NeuLog

Panda

First Steps in Science

Temperature Light Sound Barometer Altitude Humidity

Dew-point Acceleration Magnetic field

Panda
First Steps in Science

3_10

Contents

First Steps in Science

The laws of nature are at the base of every technological system. From the way machines operate to modern agriculture, distillation and even electric and electronic systems, there is always a natural process assisting the technology.

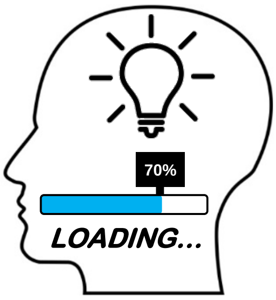
In this book, we take a deep dive into different phenomena: light, sound, air-pressure, humidity and more. We turn theory into substance by first exploring the senses, then by making a comparison to measurements taken by electronic sensors.

By using the PANDA 9 in 1 portable lab, children receive real-time measurements and feedback to what they do as they do it. Phenomena that are difficult to grasp are illustrated and materialized before their eyes.

The "PANDA – First Steps in Science" book is a step-by-step instructor's guide that leads young children into the world of science, by exploring their environment.

The "PANDA – Explore Science" book includes advanced experiments for self-practice, guided by an instructor.

Each book offers an easy trail to follow, guiding a young child through this fascinating world of science, creating a strong base for the future, for every path he/she chooses later on in life.



Goals

The aim of the **PANDA – First Steps in Science** book is to develop important skills of **observation** and **analysis**.

Each experiment in this book is designed to be playful and to encourage **curiosity**, by first exploring the senses.

Performing measurements with PANDA illustrates scientific subjects. Young children develop **analytical skills** for directing **research** and creating **reports** while they play.

By working together, analyzing and discussing the results, young children develop **verbal skills** and a sense of **team work**.

Lesson structure

All the following recommendations are not obligatory. The order of the experiments and subjects may be changed. You can make any adaptation, as you see fit.

Each lesson is divided into the following parts:

Introduction

A short description of what we are about to observe and examine.

The idea is to lead the children to an experiment straight away. Let them experience the subject first, and discuss it later.

Experiment

This part is a step-by-step guide on how to conduct the experiment, leading the children to observe and to measure.

Each experiment has its own worksheet with instructions. The worksheets are also used for writing results and creating reports.

You can download the worksheets as an open WORD document from **www.neulog.com** and hand them out.

Discussion during the experiment

For each subject there are discussion questions, relevant to the experiment.

Recommendations for classroom teaching:

- Use the questions to create a discussion in small groups, while the other groups continue with their experiment.
- Small groups or one-on-one discussion allows even the shy student to participate.
- Students should present the results of their measurements, explain and discuss those results.
- Questions and directions should be kept to a minimum since the discussion segment is about developing the students' ability to observe, to draw conclusions and their conversation skills.

Summary and more to know

With experimentation students understand the subject matter. They observe, measure and discuss their results. Now, it is time for an overview of the subject.

More examples from nature may be added.

A few more notes on the lesson plans

- Make the introduction short. Expand somewhat in the discussion and summary.

  A long introduction makes it difficult for the students to see where it leads.
- Use short stories or examples from everyday life in the summary.
- Prepare for the lesson by first reading the "**Discussion during the experiment**" and the "**Summary and more to know**".

  The scientific background for the experiment is laid out in the summery segment.
- It is recommended to divide the class to teams of 2-4 students.
- Use the discussions to help children develop listening and speaking skills.

PANDA – 9 in 1 Portable Lab

The PANDA is a colorful display, touchscreen, sensor lab that brings science to life by making it tangible. It is the primary school tool for excellence in environmental data collection and for experiments in biology, physics and chemistry.

The PANDA's real-time display of measurements, feedback and graphs strongly connects a child's sensations or actions in nature to the phenomena, making it easier to explain complex laws of nature.

Features:

The PANDA is a multi-sensor module that includes 9 built in sensors:

Temperature **Light** **Sound** **Barometer** **Altitude** **Humidity**

Dew-point **Acceleration** **Magnetic field**

The PANDA also includes:

- A 3.2" (320 x 240 pixels) color display
- A touchscreen
- A USB connector
- A rechargeable battery

Data analyzing modes and display options:

The PANDA has two modes for performing sensor measurements: ***Normal*** and ***Experiment***.

Normal mode:

In this mode, the panda displays real-time measurements of a chosen sensor.

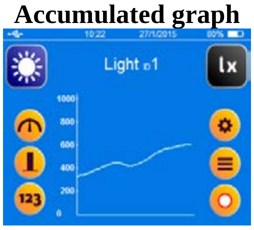
The normal mode has 4 display options:

Digital

Bar

Analog meter

Accumulated graph



Experiment mode:

In this mode, the PANDA records the measurements of ***all*** sensors participating in an experiment over a pre-determined period of time.

The PANDA can display an experiment's results, 2 sensors at a time.

The Panda software, for PC, MAC or tablet:

The data collected by the PANDA can be further analyzed with the PANDA software, specially designed for primary schools, using a PC, a MAC or a tablet. It is super friendly and intuitive to use.

Experiment 1.1 – Getting to Know the PANDA

Objectives:

- To be familiar with the PANDA.
- To learn about the PANDA sensor options.
- To learn about the PANDA different display modes.

Introduction

A short description of what we are about to observe and examine.

The idea is to lead the children to an experiment straight away. Let them experience the subject first, and discuss it later.

Experiment

1. ***Hold*** the PANDA.

2. ***Click*** the POWER button and turn the PANDA on.

   The PANDA opens, showing the sound sensor digital display.

3. ***Make*** a sound and note how the displayed values change.

4. ***Navigate*** through the different display options, testing each one.

5. ***Ask*** the children to repeat these steps with their PANDA.

6. ***Present*** another sensor.

7. ***Ask*** the children to explore the other sensors.

Discussion during the experiment

- Present the four options of the sound display.

  What is the difference between the accumulated graph and the other display modes?

  (The accumulated graph shows all of the recent recorded events. Other display modes show only the most recent one.)

- Find and write a list of the PANDA sensors.

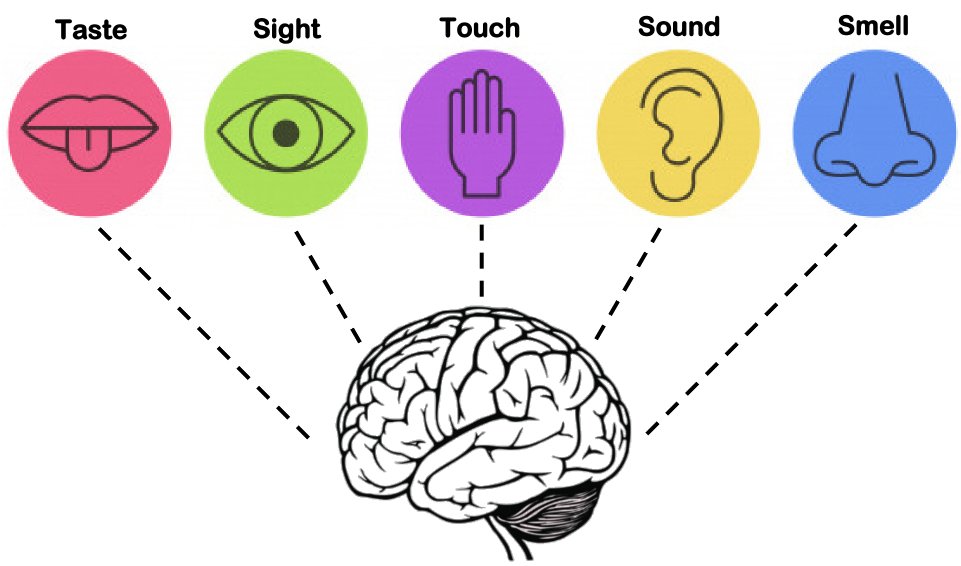
  (Show the students how to select a sensor.)

