Finn the Fox

Discovering the Brain with Red Light

Dr. rer. medic. Laura Bell

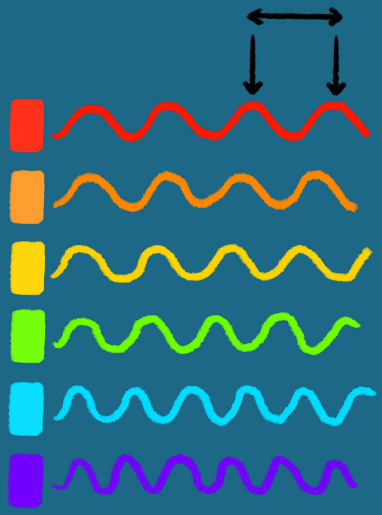
This is FINN.

Finn is a fox.

Finn is very curious.

Recently, Finn discovered that WHITE LIGHT is made of all of the colours of the RAINBOW.

A special shape, a PRISM, can break the white light into different colors.



Light travels in waves. Each color of light has a different WAVELENGTH.

A wavelength is the distance between two peaks of the waves.

Finn has been told that a special kind of RED light can be used to look at the BRAIN.

To find out more about this special kind of red light
and to understand how it helps us
to see what the brain does,

he visits Dr. Panda.

Dr. Panda is a
SCIENTIST.

This means he is just
as curious as Finn.

Dr. Panda is especially
curious about the brain.
He has a device that
helps him to find out
how the brain works.


Maybe
Dr. Panda can
READ MY MIND
with his device?

„No.“ says Dr. Panda. „I will explain it to you.“

Scientists take a device to look at the brain.
This device uses that special kind of red light
called near infrared light.

Therefore the device is called

fUNCTIONAL NEAR-INFRARED SPECTROSCPY.

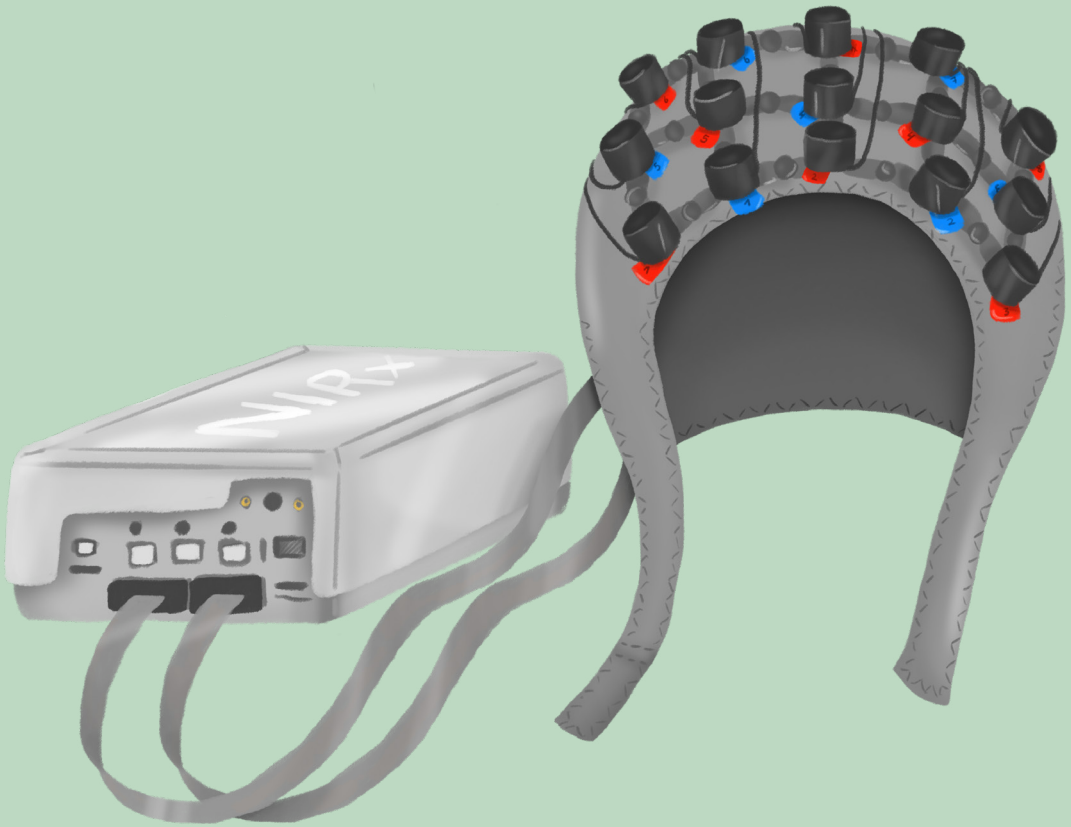
Wow - that is a very complicated word.
But Dr. Panda says it is also often called

