube.com/watch?v=vmo0FRAVgkM>

Water is a vital component of every living thing. Although it is one of nature's simplest chemicals, water has unique properties that promote a wide variety of physical, chemical and biological processes.

Water in the soil is something quite different from water in a drinking glass.

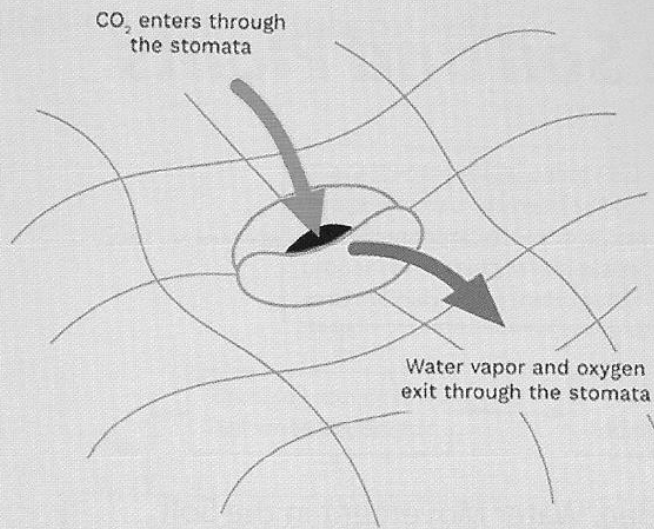
5 Water causes soil particles to swell and shrink, to adhere to each other and to form structural aggregates. Water participates in innumerable chemical reactions that release or tie up nutrients, create acidity and wear down minerals.

10 Fresh plant tissues commonly contain 70% to 85% water. This is by no means inert filler since virtually most physiological processes take place in its presence. Moreover, water is one of the raw materials used in the production of substances that comprise the solids of the plant, as it is means of dissolving all the other food materials.

15 However, only a fraction of the water absorbed by the roots from the soil is actually used by the plant. About 99% of it escapes through the leaves and stem as water vapor during a process known as transpiration. Light affects the rate of transpiration as it causes the opening of stomata, not to mention the fact that absorbed sunlight increases the temperature of the leaf.

20 Plants normally wilt or die, not because of high temperatures but because of loss of water; this may be encountered in guttation. During guttation the water appears on the tips and margins of leaves as clear drops that are often noticed in the early morning. As the day goes on and environment temperature rises, the water can either evaporate or can be reabsorbed.

The Function of Plant Stomata



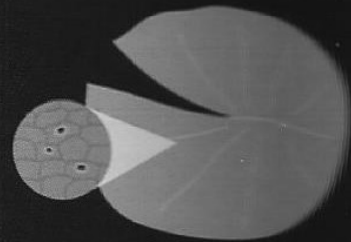
Stomata are tiny pores in plant tissue that open and close to enable gas exchange. They help with photosynthesis and hydration.

ThoughtCo.