- Play with the other sensors.

Summary and more to know

The human senses:

Human beings have 5 senses: sight, sound, smell, touch and taste. These senses send signals to the brain. The brain analyzes these signals and takes actions accordingly.



The PANDA sensors:

The PANDA portable lab has 9 sensors: light, sound, temperature, barometer, altitude, humidity, dew-point, acceleration, and magnetic-field. It also has a small computer that receives signals from the sensors and converts them into values we can read and understand. For example: temperature degrees (Celsius or Fahrenheit), light intensity (lux unit).

Displaying measurement results:

There are 3 different ways to display measurements:

1. ***Analog display*** – The measured value is presented on a scale.

   Here we can compare the measured value to the minimum and maximum values in that range.

2. ***Digital display*** – The measured value is given a number.

3. ***Accumulated display*** – Collected display of a series of results over a period of time.

   Here we can easily review changes and compare measurements from different experiments.

Experiment 1.2 – Light Intensity

Objectives:

- To test and compare the human eye to a light sensor.
- To measure the light intensity in different environments.
- To learn about the light unit LUX.

Introduction

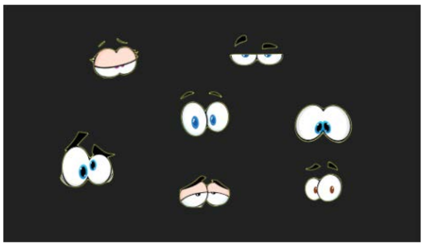
In this experiment we measure the light intensity in different environments (indoors and outdoors), using the PANDA's light sensor.

We explore the human eye: can it be used as a light sensor?

We learn about the light unit Lux.

Experiment

1. ***Darken*** the room (not to complete darkness).



2. ***Show*** the children a picture from a distance of 5 meters.

3. ***Ask*** them to try and see its details.

4. ***Wait*** for a few minutes, then ***ask*** them to notice if the picture becomes visible.

5. ***Ask*** the children:

   "How is it that the picture became more visible, although the room remained dark?"

6. ***Turn on*** the lights.

7. ***Present*** the PANDA's light sensor.

8. ***Instruct*** the children:

   ✩ ***Click on*** the button on the upper left-hand side of the PANDA's screen.

   ✩ ***Choose*** the ***Light*** option (if it is not already selected).

   ✩ ***Click on*** the 

 button and change the range to ***0-6000 lx***.

9. ***Explain*** to the children how to change ranges in the PANDA's light sensor.

10. ***Change*** the display to a ***digital*** display.

11. ***Ask*** the children to ***write down*** the different light intensity measurements in table 1:

Table 1 – Light intensity in the classroom		
Window shutters	**Light**	**Measured value (in Lux)**
open	on	
open	off	
close	off	
close	on	

12. ***Ask*** the children to identify the PANDA's light sensor.

13. Again, ***ask*** the children to ***write down*** the again the light intensity measurements in table 2:

Table 2 – Light intensity in the classroom		
Window shutters	**Light**	**Measured value (in Lux)**
open	on	
open	off	
close	off	
close	on	

14. ***Observe*** the light intensity in other Panda modes:

Column   Graph   Gauge

15. ***Change*** the display to a ***digital*** display.

16. ***Direct*** the PANDA's light sensor towards a white board. Then, direct it towards a black board.

17. ***Ask*** the children to ***write down*** the different light intensity measurements in table 3:

Table 3 – Light intensity against white and black boards	
Sensor direction	**Measured value (in Lux)**
Sensor turned towards a white board	
Sensor turned towards a black board	

18. ***Click on*** the  button and change the range to ***0-240000 lx***.

19. ***Ask*** the children to ***measure*** the light intensity outdoors. ***Use*** different measurement' ranges and ***fill out*** table 4:

Table 4 – Light intensity outdoors		
Sensor	**Measured value (0-6,000 range)**	**Measured value (0-240,000 range)**
Sensor turned towards the sun		
Sensor turned towards the horizon		

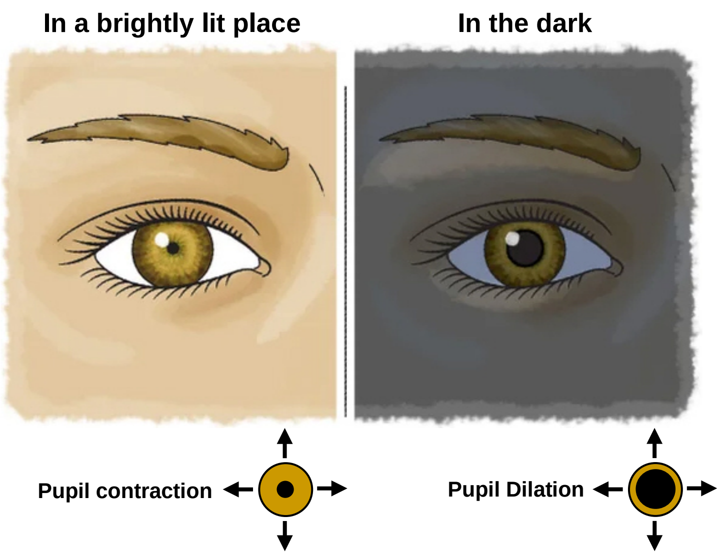
Discussion during the experiment

- In a room setting, which of the ranges would be more sensitive to light intensity changes: the 0-6000 range or the 0-240,000 range?
- Does the PANDA's light sensor adapt itself to the light the same way the human eye adapts itself?
- Does a time lapse of a few minutes change the sensor's measurements?
- To measure the ***real*** light intensity of a room – do we aim the sensor at the lamp or alongside the lamp?
- What does the PANDA's light sensor measure if the sensor is not aimed at a specific light source?

Summary and more to know

Our eyes' pupils have an amazing adaptative ability. They can expand or contract according to the intensity of the light around us.

The Human eye (the size of a pupil)



Some animals have pupils with amazing flexibility, like cats, for example. Depending on the light, the shape of a cat's pupil changes from a slit to almost fully round. Muscles on either side of the cat's pupil open the slit wide or cause it to narrow.

Cat's eye (the size of a pupil)

Measuring light using the PANDA:

A light sensor measures (in lux units) the light that flows around it (light intensity per unit area).

When the sensor is not aimed towards a light source, the measured light intensity is the general light indoors reflected from the walls and various objects in the room.

Experiment 1.3 – Sound Levels

Objectives:

- To measure sound levels from different sources.
- To test and compare whether the human ear can be used as a sound sensor.
- To learn about the sound unit Decibel (dB).

