



## The World As We Know It (🌍 A Cognitive Health Story) (4<sup>th</sup> Grade – 9-10 yrs)

All animals get information about the world around them and they use this information to modify their behaviors in a way that allows them to survive.

- The world as we know it is dependent on our sensory receptors.
- Humans are the only animals that are able to enhance their sensory systems to detect stimuli that they would not normally be able to detect. That gives humans a definite advantage as to what they can learn about the world.
- How our brains perceive the information that is obtained from our sensory systems depends on a number of factors. We need to understand that not only is the world around us constantly changing, but that our perception of the world also changes. What we know about the world allows us to choose behaviors that will allow us to not only survive – but, to thrive.

### 🌍 SLIDE #1 - INTRODUCTION:

Good Morning (Afternoon)!

My name is \_\_\_\_\_ and I (describe who you are and give your relation to neuroscience – ex. you are a Neuroscientist, you study neuroscience, you have a friend that is a neuroscientist or you have recently been learning a lot about neuroscience).

Neuroscience, that's a really big word! But, a neuroscientist is a person who knows a lot about the brain.

I am here today to talk to you about how you can help to make your brain healthy – feeling good. It is REALLY easy and anyone can do it.

I love to talk about Brain Health because it's SPECTacular!!! SPECTacular means "GREAT". When your brain is SPECTacular, you are a happy and healthy person.

This story is about Cognitive Health – which is the C in SPECTacular. Cognitive Health is about thinking...and not just when you are in school. Cognitive is a big word that means being able to think.

Your brain thinks all the time, that is something you do inside of your head.

It is your brain's job to think and by thinking you are making your brain healthy.

So, let's see how you can keep your brain healthy.

### 🌍 SLIDE #2 – THE WORLD AS WE KNOW IT

We are constantly learning about the world around us so that we can change our behaviors allowing us to survive.

How you change your behaviors depends on how you **perceive** the world around you and that depends on getting information from your sensory systems.

We will talk about how what you “know” about the world around you may be different than you think.

### **SLIDE #3 – THE WORLD CHANGES**

When you got up this morning, you may have looked outside to see what the weather was like.

We all know that the weather changes during different seasons. Your “getting dressed” behaviors need to change when the weather is changing in the world.

When the weather gets colder, you need to wear more clothes to protect yourself from getting sick.

What we know about the world arounds us depends on information that we get from our sensory systems.

### **SLIDE #4 – SENSORY SYSTEMS**

We have 5 senses that we use to get information from the world around us.

We can see, hear, smell, taste and feel things (with our skin).

Actually, we have a 6<sup>th</sup> sense – we also have a sense of balance.

We need our senses to get information about the world that we live in so that we can survive.

Our senses give us information about whether or not something can be eaten, or if there is danger around.

### **SLIDE #5 – SENSORY RECEPTORS**

Our sensory systems have receptors that are designed to respond to certain *stimuli* – or things - in the world.

In your body, you have different sensory *receptors* responding to different stimuli.

Your eyes have cute little receptors called rods and cones, they respond to light energy. You see light and dark with your rods and you have 3 types of cone cells that let you see colors.

Your ears have hair cells that respond to different wavelengths of sound – actual movement of air molecules. The air moves faster when there are high squeaky sounds and slower with low frequency sounds. We tend to focus on the frequency of people talking.

Your nose has bipolar cells that respond to chemicals that are in the air and float up into your nose. This means that chemicals actually go into your nose! That is ok if you are smelling something good like chocolate cookies – but, what about when you smell dog poop – yuck!

Your tongue has taste cells that respond to chemicals from things that you put in your mouth. You have taste cells for salty, sweet, bitter, sour and umami (meaty). A new taste cell may exist for fat – called oleogustus.

Your skin has the ends of nerves, some of which are covered and some that are not, that respond to things that your skin touches. Your skin can tell when something is pulling or stretching your skin, or if something is hard or soft, or if something is hot or cold, or if something is painful.

If the stimulus is out in the world, then your sensory receptors will respond and start sending that information to your brain.

## SLIDE #6 – SENSORY RECEPTORS

All animals need to learn about the world around them, so all animals have sensory systems. However, the sensory systems of all animals are not the same.

One of the things that is different in the sensory systems of different animals is the types of sensory receptors.