fNIRS

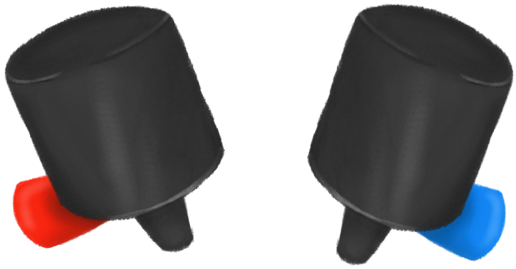
That is much easier!

To look at the brain with fNIRS,
you have to wear a special cap.

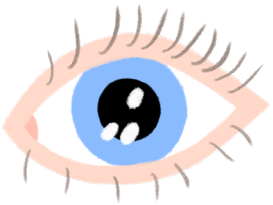
The cap is then connected to the fNIRS device.

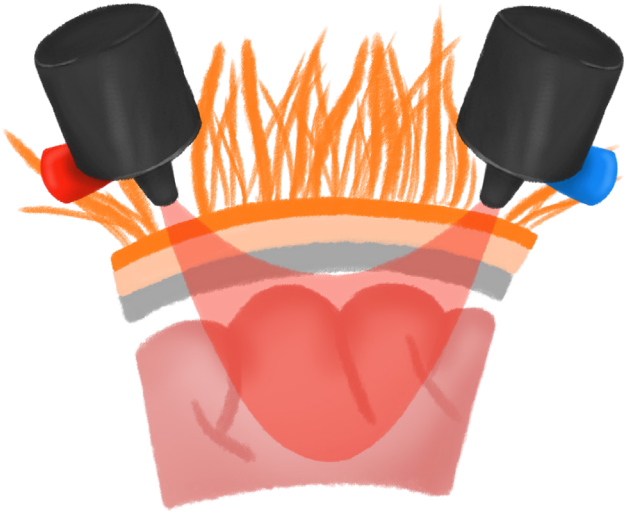


Within the cap are PLUGS. These plugs are the eyes of the device.



Some of the plugs (red) shine near-infrared light onto your head.





The light then travels through the hair, the skin and the skull until it reaches the brain.

Others plugs (blue) measure how much light returns to the surface of the head.