Introduction

In this experiment we measure the sound levels of different musical instruments using the PANDA's sound sensor. We also measure the sound levels of a whisper, a person talking and shouting.

We explore the human ear, testing its viability as a sound sensor.

We learn about the sound unit (decibel).

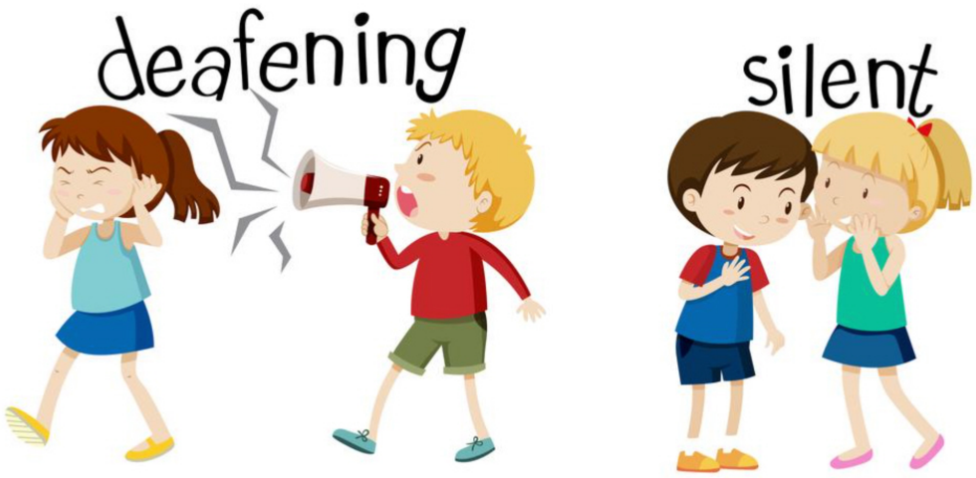
Experiment

1. ***Ask*** the children to whisper. Every few seconds, ask them to be a bit louder, to the point where they are too loud.

2. ***Ask*** one of the children to whisper very softly and ***ask*** another child to speak as loud as s/he can.

3. ***Ask*** the children:

   "Can you understand each other when you are whispering? Can you understand each other when you are shouting?"



4. ***Instruct*** the children:

   ☆ ***Click on*** the button on the upper left-hand side of the PANDA screen.

   ☆ ***Choose*** the ***Sound*** option (if it is not already selected).

5. ***Ask*** the children to ***write down*** the different sound level measurements in table 1:

Table 1 – Sound level (our voice)	
Speaking level	**Measured value (in dB)**
Whispering 	
Talking 	
Shouting 	

6. ***Repeat*** different sounds (whisper, talk, shout). Each time, ***observe*** the sound levels in the different PANDA graph modes:

Column  Graph  Gauge 

7. ***Ask*** the children to reach 45 dB, using their voices.

8. ***Ask*** the children to reach 90 dB, using their voices.

9. ***Ask*** the children to ***write down*** the different sound level measurements, by using a drum (or a box as a drum) or by clapping their hands:

Table 2 – Sound level (drumming and clapping)		
Make a sound using	**Sound level**	**Measured value (in dB)**
A drum 	low	
A drum 	high	
Clapping 	low	
Clapping 	high	

10. ***Repeat*** the different sounds (drum-low, drum-high, clapping-low, clapping-high). Each time, ***observe*** the sound levels in the different PANDA graph modes:

Column  Graph  Gauge 

11. ***Ask*** the students to reach 45 dB using a drum () or clapping ().

12. ***Ask*** the students to reach 90 dB using a drum () or clapping ().

Discussion during the experiment

- Using your voice / a drum / clapping –

  ✯ Were you able to reach 45 dB?
  ✯ Were you able to reach 90 dB?

  Which technique was the easiest?

- Which of the PANDA graph modes did you like the most while making the different sounds? Why?

  Column   Graph   Gauge

- Ask your desk partner to make a noise, and try to guess its decibel level. Now look at the PANDA and see if you guessed right.

- Explain – why is it hard to hear someone when they are far away?

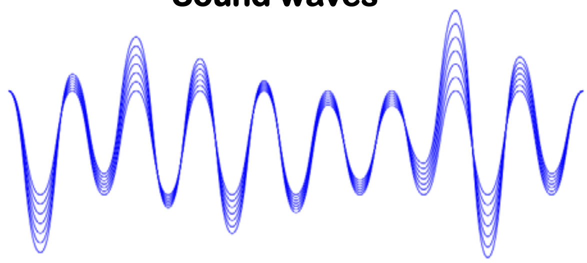
Summary and more to know

Ears and sound:

Sound comes from vibrations.

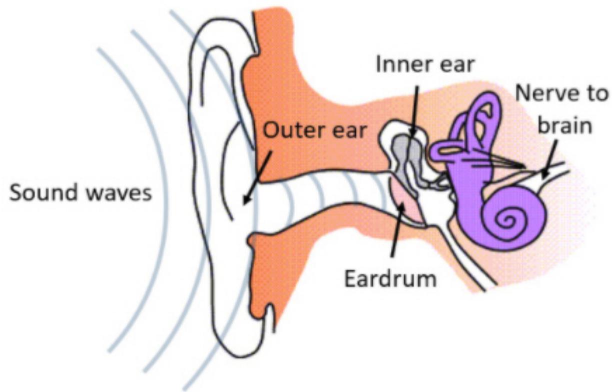
These vibrations create sound waves.

Sound waves



Sound waves move through air, water or even solid objects before reaching our ears.

These sound waves vibrate the ear drum in our ear.



Our brain translates the vibration back to sounds.

The human ear has an amazing ability of being able to hear and understand different sounds at the same time. We can hear and understand someone speaking to us, while listening to music on a busy street, full of noises.

Did you know?

Many animals use sound to detect danger and escape attacks.

Dogs can hear sound at a higher pitch than humans, which means that they can actually hear noises we can't!

Measuring sound using PANDA:

The unit for measuring sound levels is called decibel (dB).

The decibel is the common unit of sound measurement. A decibel is one tenth of a bel (B), or 10 decibels equal 1 bel.

Alexander Graham Bell:

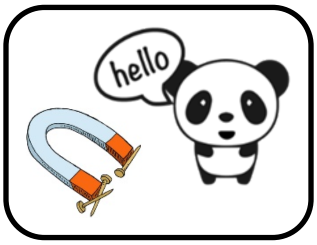
The bel unit was named after Alexander Graham Bell, an American inventor, scientist and engineer who invented the first practical telephone.

Here are some common examples of noises and their dB levels:

10 dB – Breathing
50 dB – Whisper, leaves rustles
70 dB – Street noise
80 dB – Vacuum cleaner
105 dB – Alarm clock
115 dB – Drilling machine
145 dB – Airplane taking off

Next time you hear a noise, try to figure out how many decibels that noise produces.

Experiment 1.4 – Magnets



Objectives:

- To learn basic magnet properties.
- To study how different poles have different magnetic field values.

Introduction

In this experiment we use two bar magnets, one stronger than the other.

We catch as many paper clips as possible with each magnet, and at each of the magnet's poles.

