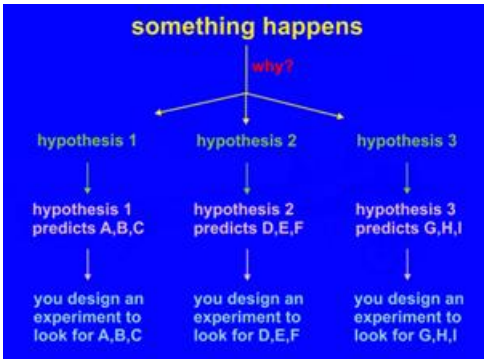
**Fascinating Education Script**
**Introduction to Science Lessons**

# Lesson 1: CALCIUM

## Slide 1: Introductory slide

## Slide 2: Science is not that hard.

Hi y'all. My name is Sheldon Margulies and I'm a doctor in Silver Spring Maryland, just outside of Washington, D.C. My day job used to include teaching medical students about how the brain works. After many years of teaching, I've learned that only half of teaching is teaching. The other half of teaching, and in my opinion, the more important half, is to get students to realize that they can learn the subject, and feel so good about what they've accomplished that they want to keep going.




In the next four lessons, we're going to look at all sorts of things. I want you to begin to look at things and ask why they happen. If you don't ask, I will. But don't be embarrassed if you don't know the answer. All I want you to do is think of some way to explain what you see. We'll call your idea a hypothesis.

To find out if your hypothesis makes sense, think about your hypothesis and ask yourself what the hypothesis would predict if it were true. Then think of an experiment that will find whatever the hypothesis predicted. If you do find what your idea predicted, you will then have evidence supporting your hypothesis.

Science is not that hard. All science does is try to explain how the world works, because, as you will see, we can't always rely on common sense. So when you ask why something happens, don't let anybody dismiss you with, "That's just common sense," or "That's just the way it is, youngster."

Instead of being disappointed, be outraged that no one can explain why something happens. There is an answer out there, and with books and the internet, there will always be someone there to help you answer why things happen.

And don't forget: if something is unclear, it's not you, it's me. I haven't explained it clearly enough and I want you to email me about what is unclear. Fully understanding a subject, any subject, is the key to enjoying it. And if you enjoy your work, you will never work a day in your life.

## Slide 3: What happens when you boil water?

Let's begin with this bowl of water and this pile of salt. What would happen to the pot of water and the pile of salt if we let them sit there for a few weeks? The water would be all gone but the salt would be exactly the same. Now where did the water go?
Sure, the water evaporated into the air.

Now let's add a little energy to the water by placing it on a hot stove. How long do you think it would take to boil away all the water?

Maybe 20 minutes. By adding energy in the form of heat, we made the water evaporate a lot faster.

## Slide 4: What happens if we add salt before we boil the water?

Suppose we add a bunch of salt to the water before we boil it?

Will the salt evaporate away with the water, or will it remain in the pot after all the water is boiled away?

all that white stuff salt? How would you go about finding out?

First, you could taste it.

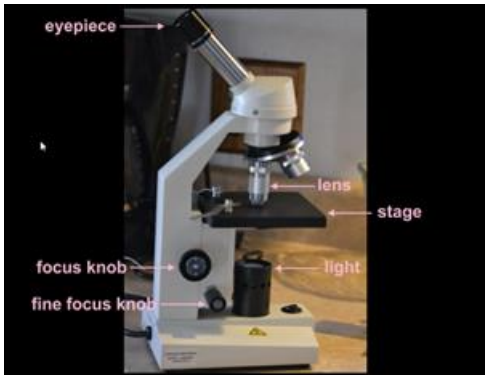
Yes, it takes like salt. What's another way to find out if the left over grains are really salt?

## Slide 5: Using a microscope to examine things.

We could try getting a close-up look at the grains with this magnifying glass.

How about getting a closer look with a microscope?

Here's how your use a microscope. You put whatever you want to look at – we call it the specimen -- on the stage, and look through the eyepiece.




The lens allows you to see up close, but you have to focus with the focus knob to see things nice and sharp.

If what you are seeing is still fuzzy, you can fine tune the focus with the fine focus knob. The light at the bottom shines up through the stage so you can see the specimen better.

## Slide 6: What is the difference between the salt and the water? Let's look at the evidence.

So after boiling away the water, what do the left-over grains look like with a magnifying glass?

So you see that many of them look like little cubes with straight sharp edges?

Let's look at real salt under a microscope. These real salt crystals also look like little cubes, similar to the crystals we got after boiling away the salt water. We now have pretty good evidence that salt does not boil away like water does.

What does this tell you about the difference between salt and water?

We know that water will hang together in a puddle or a pot, but with a little extra energy in the form of heat, water readily leaves and evaporates into the air.

