Name: _____

Date: _____ Period: _____

Plant Cells

Crash Course Biology #6

1. The earliest plants were _____, which reproduce by shedding spores.

2. Some lycophytes evolved into scale trees, which covered the earth and are sometimes called "_____forests" because they fossilized into giant coal seams.

3. This productive epoch of geological history was called the _____ period.

4. Angiosperms, or plants that use _____ to reproduce didn't develop until the end of the cretaceous period.

5. Plant and animal cells are both _____ cells, meaning they have a nucleus.
   a. The nucleus contains the DNA and is enclosed by a separate _____.
   b. Eukaryotic cells have _____ suspended in cytoplasm.

6. Plants have a rigid _____ _____ surrounding the plasma membrane. It is made of _____ and lignin. The cell wall gives _____ to the parts of a plant.

7. Humans cannot digest cellulose. How do animals like goats digest cellulose?

8. Plant cells also have _____, organelles that plants use to make and store compounds that they need.

9. How did plastids and mitochondria evolve? How do we know?

10. Chloroplasts convert light energy from the sun into _____ and into _____.

11. Plant cells have a large central _____, which they can push water into to provide turgor pressure from inside the cell.

A Recap: The Basics

1. They have a cell wall that's made of _____.

2. They have a _____ – the headquarters of any eukaryotic cell – that stores genetic information.

3. They have plastids, including _____.

4. They have a central vacuole that stores _____ and other stuff that helps give the cell structural support.

ANSWERS

Plant Cells

Crash Course Biology #6

1. The earliest plants were **lycophytes**, which reproduce by shedding spores.

2. Some lycophytes evolved into scale trees, which covered the earth and are sometimes called "**coal** forests" because they fossilized into giant coal seams.

3. This productive epoch of geological history was called the **carboniferous** period.

4. Angiosperms, or plants that use **flowers** to reproduce didn't develop until the end of the cretaceous period.

5. Plant and animal cells are both **eukaryotic** cells, meaning they have a nucleus.
    a. The nucleus contains the DNA and is enclosed by a separate **membrane**.
    b. Eukaryotic cells have **organelles** suspended in cytoplasm.

6. Plants have a rigid **cell wall** surrounding the plasma membrane. It is made of **cellulose** and lignin. The cell wall gives **structure** to the parts of a plant.

7. Humans cannot digest cellulose. How do animals like goats digest cellulose? **They have a bacteria in their stomachs that actually does the digestion.**

8. Plant cells also have **plastids**, organelles that plants use to make and store compounds that they need.

9. How did plastids and mitochondria evolve? How do we know? **They were bacteria that were absorbed into plant cells. They have a double membrane.**

10. Chloroplasts convert light energy from the sun into **sugar** and into **oxygen**.

11. Plant cells have a large central **vacuole**, which they can push water into to provide turgor pressure from inside the cell.

    A Recap: The Basics
    1. They have a cell wall that's made of **cellulose**.

    2. They have a **nucleus** – the headquarters of any eukaryotic cell – that stores genetic information.

    3. They have plastids, including **chloroplasts**.

    4. They have a central vacuole that stores **water** and other stuff that helps give the cell structural support.

CrashCourse Biology #6 – Plant Cells
Video Info: This video can be accessed via YouTube:
https://www.youtube.com/watch?v=9UvlqAVCoqY&t=136s
Video length: 10:27. Using the table of contents provided by CrashCourse with the YouTube video, you can click and watch certain sections as desired.

Transcript (retrieved from https://nerdfighteria.info/v/9UvlqAVCoqY/ and re-formatted):

Introduction

So plants are frickin' great because they have this magical wizard power that allows them to take carbon dioxide out of the air and convert it into wonderful fresh pure oxygen for us to breathe. They're also way cooler than us because unlike us, and every other animal on the planet, they don't require all kinds of hot pockets and fancy coffee drinks to keep them going. The only thing plants need to make themselves a delicious feast is sunlight and water. Just sunlight and water.

Paula Deen can't do that, she makes fried egg bacon donut burgers... I'm telling you this is surprisingly good. This is a different kind of magic. But, you know, part of this - is plants. Um, and everything in it, in fact everything that is in this McDonald's, in fact everything that you have ever eaten in your life, is either made from plants, or made from something that ate plants.

So let's talk about plants.