We measure the magnetic field strength of each magnet at each pole, using the PANDA's magnetic sensor.

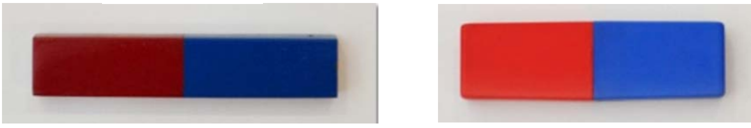
We learn about the magnetic field strength unit – the Tesla (or Microteslas μT).

Experiment

1. ***Hand out*** two magnet bars to each child.

2. ***Instruct*** them to slowly put the red pole closer to the blue pole.

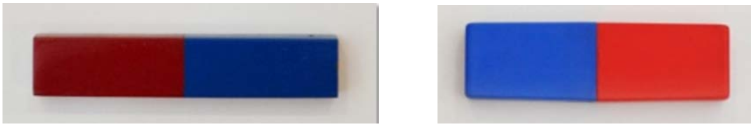
Magnet A Magnet B



3. ***Ask*** the children:

   "Did the magnets attract or repel one another?"

4. ***Turn over*** one of the magnets, so both blue poles are closer together.



5. ***Ask*** the children:

   "Did the magnets attract or repel one another?"

6. ***Pile*** paper clips on the table.

7. ***Ask*** the children:

   "Do the paper clips attract each other, repel each other or do nothing?"

8. ***Ask*** the children to catch as many paper clips as possible, by using both sides of the two magnets.

9. ***Ask*** the children:

   "How many paper clips did you catch with each magnet? Which magnet is stronger? Explain why."

10. ***Instruct*** the children to hold one of the magnets and create a chain of paper clips that will hang from it.

11. ***Ask*** the children:

    "Why do the paper clips stick to each other?"

12. ***Insert*** a piece of paper between the magnet and the first paper clip in the chain. Does the magnet still attract the chain of paper clips?

Measurements of magnetic fields:

13. ***Instruct*** the children:

- ✯ ***Click on*** the button on the upper left-hand side of the PANDA screen.
- ✯ ***Choose*** the ***Magnetic*** option (if it is not already selected).
- ✯ ***Click on*** the 

 or the 

 button located on the right-hand side.
- ✯ ***Choose*** the ***X axis*** option.

14. ***Ask*** the children to ***write down*** the different magnetic field measurements for a single magnet bar in table 1.

Make sure that the magnet bar is about 10 cm away from the PANDA.

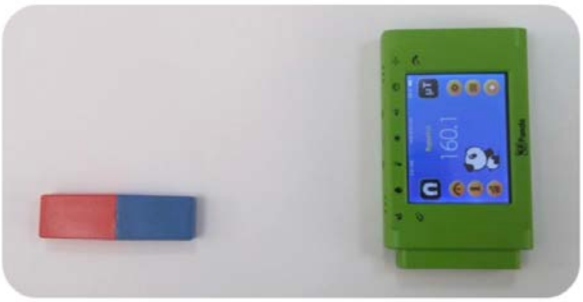
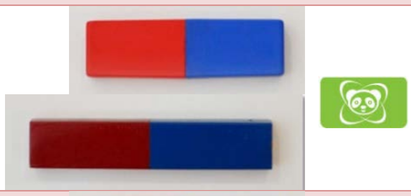
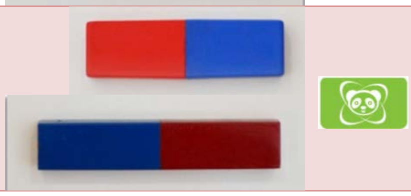


Table 1 – Magnetic field measurements, single bar			
Magnet			Magnetic field strength (in µT)
Magnet A (red side)			
Magnet A (blue side)			
Magnet B (red side)			
Magnet B (blue side)			

15. ***Ask*** the children to ***write down*** the different magnetic field measurements for two magnet bars together in table 2.

    Make sure that the magnet bars are about 10 cm away from the PANDA.

Table 2 – Magnetic field measurements, both bars		
Magnet		**Magnetic field strength (in μT)**
Both magnets facing the same direction		
Magnets facing in opposite directions		

16. ***Observe*** the magnetic field strength changes in other PANDA modes:

    Column Graph Gauge

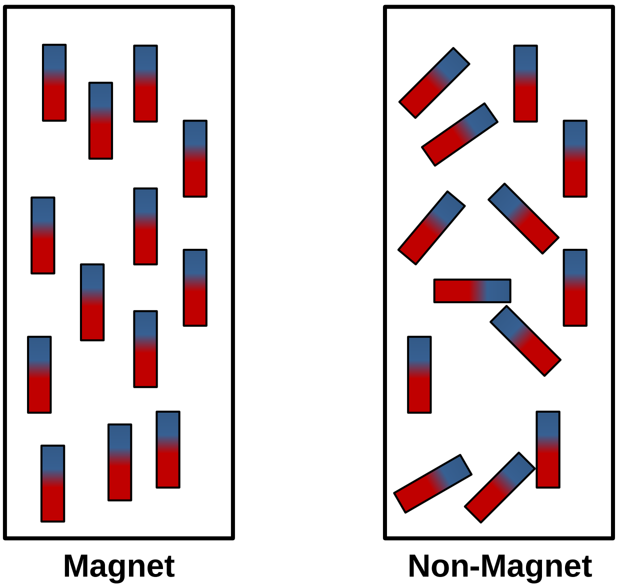
Discussion during the experiment

- Does the magnet that attracts more paper clips have stronger magnetic field?
- When holding both magnets with their magnetic poles facing in the same direction, do they have a stronger magnetic field than when the poles are facing in opposite directions?
- Why did the magnet attract the paper clips?
- Where can you find magnets in your daily life?
- Think about a new way where you can use magnets.

Summary and more to know

Magnetic materials:

All matter in nature has many little magnets in it, but as we saw in the beginning of the lesson, not all matter behaves as magnets.



In non-magnet matter, all the little magnets inside rest in different directions, cancelling each other out and thus cancelling the magnetic attraction.

In magnetic matter, a large number of these magnets inside are aligned in the same direction, thereby enabling the magnetic attraction.

Some matter can be turn into magnets. With these types of matter, the little magnets can be aligned in the same direction.

When we place a paper clip next to a magnet, for example, the little magnets in the paper clip turn to align in the direction of the magnet. The paper clip becomes a magnet in itself, attracting another paper clip in a similar fashion.

Magnets attract certain metals in nature, but not all. The main material we use to make magnets today is Iron.

Magnetism:

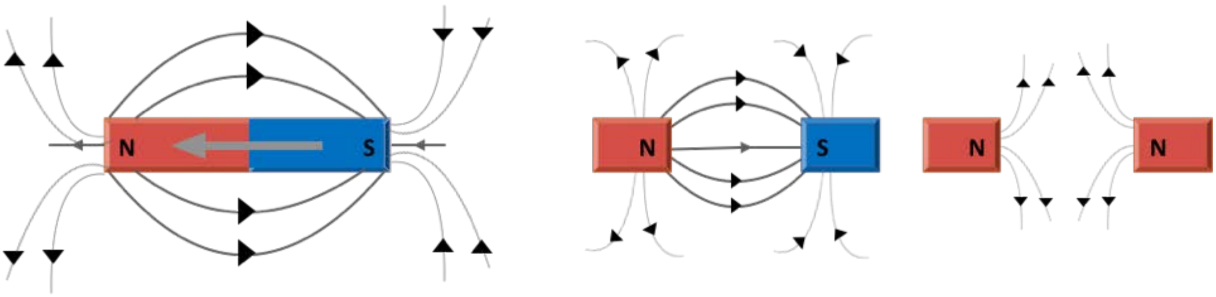
Magnetism is an invisible force or field caused by the unique properties of certain materials.