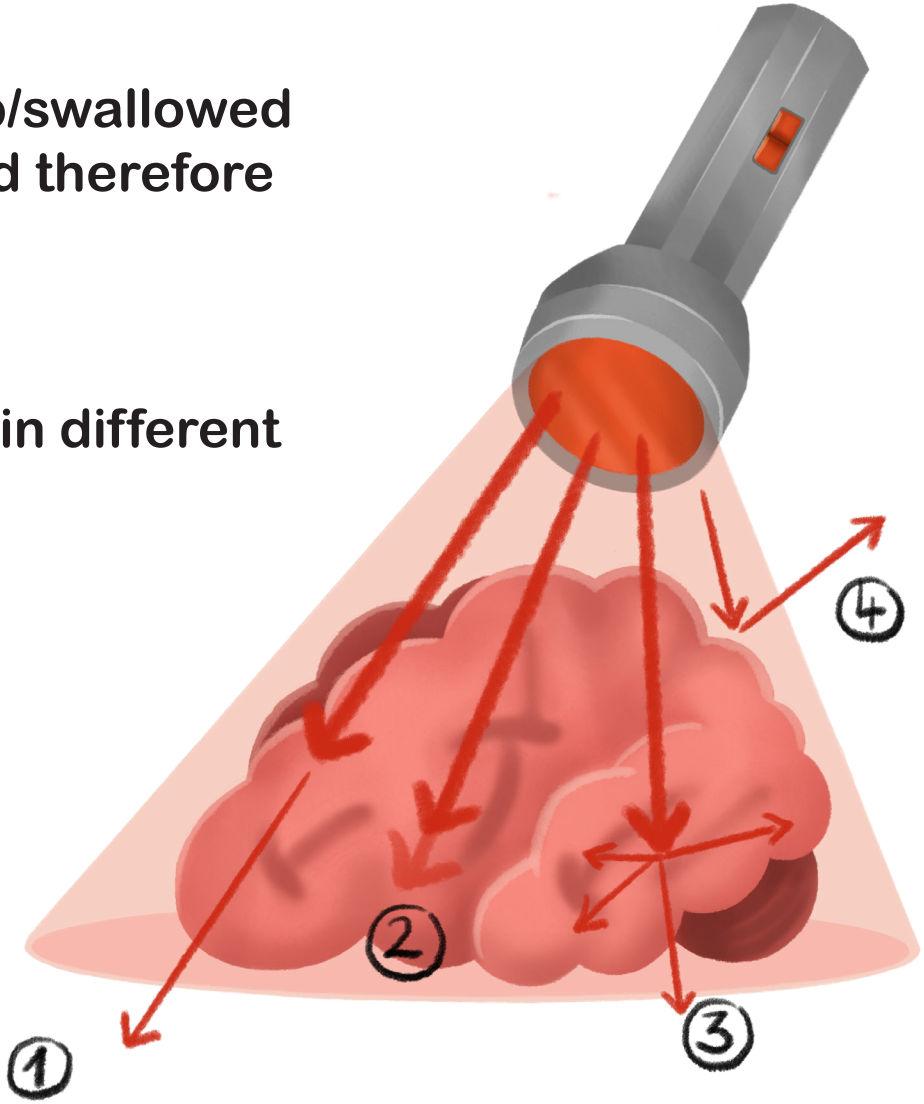
Some of the light is ...

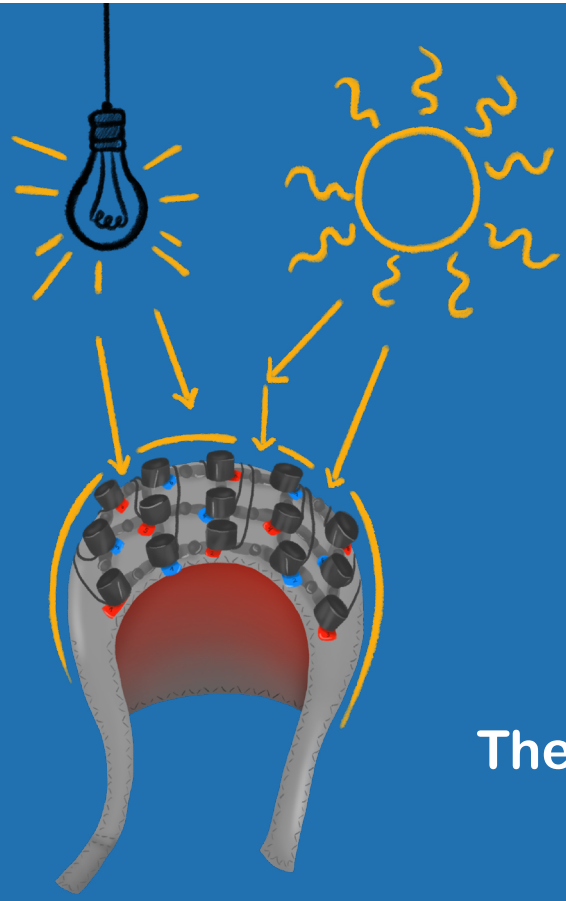
1 - ... TRANSMITTED
(it passes through an object).

2 - ... ABSORBED
(it gets eaten up/swallowed by the brain and therefore gets less).

3 - ... SCATTERED
(it is redirected in different directions).

4 - ... REFLECTED
(it bounces of).





