PHYSICIS SUMARRIES.

HOW SMOKE DETECTORS WORK.

1. Photoelectric (Optical) Smoke Detectors.

These alarms use a light source to detect smoke and are best at sensing **slow-burning, smoldering fires** (like a couch or mattress catching fire).

- **The Setup**: Inside the device is a T-shaped chamber containing an infrared **LED light** and a light-sensitive **photodiode sensor**. They are angled away from each other so the light normally shines in a straight line, completely missing the sensor.
- **The Trigger**: When smoke enters the chamber, the smoke particles **scatter the light beam** in all directions. Some of this scattered light hits the sensor, completes the electronic path, and triggers the alarm horn.

2. Ionization Smoke Detectors

These alarms use a continuous electrical current to detect smoke and excel at sensing **fast-flaming, aggressive fires** (like paper or grease fires).

- **The Setup**: The detector houses an ionization chamber with **two metal plates** connected to a battery, creating an open circuit. A minute, harmless trace of radioactive material (**Americium-241**) strips electrons from nitrogen and oxygen molecules in the air. This "ionizes" the air, turning it into a conductor that allows a steady **electrical current** to flow between the plates.
- **The Trigger**: When smoke enters this chamber, the smoke particles attach to the ionized air molecules and **disrupt the electrical current**. The internal microchip detects this drop in cur

HOW AN ELECTRIC BELL WORKS.

- ✓ **Closing the Circuit**: When you press the doorbell button, the circuit completes, and electric current flows from the battery through the coils of the **electromagnet**.
- ✓ **Magnetic Attraction**: The electric current magnetizes the iron core. This electromagnet immediately pulls the soft iron **armature** toward it.
- ✓ **The Strike**: As the armature moves forward, the attached **hammer** strikes the metallic **gong**, creating a single loud "clang" sound.
- ✓ **Breaking the Circuit**: The forward movement of the armature pulls it away from the **contact screw**. This physical separation gaps the connection and immediately breaks the electrical circuit.

- ✓ **Demagnetization**: Because the circuit is broken, current stops flowing. The electromagnet instantly loses its magnetism and stops pulling the armature.
- ✓ **The Reset**: A spring pulls the flexible armature back to its original resting position.
- ✓ **Repeating the Cycle**: Once the armature snaps back, it touches the contact screw again. The circuit closes, current flows, and the entire cycle repeats dozens of times per second, creating a continuous **ringing** sound.

HOW A MOTOR WORKS.

- ❖ An electric motor works by **converting electrical energy into mechanical energy** using the fundamental principles of magnetism. When an electric current flows through a wire coil inside a magnetic field, it creates a magnetic force that forces the coil to rotate.

HOW SPEAKERS PRODUCE SOUND.

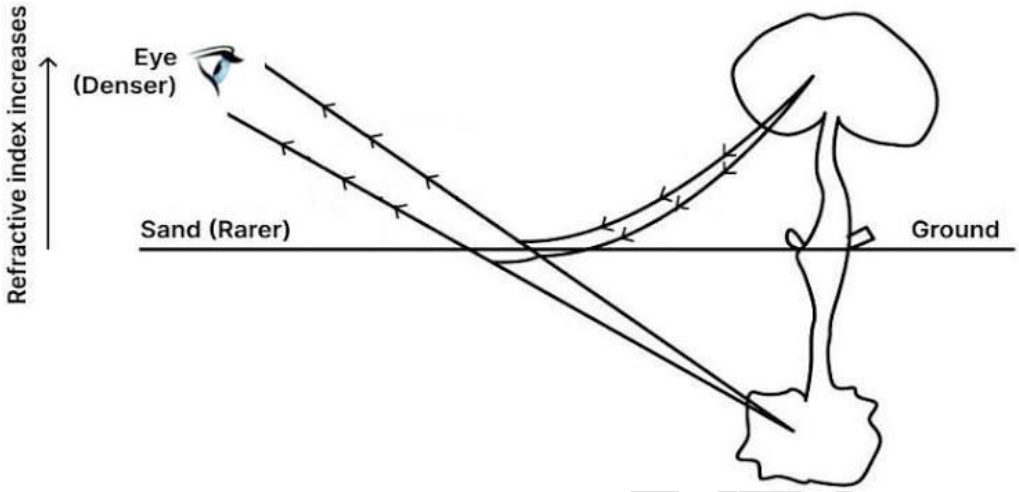
- ➢ **Permanent Magnet**: A fixed magnet at the base of the speaker that creates a constant, steady magnetic field.
- ➢ **Voice Coil**: A cylinder wrapped in thin copper wire that sits inside the permanent magnet's field. It acts as a temporary electromagnet.
- ➢ **Cone (Diaphragm)**: The large, flexible, cone-shaped membrane (usually made of paper, plastic, or metal) attached directly to the voice coil.
- ➢ **Suspension (Spider and Surround)**: Flexible rings that keep the voice coil and cone centered while allowing them to move freely backward and forward.