In a magnet there are two poles: a North-seeking pole and a South-seeking pole.

The magnetic force in a magnet flows from the North pole to the South pole. This creates a magnetic field around a magnet.

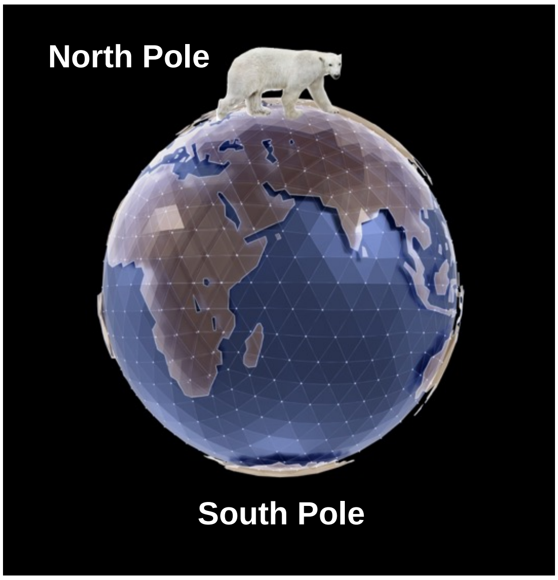
A North and a South pole will attract each other.

Two North poles or two South poles will repel each other.



The Earth behaves as a magnet.

The Earth poles are the North Pole and the South Pole.



Magnetic compass:

The magnetic compass is a light weight magnet that floats on liquid and rotates on an axis.

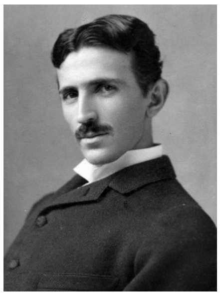
The magnetic compass's poles are aligned with the Earth's poles. The compass' North needle turns towards the Earth's North pole, thus pointing to the North.

Measuring magnetic fields using PANDA:

The unit for measuring the magnetic field strength is called Microtesla (µT).

Micro means one millionth (one divided by a million).

Nikola Tesla:



Nikola Tesla was a Serbian-American inventor, electrical engineer, mechanical engineer and physicist. Many consider Tesla one of the greatest inventors of all time.

Tesla invented the alternating current (AC), upon which all modern electricity networks are based. He invented both the induction motor and a generator that runs on alternating current. He also invented radio broadcasting, although it was attributed to Marconi.

Unfortunately, and although his many inventions are used all over the world, Tesla died destitute.

Experiment 1.5 – Barometric Pressure and Altitude

Objectives:

- To learn about the connection between barometric/air pressure and altitude.
- To explore the barometric pressure and altitude measurements at different heights.

Introduction

In this experiment we measure barometric pressure and altitude at different heights of a building, using the PANDA's barometer and altitude sensors.

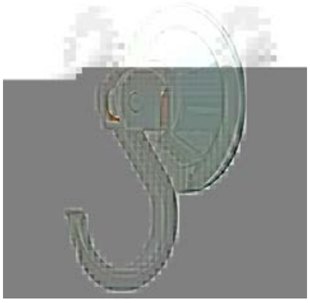
We learn about the pressure unit kPa.

Experiment

1. ***Ask*** the children:

   "Do you know what ***air pressure*** is?"

2. ***Demonstrate*** the meaning of air pressure by attaching a vacuum hook or a drain plunger to a wall.




3. ***Ask*** the children:

   "What makes the hook (or plunger) stick to the wall?"

4. ***Have*** the children play with the vacuum hooks (or with the plungers).

5. ***Try*** to pull them off the wall, and feel how strongly they are attached.

6. ***Instruct*** the children:

   ✯ ***Click on*** the button on the upper left-hand side of the PANDA screen.

   ✯ ***Choose*** the ***Barometer*** option (if it is not already selected).

   ✯ ***Click on*** the button on the upper right-hand side of the screen.

   Choose kPa.

   ✯ ***Check*** that the local barometric pressure is in kPa units (kilopascal – 1,000 pascal).

   ✯ ***Click on*** the button on the upper left-hand side of the PANDA screen.

   Choose Altitude.

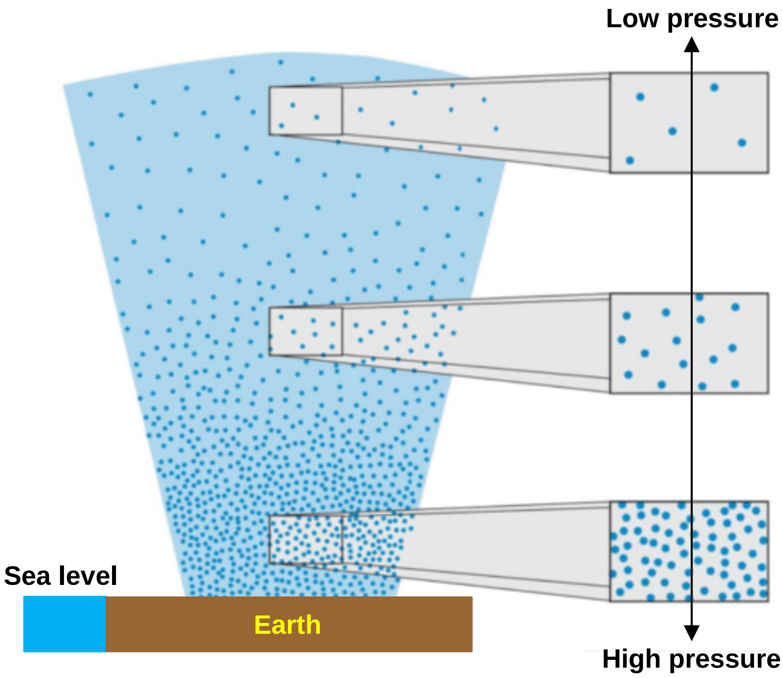
   ✯ ***Check*** that the local sea level is in meters.

7. ***Ask*** the children to ***write down*** the barometric pressure and the height above sea level of 3 different floors in table 1.

Table 1 – Barometric pressure and altitude for each floor			
Floor		**Barometric pressure (in kPa)**	**Altitude (in m)**
Ground/First floor			
Second floor			
Top floor			

Discussion during the experiment

- What is the easiest way to release a vacuum hook (or a plunger)?
- What floor had the highest barometric pressure?
- What floor had the lowest barometric pressure?
- The following image represents the Earth's air pressure. The bottom of the image shows the air pressure at sea level. Does the image match your results? Explain.



- At a high altitude it is harder for people to breathe. Why?
- Guess the measured air pressure on the 5th floor. Can you guess the air pressure on the 100th floor?