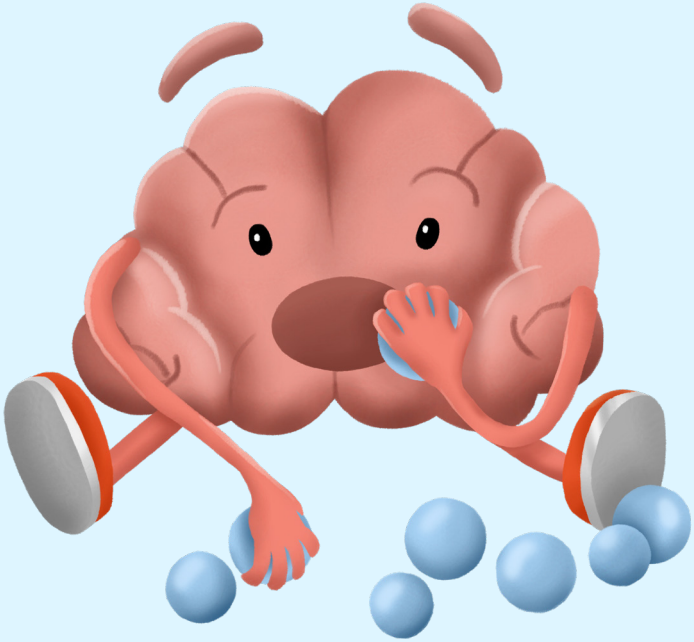
But why is the cap **black**?

Because there are other light sources, like lightbulbs or the sun.

The device‘s light is not strong (less than usual sunshine).

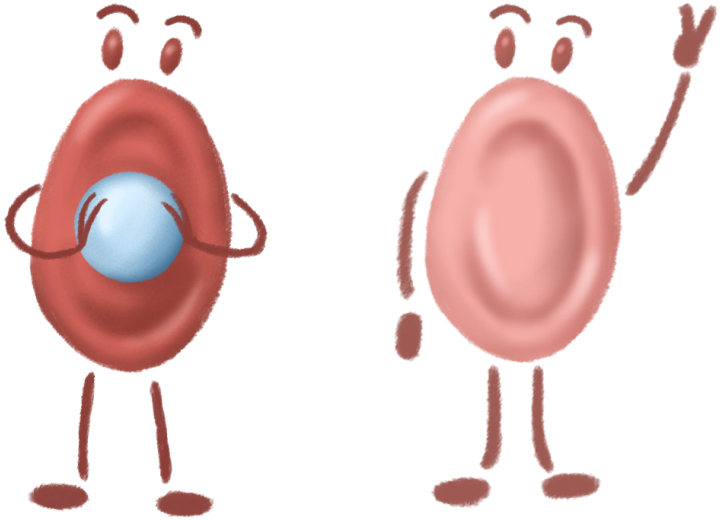
So to make sure the device‘s eyes see the light it is shining, we have to make sure that no other light reaches the eyes of the device. Hence we use a black cap. It works like a shield for protection against other light sources - or like really, really dark sun glasses.

The near-infrared light actually does not show us the brain itself. Rather it tells us how much oxygen a certain part of the brain is eating.



Our brains are always hungry.
One thing a brain likes to eat is OXYGEN.
It always eats oxygen, because it provides it with energy! When we are active - for example when we run - some areas of our brain (those that tell our muscles how to run) need even more oxygen.

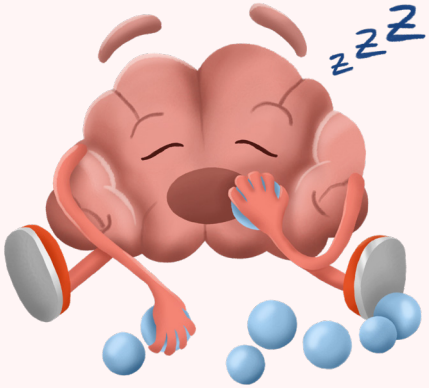
These little guys help to bring oxygen to the brain.

