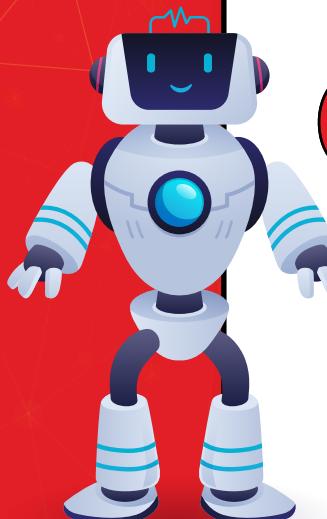
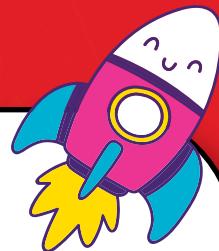




In Line with CBSE & in Tune with  
Child's Aspirations  
& their Technological Future



# Easy Computers & Coding

CLASS **6**



Follows  
**TIY ( Teach it Yourself) Approach**

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# MAKING PRESENTATION STANDOUT 1



## » Learning Review

Power point has dozens of tools to prop up quality & appeal of presentation. In this grade we shall discuss five of them. By the end of this lesson – provided they practice, children will be clear about:

Use of Slide Zoom in a PPT.

- Making photo albums & inserting in PPT.
- Direct screen recording in PPT.
- Making ink annotations on slides.

Adding mathematical equations in slides.

## » Slide Zoom

Slide Zoom is a **PPT booster** that allows you to navigate to any slide from any other, in an interactive way. When asking your audience questions, you can **Directly go Back** to your content. It helps make **Dynamic Presentations**.

Audience love it. To create:

- Select **Insert > Zoom** in links group. In dropdown select

**Slide Zoom**. Select the slides. Select Insert.

- Selected slides appears as

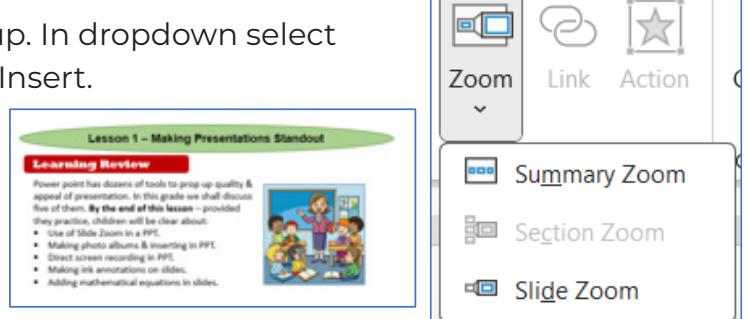
**Thumbnails** on the slide in which inserted. Adjust position as desired.

- While playing, switch to slide

show mode (will not work

in any other). Click on thumbnail you want to zoom in.

Now **Try Making one** in any of your existing PPT.



## » Show Stealers - Photo Albums to PPT

Power Point **photo album** is a presentation you can create to display your family or business photographs sequentially. You can also use it to **create visual content** on any subject for your school. You could **then code** this visual content for playing automatically. You could also **convert it into a video** with music & sound. You can become a **show stealer** in the school.

Let us tell you how?

You can either download a ready templet or create your own.

You can also **download templets** from Freepix, Shutterstock etc.



## 1 Making a Photo Album

- Go to **Insert**.

Click the arrow under **Photo Album**

- In dropdown click **New Photo Album**.

- Photo Album dialog box opens.

Under Insert picture

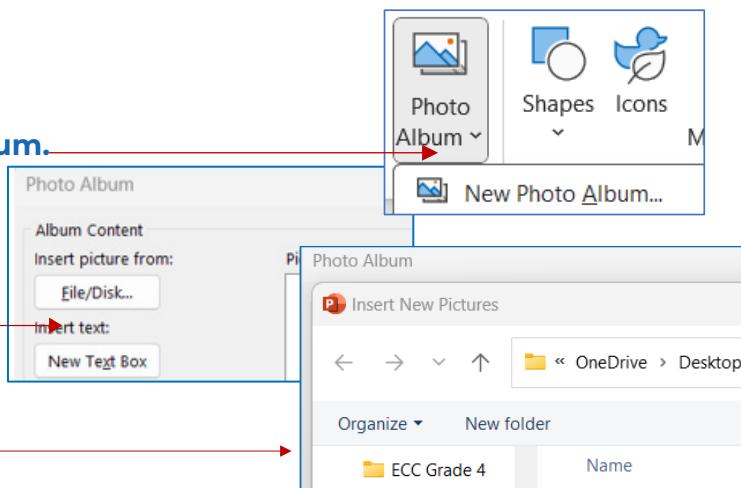
From click **File/Disk**.

- In **Insert New Pictures** dialog box,

locate & click the folder that contains

the picture that you want to insert,

& then click **Insert**.



• If you want to change the order in which the pictures are displayed, under **Pictures in album**, click the **file name** of the picture that you want to move, & then use the arrow buttons to move it up or down in the list.

- In the **Photo Album** dialog box, click **Create**.



## 2 What more you can do

You can now add **captions** to the pictures, change the **look** of a picture, **remove** a picture & **share** the album with others. Now **Try these Yourself**.

## » Direct Screen Recording

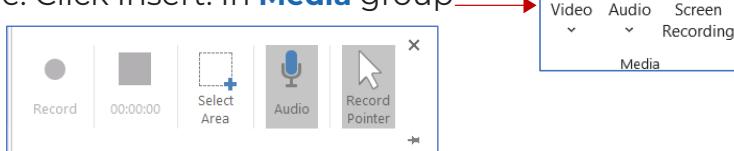
Screen recording is great for **Adding Fizz** to your PPT's. You can **record & edit** **without leaving the PPT**. It is useful for creating tutorials, teaching, recording a conference or a webinar. For this the PC must have a soundcard, mic & speakers.

### 1 Recording the Video

- Open PPT. Select desired slide. Click Insert. In **Media** group select Screen Recording option.

A **Control Dock**

appears.



- Select & drag **cross-haired cursor +** to select the area of the screen you want to record. If you want to select the entire screen for recording, press Windows logo key+Shift+F.

- Select **Record**. Use **Pause** as needed & **Stop** when you're done.



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# INTRODUCTION TO EXCEL

2



## ➤ Learning Review

Microsoft Excel is a Spreadsheet program that helps organize, format, & calculate data.

By the end of this lesson children will be clear about:  
Features of excel.

- Layout & key components of a worksheet.
- Data types handled & aids to traverse it.
- Making a simple worksheet & doing calculations.

## ➤ Features of Excel

Excel's key feature are its **grid of cells**, which contains **numbers, text, or formulas**. Users can group cells into **rows & columns**, & then **add, sort, filter, & chart** the data. Its uses include, simple calculations, data analysis, & project management. It complements the appeal of power point presentations & word documents.

## ➤ Opening Layout of Excel

To open Excel:

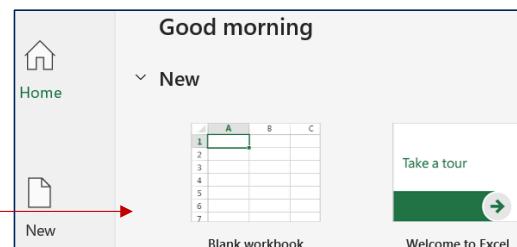
Click on **start** button, & select **Excel**.

- Window similar to word opens.

It contains number of thumbnails.

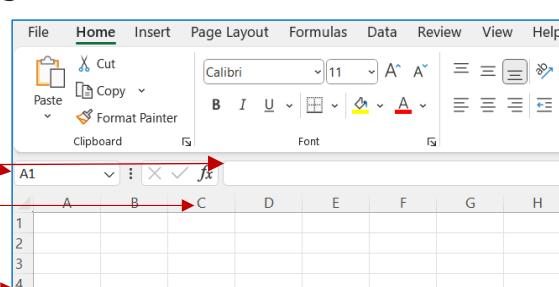
- Select **Blank Workbook**.

Screen Similar to word **opens**.

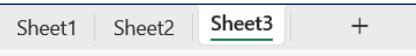


In this screen, **identify** (from top) the following:

- **Tabs** bar.
- **Groups** bar. Look at groups of all tabs.
- **Name box**. (A1 default).
- **Formula bar** (white).
- **Column** (A, B, C) headings.
- **Working area** of grid of columns & rows.
- **Row headings** (1, 2, 3) along the side.



Bottom of workbook has **Worksheets**, & + to add.

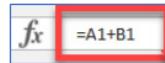


## » Key Components of Worksheet

A worksheet, also called Spreadsheet, includes:

- **Cells.** Individual boxes where rows & columns intersect.  
Each cell has a unique address, like A1 or B2.
- **Rows & Columns.** They organize themselves to create cells.
- **Cell range.** Group of cells that you want to work with. It is defined by reference of cell in upper left corner of the range as minimum value, & cell in the lower right corner as maximum value. For example, range A1:C2 includes all cells from A1 to C2.
- **Formula bar.** Where you can enter, see or edit formulas & functions.
- **Active cell.** Cell (B2) in which you can enter data.
- **Menu bar.** Displayed when you start Excel.
- **Standard & Formatting Toolbar.** Standard toolbar contains buttons for file operations, such as New, Open, Save, & Print. Formatting toolbar contains buttons for text formatting, such as font, size, bold, numbering, & bullets.
- **Name bar.** Shows name of program. Name of open sheet gets highlighted in **status bar** at bottom. Icon + is used to add another sheet.

	A	B	C
1	A1	B1	
2	A2	B2	
3			



A	B
1	A1
2	A2



## » Data Types Handled

- Key data types handled by Excel include numbers, text, & formulas.
- Others include logical, decimal, currency, error & strings.
- Numbers are right aligned to a cell & text is left aligned.
- Numbers are from 0 to 9. Text is a series of characters including letters, nums, special characters, space etc.
- Formula is a mathematical equation involving nums, symbols & cell addresses. They begin with an equal to (=) sign.

## » Making a Simple Worksheet

### 1 Making the Worksheet

- Opening. To open a new workbook select Blank workbook in opening screen.
- Heading. Click cell D1 and type 'CLASS RECORD'. Center it using Center button Alternately, using Merge & Center.

	A	B	C	D	E	F	G	H
1	CLASS RECORD							
2	Names	English	Science	Maths	Hindi	Art	Social	Total
3	Prashant	78	86	91	94	87	74	
4	Deepak	72	68	68	85	77	56	
5	Sahil	88	89	93	75	79	85	
6	Priya	55	66	58	67	83	54	
7	Shalini	93	82	97	88	90	86	

For this, select cell range C1:F1. Click Merge & Center button in Alignment group of Home tab. Cells will get merged & text will be centered.