Summary and more to know

Air pressure:

Air has substance and it puts pressure on everything it touches. This is called air pressure.

When we press the vacuum hook or plunger to a wall, we take the air out. The air pressure inside goes down and that is what holds the hook to the wall.

At sea level there is a high concentration of air molecules, meaning a high air pressure. At the top of a building or a hill there are fewer air molecules, meaning a lower air pressure. The higher you climb, the lower the air pressure.

Evaluating changes in air pressure helps to predict the weather. When the measured air pressure is lower than the norm, it means that the weather will be cloudy, windy and rainy. When the measured air pressure is higher than the norm, it means fair and calm weather.

Altitude:

Altitude is the height of a point or an object in relation to sea level.

Altitude is estimated from air pressure measurements, and this is the reason why the calculation of altitude may not be accurate and may change depending on the weather.

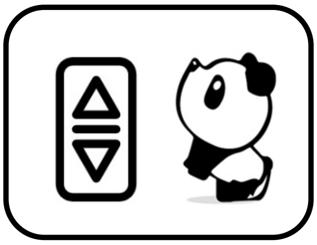
Measuring air pressure using PANDA:

The most common pressure units are Pascal (Pa), kilopascal (kPa), megapascal (mPa), psi (pound per square inch), torr (mmHg – millimeter of mercury), atm (atmosphere pressure) and Bar.

Blaise Pascal:

Blaise Pascal (1623-1662) was a French mathematician, physicist and philosopher who dealt with varied subjects. Pascal made important contributions to the study of fluids and clarified the concepts of pressure and vacuum.

Experiment 1.6 – Acceleration in Everyday Life



Objectives:

- To learn about velocity and acceleration.
- To measure acceleration changes in daily life activities.

Introduction

In this experiment we measure the acceleration changes of a toy car, using the PANDA's acceleration sensor.

This time, we will run an experiment using the PANDA and collect data over a period of time.

Experiment

1. ***Attach*** the PANDA to a flat four wheels toy car, using rubber bands (you can use a domino LEGO basic toy car, for example).

The PANDA screen should be perpendicular to the ground.

2. ***Instruct*** the children:

   - ***Click on*** the button on the upper left-hand side of the PANDA screen.
   - ***Choose*** the ***Acceleration*** option (if it is not already selected).
   - ***Click on*** the button on the upper right-hand side of the screen.
   - ***Choose*** the ***Y Axis***.
   - ***Click on*** the ***Run Experiment*** button.
   - ***Make sure*** that the experiment duration is 10 seconds.
   - ***Click on*** the ***Record*** button.

3. ***Push*** the toy car in one direction, so it rides for about 0.5 meters.

The car will accelerate for a while and then it will decelerate until it stops.

4. ***Draw*** the results on the following graph:

The graph illustrates how the measured value changes over time.

5. ***Repeat*** the experiment. This time, when the PANDA toy car stops, ***push*** it back immediately before the end of experiment.

The graph illustrates how the measured value changes over time.

6. If possible, ***repeat*** the experiment with a remote-control toy car.

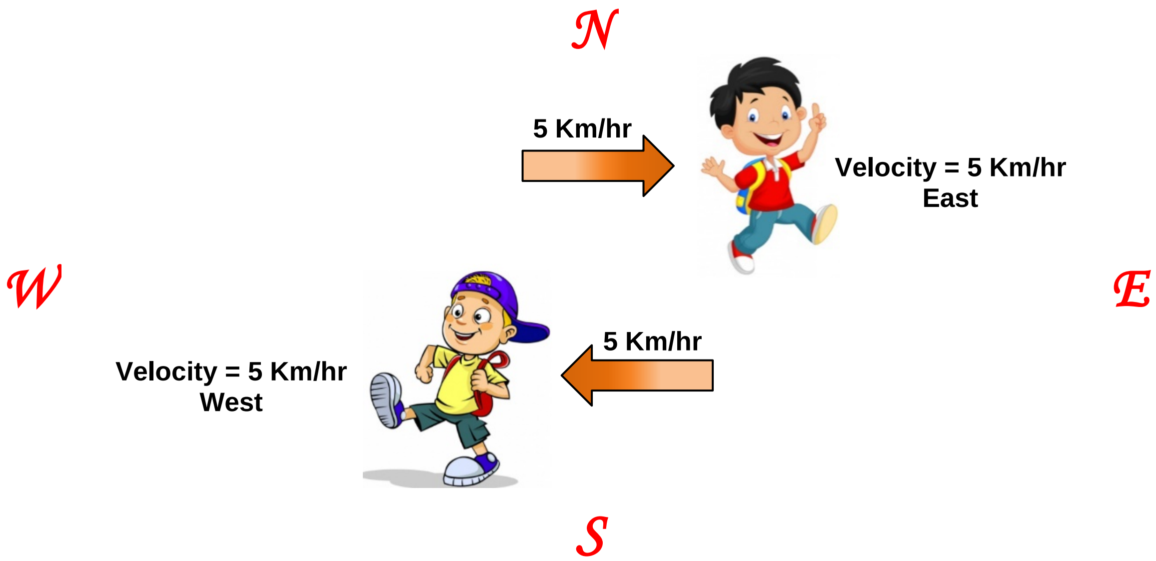
Discussion during the experiment

- Ask the children to explain the graphs they got.
- Acceleration and deceleration:
  - ✯ When a car speeds up (increases its velocity) – it is called positive acceleration (acceleration).
  - ✯ When a car slows down (decreases its velocity) – it is called negative acceleration (deceleration).
- Roller coaster ride:
  - ✯ What does a roller coaster ride feel like?
  - ✯ Can you feel the acceleration and deceleration of the roller coaster?
  - ✯ What would a PANDA graph look like on a roller coaster?
- Think of other examples from daily life that are related to acceleration and deceleration, such as: running, pushing a swing, or jumping. Describe the progression of movement using the terms acceleration and deceleration.

Summary and more to know

Velocity and acceleration:

Velocity is the speed of an object plus its direction.



Acceleration is the rate of a change in the velocity of an object.

An object that is accelerating is an object that is speeding up. An object that is decelerating is an object that is slowing down.

Use the PANDA to measure acceleration in a car, a roller coaster or even when jumping up and down, to uncover interesting results.

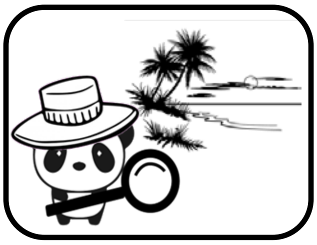
Next time you run, think about your acceleration, and how does it change when you start to speed up, and when you slow down.

Guinness World Record in acceleration:

On May 2019 a race car set a Guinness World Record for the highest acceleration rate for a lawnmower.

Stunt driver Jessica Hawkins took the race car from 0 to 100 miles per hour (160 kilometers per hour) in just 6.285 seconds, on a race track in Germany. She also got the Honda Mean Mower V2 to a recorded top speed of 150 mph (240 kph).

Experiment 1.7 – Relative Humidity in Different Environments



Objectives:

- To learn about relative humidity.
- To explore relative humidity changes in different environments.

Introduction

In this experiment we measure relative humidity in different environments (indoors and outdoors) using the PANDA's relative humidity sensor.

