Science of Life Explorations

Plant Life Cycles:

Activity #1 Plants as Living Things
What is a life cycle? Do rocks have one? What do you remember or know about things that are ORGANIC (living organisms) or INORGANIC?

“\text{I feel heavy today.}”

Something that is not living, like a rock, is called INORGANIC. Rocks can change due to forces around them, but they do not have a life cycle, and they can’t change on their own.

Living organisms have a life cycle that includes something like an egg or a seed, don’t they? They mature, or grow up, they reproduce and they eventually die.

Growth usually means an increase in size. With that increase in size, there is usually some other changes, too.

This lesson will discuss how plants change during their life cycles and how they reproduce.

What is the difference between organic and inorganic?
What are genes and how do they affect plants?
How do plants reproduce?
Why do some plants have flowers and others don’t?
What is a fruit?
How do animals, people, wind and water help plants and their seeds?
How many new plants can one plant make?
You know that a rock is INORGANIC (not living) and a tree is ORGANIC. But, what about a piece of wood in a workshop?

First, let’s look at seven CHARACTERISTICS of something that is a living organism:

1. it can regulate itself to maintain itself:
   for example, a dog pants to cool off and a plant can drop leaves if it isn’t getting enough water

2. it is made up of organized cells:
   the cells and the way the cells work together is the reason it is able to be alive

3. it has a METABOLISM:
   it consumes energy quickly or slowly or creates food energy to stay alive

4. it grows

5. it adapts to its environment

6. it responds to things:
   plant leaves turn towards the sun or a rabbit runs from a fox

7. it can reproduce

Everything that is living is organic and has a LIFE SPAN. This means that someday it will no longer be alive. Anything that was alive is still considered organic and it will eventually become part of the environment around it. Remember our lessons about soil and compost? So, to answer our first question, wood is organic because it was once part of a living organism, although it no longer shows the traits above.

Living things are organic. Even when they are no longer alive, they are still organic. Non-living things are inorganic and always will be.
“Wow, look how you’ve grown. You are going to be tall like your dad!”

“Those big brown eyes run in your family.”

Many of the things that make you special are traits that come from your parents. Their traits come from their parents and on and on.

All of your traits are determined by your DNA. DNA is a chemical code that makes up your GENES. Many genes are in each of your 23 sets of CHROMOSOMES.

Chromosomes come in sets. You get half of the set from your mother and half from your father.

Name someone you know who looks a lot like their mom or dad:

__________________________

Explain:

__________________________

__________________________

__________________________

Do you have brothers or sisters or both? Do they look just like you? You have the same parents, right? Our cells have 23 pairs of chromosomes or 46 total. From each parent we only get half or 23 singles, not pairs. So, you might not get the same 23 as your brother or sister. That’s why you might look similar but are not exactly the same! Only identical twins have the same exact genes.
How do plants wear their GENES?
(Get it? Genes not jeans)

We’ve learned that the DNA information found in your genes decide the way each cell is made and how those cells go together to create something unique. That information comes from two sources, your mother and your father.

Plants don’t really have a mom and dad, but they also get two sources of genes.

A long time ago a man named Gregor Mendel wondered why some pea plants had different traits. Chromosomes have two choices for everything because one choice comes from the father and one choice comes from the mother. For each choices, one is DOMINANT and one is RECESSIVE.

This means that the dominant gene is likely to ‘take charge’. In plants, the tall trait is dominant and the short trait is recessive. Then why aren’t plants always tall? Because sometimes a plant only gets short genes!

Mr. Mendel experimented with plants by moving pollen from one plant flower to another. He didn’t let it happen by chance. He found out that when he worked at it long enough, he could cause a plant to have only certain traits, like tall and pink. This is called a CULTIVAR. It is the result of choosing only certain traits until eventually they are the only trait.
How do plants reproduce?

In previous lessons, we have worked with seeds, discussed plant anatomy and the interaction between plants, the soil, water, the air as well as animals, humans and insects. We hope you were able to start seeds indoors, experiment with some of the seeds, and grow plants with others.

But where do those seeds come from?

And, do all plants come from seeds?

Plants can be very different, as you've learned. Some can multiply without seeds. Have you ever seen a spider plant? It is an indoor plant. Small plants are created by the main plant and can be removed and planted. This is reproduction without seeds.

Some plants send out root-like structures called runners and some create bulbs that can actually be new plants. Because they are getting their genetic information (genes) from one plant only, they are called clones.

Strawberry plants also make new plants by producing new plants on runners. They are called plantlets. Once the new plant has healthy roots, the runner can be cut and the new plant can be moved to a new location or left to grow next to the 'mother' plant.

Strawberries also produce seeds! They are one of the plants that can reproduce both ways.
The most common way plants reproduce is from seeds. Even though it often appears that only one plant is involved, genes from two different sources are used to create new seeds.