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# EDITING EXCEL WORKSHEETS

3



## » Learning Review

In this lesson we shall learn entering data & some basic aspects of its editing.

By the end, children will be comfortable with:

- Selection of cells, rows & columns.
- Changing row height & column width.
- Copying & moving data.
- Changing cell contents.
- Auto fill, & ML enabled Flash fill utilities.

## » Selecting Cells, Rows & Columns

### 1 Selection of Single Cell

Click on the cell. It gets highlighted. Note the **small square** at its bottom right. The column & row num also gets highlighted.

	A	B	C
1			
2			
3			

### 2 Selection of Group of Cells

Click on small square of the cell, drag to include required cells.

To select entire sheet use **Ctrl + A, or Select All** button as shown.

	A	B	C	D	E
1					
2					
3					
4					
5					
6					

### 3 Selecting Adjacent & non Adjacent Rows/columns

- To select adjacent row/column, **click** on first row/column. **Hold shift** key while you select the last row/column.
- For non adjacent, **click** on first row/column. **Hold Ctrl** key while you select the other rows/columns.

## » Working with Cells, Rows & Columns

### 1 Inserting Blank Cells

To Insert:

- Say you have a row of cells:

You want to insert BB, CC & DD after AA.

- Select **cell or cells** to right or above where you want to insert the new cells.

Make sure you shift the same num you want to insert.

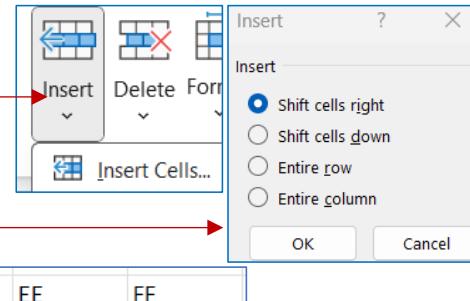


- Right click on selected range & select Insert, or Press **Insert** in cells group of home page.  
In its dropdown select **Insert Cells**.

- Insert window opens.  
Click **shift cell right** & **ok**.

Space to add BB,  
CC & DD is created.

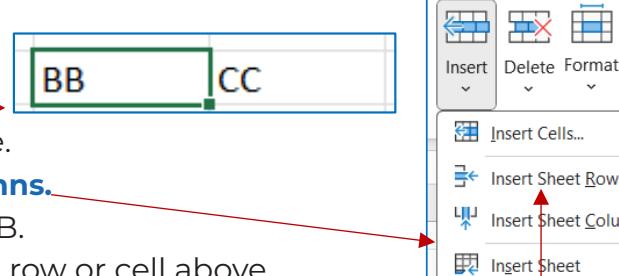
AA			EE	FF
----	--	--	----	----



## 2 Inserting a Column/Row

- Select **column** to left of which you want a column to be added
- Click **Insert** in cell group of home page.
- In dropdown select **Insert Sheet Columns**.
- A column gets inserted to the left of BB.

**Note:** You can **add a row**, by selecting the row or cell above which you want the row to be added by selecting **Insert Sheets Rows** option.



## 3 Deleting Columns/Rows

To delete a column or row:

- Select **column** to be deleted by clicking on its header (Say column C).
- Click on delete in **cells** group of **home page** & in its dropdown select **Delete Sheet Columns**. Alternately **right click on header** of selected column, & in context menu select delete. It gets deleted.
- A row is deleted in same way. **Try yourself.**

## 4 Changing Row Height & Column Width

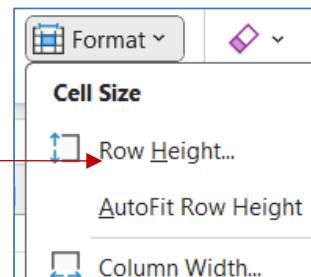
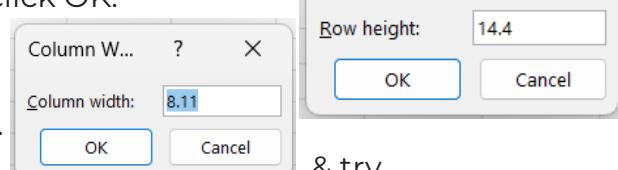
To do these click on dropdown arrow of **Format** in **Cells** group of **home tab**. Kindly **Read & Do** all options.

- For row height, select row, click on row height in the dropdown. This opens:

Enter desired values & click OK.

Changes get reflected.

- Procedure for column width is similar.  
Select column width

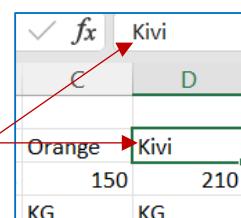


& try.

## Entering Data in Cells

### 1 Entry of Text & Nums

Nums & characters while being typed in a cell, can be seen in the cell, as well as in formula bar.



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# UNDERSTANDING GIMP BASICS

4



## » Learning Review

GIMP is a major enhancement in Basic paint. It is a big & important topic. We shall do it in multiple lessons. In the we shall cover the basics. By the end, children will have an insight covering:

- Its features, installation & components.
- GIMP Docks, Its components & modes.
- Opening a new file & an existing file to work.
- Saving worked on files & exiting the app.

## » What is GIMP

GIMP ([GNU Image Manipulation Program](#)) is an **image editing** SW used as a simple paint program, or an expert quality photo retouching program. It is part of **GNU** (GNU's not Unix) **Project**. It is released under the [GNU General Public License](#), providing free, open-source image editing program that can be used for a variety of tasks.



## » Features of GIMP

It features include a **user friendly interface**, working on multiple image formats like **BMP** ( Bitmap), **GIF** (Graphic Interchange Format) & **JPEG** ( Joint Photographic Export Group). **It can be used for:**

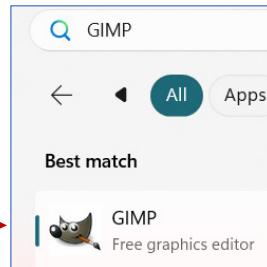
- Photo retouching.
- Image composition to create original artwork and graphic design elements.
- Image format conversion.
- Drawing. It has a suite of tools, including brush, pencil, airbrush, & clone tool.
- **It also has:**
  - Editable text layers.
  - Layers & channels with multiple undo/redo options.
  - Transformation tools for rotating, scaling, shearing, & flipping images.



## » Installing GIMP

To install GIMP:

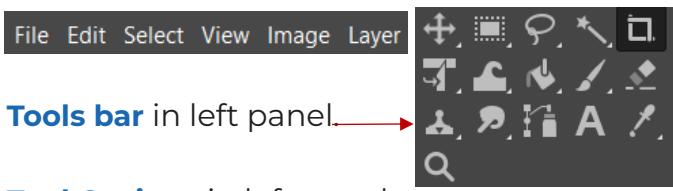
- Click on **Start** Button.
- In search bar of window that opens, type **GIMP**.
- Click on **GIMP**.  
→
- Click on **download**. Follow steps.
- Once download is completed click **install**. On completion, click **finish**.



## » Components of GIMP

Key components of opening Screen are:

- **Title bar.**



- **Right Panel.**  
→

- **Workspace.** In-between the above panels.

This is the area for working on the image windows.

- **Status area.** At bottom of working area

Will understand during actual use ahead.

## » GIMP Docks

**Dialog** is a **movable window** that contains options for tools, or dedicated to a special task to be performed by that tool.

GIMP, **Docks** hold a **collection of dialogs**, such as movable windows for Brushes, Palettes, Tools etc. Docks allow to **arrange working windows** on the screen as per your convenience, as against having fixed windows. This makes navigating between windows easy. It has three default docks:



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# UNDERSTANDING SELECTION TOOLS

5



## » Learning Review

By the end of this lesson children will have a fair idea of:

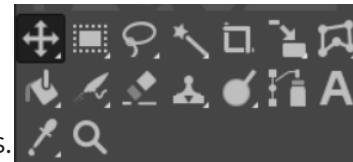
- GIMP toolbox & its categories.
- Purpose of selection tools & how to use them.
- Use of five basic selection tools.

## » GIMP Toolbox

Tool is a **means to operate** on images.

To help us use tools, GIMP provides a **Toolbox**.

Using the contents of this box, we can perform basic tasks such as selections, drawing, erasing & more on our images.

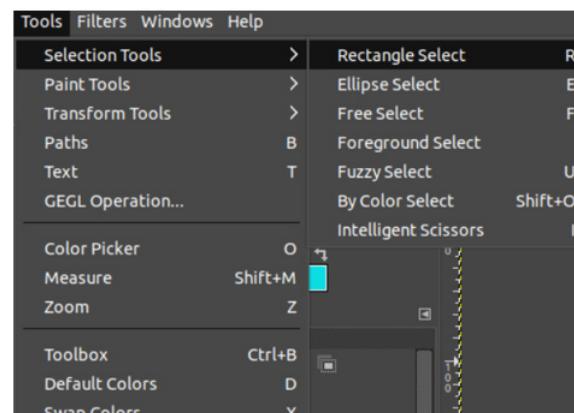


Each tool of this box has its own icon.

It incorporates a **specified action we need**

**to take when using it.** Tools are activated by a **left click** on it, or by shortcuts. Tools are divided into **five main categories:**

- Selection tools
- Paint tools.
- Transform tools.
- Color tools.
- Miscellaneous tools.



## » Selection Tools

Selection tools are used to **select an image**, or a region from a layer to work on elsewhere.

These are the main seven selection tools:

These exist in the toolbox.

- When we select a tool, pointer

Inside the image changes according to the active tool.



<input type="checkbox"/> Rectangle Select	R
<input type="radio"/> Ellipse Select	E
<input type="checkbox"/> Free Select	F
<input type="checkbox"/> Foreground Select	
<input type="checkbox"/> Fuzzy Select	U
<input type="checkbox"/> By Color Select	Shift+O
<input type="checkbox"/> Intelligent Scissors	I

- White dropdown against the tools shows icons that are grouped with it. You may have to select them from this dropdown. Last selected icon appears in above image.
- **Basic procedure of use of all tools is similar.** We shall five of them.



## 1 Rectangle Select Tool

It is the **most used selection tool**.