Plants on land have stomata on the underside of their leaves



Floating aquatic plants have stomata on the upper surface of their leaves

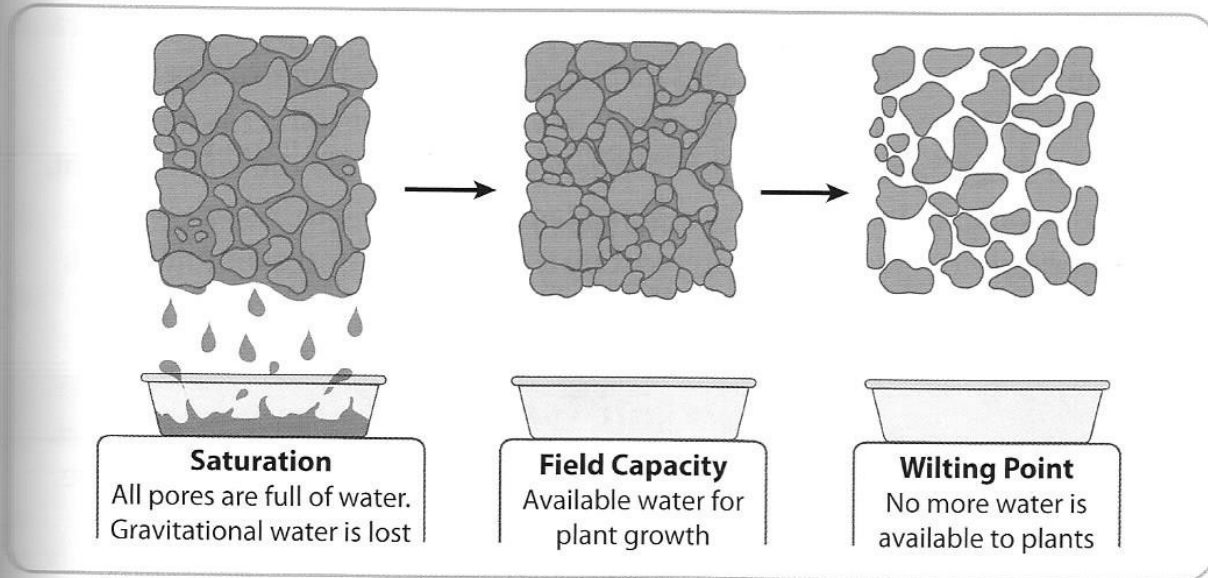


Plant Stomata Function

[Source: ThoughtCo/J.R. Bee].



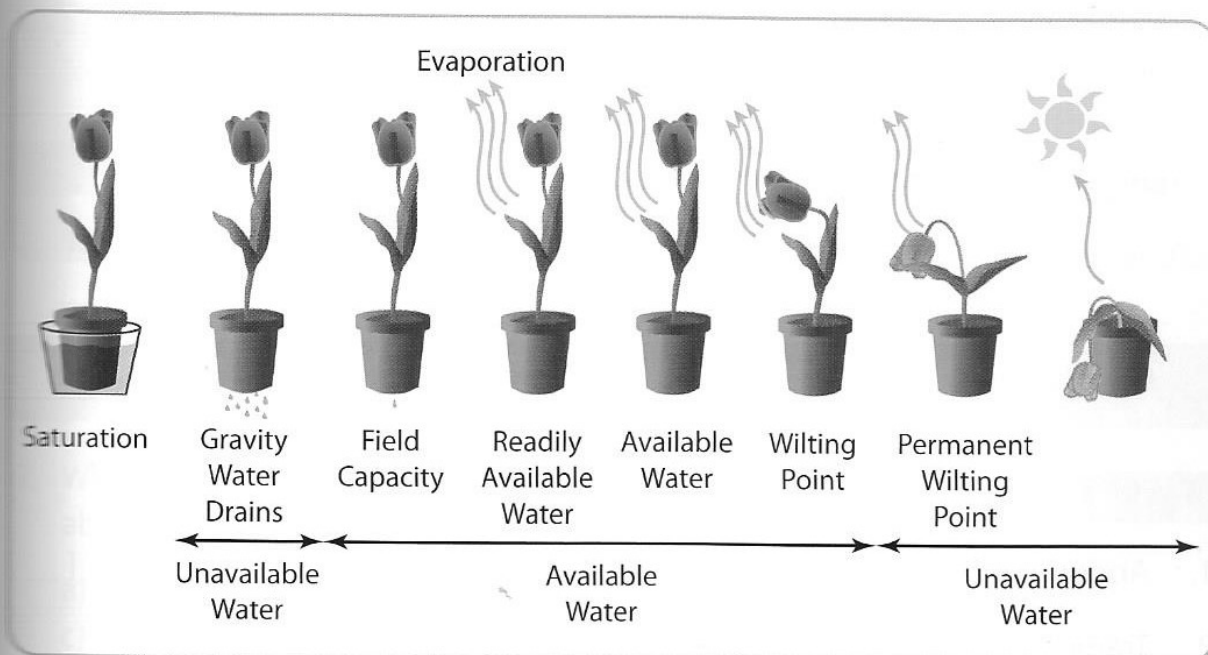
Guttation



Soil Water Status

Generally, water is supplied to plants through rain or snow. However, not all water falling in the soil is available to plants. This is true with free or gravitational water that drains away leaving a thin film surrounding and adhering to each tiny soil particle. This mass of films of water left is called capillary water. It is this capillary water, filled with dissolved food materials, which is the principal source of moisture for plants.