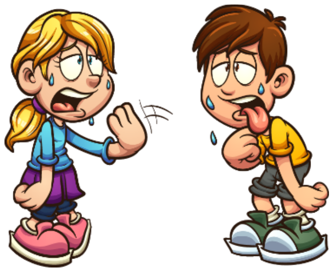
We test whether we can feel if the air is humid or not in those different environments.

We learn about expressing relative humidity as percentages.

Experiment

1. ***Ask*** the children:

   "Did you ever feel hot and sticky (sweaty)? What did you do to cool off?"



2. ***Take*** two wet pieces of cloth, identical in size, and lay each on a plate.
3. ***Place*** one cloth near an air-conditioner.
4. ***Place*** the other far away from the air-conditioner.
5. During the lesson, ***check*** to see which cloth dried quicker.
6. ***Instruct*** the children:
   - ✯ ***Click on*** the button on the upper left-hand side of the PANDA screen.
   - ✯ ***Choose*** the ***Humidity*** option (if it is not already selected).

7. ***Ask*** the children to ***write down*** the different relative humidity measurements in table 1.

   ✯ The response of the PANDA's humidity sensor takes a little time. Wait until the measurement is stable.

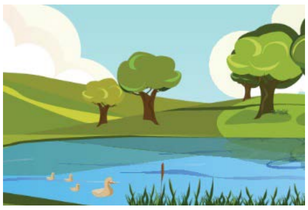
   ✯ It is preferable to send one of the students to measure outside and report back.

Table 1 – Relative humidity measurements	
Location	**Relative humidity (in %)**
Near an air-conditioner 	
Far from an air-conditioner 	
Outside the building 	

8. ***Surf*** the web with the children to find relative humidity measurements in different weather climates.

9. ***Ask*** the children to ***write down*** the measurements in table 2.

Table 2 – Different climates – relative humidity measurements

Location	Relative humidity (in %)
Next to a water source 	
In a dry area 	
In a tropical forest 	

Discussion during the experiment

- Where is it more humid – near an air-conditioner or far from it?
- Can you feel the difference? Where do you feel less sweaty?
- According to the different climate measurements, where is it more humid – near a water source or far from it?
- Were the wet pieces of cloth affected by the different humidity levels?
- How does a fan help when you feeling hot and sweaty?

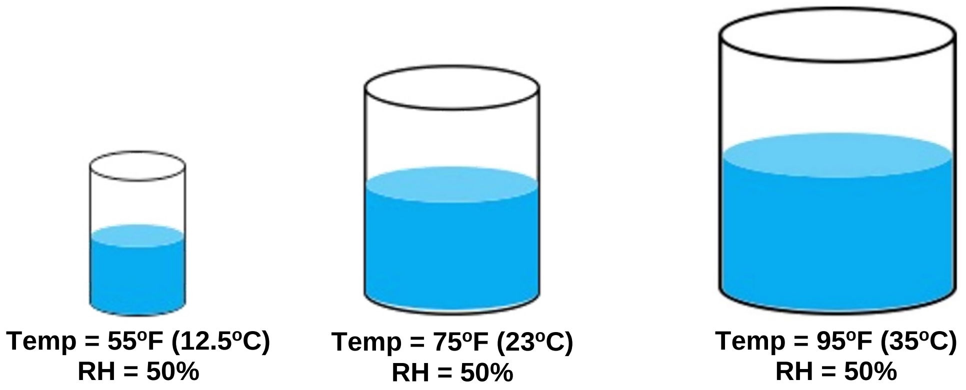
Summary and more to know

The amount of water vapor in the air is described by using the term relative humidity. It is shown as a percentage.

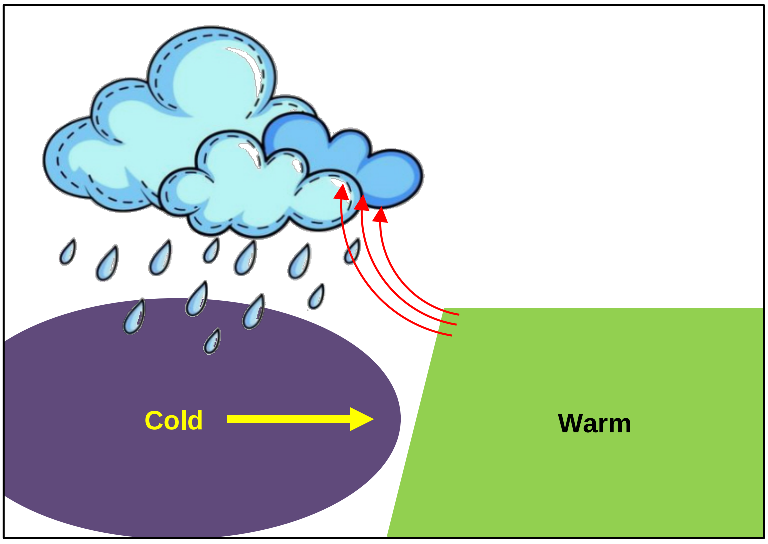
The air's ability to hold water vapor depends on the temperature. As air's temperature gets higher its ability to hold water vapor is higher.

For example, a relative humidity of 50% means that the air is holding one half of the water vapor it can hold in that temperature.

The following picture shows examples of water in the air at different temperatures:



When cold wind reaches an area with saturated air (humid), that air cools down. As it cools down, its ability to hold water vapor decreases, and it begins to discharge water vapor.



That vapor is condensed to water droplets which leads to rain.

We cannot see humidity, only feel it. The lower the humidity is, the more comfortable we feel. When the air is dry and less humid, our skin is dry too. Dry air absorbs sweat fast and cools us down.

High humidity level also affects our hair. It makes it curlier and frizzier.

Tropical forest:

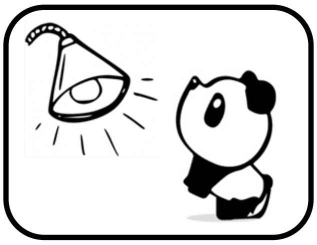
Tropical forests are humid and warm all year-round.

The average temperature in tropical rainforests ranges from 70° to 85°F (21° to 30°C).

The humidity levels are also high: 77% to 88% all year round.

That is very humid!

Experiment 1.8 – Temperature in Different Environments



Objectives:

- To learn about temperature and heat.
- To explore temperature changes in different environments.

Introduction

In this experiment we measure the temperature in different environments (indoors and outdoors), using the PANDA's temperature sensor.

We test our senses to see if we can feel the air temperature as high or low.

We learn about the temperature units Celsius (°C) and Fahrenheit (°F).

Experiment

1. ***Ask*** the children:

   "What season is it now? When you are outside, is it warm or cold?"
   "How do you feel in the winter? How do you feel in the summer?"

2. ***Ask*** the children:

   "What do you do when it is warm?"
   "What do you do when it is cold?"

3. ***Instruct*** the children:

   ✯ ***Click on*** the button on the upper left-hand side of the PANDA screen.

   ✯ ***Choose*** the ***Temperature*** option (if it is not already selected).

4. ***Change*** the measurement units from °C to °F and back to °C.