It is used to select a rectangular region from

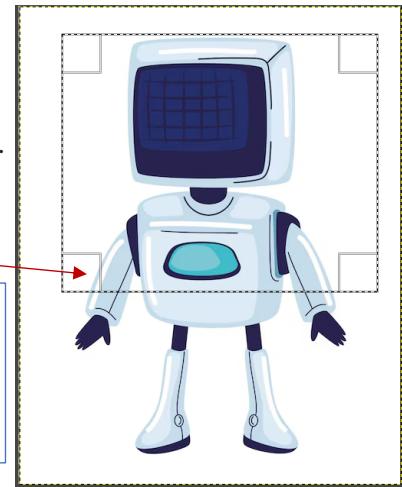
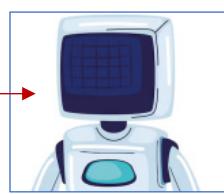
an active layer. To use:

- Open an image. Use keyboard shortcut R, or Click Rectangle selection tool on the tool bar.



You can also select from the menu bar using **Tools > Selection Tools > Rectangle**.

- Move mouse over the image, the pointer will change to a rectangle.
- Drag mouse to make selection. Release when done. You will find the selection with four small rectangles in the corners called **Resizing Handles**.
- On completion, click inside the selection or press enter. This selection can now be cut & pasted anywhere
- Resizing handles can be created on the sides as well. **Try & see**.



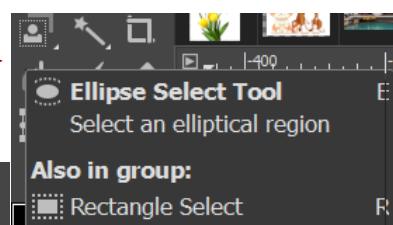
## 2 Eclipse Select Tool



It is clubbed with rectangle in dropdown of two shape tools

- To select use keyboard shortcut E, or click eclipse selection tool in tool box.

You can also select from

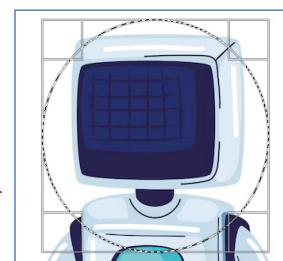


menu bar using **Tools > Selection Tools > Eclipse**.

- To select, move mouse over the image, the pointer will change to an eclipse.

- Drag mouse to make selection (say the head of the humanoid Robot).

Release when done.



## 3 Free Select (lasso) Tool

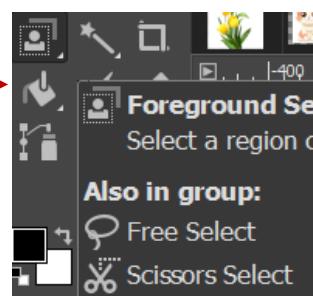


It is part of a selection of three free hand tools.

All three are accessed by this dropdown.

Select **Lasso**. To use:

Hold down **left mouse button**, carefully move cursor around cat's head. Make sure of connecting end point with the starting point.



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# HTML BASICS 6

## » Learning Review

By the end of this lesson children will have a fair understanding of basics of HTML 5, its key features, tools & rules, Key ingredients, understanding of Tags, Elements & Attributes, & an opportunity to use basic Tags & make a simple web page.

## » Basic Introduction

### ① The Idea of Markup Languages

The idea and terminology used in markup languages evolved from traditional "marking up," done while editing an author's manuscripts, using a red/green pen or a black/blue pencil.

### ② What is HTML

- **HTML** is a standard markup language, containing the complete code for creating Web pages. It stands for Hyper Text Markup Language.
- **Hypertext** is text that contains links to other texts, images, tables, or other content. When a user activates a hyperlink; the hypertext system retrieves the related information.
- **Markup language** is a system of tags or codes that annotates a document to define its structure and presentation. It's used to structure & organize information, control display, & enrich content. We have some other markup languages besides HTML.

### ③ What does HTML do

- It describes the structure of a Web page.
- A web page consists of a series of elements. These elements tell the browser how to display the content.
- These elements also label pieces of content such as "this is a heading", "this is a paragraph", "this is a link", etc.

### ④ Key Features of HTML

- HTML is a beginner-friendly language that can be used to develop web-based games.
- HTML is not case sensitive.
- HTML works on any operating system or device, including Windows, Mac, and Linux.
- HTML supports:



- Tables.
- Lists, that are used to list items in navigation menus, recipes, or blog posts
- Multimedia, including audio and video
- SEO.
- Has offline capabilities with Cache API and Service Workers.
- Responsive design of its semantics allows a site to be rendered differently for each visitor's device.

## » Basic Tools

You require two basic tools for working on HTML 5:

### 1 HTML Editor

It is a program that allows making & editing of HTML code for websites and other web documents. There are two main types of HTML editors:

- **WYSIWYG Editor:** Stands for "What You See Is What You Get" and shows the document as it will appear in the browser. This allows you to code with little or no knowledge of HTML commands. You can simply place the elements in the interface, & the code will get added automatically.

- **Text Editor:** These include Notepad, Notepad ++, Atom, or Wordpad. They allow users to edit the source code directly. We shall use Notepad ++.

Some HTML editors can also handle other technologies, such as CSS, XML, JavaScript, and ECMAScript. They may also be able to manage communication with remote web servers and version control systems.

### 2 Web Browser

This we have learnt earlier.

## » Tags, Elements & Attributes

- HTML **Tags** are keywords that are used to instruct web browsers on how to display and format a web page. They are made up of elements and attributes. They are used to create the structure, appearance, and functionality of a website.
- They are of two types – Container tags & empty tags. They are enclosed in two angle brackets, < and >.
- Most HTML tags come in pairs. First is the opening tag and second the closing tag. Closing tag has the same text as the opening tag, but with an additional forward-slash (/) character.
- An **Element** is an object on the page, like a heading, paragraph, or an image. They are placed between an opening tag & a closing tag.
- Attribute is the property providing additional information about an element. It is always specified inside the opening tag.

<p> </p>

<p> Para Heading </p>

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# CONSOLIDATING PART 1 - COMPUTERS

7

## » Recap of Essentials

### 1 Making Dynamic Presentations



- **Using Slide Zoom.** **Insert > Zoom > Slide Zoom > select slide > Insert.** Thumbnail appears. Adjunct position. To use click on slide show mode & click thumbnail.  
To learn its various uses, view link - <https://www.xelplus.com/use-powerpoint-slide-zoom-the-right-way/>
- Adding a Photo album. **Insert > Photo Album > New Photo Album > file/disk.** Locate folder & click insert.
- **Inserting Video in Slide.** **Insert > Video.** Select source of video.

Click on video. It gets inserted. Click on start icon to play.

- **Inserting hand Annotations.** **Draw > select pen > in dropdown select colour & thickness.** In similar way apply shapes & Type equation here.

### 2 Getting Started with Excel



- Open & get familiarised with layout of opening screen.
- Familiarise with rows, columns, cells, cell range & active cell.
- Familiarise with menu bar, formula bar, name bar & tool bar.
- Data types include nums, text, formulas, decimals, currency, errors strings & more. Numbers are right aligned & text is left aligned.
- Numbers are from 0 to 9. Text is a series of characters including letters, nums, special characters, space etc.

- Formula is a mathematical equation involving nums, symbols & cell addresses. They begin with an equal to (=) sign.

### 3 Working with & Editing Excel



- Under Home tab in Cells group get familiarised with the options under Insert, Delete & Format.
- Under Home tab in Editing group get familiarised with the options under Sum & under Sort & Filter.
- Get used to the various options for selection of cells, columns & rows.



## 4 GIMP Basics



- Familiarise with Title bar, Tool bar, Tool options, Right panel, Workspace & Status area.
  - Dock is a movable window containing tools to perform tasks.
  - Layers are stackable sheets of paper to create a composition.
  - Channels are components of a pixel's color.
- Paths are curves used to create complex selections, strokes, & shapes.
  - Multi-window is the default mode. In this the left & right panels located on sides of working area can be moved across the screen.
  - In Single-window mode the panels cannot be moved, but their width can be changed.

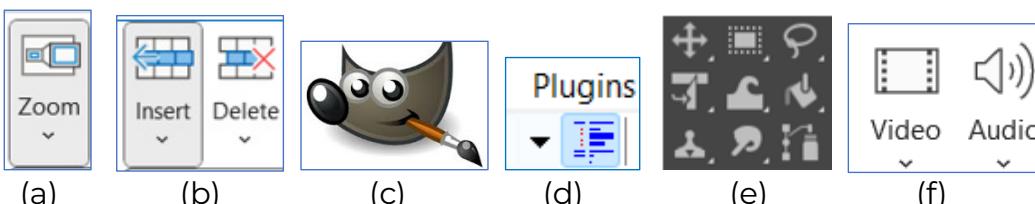
## 5 GIMP Toolbox



- GIMP provides a toolbox containing selection, paint, transform, colour & miscellaneous tools.
- It has 16 selection tools are divided into seven categories. Procedure of use for all is similar.
- To select follow **Tools > Selection Tools > Eclipse**.

## » Identify & Tell Me

- 1 Identify the selections & mention where do they exist.



(a)

(b)

(c)

(d)

(e)

(f)

## » Quick Assessment



- 1 Select True or False.

- (a) Lasso selection tool is used to select objects.
- (b) A workbook can contain only one worksheet.
- (c) By default text data is right aligned in an excel sheet cell.
- (d) Single window is the default mode of GIMP.
- (e) You can invert a selection using invert + I.
- (f) In HTML, tags & attributes are case sensitive.
- (g) The <line> tag draws a horizontal line across a web page.
- (h) In excel a formula starts with asterisk sign.

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# INTRODUCTION TO AUTOMATION

8



## » Learning Review

**By the end of this lesson** – children will have a fair idea of:

- What is automation & its link with Robotics.
- What are sensors & the importance of code in their functioning.

## » What is Automation

At its simplest, automation means **making something automatic**. It refers to **performing one or many tasks autonomously** with minimal or no human interaction.

Automation describes technologies that **reduce human intervention** in processes.



- Automation is used in almost all industries, including Manufacturing, IT, Business, Agriculture, Finance, Medical, Transportation, construction, & more.
- Automation can help businesses: increase productivity and profitability, improve customer service and satisfaction, reduce costs and operational errors, adhere to compliance standards, and optimize operational efficiency.
- There are different types of automation systems, including fixed, programmable, flexible, and integrated.
- At its simplest, automation means **making something automatic**. It refers to **performing one or many tasks autonomously** with minimal or no human interaction.