What about salt? Even when we added heat energy to the pot, salt didn't evaporate? Salt doesn't just hang together; it sticks together.


Why? Why does salt stick to itself so much more than water?

This is one of the things you're going to learn in chemistry where you'll learn why some things, like gases, aren't sticky at all and rapidly evaporate into the air without the addition of any heat energy.

## Slide 7: Why do we need calcium?

This morning when you had breakfast, many of you had a glass of milk or poured milk over your cereal.

What's in milk that's so important?

Calcium.

Have you ever seen calcium?

Here is calcium. Chalk that we use to write on sidewalks is made of calcium. So are these seashells.

Why do we need calcium?

What's your hypothesis?

## Slide 8: What's your hypothesis about why we need calcium?

To make our bones strong.

If your hypothesis is that calcium is what makes our bones strong, what does your hypothesis predict?

Sure, that if you didn't have calcium in your bones, they would be soft.

What kind of experiment could you design that would test whether bones without calcium would become soft?

Since we can't do the experiment in humans, let's use this chicken bone, if we can tear it out of this youngster's hands.

How could we find out what this chicken bone would be like without calcium?

How could we remove the calcium from a chicken bone?

A quick search on the internet reveals that we can remove calcium from a chicken bone by soaking the bone in a glass of vinegar.

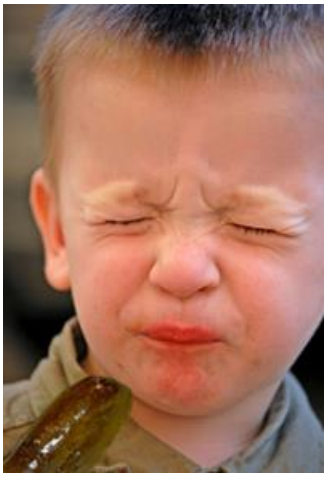
We'll leave the chicken bone in the vinegar for a few days.

**Slide 9: What does vinegar taste like?**


By the way, what is vinegar?

Vinegar is acetic acid.

Sour pickles are made in vinegar.



Dab a drop of vinegar from a pickle on your tongue. What does vinegar taste like? Vinegar is sour?


In fact, all acids are sour. What else is sour? What else makes you scrunch up your face when to taste it?

Lemons.

What's the acid in lemons?

Citric acid.

**Slide 10: Does calcium make our bones hard?**

It's been a few days now and it's time to pull the chicken bone out of the vinegar.

Look what happened to the chicken bone. It's become soft. If we can show that the calcium dissolved into the vinegar, it would support your hypothesis that calcium is what makes our bones strong.

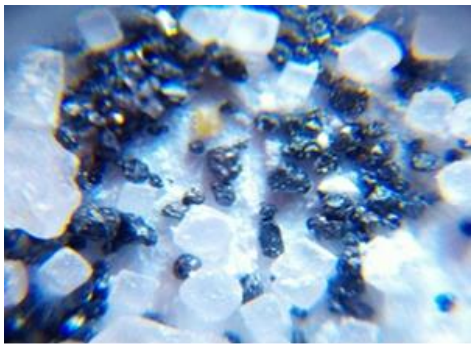
What kind of experiment could you think of to demonstrate that the calcium was now dissolved in the vinegar?

Yes, we could boil away the vinegar and see if we find any calcium left behind.

After boiling off the vinegar, it looks like there are two types of crystals left.

Under the microscope, there are definitely two kinds of crystals.

To determine if one of those crystals is calcium, we need some understanding of chemistry, but don't go to Fascinating Chemistry just yet.



If one of the crystals is calcium, what could the other crystal be?

Could they be crystals of acetic acid that make up vinegar?

As you can see, asking one question leads us to discoveries that make us ask more questions, and on it goes.

But it sure looks at this point like calcium is what makes bone so hard.

**Slide 11: What makes eggshells hard?**

Why do you suppose eggshells are so hard?

How would you show that calcium is what makes eggshells hard?

Okay, let's soak this egg in vinegar for a few days. What do you predict will happen?

You're right. Look how soft this eggshell is now.

What other parts of our bodies need calcium besides our bones?

**Slide 12: What foods have lots of calcium?**

Yes, our teeth.

What foods have lots of calcium?

Dairy products like milk, yogurt, cheese, and ice cream.


Does orange juice have calcium? How would you find out?

Let's look at the food label.

Regular orange juice has only 3% of our daily requirement for calcium, while calcium supplemented orange juice has ten times as much calcium.