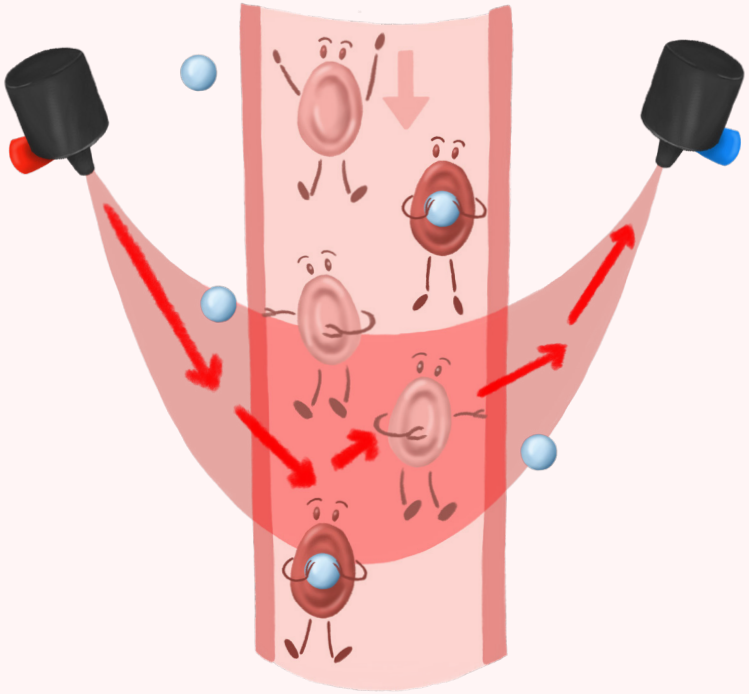


They are called HEMOGLOBIN.

Here you can see hemoglobin
with (left) and without (right) oxygen.
They travel through your BLOOD STREAM.

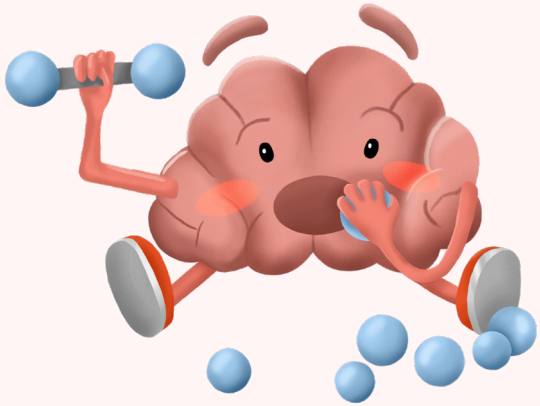
This is how your blood stream looks in brain regions that are NOT ACTIVE.

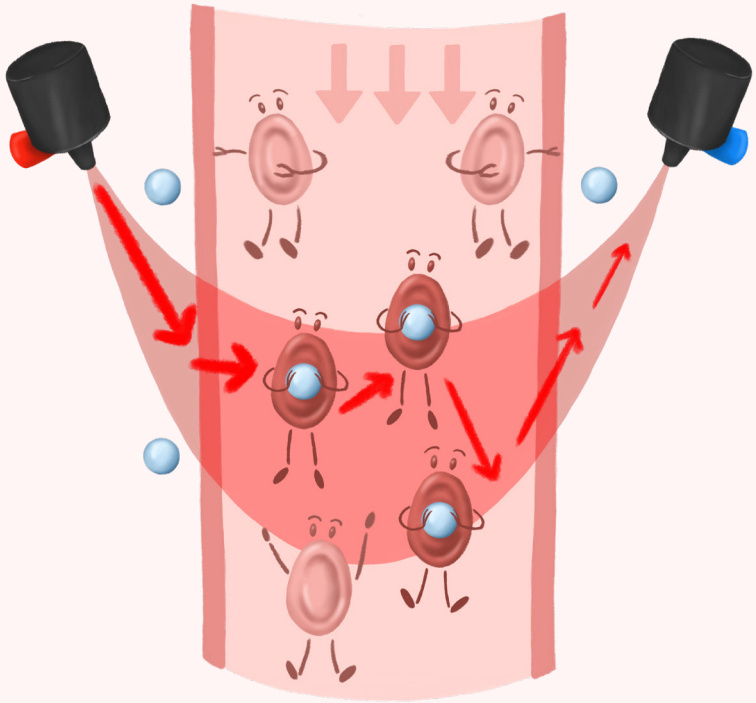




The blood flows in the blood vessels.