## » Coding & the World of Sensors

### ① What is a sensor

A sensor is a device that detects and responds to changes in the physical environment, and converts that information into a signal that can be processed by a machine.

Sensors can detect a variety of inputs, including light, heat, motion, pressure, moisture, and more. The output from a sensor is usually a signal that can be displayed in a human-readable format, or transmitted electronically for further processing. Att photo shows



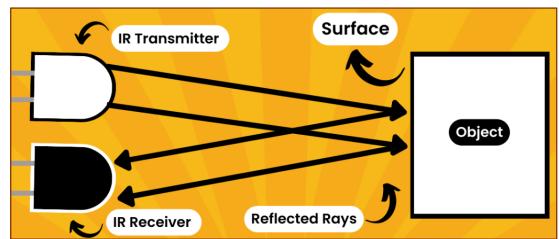
a **Gesture Sensor**. It senses the environment to **pick up changes** as input to be processed & displayed on the **goggle to enable VR gaming**.

**The key take is that, Coding sits at the very core of Automation.**

## 2 Categorisation of Sensors

Sensors can be categorized in multiple ways. Most common is to classify them as either active or passive.

- **Active sensor** is one that requires an external power source to respond to environmental input and generate output. These transmit & receive.



- **Passive sensor** on the other hand, doesn't require an external power source to detect environmental input. It relies on the environment itself for its power, using sources such as light or thermal energy. They only receive.

Another classification includes sensors that by nature of their construction are **inductive, capacitive, photoelectric, magnetic** sensors etc.

## 3 How do sensors work

- Sensors detect changes in their environment, & convert them into electrical signals or analog voltages. These are then processed & displayed, or sent to other devices for further processing.

- Talking to Siri, a sound sensor converts our voice to an electrical signal. These output signals are then converted into machine readable **binary codes**. These codes are read by processors in computers & phones, to enable Siri to do her job.



- Many modern **sensors have integral processors in** them. This makes them very potent devices.



## 4 How Sensors are Used

Sensors are used in many different places, including homes, hospitals, shopping centers, & smartphones. For example, parking sensors help safe parking in parking lots. Air quality sensors help ensure a healthy living environment by adjusting ventilation or the air purification system.



## 5 How They are Made

Sensors contain components like integrated circuits, transistors, & diodes, which are made of semiconducting material.

These act as switches (logical Gates like AND, OR & NOT) controlling the flow of electrical charges through the circuit.



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# CODING SENSORS 1

9



## Learning Review

**By the end of this lesson** – children will have a fair idea of:

- Sensor categories.
- Working of temp, IR & ultrasonic sensors.
- Coding these three sensors

## Sensor no 1 – Temperature Sensor

- Temperature is one of the most commonly measured environmental quantities.
- There are different types of temperature sensors such as a thermocouples, thermistors, semiconductor temperature sensors, resistance temperature detectors (RTDs) etc.
- Based on requirement, different types of sensors are used in different applications.



### Project with Temperature Sensor

Temperature sensors are used to monitor temperature & execute actions.  
Ever wondered how your AC switches go on & off automatically?  
Because they are controlled by a temperature sensor.



The story line of this project is that:

**Temp sensor is monitoring the temperature of the room.**

**If it rises to 30 degrees, an alarm will go up.**

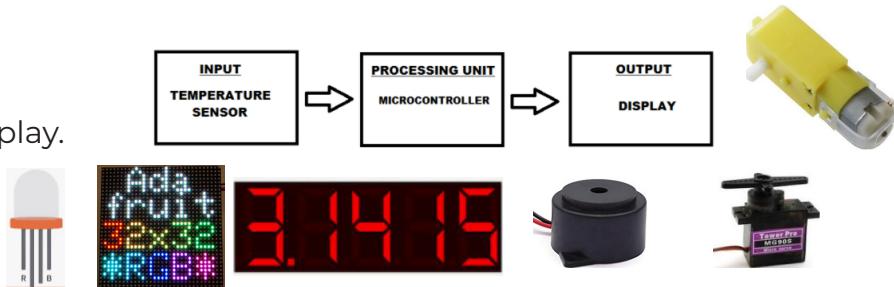
```
when Halocode starts up
forever
    [Typical Code Temperature Sensor]
        if (temperature sensor v1) > (30) then
            speaker (1 v) plays note [C4 v] for (0.25) beats
            speaker (1 v) plays note [G3 v] for (0.25) beats
            speaker (1 v) plays note [A3 v] for (0.25) beats
        else
            speaker (1 v) stops sound
```



## » Output Devices of Sensors

No sensor can be complete without accompanying output device. A sensor-based project could require more than one output device. Some common output devices include:

- RGB LED's.
- LED Matrix.
- Seven segment display.
- Buzzer.
- Speaker.
- DC Motor.
- Servo Motor.



## » Sensor no 2 – IR Sensor

- IR Sensor is an electronic device to detect & measures infrared radiation in the environment.

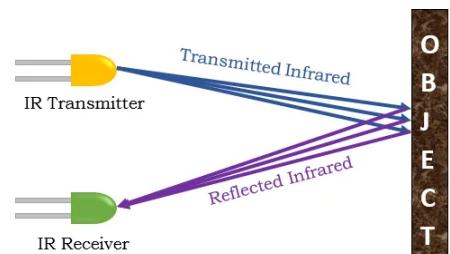


- Any object that has a temperature above **five degree Kelvin (-268.15 C)** emits heat, and in turn **gives out infrared radiation**. These radiations are in the visible light region of the EM spectrum. IR is however, **invisible to the human eye**, but visible to some animals.

### ① Working of IR Sensor

IR sensor has:

- A light source that emits radiation of required wavelength.
- This radiation reaches the object & is reflected back.
- The reflected radiation is detected by an IR receiver.
- The detected radiation is then processed based on its intensity.



There are two **types of infrared sensors**: Active and Passive.

### ② Project with IR Sensor - Line Following Robot

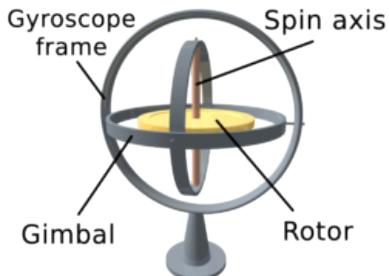
In factory floors robots deliver sub assemblies. **Wondered How?** A line follower consists of an infrared light sensor & an infrared LED. It illuminates a surface with infrared light. The sensor picks up the reflected radiation &, based on its intensity, determines the reflectivity of the surface. Light-coloured surfaces will reflect more than dark, resulting in their appearing brighter to the sensor.



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# CODING SENSORS 2 10



## » Learning Review

**By the end of this lesson** – children will have a fair idea of:

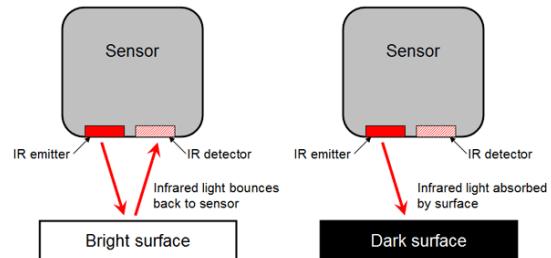
- Light Sensor, color sensor & gyro sensor.
- Doing a project using each sensor.

## » Learning Review

A colour sensor consists of two main parts. An Emitter & a Detector.

### 1 Emitter & Detector

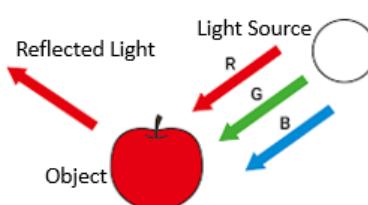
- A diode that emits light is called IR Emitter.
- A sensing plate that measures the intensity of reflected light falling on it is called IR Detector. A bright surface reflects most of it back. A dark surface absorbs most of it & has very little to reflect back.



### 2 Emitter & Detector

To detect colours of material, five main things come into play.

- A white light source to illuminate the material surface (input). It is better to use white light emitters.
- A receiver which can measure the reflected wavelengths.
- A surface whose colour has to be detected (object).
- Filters that aid detection.
- A light to voltage converter that gives the output of the sensor.



The receiver (detector) has three filters with wavelength sensitivities at 580nm, 540nm, 450nm. These measure the wavelengths of red, green and blue colours respectively.

### 3 Emitter & Detector

Codey Rocky is an education robot that can not only recognise colours but it can convert the detected colour frequencies to those of music.

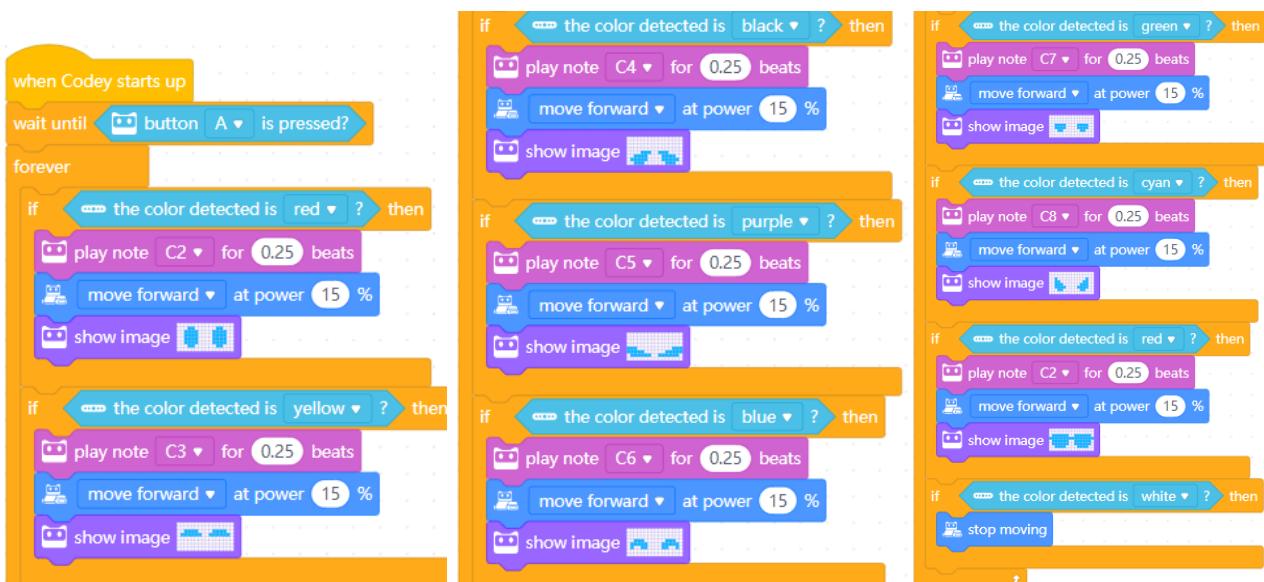
The story line of the project is:

**When button A is pressed, Codey starts moving forward. As it moves, it recognises the colours & converts them in to corresponding musical notes like Sa, Re, Ga, Ma, etc. It also changes facial expressions as per the colour. When it encounters white colour, it stops.**



What you learn in this will apply to most other robots. Focus on its code.