In our last lesson, you learned that flowering plants can produce seeds in flowers or in cones.

The most well known and common plants that produce their seeds in cones are conifers, like the spruce and pine.

Let’s learn about the pine tree life cycle.
A pine tree has two types of cones on one tree. Cones found near the top of the tree are the male cones and produce pollen. They are smaller and grow in clusters. Cones found farther down the tree are the female cones and contain OVULES. Ovules are like eggs. They will not become the seed for a new plant until they are POLLINATED.

From what you know about pollen and how it travels, why do you think the cones with pollen are highest on the tree?

When pollen is released and rests on the female cones, it takes another year before the pollen and ovules have created seeds!

When seeds are released from the cone, they must find contact with the soil and receive moisture to GERMINATE. The tiny seed sends out a root first, and then a shoot which will become the stem of the new pine tree.
Most of us can recognize a flower when it's brightly colored. Some plants have flowers we never notice because they don't have pretty petals.

Flowers that use the wind for pollination instead of insects do not need pretty petals or scent to attract attention. One example is the grass family.

Flowering plants contain parts that work to make pollen, and some that work to make eggs. To make it easy to think about, we can call them male parts and female parts. There are many parts to a flower. We hope you can remember some of them after this lesson.
Four things make up the PISTIL, or female part of the flower. Two things make up the STAMEN or male part of the flower.

Most flowers also have these parts:

PETALS - the petal is the brightly colored part of the flower. It can be a landing pad for insects. Do you remember that insects can see special colors on petals that we can't see?

SEPALS - the sepal looks like a leaf, but it is the part of the flower just above the stem that holds the petals in place and protects the pistil and stamen. It is usually green and stays closed around the flower bud until it is the right time for the flower to open

Using the diagram on the previous page, fill in the blanks below using the eight flower words below:

Female (Pistil):

1. Stigma
2. Style
3. Ovary
4. Ovule

Male (Stamen):

5. Anther
6. Filament

helper parts:

7. Sepal
8. Petal

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Many flowers produce seeds and then fade away and drop the seeds on the ground. Some flowers produce a new part of the plant called a fruit. The fruit is a way to protect seeds. It can help them travel farther or to wait for the right conditions before germinating in the soil.

We eat plant seeds when we eat grains such as wheat. We also eat some seeds when they are in fruit, such as strawberries.

Let's look at different ways seeds are in fruits.

**Pear blossom and fruit:** once the ovules receive pollen, the ovary gets larger and holds the seeds.

**Strawberry blossom and fruit:** The ovules are located outside the ovary and so the seeds end up on the outside of the fruit!
Plant life cycles don’t just affect sweet fruits. Pollination occurs in all flowering plants.

Do you remember the life cycle of corn? Tassels high above the plant drop pollen onto the silks. Each silk gets pollen onto the cob where each kernel of corn is created as a seed!

Corn is a grass plant, a monocot, and does not have showy flower petals.

Do you know that many plants have flowers that do not have male and female parts on the same flower?

Corn is one plant that has male flowers and female flowers. The tassels contain the pollen, so they are the male flowers. The cob and its silks are the female flower.
Some seeds move with the wind and some depend on animals to carry them to a place where they may be able to germinate and grow.

Most of you are familiar with how dandelion seeds move through the air. Below are 12 examples of how plants produce and protect seeds. Discuss how each of these plants get seeds from the parent plant to the ground. What kind of helpers are used? (wind? water? animals? people?) Because you probably don’t know for sure, form a hypothesis based on what you’ve learned so far.

a) maple  b) pine  c) willow  d) witch hazel
e) mangrove  f) coconut  g) pecan  h) black walnut
i) apple  j) cherry  k) beech  l) oak

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Beans and more beans...

One bean plant can produce many pods. The bean pod above has four beans in it. Let’s think about how many bean plants can come from one bean seed.

Mrs. Smith planted one seed that she kept from last year’s garden. The seed germinated and grew into a healthy plant, because it had sun, good soil and water. Mrs. Smith had beneficial insects in her garden so she didn’t have any problems with insects. Soon it was time to harvest the beans!

Mrs. Smith wanted to see how many beans she had. She took 10 bean pods off of the plant and each pod had four beans in it. That’s easy math, right?

She had ________________ beans. This was her YIELD from one bean seed.

She wanted to eat them but she also wanted to keep some seeds for next year. If Mrs. Smith planted all the beans and each bean gave her the same number of beans as this year’s plant, how many single beans would she have?

_______ x _________ = ___________! That’s a lot of beans.

Mrs. Smith decided to eat 3/4 of her beans and keep the rest to plant next year. If she had the same YIELD (four beans in each of 10 pods) how many beans could she have next year?