Soil, like a sponge, is porous. The holes in soil can be divided into two main groups; some bigger holes (called macro-pores), and some smaller holes (micro-pores). When soil is saturated with water, all the pores are filled with water and



The Range of Water Availability to Plants

there is no room for air in the soil. But if the soil is drained well, soon water drains out of the macro-pores and air takes its place. That is how plant roots can breathe. Most plants and crops die after a few days if their soil is saturated.

35 On the other hand, when soil moisture is lowered below the wilting point, water is unavailable to plants. As a result, plants are unable to absorb water quickly enough to replace the water lost by transpiration and eventually wilt.

Special Terms

Capillary water	water held as a film around soil particles and in the capillary spaces.
Gravitational water	water which the soil is unable to retain against the force of gravity; free water; excess water; drainage water.
Guttation	forcing of water or cell sap from inside plants, through pores on leaves and stems out on free surfaces of plants.
Organism	a living thing, plant or animal.
Permanent wilting point	the percentage of moisture in the soil at which plants wilt and fail to recover even when placed in an atmosphere saturated with water vapor.
Physiological	referring to the functions of the organs of plants and animals.
Stoma [pl. stomata]	an opening in the epidermal layer which leads to intercellular spaces.
Transpiration	the process by which water vapor leaves the living plant body and enters the atmosphere.

Practice Tasks

Task 1 *True or False?*

1. About 80% of the water absorbed from the soil is used by a plant. []
2. Transpiration is the production of new substances comprising the plant solids. []

3. High temperature is not the major cause of plants' wilting of foliage. [__]
4. Water is one of the raw materials required for plants' substances. [__]
5. High temperatures do not affect the transpiration rate of plants. [__]
6. Guttation is a process related to water kept by plants. [__]
7. The permanent wilting point is a non-reversible state. [__]
8. Sunlight affects the rate of transpiration. [__]
9. Even if plants have reached the permanent wilting point, their placing in an atmosphere saturated with vapor is likely to reverse this state. [__]
10. Gravitational water is always retained by soil. [__]
11. Capillary water is the major source of moisture for plants. [__]
12. Water is a simple filler of plant tissues. [__]
13. All physiological processes require water to take place. [__]
14. The plant absorbs all the water from the soil. [__]
15. Plants may absorb guttation water. [__]
16. Free water is another source of water for plants. [__]
17. Plants wilt when water is replaced faster than it is lost. [__]

Task 2 Choose one of the options to complete the sentences

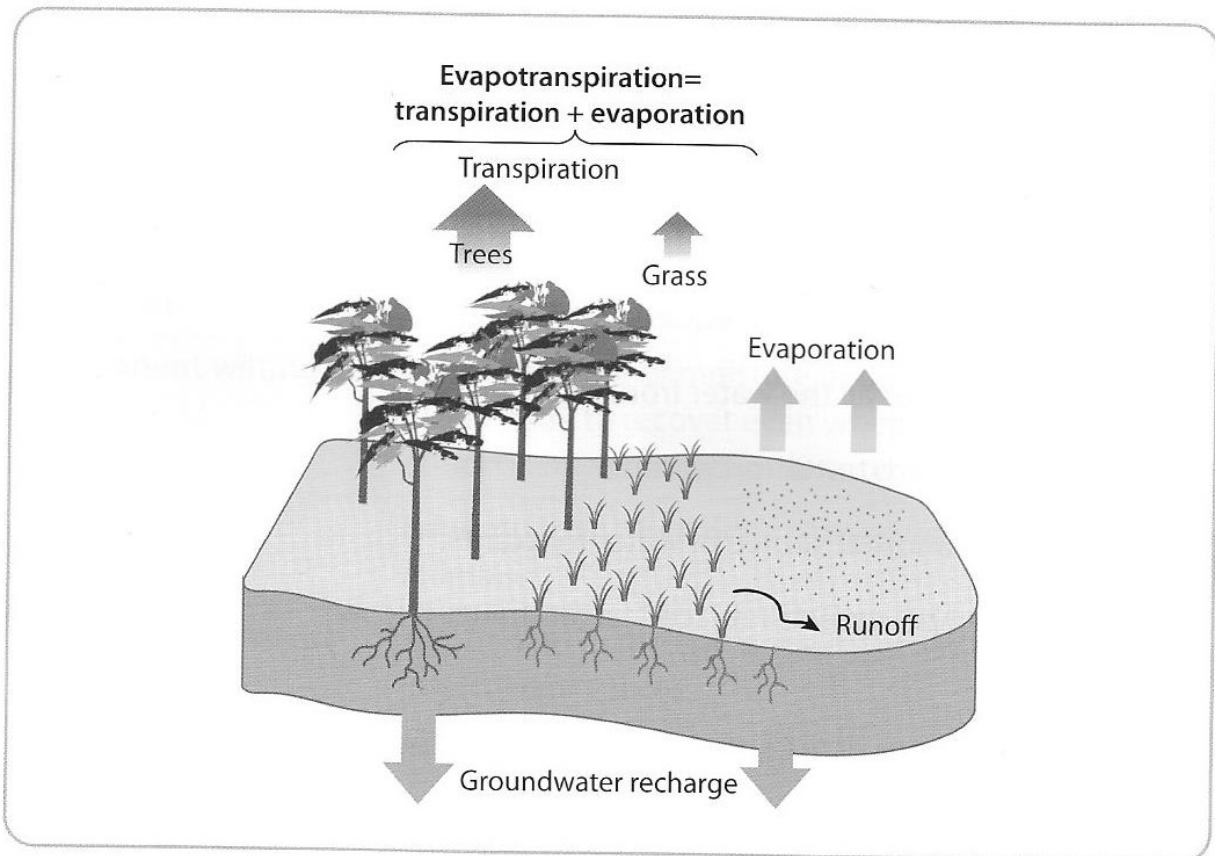
1. When water appears from inside plants through pores on leaves we refer to _____ .