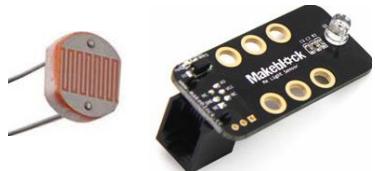
### 4 Final Code Colour Sensor



## ➤ Sensor no 5 – Light Sensor

A light sensor is a photoelectric device that converts light energy (photons) they detect to electrical energy (electrons).

It is similar to an IR Sensor. This is a passive sensor in the range visible to humans, IR sensor is in the IR range of light spectrum. Thus, they are able to tell the colour based on intensity of light they are receiving.



### 1 Uses of Light Sensors

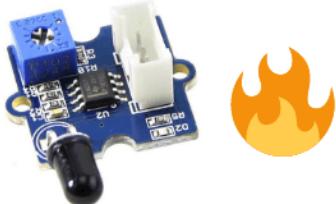
Light sensors have several uses in industrial and everyday consumer applications. For example they can:

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# CODING SENSORS 3

# 11



## » Learning Review

By the end of this lesson – children will have a fair idea of:

- Touch sensor, flame sensor, soil moisture sensor & flame sensor.
- Doing projects with above sensors.

## » Sensor no 7 – Touch Sensor

Touch Sensors are electronic sensors that can detect touch.

They operate as a switch when touched. These sensors are used in lamps, touch screens of the mobile, etc. Touch sensors offer an intuitive user interface

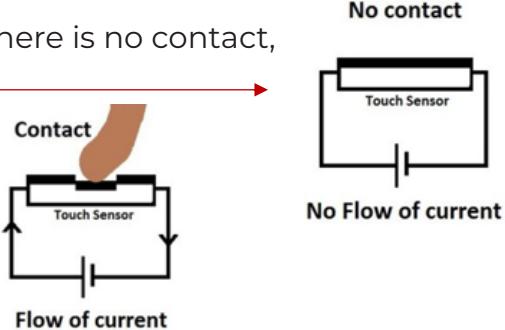


Touch sensors are also known as **Tactile Sensors**. These are simple to design, low cost and are produced in large scale. With advances in technology, these sensors are rapidly replacing the mechanical switches.

### 1 Working of a Touch Sensor

A touch sensor works like a switch. When there is no contact, no current flows through the circuit.

When there's contact, touch, pressure or force on the surface of a touch sensor, opens the electrical circuit & allows currents to flow through it.

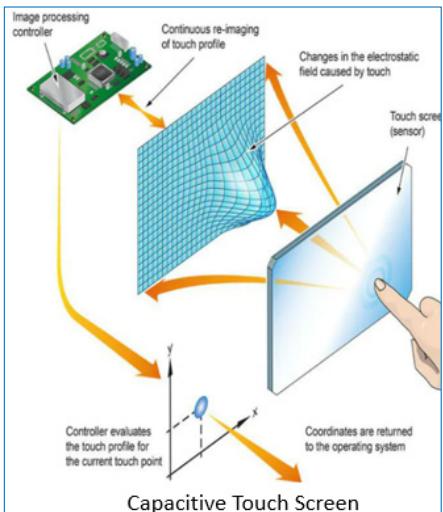


### 2 Types of Touch Sensor

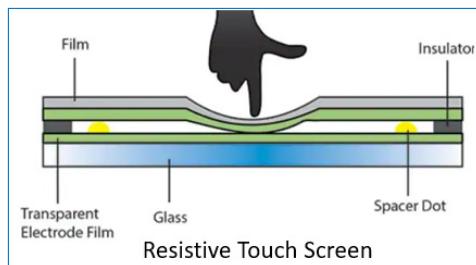
They are of two main types:

- Capacitive Touch Sensors. These are used in smartphones, home appliances, automotives & other industrial applications.
- Resistive Touch sensors. These are used in musical instrument, keypads, old mobile phones & Foot pronation monitoring.





### 3 Types of Touch Sensor



### 4 Project with Touch Sensor

The aim is to see how 4 touch sensors of a controller Halo Code will control its 12 LED's.

The story line is:

**When HaloCode starts up and we touch sessor:**

- 0 - it displays light animation Meteor.
- 1 - it displays light animation rainbow.
- 2 - it displays light animation spindrift.
- 3 - it displays light animation firefly.



### 5 Final Code Touch Sensor

```

when touch sensor 0 is touched
  play LED animation meteor until done
when touch sensor 2 is touched
  play LED animation rainbow until done
when touch sensor 3 is touched
  play LED animation spindrift until done
when touch sensor 1 is touched
  play LED animation firefly until done
  
```

```

when button is pressed
repeat (3)
  all LEDs light up
  wait (1) seconds
  light off all LEDs
  wait (0.5) seconds
  light off all LEDs
  
```

## » Sensor no 8 – Soil Moisture Sensor

This is a simple sensor. It is a fork-shaped probe with two exposed conductors. These act as a variable resistor whose resistance varies according to the water content in the soil.

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# IOT & IIOT 12

## » Learning Review

**By the end of this lesson,** children will have a fair idea of what is IoT & IIoT, their applications, enabling & supporting technologies, IoT platforms, Future of IoT, & the job market.

## » What is IoT

IoT stands for **Internet of Things**. It is a network of physical devices that are connected to the internet & can communicate with each other. IoT devices are equipped with sensors, software, and other technologies that allow them to exchange data with other devices and systems.

Goal of IoT is to create self-reporting devices that can communicate with each other and users in real time. IoT devices can collect data from their surroundings and use that information to understand user preferences, adjust accordingly, and issue alerts. IoT devices can include Smart thermostats, Smartwatches, RFID-enabled clothing & curtains, Industrial machinery, & Transportation systems.



Term “Internet of Things” was coined in 1999 by Kevin Ashton, MIT's Executive Director of Auto-ID Labs. IoT devices can range from everyday household objects to Smart thermostats, Smartwatches, RFID-enabled clothing, Industrial machinery, and Transportation systems. IoT devices communicate with the cloud through connectivity, such as Wi-Fi, Bluetooth, cellular, Zigbee, and LoRaWAN. Once data reaches the cloud, software processes it and decides whether to carry out an action, such as adjusting the sensors/devices.

## » Enabling Technologies

IoT is made possible by three key technologies:

- **Sensors.** Sensors are devices that collect data from the physical world.
- **Networks.** Wired or Wireless they connect sensors to the internet.
- **Coding.** Using different platforms, they write instructions for the machine to input, store, and analyze data collected by sensors, & give outputs to HW or SW based control devices.



## » Types of IoT Platforms

Today billions of devices are connected to the internet, collecting and sharing information. They range from smart home setups like cooking appliances and smoke detectors to military-grade surveillance equipment. List below outlines common IoT applications.

- **Consumer IoT:** Consumer IoT refers to personal and wearable devices that connect to the internet. These devices are often referred to as smart devices.
- **Industrial Internet of Things (IIoT):** The IIoT is a system of interconnected devices in the industrial sector. Manufacturing machinery and devices used for energy management are part of it.
- **Commercial IoT:** Commercial IoT refers to tools and systems used outside of the home. Businesses and health care organizations leverage commercial IoT for auditable data trails and consumer management.

**Consumer IoT Devices** There home options include:

- Smart speakers.
- Thermostats.
- Lighting systems.
- Security cameras.
- Door locks.
- Appliances.
- Robotic vacuum cleaners.
- Wireless kitchen appliances.



## » What is IIoT

A sub set of IoT, it stands for Industrial Internet of Things, which is use of Internet of Things (IoT) technology in industrial applications. IIoT networks connect devices, sensors, & instruments to industrial applications.

### Industrial Internet of Things (IIoT)

This is use of connected devices, sensors, and instruments to collect, monitor, and analyze data in industrial settings. IIoT is a key component of Industry 4.0 technologies (Industry 4.0, also called Fourth Industrial Revolution or **4IR**, is the next phase in digitization of manufacturing sector).



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# CONSOLIDATING PART 2 - CODING 13

## » Recap of Essentials

### 1 Automation



- Automation relates to a machine performing one or more tasks all on its own.
- Sensor checks environmental inputs to be evaluated by code to help automation.
- Sensors can be active or passive.
- Sensors work using logical switches called gates.

### 2 IOT & IIOT



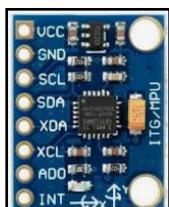
- Like the internet of computers, IOT is the internet of things. It connects communication devices.
- Like the IOT, IIOT is industrial internet of things. It connects machines & industrial devices. It is part of industrial revolution 4.0.
- Both use three key technologies – sensors, networks & coding.
- We also have the consumer IOT & commercial IOT.
- Technologies supporting these include cloud computing, big data, security, & actuators.

## » Identify & Tell Me

### 1 Identify the sensors below:



(a)



(b)



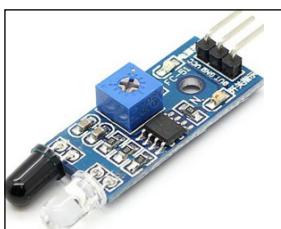
(c)



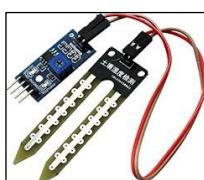
(d)



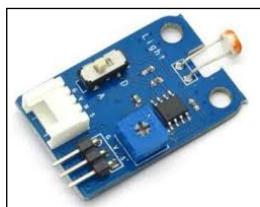
(e)



(f)



(g)



(h)

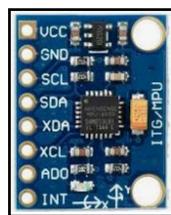


(i)

**2** Tell the places where sensors below are used:



(a)



(b)



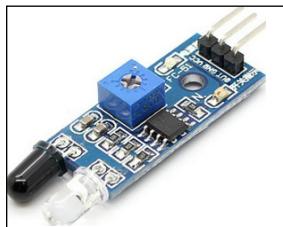
(c)



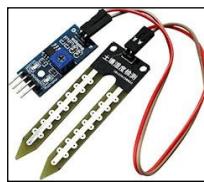
(d)



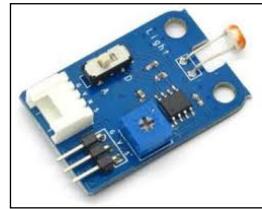
(e)



(f)



(g)



(h)



(i)

## Quick Assessment

**1** Select True or False:

- (a) Sensors cannot be used in series.
- (b) Sensors check the environment to give inputs for evaluation.
- (c) An ultraviolet sensor is used to detect UV waves in the atmosphere.
- (d) Automation does not require sensors.