The type of sensory receptors that an animal has depends on the type of information about the world that is important for the animal.

For example, to allow us to “see” the world around us we have rods and cones – sensory receptors for our visual system.

These receptors “catch” different wavelengths of light that are on electromagnetic spectrum.

The rods tell our brain about **light and dark** and the cones tell our brain about **colors**.

## SLIDE #7 – ELECTROMAGNETIC SPECTRUM

The **electromagnetic spectrum** describes different energy sources that are out there in the world. Our brain converts energy that is in the world into something that our brains can understand.

Different kinds of information are transmitted using different **wavelengths**.

Light energy – that we can see - is transmitted using wavelengths on a small part of the electromagnetic spectrum (between 400 and 700 nanometers).

There are lots of wavelengths along the electromagnetic spectrum that are invisible to us – because we do not have the receptors to change the energy into something your brain can perceive.

## SLIDE #8 – RECEPTORS FOR SEEING

Different animals “see” different things based on the types of sensory receptors they have.

We have 3 types of cones and one type of rod and we can see the entire rainbow of colors that are a mix of red, green and blue (rgb). Our television sets take advantage of this information and use only red, green and blue subpixels to make the colors we see on tv.

Dogs only have 2 types of cones – so they see the world in shades of blue and yellow. This means that things that are important to dogs staying alive can be seen with mixing blue and yellow.

Chickens have 4 types of cones – so they see more colors in their rainbow!!! Chickens must lead a very colorful life!

## SLIDE #9 – HEARING

We can hear things – waves of electromagnetic energy – we hear some things – other animals hear other things.

But, animals hear different things based on the hair cell receptors they have in their ears.

## SLIDE #10 – HEARING

When it comes to hearing, people and chickens hear about the same.

Humans and chickens hear between electromagnetic energy between 20 and 20,000 Hz. (A hertz is a cycle of air movement – wave – per second.)

But, when it comes to hearing – dogs rule!!! They hear sounds between 40 and 60,000 Hz

So yes, dogs rule when it comes to hearing and people and chickens drool.

### SLIDE #11 – TASTE

What things taste like depends on the types and number of taste cells on your tongue. Humans and animals are different.

Both humans and dogs have taste receptors for salty, sweet, bitter, sour and umami (meaty) – and probably fat.

However, humans have way more taste receptors (found on taste buds) than dogs. This is probably why dogs will eat a lot of things that humans would not eat – think poop!

### SLIDE #12 – TECHNOLOGY

People can use technology to help their sensory receptors get information about the world around us.

People can use technology to help their sensory systems when they are not working correctly for some reason.

Like using glasses (or contacts) to help people see. Or, using hearing aids to help people to hear.

### SLIDE #13 – TECHNOLOGY OR SUPERHEROS

People can use technology to get information about the world even when they do not have the sensory system to get the information.

Different kinds of information are transmitted using different **wavelengths** – movement of molecules.

Light energy – that we can see - is transmitted using wavelengths between 400 and 700 nanometers.

Sounds – that we can hear – are transmitted using wavelengths between 1.7 centimeter and 17 meters or 20 – 20,000 Hz (waves per second). Other animals hear different sound waves.

Now, there are other wavelengths of energy on the electromagnetic spectrum, such as X-rays, radio waves, etc.

With our eyes, we cannot see the bones inside our body – but, with an x-ray machine we can.

With our ears, we cannot catch the radio waves in the air, but with a device – like a radio, smart phones, earbuds – we can hear the radio.

We do not have sensory receptors in our bodies that can catch and translate those wavelengths of electromagnetic energy.

If we had sensory receptors that could translate the electromagnetic energy that allows us to see inside our bodies – we would have x-ray vision.

If we had sensory receptors that could translate the electromagnetic energy that allows us to hear the radio waves in the air – we would have superhuman hearing.

If we could see and hear those electromagnetic energy wavelengths – we would be superheroes.

We don't have those sensory receptors in our body to translate those wavelengths of energy and we are not superheroes.

But, humans are smart and they go to school to learn things – so they can build machines that can help us translate energy from the electromagnetic spectrum that our bodies cannot.

## SLIDE #14 – DECIDES

So, your sensory systems send your brain information...then what?

Your brain puts all of that information from all your sensory system together with information about what you have already learned about the world.

Your brain then “decides” what is important at that particular time and then your brain motivates you to do a behavior.

