ScienceCube

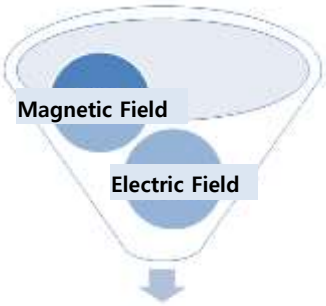
Electromagnetic Field of Electronic Devices

1. **It is possible to measure the electromagnetic field of surrounding electronic devices and compare the intensity of electromagnetic waves in daily life.**
2. **You can understand and explain ways to avoid the effects of electromagnetic waves on the human body.**

Fundamental Concept

1. Electromagnetic Waves

Electromagnetic waves are waves of energy that propagate through space due to periodic changes in electricity and magnetism. The space influenced by electric force is called an electric field, while the space influenced by magnetic force is called a magnetic field. Electromagnetic waves span a wide frequency range of 0-10^22 Hz and travel at the speed of light.



Electromagnetic Wave

Electromagnetic waves exist wherever there is a flow of electricity, meaning they are present in almost all spaces in our daily lives. X-rays used in hospitals, infrared rays installed in saunas, microwaves from microwave ovens, radio waves from mobile phones, TVs, and radios, and alternating current from household power sources are all examples of electromagnetic waves.

2. Effects of Electromagnetic Waves on the Human Body

The magnetic field intensity that typically affects the human body is considered to be 2-3 mG (milligauss), where G is the unit of magnetic field strength (1 mG is 1/1000 of a G). Compared to the Earth's magnetic field strength of 600 mG, this is quite weak. However, experts argue that even this level of magnetic field can significantly impact the human body. It is suggested that electric fields flowing through the skin can cause skin conditions such as eczema and that women who use computers professionally may experience accelerated skin aging. Symptoms such as lethargy, insomnia, nervousness, headaches, decreased melatonin hormone levels affecting deep sleep, and reduced pulse rates are associated with electromagnetic waves. There are also reports linking electromagnetic waves to increased rates of leukemia, lymphoma, brain cancer, central nervous system cancer, breast cancer, dementia, miscarriages, and birth defects.

3. Methods to Block Electromagnetic Waves

Electric fields can be eliminated by grounding conductors nearby, allowing the electric fields to flow into the ground through the conductors. Even when a person is in an electric field, the electric field flows out through the body surface to the ground, causing no problems. However, unlike electric fields, magnetic fields are not easily shielded and can pass through materials. Fortunately, magnetic fields weaken rapidly with distance. For example, the magnetic field strength falls below 2 mG when you are 50 meters away from high-voltage lines, and for household electrical appliances, the magnetic field strength drops to negligible levels at 50 cm distance.

Recently, fabrics and clothing with shielding pockets claiming to block electromagnetic waves have been introduced. Additionally, some small devices advertised as blocking electromagnetic waves when carried are also available, though these claims are largely exaggerated. The blocking or absorption of electromagnetic waves does not work like vacuuming up dust, and no matter how well the electric field component is shielded, the magnetic field component cannot be avoided.