_______ x _________ = ______________
Review and test yourself!

Fill in the blanks with these four words:

- petal
- sepal
- stamen
- pistil

Together, these four parts are called the _ _ _ _ _ _

Together, these two parts are called the      _ _ _ _ _ _

anther

filament

Together, these two parts are called the _ _ _ _ _ _

Organic material is living organisms or what is left when they are no longer living. Inorganic material is not alive and never was.

Genes are the information passed from one generation to the next to determine traits. Half of a person’s genetic information comes from his or her mother and half comes from his or her father.

Plants can reproduce in two ways:
Some plants produce new plants from roots, runners or cuttings.
Most plants use genetic information from two sources to develop seeds.

Plants with flowers or cones both use two sources of genetic information; one source is from the pollen and one source is from ovules.

Plants use the help of wind, rain and animals to move seeds to places where they can germinate. Some plants produce fruits to carry and protect seeds.
Place a 1, 2 or 3 next to each photo to show the development of a strawberry fruit.

Wood such as lumber or firewood is inorganic

_____ true

Genes are traits that only humans have

_____ true

Fruits are the only way plants move their seeds to other places

_____ true

The stamen and pistil are two flower parts which plants use to reproduce. Which of these two is considered the male parts of the plant?

________________________

Of the stamen or pistil, which part produces pollen?

________________________
characteristics - traits that describe something

chromosomes - pairs of genes that are the instructions for cells

clones - something that is created from part of a plant or animal without combining two sets of genes; identical replicas

cultivar - repeatedly choosing only the traits desired until the other traits no longer exist

dominant - something that is in charge of or decides how something is going to be

genes - inherited information that tell cells how to be and determine the traits of the entire organism

germinate, germination - when a seed begins to grow into a plant

inorganic - something that is not living and never was

interaction - existing or working together

life span - how long a living thing is expected to live under normal conditions

metabolism - the way a living thing uses energy to live

organic - something that is alive or was once alive

ovules - female flowering plant parts which create seeds after pollination

petals - special types of leaves which are used to attract pollinators with their color or scent

pistil - the group name for the female parts of a flowering plant

pollination, pollinated - getting pollen to the ovules to begin making seeds
recessive - genes that do not decide how something is going to be unless there are not dominant genes

sepals - special types of leaves which protect the base of the flower

stamen - the group name of the male parts of a flowering plant

yield - the amount of plants or fruit or seeds created in a season

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For Teachers and Parents:

This lesson helps students learn about the life cycles of plants and expand on their basic knowledge that seeds will sprout into plants.

One basic we will examine is organic versus inorganic and the seven characteristics of living organisms. It is easy to realize that a rock is inorganic (not living). But, what about wood? Because wood was once living and as a tree displayed the seven characteristics of a living organism, wood is still organic, even though it is no longer living.

One of these seven characteristics is the ability to reproduce itself.

Students will also learn some simple concepts of genetics. Most students will have heard of DNA, so the lesson explains how segments of DNA (a chemical code or recipe) are the components of our genes. Thousands of specific genes make up our chromosomes. Each cell in our body has a nucleus containing the 23 pairs of chromosomes that determine the purpose of each cell and together how the cells work together to create a special and unique you.

Everything that is reproduced sexually receives half their chromosomes from each parent. This includes plants. However, some plants can reproduce asexually (without two sources of genes) because they and produce small ‘daughter’ plants or plantlets through their roots or by creating runners. The common houseplant, the spider plant, is an easy-to-recognize example of this.

This lesson focuses more on the majority of plants who do reproduce by producing seeds. Students will probably be aware of the term pollination and the insect’s role in this. They will also be familiar with some plant seeds such as maple tree ‘helicopters’ or dandelion seeds which float in the air during June.

For your information, some plants have only male flowers or only female flowers (holly plants) or have male flowers and female flowers on the same plant but in different places. We will focus on plants with common flowers which possess both male and female parts on the same flower.

Plant flowers also vary widely due to how seeds will be dispersed after pollination. Grass seeds are not showy because they depend on wind not insects. Flowers that depend on insects for pollination are often showy and or fragrant to encourage visitors. Students will learn about the parts of such a flower.

The Pistil (female parts of the flower) which include:
- stigma, style, ovary, ovule
The Stamen (male parts of the flower) which include:
- anther and filament
The Petals which are used for attracting pollinators
The Sepals which is are modified leaves that protect the flower before it opens
Page 1 Before starting on life cycles, reinforce the concepts of what makes something organic or inorganic. Is it as simple as living vs. non-living? The next page lists the seven characteristics of a living organism.

Page 2 The concept of whether wood is organic or inorganic will challenge some students. Only organic things can be alive or dead because they have a lifespan. Change continues after death in organic organisms.