5. ***Ask*** the children to ***write down*** the temperature measured in different locations in the classroom in table 1:

The PANDA's temperature sensor needs a little time until its value is stabilized.

Table 1 – Temperature levels (in the classroom)		
Location in the classroom	**Measured temperature**	
	^{o}C	**^{o}F**
In your seat 		
Under the lamp 		
Near an air-conditioner 		

6. ***Ask*** the children to ***write down*** the temperature they measured outdoors in table 2.

   The PANDA's temperature sensor needs a little time until its value is stabilized.

Table 2 – Temperature levels (outdoors)		
Location outdoors	**Measured temperature**	
	ºC	**ºF**
In the sun 		
In the shade 		

Discussion during the experiment

- When it is warm outside, is the temperature high or low?
- When it is cold outside, is the temperature high or low?
- When moving the PANDA to different spots, does the temperature update right away? Explain why.
- Why is it cooler in the shade then under the sun?
- Do you remember a time when your parent checked your body temperature? Why did they do that?

Summary and more to know

Temperature is the degree of how hot or cold something is. It can be the air, an object or the human body.

Temperature is measured in degrees, either in Fahrenheit, in Celsius, or in the Kelvin scales.

The temperature around us:

The refrigerator and freezer have a lower temperature than the room temperature. This is why they keep our food nice and cool.

A lamp is usually warmer than the rest of the room, since it emits heat. That means that the temperature would be higher near a lamp.

The Sun warms the Earth and makes it a place where humans, animals, and plants can live in.

In the sun the temperature would be higher. In the shade there is less sunlight so the area would be cooler, which means that the temperature is lower.

The heat we feel is actually the temperature of the heated earth.

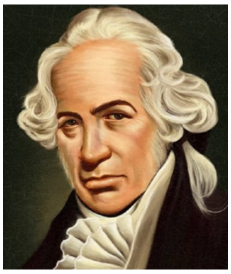
The earth heats up and cools down quickly. That is why in the desert the days are extremely hot, while the nights are extremely cold.

The water in the sea heats up and cools down much slower. That is why the temperature near the sea is temperate.

At home, you can ask grownups to help you check the temperature outside by using information from the internet. You will notice that the temperature changes every day and also throughout the day. Knowing the temperature helps us decide what to wear.

Thermometers:

A thermometer is a device that measures temperature.



The ***Mercury thermometer*** is considered to be the first modern thermometer. It was invented by a German scientist that lived in Holland named ***Daniel Gabriel Fahrenheit*** about 300 years ago.

Fahrenheit chose to build the following scale:

- 96ºF – the average temperature for a healthy man (37.5ºC)
- 0ºF – the temperature of ice mixed with salt in equal amounts.

The salt melts the ice, creating a fixed temperature, as long as the ice was not completely melted.

After the death of Fahrenheit, his scale was changed a little. On the new scale:

- 212ºF – the boiling point of distilled water at sea level.
- 32ºF – the freezing point of distilled water.

Anders Celsius, a Swedish scientist, defined a different scale:

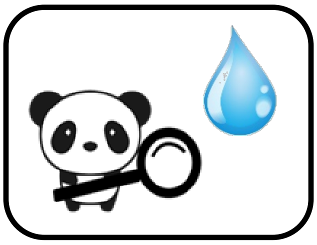
- 100ºC – the boiling point of distilled water at sea level.
- 0ºC – the freezing point of distilled water.

Did you know?

The metric system of measurement was invented after the French revolution at the beginning of the 19^{th} Century, and became Napoleon's favorite method.

Until then, most scales were based on 12 or multiples of 12, so the scale could be divided in a simple way. For example, the part of a day, an hour, a circle.

Experiment 1.9 – Dew Point and Dew Formation



Objectives

- To learn about dew and dew point.
- To measure dew point and observe dew formation at that temperature.

Introduction

In this experiment we measure the local dew point. We observe dew formation by mixing water at different temperatures.

Experiment

For the following experiments, please use a thermometer, or the NeuLog external temperature sensor.

1. ***Show*** the children a picture of leaves covered with dew.

2. ***Ask*** the children:

   "What is dew and how is it created?"

3. ***Instruct*** the children:

   ✯ ***Click on*** the button on the upper left-hand side of the PANDA screen.

   ✯ ***Choose*** the ***Dew point*** option (if it is not already selected).

4. ***Change*** the measurement units from °C to °F and back to °C.

5. ***Perform*** the following measurements and ***fill in*** table 1.

Table 1 – Measurements in the classroom	
Type of measurement	**Result**
Dew point	
Relative humidity	
Temperature	

Creating dew:

6. ***Pour*** a small amount of water in room temperature into a big glass (thin walls recommended).

7. ***Add*** ice cubes to the glass.

8. ***Observe*** what happens.

   At some point, water droplets will appear on the external side of the glass.

   Good job! You succeeded in creating dew drops.

9. ***Use*** the thermometer or the NeuLog external temperature sensor (connected to the PANDA), and ***measure*** the water's temperature.

   Is this temperature compatible with the dew point you measured with the PANDA?

Discussion during the experiment

- If the air is ***more*** humid – how would it affect the temperature in which dew is created?

  Hint – when the air is more humid there is more water vapor.

- If the air is ***less*** humid – how would it affect the temperature in which dew is created?

  Hint – when the air is less humid, there is less water vapor.

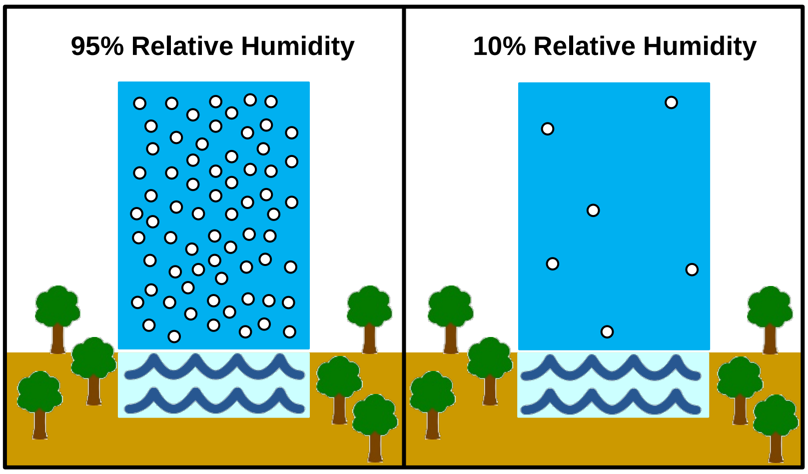
- Try to think of examples from daily life where you can see dew.

Summary and more to know

Condensation is a process by which gas turns to liquid when it touches a cooler surface.

Dew point is the temperature level in which water vapor condenses to liquid water when it touches a surface.

The water vapor level in the air affects the dew point.



The higher the water vapor level, the higher the humidity level, and the higher the dew point.

That is to say: the dew point of humid air will be higher than the dew point of dry air.

Condensation of water vapor begins when the air temperature goes below the dew point.

Water vapor levels in the air vary from place to place and according to seasons.

The world's highest reported dew point is 35ºC (or 95ºF), recorded on July 8, 2003, at Dhahran, Saudi Arabia on the Persian Gulf.

The temperature and humidity in Dhahran are extremely high.

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