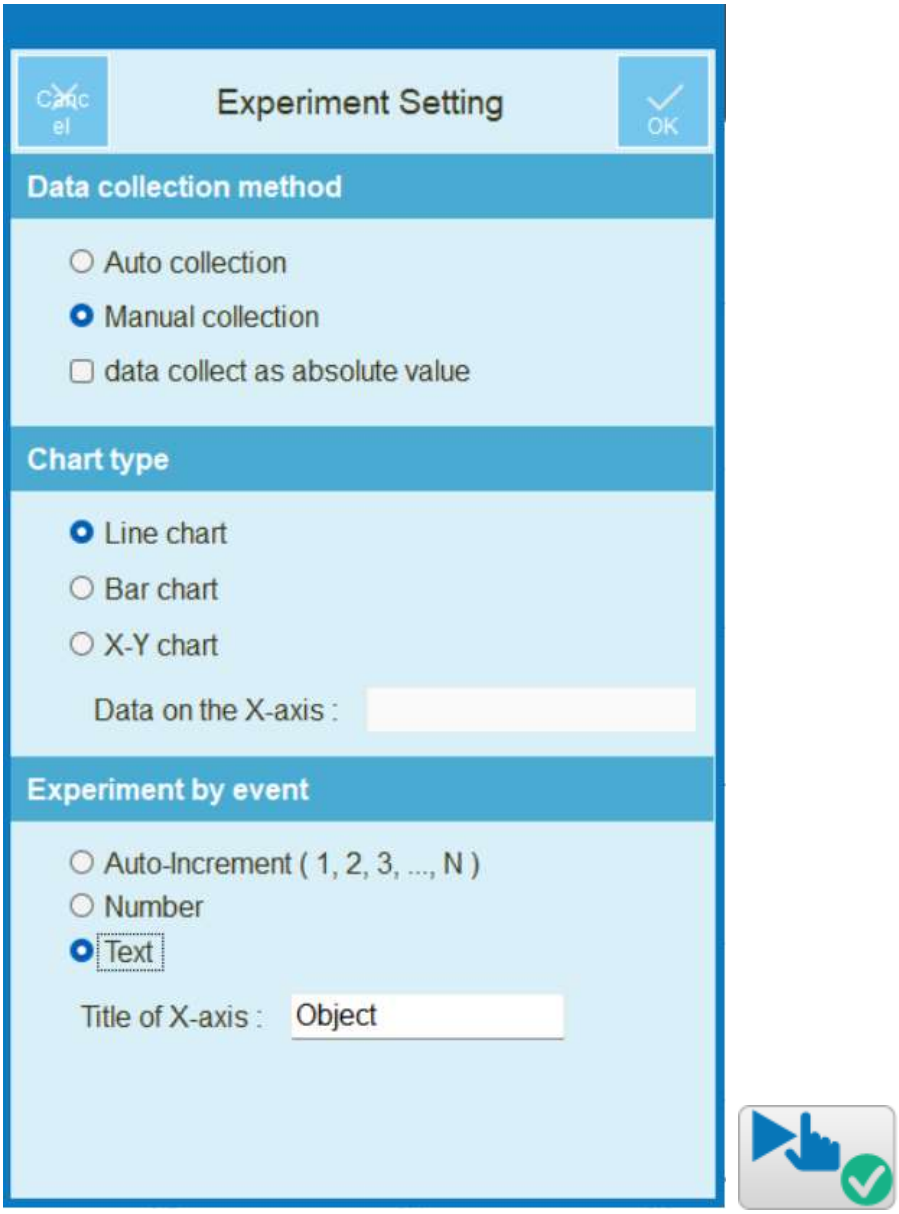
Experiment

Materials Needed

Interface (Smart Sensor Box), Science# Program, Smart Device, Ruler, Electronic Devices

Interface Setup

1.  Launch the Science# program.
2. Click  the 'Geomagnetic Field' option.
3. Press  the button to set up the experimental environment as shown below or use the automatic setting  option.



Data Collection

[Comparison of Magnetic Fields by Type of Electronic Device]

1. Click  to set the graph type to a bar graph.
2. Press  to start data collection.
3. Place the Smart Sensor Box in a space without nearby electronic devices.
4. When the values stabilize, click  and enter 'No Object' in the text input window.

5. Align the direction of the Smart Sensor Box with a fixed direction (y-axis) regardless of the direction of the electronic devices, and measure the magnetic field at a 1 cm distance.

6. After measuring, press to stop data collection.
7. Select only the y-axis values to compare the magnetic field strength of different electronic devices.

[Measurement of Magnetic Field by Distance]

8. Add a new chart.
9. Click to change the x-axis title to 'Distance.'
10. Press to start data collection.
11. Place the device with the strongest magnetic field close to the sensor and click , entering '0' in the text input window.
12. Increase the distance from the object by 5 cm increments and measure the magnetic field, entering the distance each time. (Ensure the sensor's direction does not change.)
13. After measuring, press to stop data collection.
14. Select only the y-axis values to compare the magnetic field strength by distance..

Data Analysis

Recording Data

1. Compare the magnetic field strength by type of electronic device using a bar graph and record the values in a table.

Electronic Device	No Object						
Magnetic Field (G)							

2. Create a graph showing the magnetic field strength by distance from the electronic device and record the values in a table.

Distance (cm)	0	5	10	15	20	25	30
Magnetic Field (G)							

Data Application

1. Explain why the measured magnetic field value was not zero even in an empty space without electronic devices.

2. Record the electronic devices with the highest and lowest magnetic field measurements..

Highest Magnetic Field Device	Lowest Magnetic Field Device

3. Summarize the results of the experiment on the magnetic field strength by distance from the electronic device.

4. Describe your thoughts on efforts to avoid the effects of electromagnetic waves on the human body based on the experiment results.