**2** Fill in the blanks:

- (a) IOT stands for .....
- (b) UV stands for .....
- (c) Gyro sensor is used to monitor.....
- (d) What is the role of proximity sensor .....

**3** Give short answers:

- (a) What is automation.
- (b) What is industry 4.0.
- (c) What are the two main types of sensors.
- (d) What is IOT.

**4** Explain the working of the following sensors:

- (a) IR sensor.
- (b) Soil moisture sensor.
- (c) Touch sensor.
- (d) Proximity sensor.

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# ESSENCE OF WIRELESS COMMUNICATIONS 14

## » Learning Review

**By the end of this lesson** – children will have an introductory idea of what is telecom; what are wireless communications; what are EM & radio spectrums, modulation & multiplexing; the layout & working of a GSM network, & an introduction to IP networks.

## » The three Amazing Facts

Have you ever wondered, how within a second you can contact your near & dear sitting thousands of miles away, & also share photos & live video sessions with them. Till a few years back it was unbelievable. In our younger days in the seventies, eighties and nineties, to just talk to them for a few minutes would have taken hours of trying & waiting. Thanks to the rapid developments in the world of **Telecommunication**.

The second amazing thing about telecom is that in the nineties we would have to pay over a hundred rupees to talk for just three minutes. Today it is free.

The third amazing fact is that telecom along with its IT affiliates is the largest employer in the world. At the face of it you may feel it so, but as you dive in, opportunities exist in every page of it.

Telecommunications, also known as **Telecom**, is electronic transmission of information over long distances. It includes exchange of voice, data, video, and image-based information. This **exchange** of information is done over Wired medium, or Wireless medium.

**Wired mediums** include copper wires or cables, optical fiber cable (having a type of fiber that can transmit signals), & electrical power lines being used as a communicating medium.

**Wireless mediums** include radio or wireless communications, & satellite-based communications. It also includes infra red (IR) systems.

In this lesson we shall talk of wireless medium. To learn wireless, we need clarity on three important terms:

- What are **Electromagnetic Waves** & their relevance to telecom.
- How to superimpose voice & data on them to enable them to carry the voice & data from point A To B. This is called **Modulation**.
- How to increase the amount of data that you can carry over it. This is **Multiplexing**.



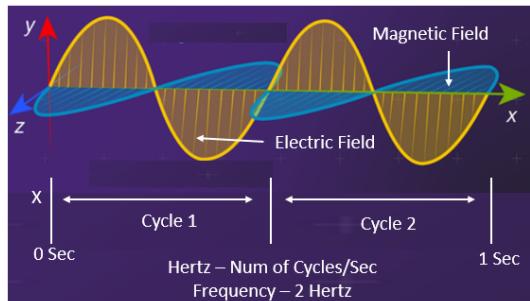
# EM Waves & Radio Spectrum

## 1 Electromagnetic (EM) Waves

Wireless works using EM waves. They provide the road for information to move from point A to B.

To do so, we Input Alternate Current to an antenna. This creates a magnetic field that propagates outwards from the antenna as a wave. This wave has three components:

- Time along X axis.
- Electric field along Y axis.
- Magnetic field along Z axis



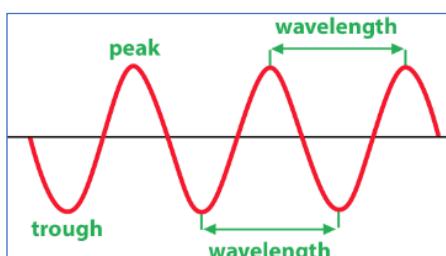
## 2 Cycle & Frequency

If we take a close look at these waves, they go up & down. One round of this up & down move is called a Cycle. It is measured in Hertz. Number of cycles per sec is called Frequency (Freq). This ex has 2 cycles/sec. Thus, its frequency (freq) is 2 Hertz.

## 3 Units of Measuring Freq

Hz is the unit to measure freq. It is a very small unit, so we prefer to use kHz, MHz & GHz for measuring freq. Use of EM waves is common to both wireless & non wireless systems.

Hertz	Hz	1 cycle per second
Kilohertz	kHz	1,000 Hz
Megahertz	MHz	1,000,000 Hz
Gigahertz	GHz	1,000,000,000 Hz

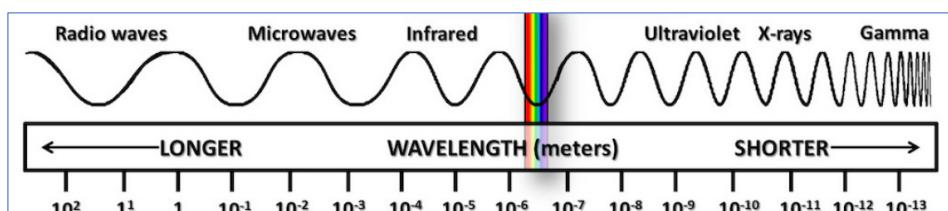


## 4 Wavelength

Wavelength is the distance between two identical points on a wave, such as two adjacent peaks or troughs. It is inversely proportional to freq.

## 5 Electromagnetic Spectrum

In this, the radio spectrum falls in radio freq bands & Microwave band. It is further divided into Very low frequencies (VLF), High frequencies (HF), Ultra high freq (UHF), & Super high freq (SHF) bands. Submarines use VLF. Walkie Talkie radios use HF & GSM uses UHF & SHF.



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# INTERNET SURFING 15

## » Learning Review

**By the end of this lesson** – children will have an introductory idea of what is surfing, SEO, web browsers, difference between the two, what are cookies, working of catches, Tools to enhance your browsing experience, & surfing Shortcuts.

**"Surfing the internet"** is the act of using a web browser to navigate and explore websites and webpages. It's also known as **Browsing the Web**.

## » Search Engines

It is a software program that helps find information on internet or in a database. Popular search engines include Google, Bing, and Yahoo. They work by:

- **Indexing:** Continuously scanning internet & cataloging content of each page.
- **Returning results:** When a user enters a search term, the search engine uses algorithms to find the most relevant websites and return them in a list .

Search engines can vary in their scope, functionality, & content types they index:

- **Internet search engines:** Designed to catalog everything on the web
- **Enterprise search engines:** Designed for close user groups, they help find internal information within an organization.
- **Desktop search engines:** Index files on a local network.

Search Engine Optimization (SEO). It is a set of practices that help improve a website's visibility and ranking in search engines like Google, Bing, and Yahoo. The goal of SEO is to increase the amount of relevant, high-quality content that appears in search results, which can lead to more traffic to a website. It is the job of person making the web site.

## » Web Browsers

### 1 What are Web browsers

They are software applications that retrieve and display webpages. When you enter a URL or click on a link, the browser sends a request to a web server, which then sends back the requested webpage's data. The browser interprets this data and presents it to you as a web page with text, images, and interactive elements.

### 2 Web Browser Choices

There are several web browsers you can use for web surfing, including Google Chrome, Mozilla Firefox, Microsoft Edge, and Opera. These browsers provide different features and experiences, so you can choose the one that suits your preferences.



### **3 Changing Web Browser**

Most web browsers allow you to change the default search engine to one of your choices. You can select from popular search engines like Google, Bing, or Yahoo, or choose a specialized search engine depending on your needs. By customizing your default search engine, you can tailor your web surfing experience to your preferred search provider.

### **4 What is URL**

To start web surfing, you need a device such as a computer, smartphone, or tablet with an internet connection. Launch a web browser, type in the uniform resource locator (URL) of a website, and press Enter to begin your web surfing journey

## **» Difference between Search Engines & Web Browsers**

Search Engine Optimization (SEO) is a set of techniques that improve the quality and quantity of links to a website, while a web browser is a software program that displays web pages:

## **» HTTP vs HTTPS**

HTTP and HTTPS are both protocols used for transmitting data over the internet. The key difference is that HTTPS provides an additional layer of security through secure sockets layer and transport layer security (SSL/TLS) encryption, ensuring that the data transmitted between your browser and the website is encrypted and protected from eavesdropping or tampering. Be careful of security when opening HTTP sites.

## **» Cookies**

### **1 What are Cookies**

Cookies are small text files stored on your computer by websites you visit. They serve various purposes, such as remembering your preferences, enabling personalized experiences, and tracking your browsing activity for analytics or advertising.

### **2 Use of Cookies**

Cookies can be useful, but it's important to review and manage them to protect your privacy.

### **3 Clearing Cookies from the Browser**

In most web browsers, you can clear cookies by accessing the browser's settings or preferences. Look for options like "Clear browsing data" or "Clear cookies and site data."

" Be aware that clearing cookies will sign you out of websites, remove saved preferences, and may impact your browsing experience on some sites.

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# INTERNET MAILING 16

## » Learning Review

**By the end of this lesson** – children will have an introductory idea of what is Email, its history, how it works, its components & essentials.

## » What is Email

Email or electronic mail is the method of sending messages from a computer or mobile device from one user to one or more users via the Internet. Emails travel across different time zones within a snap of a finger and hence are considered an effective mode of communication for both personal and professional purposes.

## » History of Email

Electronic mail was used well before the internet was born. In the initial days (way back in 1965), a computer program called MAILBOX was used to share mail in electronic form. A single computer was used by multiple users to send and read emails.

In 1969, ARPANET (Advanced Research Projects Agency Network) was implemented to share electronic mail using a common network connecting numerous computers across various departments.

Later in 1971, Ray Tomlinson identified a way to send messages between users on different hosts using the @ symbol with the destination server. However, this was still within an organization using a common network.

At one point, organizations wanted to communicate with people on a different network. The need for communication between one organization to another organization led to the invention of the Internet.