Plant Evolution (0:56)

Plants probably evolved more than 500 million years ago. The earliest land plant fossils date back to more than 400 million years ago. These plants were lycophytes, which are still around today, and which reproduce through making a bunch of spores, shedding them, saying a couple of hail Marys, and hoping for the best.

Some of these lycophytes went on to evolve into scale trees which are now extinct, but huge swampy forests of them used to cover the earth. Some people call these scale tree forests "coal forests" because there were so many of them and they were so dense, and they covered the whole earth that they eventually fossilized in to giants seams of coal which are very important to our lifestyles today.

So this is now called the carboniferous period - see what they did there, uh, 'cause coal is made of carbon so they named the epoch of geological history over how face-meltingly intense and productive these forests were.

I would give, um, my left eyeball, three fingers on my left hand - the middle ones so I could hang loose - and, uk, and my pinky toe, if I were able to go back and see these scale forests because they would be freakin' awesome!

Anyway, angiosperms, or plants that use flowers to reproduce, didn't develop until the end of the cretaceous period, about 65 million years ago, just as the dinosaurs were dying out - which makes you wonder if in fact the first angiosperms assassinated all the dinosaurs! I'm not saying that's definitely what happened I'm just saying it's a little bit suspicious.

Anyway, on a cellular level, plant and animal cells are actually pretty similar. They're called eukaryotic cells, which means they have a good kernel, and that kernel is the nucleus -Not nucleus - and the nucleus can be found in all sorts of cells: animal cells, plants cells, algae cells, you know, basically all the popular kids.

Eukaryotic vs. Prokaryotic Cells (2:33)

Eukaryotic cells are way more advanced than prokaryotic cells. We have the eukaryotic

cell and we have the prokaryotic cell. Prokaryotic basically means "before the kernel" pro-kernel, and then we have the eukaryotic which means "good kernel"!

The prokaryotes include your bacteria and your archaea which you've probably met before in your lifetime. Every time you've had strep throat, for example. Or if you've ever been in a hot spring, or an oil well or something, they're everywhere, th-they cover the planet, they cover you.

But like I said eukaryotes have that separately enclosed nucleus. That all-important nucleus that contains its DNA and is enclosed by a separate membrane. Because the eukaryotic cell is a busy place there's chemical reactions going on in all different parts of the cell, it's important to keep those places divided up.

Eukaryotic cells also have these little stuff-doing factories called organelles - because we decided that we'd name everything something weird - but organelles, and they're suspended in cytoplasm - continuing with the really esoteric terminology that you're going to have to know.

Cytoplasm is mostly just water, but it's some other stuff too - well basically if you wanna know about the structure of the eukaryotic cell you should watch my video on animal cells which, uh, let's just link to it right here.

Plant and animal cells are very similar environments. They control themselves in very similar ways, but obviously plants and animals are very different things. So what are the differences in a plant cell that make it so different from an animal? Well that's what we're gonna go over now.

Cellulose and Lignin (3:58)

First, plants are thought to have evolved from green algae which evolved from some more primitive prokaryotes, and something plants inherited from their ancestors was the rigid cell wall surrounding the plasma membrane of each cell. So this cell wall of plants is mostly made out of cellulose and lignin, which are two really tough compounds.

Cellulose is, by far, the most common and easy to find complex carbohydrate in nature, though if you were to include simple carbohydrates as well glucose would win that one. And this is because - fascinating fact: Cellulose is in fact just a chain of glucose molecules. You're welcome.

If you want to jog your memory about carbohydrates and other organic molecules you can watch this episode right here.

Anyway, as it happens, you know who needs carbohydrates to live? Uh, animals.

But do you know what's a real pain in the ass to digest? Cellulose.

Plants weren't born yesterday.

Cellulose is a far more complex structure than you'll generally find in a prokaryotic cell and it's also one of the main things that differentiate a plant cell from an animal cell.

Animals do not have this rigid cell wall. They have a flexible membrane that frees them up to move around and eat plants and stuff. However, the cell wall gives structure to a plants leaves, roots, and stems, and also protects it to a degree - which is why trees aren't squishy and they don't giggle when you poke 'em.

The combination of lignin and cellulose is what makes trees, for example, able to grow really really frickin' tall. Both of these compounds are extremely strong and resistant to deterioration.

When we eat food, um, lignin and cellulose is what we call roughage because we can't digest it. It's still, you know, useful for us and certain aspects of our digestive system. But it's not nutritious. Which is why, like, eating a stick is really unappetizing, and, like, your shirt is a 100% plant shirt but it doesn't taste good.