a) transpiration	b) wilting point
c) guttation	d) acidity

2. When water leaves the plant body and escapes in the atmosphere we are talking about _____ .

a) transpiration	b) capillary water
c) demand	d) production

3. _____ water drains away from plants.
- a) capillary
 - b) dissolved
 - c) physiological
 - d) gravitational
4. _____ water creates a thin film that surrounds the soil particles.
- a) capillary
 - b) gravitational
 - c) evaporated
 - d) reabsorbed
5. The function of organs in plants are called _____.
- a) anatomical
 - b) physiological
 - c) epidermal
 - d) stomatic



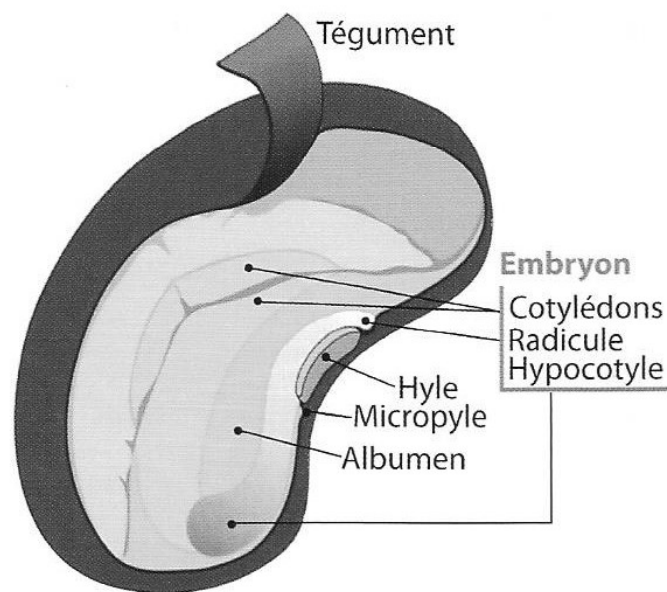
Evapotranspiration

Unit 6

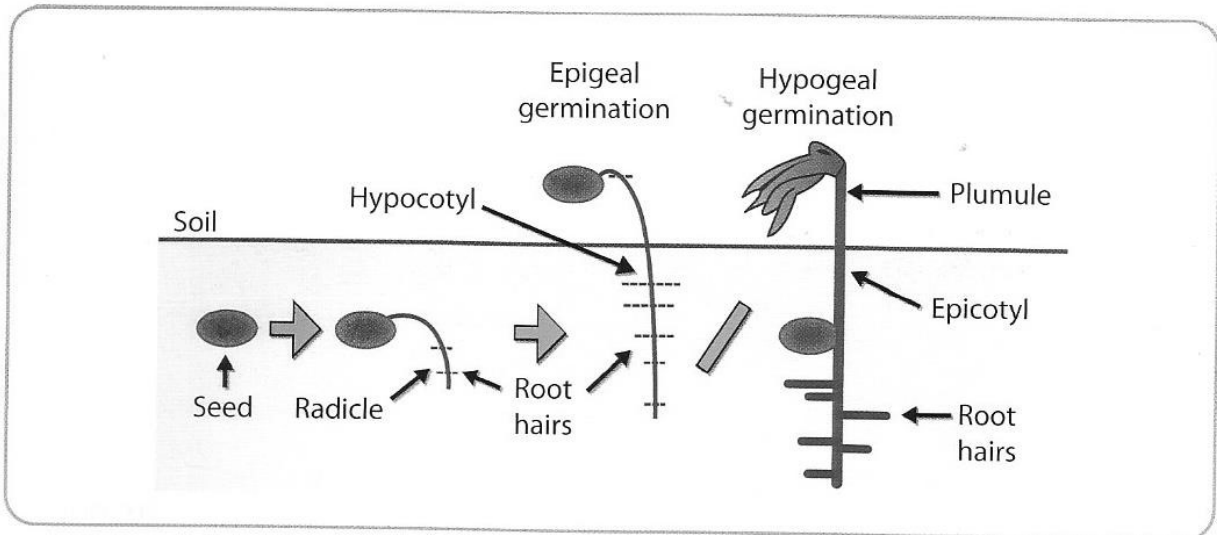
The Seed

Most farm plants are raised from seed although many so-called seeds are not simply seeds, but are fruits, or parts of fruits, containing one or more seeds. Some are larger than eggs; others are smaller than the mustard seed; some are encased in hard shells; others are enclosed in soft pulpy substances like the orange seed; some have down on them and float in the air while others have sharp spines.

But all seeds serve the same purpose of producing the new plant and all true seeds are made up of three distinct parts. There is, first, an outside coat or seedcase, called the testa, usually thin and tough, which protects the parts inside. Second there is the little embryo also called the germ. The embryo is the new plant itself, often showing clearly beginnings of a stem, leaf or leaves, called plumule, and root, called radicle. Third there is a small mass of highly



Seed Structure



Seed Germination

concentrated food, on which the embryo must feed till it can grow roots and leaves strong enough to gather its own food materials directly from the soil and air and manufacture them into plant food. This reserve food is made up chiefly of starch, sugar, protein and oil, in varying proportions, and is the main part of the nuts and grains that we eat. In wheat and corn, it is the white starchy part of the grain that makes our flour.