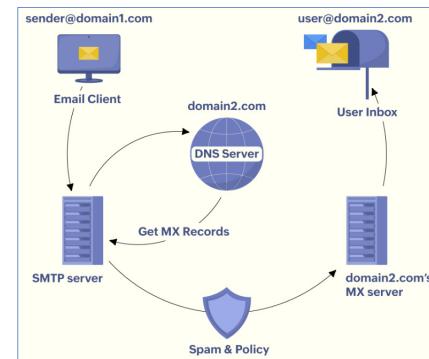
## » How Does it Work

As an end-user, all we know is that an individual composes a message, enters the recipient's email address in the To field and then clicks the **Send Mail** button. The recipient can see that the email is received in their inbox. However, in the background, there is a lot of activity involved:

- A user sends the email.
- The outgoing SMTP server validates the authenticity of the sender.



- SMTP server checks the domain details in the recipient's email address.
- SMTP server sends the email to the recipient server based on MX Record found in recipient's Domain Name Server (DNS).
- Recipient server validates the email address and delivers the mail.



## » Components of an Email

An email comprises of:

**Message envelope.** A message envelope, also called **email metadata**, contains the details necessary for communication between the sending server and receiving server. It contains the sender and recipient's email addresses with which the mail server decides where to deliver the email.

**Message header.** The header of an email contains vital information about the sender and recipient.

**Message body.** The actual content of the email can be viewed in the message body. This can include text, images or videos. Based on the email client, the content in the body of the email can either be plain text or HTML (Hypertext Markup Language). Signatures and organization disclaimers can be included at the footer of the email body based on email policies.

Information field	Description
Subject	Provides a quick glimpse of the email content.
From	Displays the sender's email address.
To	Displays the recipient's email address.
Date and time	The date and time that the email was received are as per the recipient's time zone.
Recipient	Displays the recipient's name.
Reply-to	When the recipient clicks the Reply button in the received email, the To field gets filled automatically based on the email the Reply-ID available in to field.
Carbon copy (Cc)	This field is used whenever the sender wants to send a copy of the email to other users.
Blind carbon copy (Bcc)	The email address entered in the Bcc field will not be visible to those users who were added in the To and Cc fields.
Attachments	Contains those files which the sender attaches in support of the content in the body of the email.

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# MY TINKERING LAB – HANDS-ON ELECTRONICS 17

## » Learning Review

By the end of this lesson, children will have a fair idea of the need of an electronic tinkering lab at home to gain hands on experience, which today is the key requirement to land a job. They will get to know its advantages, available options, & advantages & disadvantages of these options. Thereafter, they can make their own choice.

Many of you may have seen a Tinkering lab in your school. That is a totally different cup of tea. It is big, with lot of equipment, and handled by a professional. On the other hand, a lab at home is for novices with little or no guidance. It is designed to develop & give wings to a child's interest in tinkering & learning, as a hobby. This interest develops slowly; therefore, the home lab must also evolve slowly, in pace with the learning.

As part of this book series, we had introduced you the idea of a tinkering lab at home in grade 3. It was extremely simple. However, we kept adding things & giving projects in sync with your learning of computers & coding. You are now in grade 6. You have learnt a lot. It is now time to add electronics in your existing lab. We will guide you do so.

## » Understanding an Electronic Tinkering Lab

### 1 What is a Home Electronic Tinkering Lab

In developed countries, it is a common practice to have a mini workshop or a DIY (Do it Yourself) table at home. This is a workspace not only to do minor home jobs, but a place for children to pursue hobbies. This is where children use tools & equipment to develop interest in STEM (Science, Technology, Engineering, & Math's), as well as to develop 21st century skills.

This lesson will guide you in setting up a small lab to develop interest in tinkering, & enable you to do Arduino based Projects at home. This will give hands on opportunity to do projects, take part in competitions, stand out in school, & lay a sound foundation for the future, which you may, or may not get in school.

### 2 Challenges of a Home Lab

Say you want to make flashing LED lights to place on our bicycle. Your home tinkering lab can help. But it poses a few challenges for beginners & parents:

- Getting the Bill of material & circuit diagram of what to make. This may not be much of a challenge.



- Getting components required to make it. Getting the right components, of acceptable quality, & at the right price can be a major challenge.
- Guidance in joining the components as per the circuit diagram. This can be a challenge. It can also involve damages & wastage.
- Testing the circuit. This is the fun part & will not be a challenge.
- Thinking of what more you can do with it. Doing a project is all about learning, & how that learning can be applied in our daily life. This will be a challenge.

### 3 Types of Circuit Diagrams

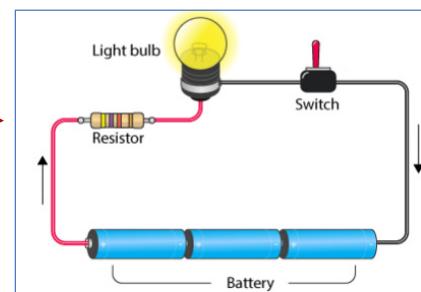
They are of two types:

- **Pictorial:** Uses simple images of components.

It is as shown here.

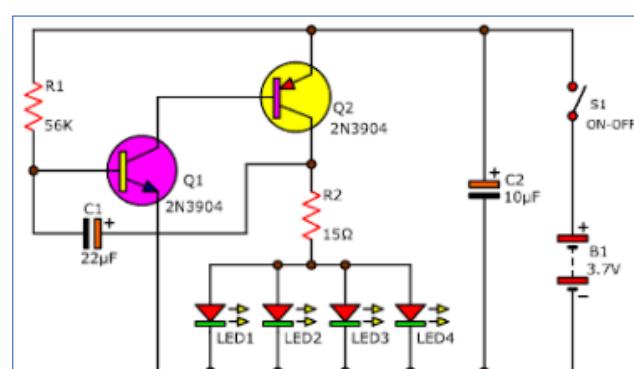
- **Schematic:** Uses standardized symbols (as below) to represent components & their interconnections.

Certainly the first appears easy, children face no problem of co-relating how exactly components are connected. The one below is a bit confusing for beginners.



### 4 Schematic Circuit Diagrams

They are a visual representation of an electrical or electronic circuit, that uses standardized symbols to show how exactly components need to be connected. They use solid lines to show the path of the current, and symbols to represent the components. This is the circuit for making flashing tail lights for a cycle. It is showing a battery, switch, LED's, transistors, resistors & capacitors.



### 5 The Age Old Method of Making Connections

The age old way of making the connections was by connecting them initially using wires, & then soldering the wires using a soldering iron, flux & solder wire, to ensure that the connections are not loose. This was very tedious & most children would lose interest, even before it started. The other was to solder them to a PCB (printed circuit board). These were costly to make, specially in low volumes.



### 5 Introduction of Bread Boards

In the prototyping stage of product development, soldering & de-soldering was a tedious operation even for professionals. This led to the development of a prototyping board called Breadboard. Since these are used by professionals who know



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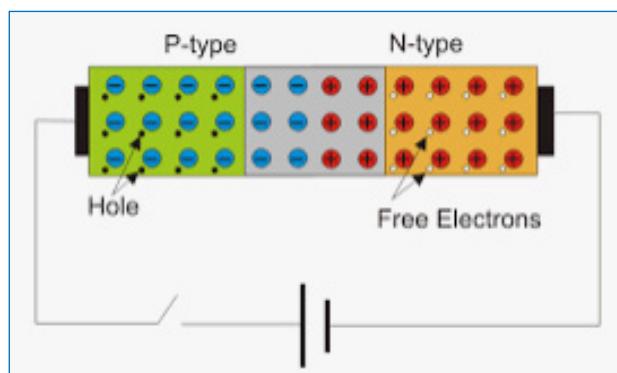
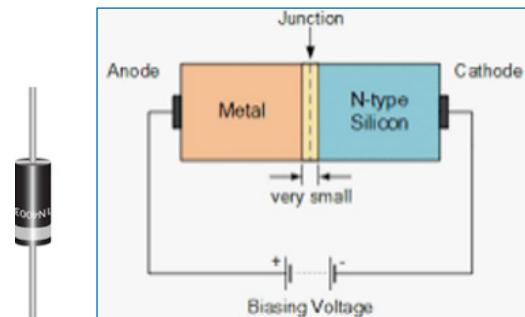
# HOW THINGS WORK

## 1 Diode

It is a device that replaces a traditional **Switch**. When voltage applied to it, is below a specified value (**forward biased**), it goes to **ON** position. When it exceeds a specified value (**reverse biased**), it goes to **OFF**.

A diode has two parts. A part made of **silicon** containing **free electrons** (red dots) called **Cathode** (n-type), & a **metallic** part containing **holes** (blue dots) called **Anode** (P-type). There exists a small junction (jn) between the two called **p-n jn**.

A battery connected across the p-n Jn makes the diode **forward biased**. This pushes electrons from n-type to p-type & pushes holes in the opposite direction (look at holes as absence of electrons). Once in the jn, the two combine leading to flow of current in the circuit.



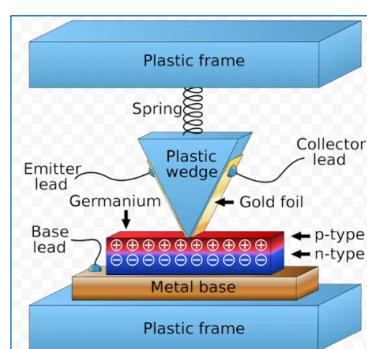
The silicon & metal parts called **wafers**, are very thin & tiny, but they are able to perform the same function, as a much bigger manually operated switch performs, & that too, automatically. Being so tiny, thousands of these diodes can be packed in a very small space.



## 2 Transistors

A few years after the invention of junction diodes, came the invention of transistors. Transistors are similar to diodes and made of silicon, but have different functions. In reality, a transistor consist of two PN diodes connected back to back. A transistor has three terminals called emitter, base, & a collector. Its two main operations are:

- It operates as different types of logical gates for electronic switching, opening and closing them many times per second.



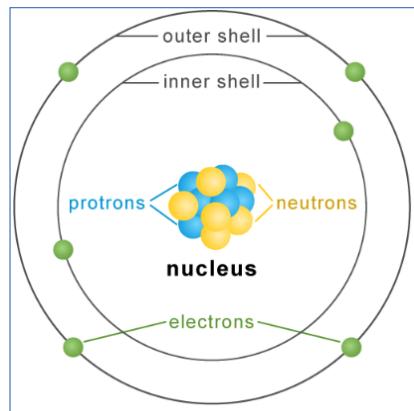
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# WHAT IS ELECTRICITY

## 1 Concept of Electricity

Everything in the universe is made of **atoms**. Center of an atom is called **nucleus**. It is made up of particles called protons & neutrons. **Neutrons** have no charge, **protons** have a positive charge (+) & **electrons** have an equal negative charge (-). They are balanced, & remain in place.