This is how your blood stream looks in brain regions that are ACTIVE.





When active - Blood vessels in the active region widen and the blood flow increases. Blood, hemoglobin and oxygen can travel FASTER.

Importantly, this means that there is more oxygen in active brain regions than in brain regions that are not active.

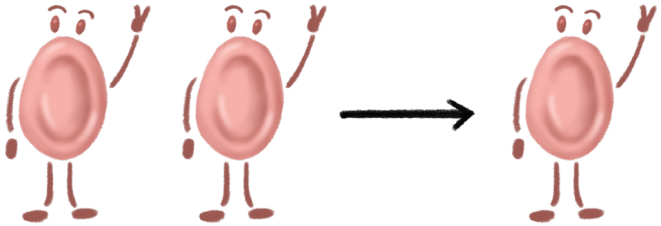
The fNIRS measures changes in light absorption. This means it does measure changes in the amount of light that gets eaten by the brain or in other words the amount of hemoglobin with and without oxygen.

To do so, the device uses
TWO different kinds of near-infrared light.
Both have a slightly different wavelength
(= they differ slightly in their distance in between the peaks of their waves in which they travel).

WAVE LENGTH 1

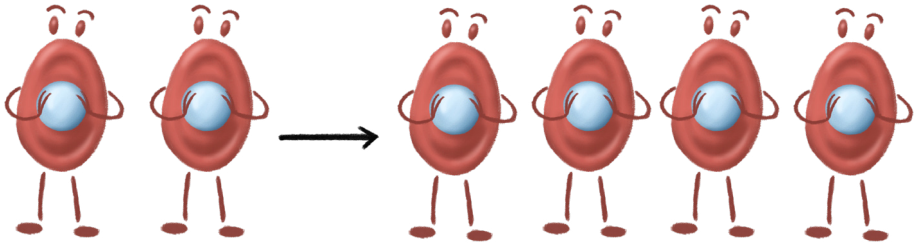
WAVE LENGTH 2

One wavelength is very good at detecting changes in blood vessels that contain many hemoglobin WITHOUT oxygen.



2-1 = 1
less than before

The other is very good at detecting changes in blood vessels that contain many hemoglobin WITH oxygen.



4-2 = 2
more than before

Together, both wavelengths tell us which areas of the brain eat most oxygen and are thus active and which are not!

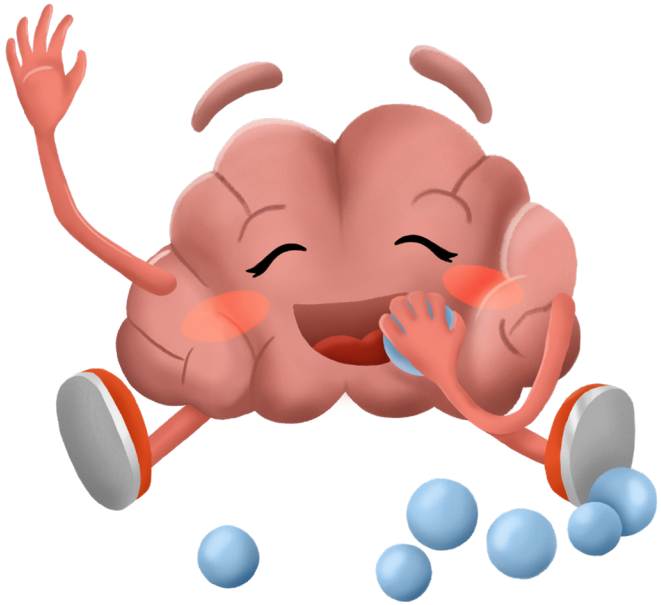
Scientists such as Dr. Panda ask other people to take part in their **EXPERIMENTS**.

An experiment is a kind of test.
They test which brain region is more active during a task than during rest.
This way, they try to find out which brain region is responsible for which task.
Clever, right?

To find the answer to that question,
scientists might ask you to play a game
on a computer, do sports or
interact with another person.

This looks like FUN!
Maybe Finn will take part in an
experiment soon too.

The end.



NIRx

ENLIGHTENING INNOVATION