Regular Orange Juice

| Nutrition Facts | |
|---|---|
| Serving Size 1 cup 248g | |
| Amount Per Serving | |
| Calories 112 | Calories from Fat 4 |
| | % Daily Value |
| Total Fat 0g | 1% |
| Saturated Fat 11g | 0% |
| Trans Fat | |
| Cholesterol 0mg | 0% |
| Sodium 2mg | 0% |
| Total Carbohydrate 26g | 9% |
| Dietary Fiber 0g | 2% |
| Sugars 21g | |
| Protein 2g | |
| Vitamin A 10% | Vitamin C 207% |
| Calcium 3% | Iron 3% |

Calcium Orange Juice

| Nutrition Facts | |
|---|---|
| Serving Size 1 cup 248g | |
| Amount Per Serving | |
| Calories 120 | Calories from Fat 0 |
| | % Daily Value |
| Total Fat 0g | 0% |
| Saturated Fat 11g | 0% |
| Trans Fat | |
| Cholesterol 0mg | 0% |
| Sodium 2mg | 0% |
| Total Carbohydrate 26g | 9% |
| Dietary Fiber 0g | 2% |
| Sugars 21g | |
| Protein 2g | |
| Vitamin A 10% | Vitamin C 207% |
| Calcium 30% | Iron 3% |

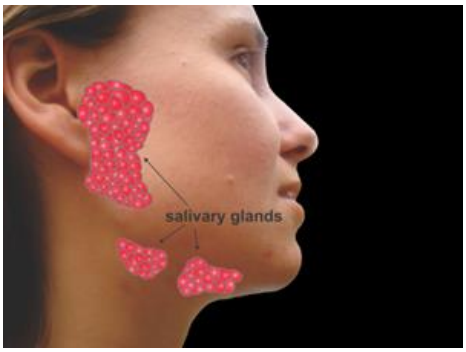
**Slide 13: How our bodies get calcium?**

When you eat foods with calcium, or any food for that matter, the food has to be broken down into tiny, tiny bits so it can get into your body. Breaking down food into very tiny bits is called digestion.

Where does digestion begin? Where do you first begin to break down the food you eat?

In your mouth. You smash the food with your teeth and saliva immediately starts breaking down the food.

Where does saliva come from?




From salivary glands behind your jaw and under your tongue. They squirt saliva into your mouth when you eat.

Now what happens to the food after you swallow it? Where does it go?

Where is your stomach?

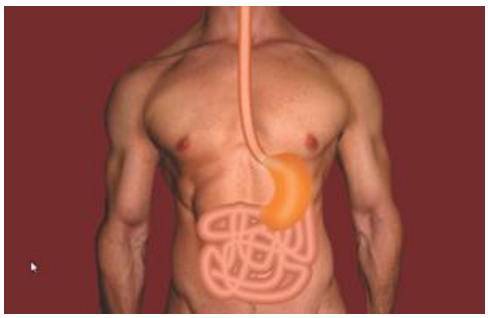
How does food get from your mouth down to your stomach?

**Slide 14: The travels of food.**

When you swallow, food goes down a tube, called the esophagus. The esophagus runs down through your chest.

Where does food go after it leaves the stomach?

In the small intestines where food is absorbed into the body.



What happens to all the food we eat after all the food has been absorbed in the small intestines?

It goes into the large intestines. Do you see how much bigger the large intestine is than the small intestine?

What does the large intestine do?

It removes any water that's still in the food, and poops out the rest as waste.

**Slide 15: What does Vitamin D do?**


Who has heard of vitamin D? Do you know what vitamin D does?

Vitamin D helps the small intestine absorb calcium from the food we eat.

Do you know that we make our own vitamin D?

Does anybody know where in our body we make vitamin D?

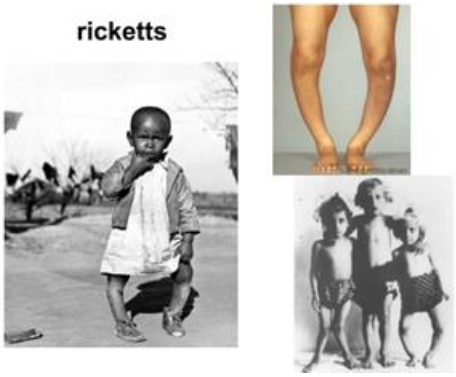
We begin making vitamin D when sunlight shines on our skin. The liver and the kidneys finish up the job, and the final vitamin D travels to the small intestine to help it absorb any calcium in the food floating by.


What do you suppose would happen if a child didn't get enough vitamin D in their diet or they didn't get enough sunlight to make vitamin D?

They wouldn't absorb enough calcium to make strong bones.

What would their bones look like?

**Slide 16: What happens if you don't absorb calcium?**




Their bones would be like our chicken bones without the calcium. The bones would bend because they're not strong enough to support the weight of the body. This illness is called rickets.

So for strong bones and teeth, get plenty of sunshine and eat foods with lots of vitamin D and lots of calcium.

This fellow took my advice. Unfortunately, strong bones won't always protect you from becoming extinct.