Electrons spin around the nucleus in **orbits**, held in their orbits by an electrical force. Force in outer orbit is lesser than inner. As & when an external (+) force is applied to an atom (putting the switch on), electrons in outer orbit of an atom, get attracted to it, & are pushed out of their orbit, to that of another atom. **Electrons, shifting from one atom of a material (say a copper wire) to that of an adjacent atom & so on, creates a flow of charge called electricity.**

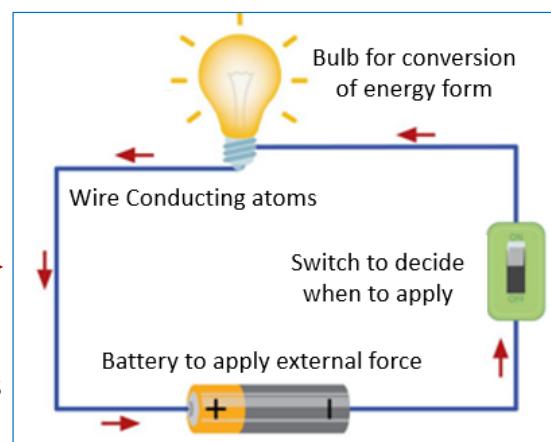
Materials that allow electron in outer orbit to shift, are called **Conductors**, & those that restrict it, are called **Insulators**. Entire electricity is based on this concept.

## 2 How is Electricity Used

Electricity is a form of energy. By itself, it is of little or no use. To be of use, it must change its form. In a bulb it is changed from electrical to light, in a motor to mechanical, & in a heater to heat. This is done by a thing called

### Electrical Circuit.

When the switch is put on the **circuit is closed**. Battery gives that external force & the flow of charge starts. In the bulb the filament converts electrical energy to light. In a motor, its coil would have converted it into mechanical. When we put the switch off, the **circuit is open**, the external force stops, flow of charge stops, & bulb stops emitting light.



## 3 Key Electrical Terms

- **Current.** Movement of electric charge via a conductor is known as current (**I**), & **Ampères** is the unit of its measurement. Electric current is often compared to the flow of water in a pipe.

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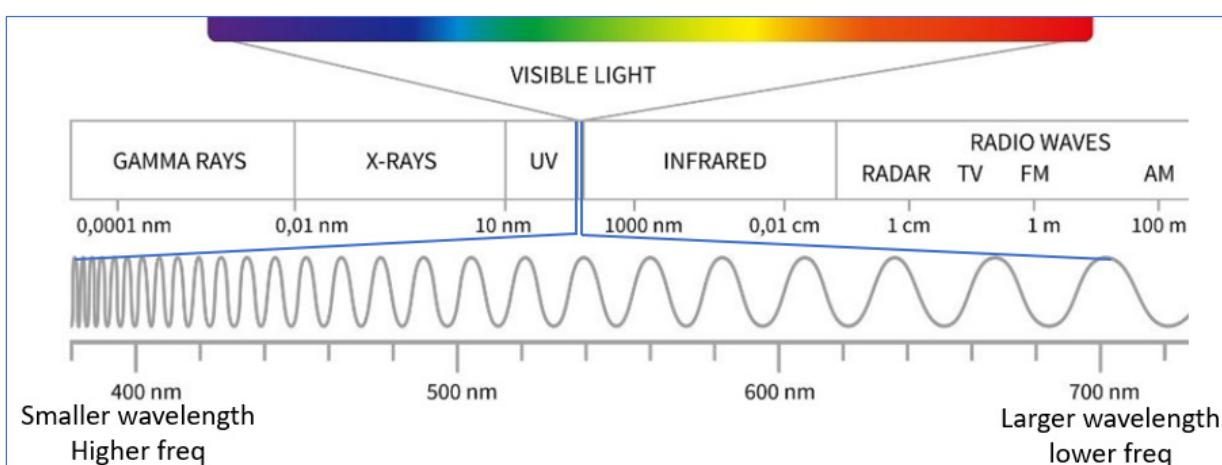
# MAGIC OF LIGHT

## 1 What is Light

Light is produced when electrons in atoms and molecules release energy (remember the theory behind light emitting diodes (LED's). The released energy is a form of electromagnetic radiation that human eyes can perceive.

## 2 How do Our Eyes See this Radiation

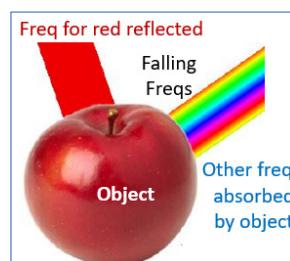
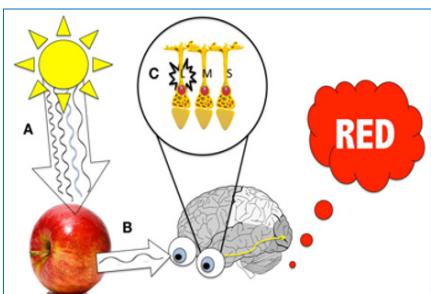
The released energy is in the form of a wave. These waves have frequencies corresponding to wavelengths 380 and 750 nanometers. They form what is called the visible band of the EM spectrum. One end of the spectrum starts with Violet, thereafter, it follows VIBGYOR, & ends with red at the other end.



Human eyes have cone-shaped cells that act as receivers. They tune to the wavelength of light coming to the eye from the objects. The color we see, depends on the freq the object emits, & what the receivers in our eyes receive.

## 3 How do Our Eyes See Colors

Say we are in a dark room. Everything appears black. When we switch on the light, it falls on objects in the room. Say it



falls on an apple. The apple will reflect some frequencies, & absorb others. When reflected light reaches our retina, it along with the brain perceives

it as red. This is how we see.

If there is a color blind person he will perceive it as some other color. A dog in the same room will perceive it as some other.

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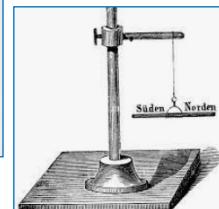
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# MAGNETISM

## 1 The Natural Magnet

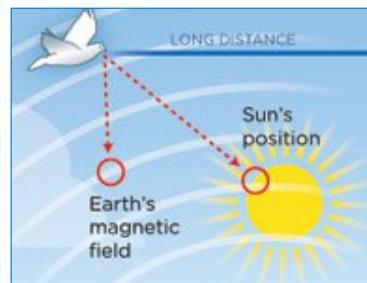
Ancient Greeks and Chinese knew about a naturally occurring magnetic stone called "**lodestone.**"

They discovered; a needle could be made magnetic by stroking it against a lodestone. This would then always point north-south. It was used for early day navigation.



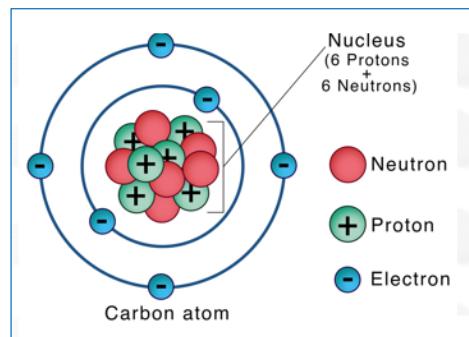
## 2 Animal Magnetism

Some animals, such as pigeons, bees, and salmon can detect Earth's magnetic field and use it to navigate. Scientists aren't sure how they do this, but these creatures seem to have magnetic material in their bodies that acts like this loadstone compass.



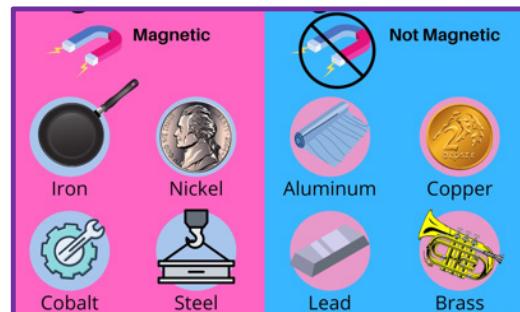
## 3 Magnetism of Materials

Every substance is made of tiny units called atoms. Let us take the structure of a Carbon atom. In this each atom has electrons that carry electric charges. Spinning like tops, the electrons circle the nucleus, or core, of neutrons & protons. This movement generates an electric current and causes each electron to act like a **microscopic magnet**.



## 4 Magnetism & Non-Magnetic Materials

In most substances, equal numbers of electrons spin in opposite directions, which cancels out their magnetism. In substances like iron, cobalt and nickel, most of the electrons spin in the same direction. This makes the atoms in these substances strongly magnetic. However, this **does not make them a magnet as yet.**

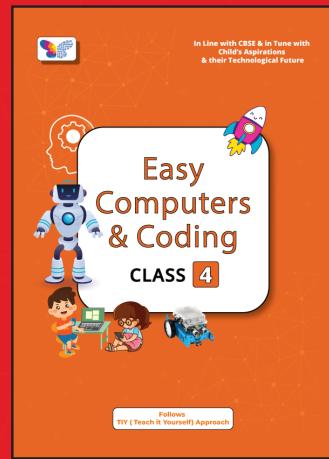
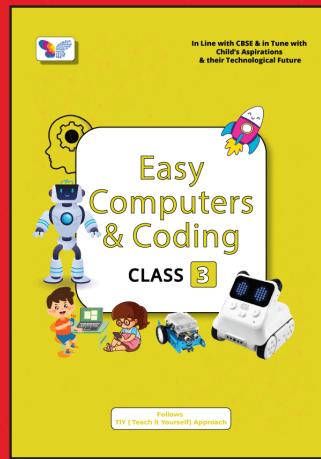


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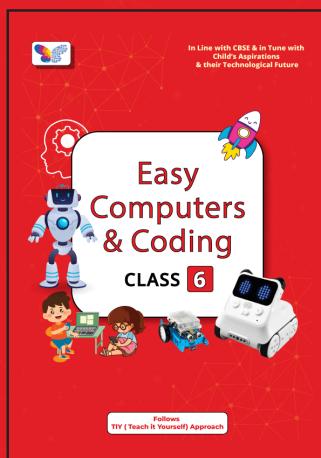
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### Level-2



### Level-3