But we can't go around eating wood like a beaver, or grass like a cow because our digestive systems just aren't set up for that. However, other animals, that don't have access to delicious donut burgers, have either developed gigantic stomachs, like sloths, or multiple stomachs, like goats, in order to make a living eating cellulose. These animals have a kind of bacteria in their stomach that actually does the digestions of the cellulose for them. It breaks the cellulose into individual glucose molecules which can then be used for food.

But other animals, like humans, mostly carnivores, don't have any of that kind of bacteria which is why it's so difficult for us to digest sticks...

Ah, but there is another reason why cellulose and lignin are very very useful to us as humans: it burns my friends! This is basically what would happen in our stomachs: it's oxidizing, it's producing the energy that we would get out of it if we were able too, except it's doing it very very quickly. And this is the kind of energy, like this energy that's coming out of it right now, is the energy that would be, uh, useful to us if we were cows! But we're not. So instead we just use it to keep ourselves warm on the cold winter nights... ow! It's on me, ow, ah!

Anyway, while we animals are walking around spending our lives searching for ever more digestible plant materials, plants don't have to do any of that. They just sit there and they make their own food, and we know how they do that. They do it with photosynthesis.

Plastids and Chloroplasts (7:05)

Another thing that plant cells have that animal cells just don't have are plastids, the organelles that plants use to make and store compounds that they need. And you want to know something super interesting about plastids? They and their fellow organelles, the mitochondria, that generate energy for the cell, actually started as bacteria that were absorbed into plant cells very early in their evolution. Like maybe some protos-like cell absorbed a bacteria and it found that instead of just digesting that bacteria for the energy that it had, it could use that bacteria, that bacteria could create energy for the cell or convert light into lovely glucose compounds which is crazy.

Nobody is precisely sure how this happened, but they know that it did happen because plastids and mitochondria have double membranes. On from the original bacteria, and one from the cell as it wrapped around it. Cool, huh?

Anyway, the most important of the plastids are the chloroplasts which convert light energy from the sun into sugar, and into oxygen which the plant doesn't need, so it just gets rid of it. All of the green parts of a plant that you see: the leaves, the non-woody stems, the unripened oranges, are all filled with cells that are filled with chloroplasts which are making food and oxygen for you.

You're very welcome, I'm sure.

Central Vacuole (8:10)

Another big difference between plant cell and an animal cell is the large, central vacuole. Plant cells can push water into vacuoles which provides turgor pressure from inside the cell which reinforces the already stiff cellulose wall and makes the rigid like a crunchy piece of celery or something.

Usually, when soil dries out or a celery stalk sits in your refrigerator for too long, the cells lose some water, turgor pressure drops, and the plant wilts, or gets all floppy.

So vacuoles are also a kind of storage container for the cell. It can contain water which plants need to save up just in case, and also other compounds that the cell might need. It can also contain and export stuff that the cell doesn't need any more, like wastes.

Some animal cells also have vacuoles, but they aren't as large and they don't have this very important job of giving the animal shape.

So now let's do this, let's just go over the basics of plant cell anatomy.

1. They have a cell wall that's made out of cellulose, and so it's really rigid and not messin' around.

2. They've got a nucleus in its own little baggy that separates it from all the other organelles. This is basically the headquarters of any eukaryotic cell. It stores the genetic information for a plant and also acts as the cells activities director telling it how to grow, when to split, when to jump and how high - that sort of thing. Animal cells have this kind of nucleus too but prokaryotes don't, which is why they're stuck hanging around in oil wells and stuff.

3. They've got plastids, including chloroplasts which are awesome, green, food-making machines.

And
4. They have a central vacuole that stores water and other stuff that helps give the cell structural support.

And so, stack these cells on top of one another like apartments in an apartment building and you've got a plant.

And all of these unique features are what makes it possible for plants to put food on our table and air in our lungs. So next time you see a plant, just, just go ahead and shake its hand. Thank it for its hard work and its service.

Now we went over that stuff pretty fast. So if you want to go back and listen to any of it, we have a review section over here for stuff that you may not have totally picked up on, or just want to watch again. It's not a huge piece of your life to rewatch some stuff so go ahead and click on these things. If you have questions to do with plant cell anatomy, uh, please leave them for us in the comments and we will hopefully get to those. You can also hook up with us on Facebook and Twitter of course, and we will see you on episode 7 of Biology Crash Course.