The dry lifeless-looking seed is not at all dead; its living germ will never grow till the right conditions for its growth are supplied to it. These conditions are heat, air, and water. In this state in which it is alive, but not active, it is called dormant. In humid and warm soil the seed absorbs water and increases in size.



Seedbeds

In a short time, the seedcase bursts open and a white sprout appears, which is the beginning of a new plantlet, or little plant. Thus, the seed begins to germinate, and its first growth is called germination.

There are great differences in seeds though. Some require a very warm seedbed to germinate while others germinate with much less heat; some seeds require less moisture and less air than others.



Watch the video titled 'Germination'
<https://www.youtube.com/watch?v=1RiKqFrJsVU>
 to revise how a seed develops into a seedling

Special Terms

Down	a fine coating of soft hairs.
Embryo	the young sporophyte which results from the union of male and female cells in a seed plant; any organism in its earliest stages of development.
Flour	the fine-ground product obtained in the milling of wheat.
Mustard	some of the herbs of the genus <i>Brassica</i> , family <i>Cruciferae</i> .
Oil	a fat which is liquid at normal atmospheric temperature.
Orange	certain tropical or subtropical trees of the genus <i>Citrus</i> , family <i>Rutaceae</i> .
Plant food	the organic compounds which nourish the cells of plants.
Seed	the embryo of a plant; kernels of corn, wheat etc., which botanically are fruits as they include the ovary wall.
Sprout	(noun) a new growth from a seed, rootstock; (verb) to cause plants, seeds, to develop sprouts or shoots.
Sugar	carbohydrates characterized by being crystalline, soluble in water and having sweet taste.
Wheat	any of the several plants of the genus <i>Triticum</i> , family <i>Graminae</i> .

Practice Tasks

Task 1 True or False?