Wow!!! That is a lot of stuff going on in your brain!!! And, this kind of thing is going on ALL the time!!!

## SLIDE #15 – PERCEPTION

While your brain is doing all that, there is something else to consider...

As all that information from your sensory systems is being put together, there is something else that could change what behavior you do. That something else is your **perception** of the information.

What is perception?

Perception or perceiving something, is you being **aware** of what is going on in the world – from information that you get from your sensory systems. And...sorry, but this is always changing too – just like the world around you is always changing.

Plus, everyone perceives things differently based on a LOT of different things.

You like chocolate, but your friend likes vanilla ice cream. To you, chocolate tastes better than vanilla. You know this because you have tried both flavors. So, when given a choice you choose chocolate.

When your friend is given a choice, they choose vanilla.

And how you perceive things changes at different times in your life.

When you were little you liked songs like “the wheels on the bus”, now you like songs by Taylor Swift, Pharrell Williams or Selena Gomez better.

## SLIDE #16 – PERCEPTIONS

Perceptions can change based on past experiences.

What if when you were little, you were bitten by a dog. So, now when you see a dog – you “see” an animal that could potentially bite you again. You do not see a cute, cuddly animal that is potentially your friend.

Now, your perception of dogs could change. If you spend more and more time with dogs and you are not bitten, then you might begin to like dogs and not feel like they are just animals that want to take a bite out of you.

### SLIDE #17 – ATTENTION

Perceptions can change based on what you are paying attention too.

Let's say you are sitting in a classroom and the teacher is talking. You should be listening to the teacher, but your friend behind you is whispering something.

You cannot hear him that well, so you turn your head and focus your attention on what your friend is saying.

Of course, at that particular time, the teacher decides to ask you a question – but, you do not what they said because you were trying to listen to your friend...yikes!

### SLIDE #18 – EMOTIONS

Perceptions can change based on emotional state.

If your family just moved into a new neighborhood and it is your first day at the new school.

You may be angry, because you liked your old school and your old friends. You are in a bad mood and even though everyone is being really nice, you decide you do not like any of the new kids.

Luckily, your perceptions can change. In fact, the more time that you spend with the new kids, the more realize that they are fun and interesting.

Lucky for you too is that the new kids, who may have perceived you as being not very nice because you were in such a bad mood, may also learn that you can also be nice.

### SLIDE #19 – SENSORY ILLUSIONS

Perceptions can change based on expectations.

When we expect to see, hear, feel, taste or smell one thing, this can actually change what we see, hear, feel, taste or smell. This is where we get sensory illusions.

If you saw this picture and you had to choose whether the dot was closer to the top or the bottom of the triangle, what would you say?

Most likely you would choose the top or the bottom – because my question made you think it was closer to the top or the bottom.

But, the dot is exactly in the middle of the triangle.

Sensory illusions are lots of fun, but they also tell us that even though our sensory system may be getting the correct information, our brain has to put everything together and the information we **perceive** is different from what we got.

### SLIDE #20 – THE WORLD AS WE KNOW IT

So, learning about the world that we live in turns out to be a LOT more complicated than we thought.

Animals learn about the world that they live in by getting information from their sensory systems.

Humans can enhance the information that we get from our sensory systems using technology. This gives us even more information.

Plus, not only is the world always changing, but the way we perceive the information we are getting about the world around us depends on lots of other factors – like what we have learned before, attention, emotional state, and our expectations – to name just a few. And, our perceptions are always changing too.

Lucky for us, we know that if we keep our brain's healthy – that our brain has the ability to assess what is going on in the world around us and help us to choose behaviors that will allow us to not only survive – but, to thrive.

## **SLIDE #21 – CONCLUSION**

Thank you all for letting me talk to you about the world as we know it.

I have enjoyed spending time with you today talking about the brain. I hope that you have had some fun and learned something about your brain.

REMEMBER, our sensory systems help us to learn about the world. Because humans are more advanced in their thinking than other animals, we are able to enhance our sensory systems to get even more information. Based on a lot of different factors, we then perceive that information and make decisions on how to behave. Using your brain to do all this, helps your brain stay healthy and that is SPECTacular.

**THANK YOU SO MUCH FOR ALL OF YOUR HELP!!! Brain Health is not just SPECTacular...it is FUN!!!**