Page 3 Here is an example of how you can help students visualize DNA, Genes and chromosomes: Let’s say one kitchen cupboard is a cell. In the cupboard are 23 sets of chromosomes in the form of 23 pairs of salt and pepper shakers. All the salt shakers came from one parent’s traits and all the pepper shakers came from the other. But they are always in pairs inside the cell. The salt and pepper in each shaker are the thousands of genes that make up each chromosome. Each salt or pepper granule (gene) is made up of DNA segments. The DNA tells the gene how to be, which tells the chromosomes how to be which tell the cell what to be.

Page 4 Because each chromosome carries dominant or recessive traits, there is a chance that one or the other will show up at any given time. However, in the plant breeding field, when only certain plants with specific traits are repeatedly bred, recessive traits may disappear.

Page 5 Students may have heard of clones previous to this lesson. In the field of plant propagation, cloning or ‘asexual reproduction’ is common. Some varieties of apples are grown this way by grafting cuttings onto root stock. This is because some cultivars do not grow true from seed. If you can get a spider plant into your classroom, this is the easiest and most memorable way to explain and show a cloned plant. The ‘baby spider plants’ can be placed on top of soil in a pot and will grow new roots. Once this is done, the runner can be cut and you have a new plant - identical to the parent plant.

Page 6 Conifers such as the pine are gymnosperms. This means ‘naked seed’. Male cones hold pollen, female cones hold ovules.
Page 7 In a previous lesson, we learned that plants can be divided into two groups called monocots and dicots. This meant that they started with one or two new first leaves. Monocots never become plants that branch out. Grass plants do have flower heads, called ‘inflorescence’ which contains both male pollen and female ovules which eventually form seeds (think grains like oats and wheat). They depend on the wind to disperse their seeds. In the case of plants with traditional flowers, we suggest you focus on four main parts: the pistil, the stamen, the sepals, and the petals.

Page 8 Have students place the four major flower part names on this illustration based on what they see on the prior page. Pollination: pollen is released from the anthers and is captured by the stigma. the pollen travels down the style to the ovary and the important act of pollination occurs when the ovule/ovules receives it and begins to form a seed or multiple seeds.

Page 9 Fruit is really the enlarged ovary of the flower, formed to protect the seed or seeds until the time is right for germination in the ground. Because fruit is sweet, it is often picked by birds and animals and of course people. In this way, fruit carries seed away from the parent plant rather than just being dropped on the ground below.

Page 11 a) maples spin through the air b) white pine seeds move on wind c) willow seeds move on the wind d) witch hazel seeds are forcefully ejected from the case e) mangrove seeds start roots, and then drop to the water and float to a muddy area where the roots take hold f) coconuts can float in the ocean to other beaches or islands g) pecans can travel on water as well h) black walnuts are often carried away and buried by animals such as squirrels i) apple seeds are dispersed by animals who eat them and pass them undigested j) cherries are often carried away by birds who drop them or discard the the seeds after eating the fruit k) beech seeds often cling to
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Mrs Smith wanted to see how many beans she had. She took 10 bean pods off of the plant and each pod had four beans in it. That's easy math, right?

She had $10 \times 4 = 40$ beans. This was her YIELD from one bean seed.

She wanted to eat them but she also wanted to keep some seeds for next year. If Mrs. Smith planted all the beans and each bean gave her the same number of beans as this year’s plant, how many single beans would she have?

$$40 \times 40 = 1600$$! That's a lot of beans.

Mrs. Smith decided to eat 3/4 of her beans and keep the rest to plant next year. If she had the same YIELD (four beans in each of 10 pods) how many beans could she have next year?

$$10 \times 40 = 400$$ (she ate 3/4 of this year’s yield [30 of 40] which left her 10 to save and plant next year. With the same yield she could have 400 again next yr.

After students have completed this activity, ask them the likelihood that all bean plants will produce exactly 10 pods with 4 beans in each pod? Also, germination is never 100%. Out of 10 seeds, it is also unlikely that every one will germinate or that 10 plants will mature.
Review and test yourself!

Fill in the blanks with these four words:

petal
sepal
stamen
pistil

Together, these four parts are called the _ pistil _

stigma and style

Together, these two parts are called the _ stamen _

ovules and ovary

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Place a 1, 2 or 3 next to each photo to show the development of a strawberry fruit.

3 ______  1 ______  2 ______

Wood such as lumber or firewood is inorganic

_____ true  X  _____ false

Genes are traits that only humans have

_____ true  X  _____ false

Fruits are the only way plants move their seeds to other places

_____ true  X  _____ false

The stamen and pistil are two flower parts which plants use to reproduce. Which of these two is considered the male parts of the plant?

stamen

______________________________

Of the stamen or pistil, which part produces pollen?  stamen