1. All seeds are of the same size. [_]
2. It is common to encounter seeds floating in the air;
these are coated with down. [_]
3. Seeds are composed of the testa, the germ and
a mass of concentrated food. [_]
4. The plumule and the radicle are encased in the seed. [_]
5. Embryos are fed with sugar and oil. [_]
6. Seeds are dead even when they are dormant. [_]
7. The sprout is the beginning of a new plantlet. [_]
8. Germination is also called wilting point. [_]
9. Warm seed beds are favorable for the growth of seeds. [_]
10. Radicle is another term for the embryo's root. [_]
11. Starch is found in wheat. [_]
12. There are seeds with sharp spines. [_]
13. Part of the plant's growth is germination. [_]
14. Seeds cannot absorb water from the soil. [_]
15. All seeds need the same quantity of water to germinate;
heat is not a crucial factor for their development. [_]
16. Moisture is redundant in the development of seeds. [_]
17. The seeds are fruits or parts of fruit. [_]
18. All seeds share the same characteristics. [_]
19. The germ protects the embryo. [_]
20. The embryo displays the characteristics of a plant. [_]
21. The embryo feeds on materials taken from the soil and air. [_]
22. The seed is dead. [_]
23. All seeds need equal proportions of air, water and heat to grow. [_]

Task 2 Fill in the blanks with the proper words from the list; extra words are provided: *Dormant, starch, seed beds, germination, elongation, down, up, testa, pulpy, sugar, germ, plantlet, protein, oil, stem, seedcase, plumule, radicle, sprout.*

1. The outside coat of a seed is called _____ or _____.
2. The embryo lying in a seed is called _____.
3. The tiny stem and leaves of an embryo are called _____.
4. The small root found in an embryo is called _____.
5. The reserve food supplying the embryo with food until it develops enough to grow roots and leaves consists of _____ and _____ and _____ and _____.
6. A seed is _____ when it is alive but not actively growing.
7. When the seedcase bursts, it opens and a _____ appears.
8. A little plant is also called _____.
9. The first stage of a seed's growth is called _____.
10. Seeds can germinate in _____.
11. Seeds can have _____ on them.
12. The orange seed is covered with a _____ substance.

Task 3 Choose one of the options to complete the sentences

1. All seeds germinate...
 - a) right next to the parent plant
 - b) whenever the conditions are right for that type of plant
 - c) as soon as they get a little wet
 - d) only after they've been eaten
2. A plant embryo...
 - a) is the new baby plant.
 - b) is the thing that attaches a seed to its mother
 - c) something outside the seed that gives the seed a clue about where it is
 - d) always floats in the ocean.

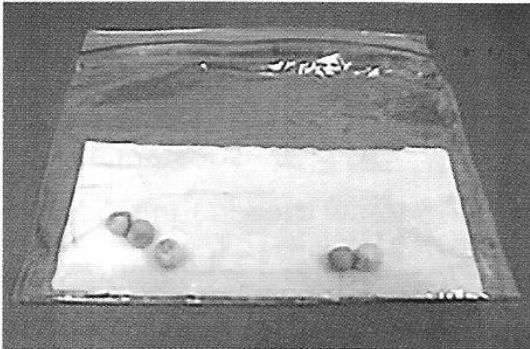
3. Plants produce seeds...
 - a) to feed animals
 - b) to travel back in time
 - c) to reproduce
 - d) to shade other plants
4. A dormant seed is...
 - a) dead
 - b) Not growing or developing
 - c) Developing but not growing
 - d) Growing

Task 4 *Seed pocket viewer experiment 1*

The instructions below indicate the steps you should follow in order to observe how seeds germinate.

1. Soak seeds in a cup of water overnight.
2. Sprinkle water on the paper towel or napkin so it's wet but not dripping.
3. Put the wet paper towel and the seeds in the sandwich bag, make sure you can see the seeds without opening the bag.

4.



5. Seal the bag. Place the bag in a warm safe place away from direct sunlight (so it doesn't get too hot).
6. Check it several times a day, open it for a few seconds to give the seeds air.
7. Then seal it to keep the moisture in. If the paper looks dry, open the bag and sprinkle more water, then make sure it's sealed.

Soon, you'll see the baby plant start growing and developing!!

One way to keep track of what happens to your seed is to draw it once a day. Make your first drawing of the seed before you soak it.