HOW MIREGE IS FORMED.

Inferior Mirages (The "Water on the Road" Illusion)

- ❖ This is the most common type, frequently seen on hot asphalt roads or in deserts.
- ❖ **The Setup:** The sun bakes the ground, heating the lowest layer of air right above it. This creates a sharp temperature gradient: **hot, less dense air at the bottom** and **cooler, denser air on top**.
- ❖ **The Bending of Light:** Cool air has a higher refractive index, while hot air has a lower refractive index. As light from the sky or a distant object travels downward, it speeds up and bends *away* from the normal line.

- **Total Internal Reflection:** When the light hits the hot layer at a very shallow angle (the critical angle), it undergoes total internal reflection, curving upward toward your eyes.
- **The Illusion:** Your brain always assumes light travels in a perfectly straight line. It traces the upward-curving ray straight back down into the ground. You see an inverted image of the sky on the ground, which your brain misinterprets as a shimmering pool of water.

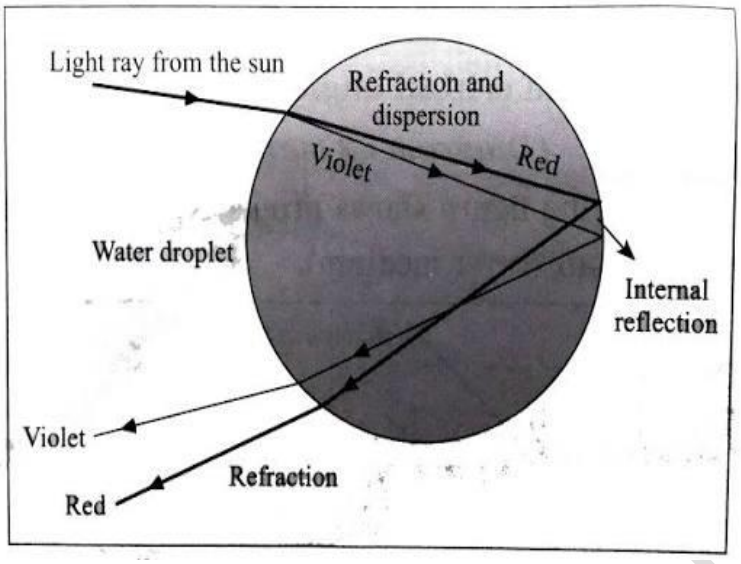


HOW A RAINBOW IS FORMED.

- **Refraction and Dispersion (Entry)**
  - ✓ Sunlight passes from the air into the denser water droplet.
  - ✓ This change in medium causes the light to bend (**refraction**).
  - ✓ White light is a mix of wavelengths.
  - ✓ Short wavelengths (violet/blue) bend more than long wavelengths (red).
  - ✓ This separation of colors is called **dispersion**.

- **Total Internal Reflection (The Bounce)**
  - ✓ The separated color rays travel through the droplet and hit the back wall.
  - ✓ Instead of passing through the back, the light bounces off the internal surface.
  - ✓ This behavior is known as **internal reflection**.

- **Refraction**
  - ✓ The reflected light reaches the front of the droplet again.
  - ✓ It exits the droplet, bending one final time as it transitions back into the air.
  - ✓ This exit broadens the color separation into a visible spectrum



WHY SOUND IS CLEAR AT NIGHT THAN DAY.

- Sound is clearer and travels farther at night primarily because of **atmospheric sound refraction** caused by temperature changes, alongside a significant drop in **ambient background noise.**

- **The Rule of Sound Speed**: Sound waves travel **faster in warm air** (where molecules have more kinetic energy and vibrate quickly) and **slower in cold air**.

- **During the Day**: The sun heats the Earth's surface, making the air closest to the ground hot, while the air higher up remains cool. Because the bottom of the sound wave moves faster in the hot air than the top of the wave in the cool air, the sound wave **bends upward** toward the sky and away from your ears.

- **At Night**: The ground cools down rapidly, leaving a layer of cold air near the surface and a layer of warmer air above it—a phenomenon called a **temperature inversion**. Because the top of the sound wave moves faster in the warm upper air than the bottom of the wave in the cold ground air, the sound wave **bends downward** back toward the Earth. This traps the sound near the surface, focusing the energy and allowing it to travel much further horizontally.

HOW A PERSON IS ABLE TO MAKE A PHONE CALL FROM UGANDA TO USA.

- ✓ **Sound to Electricity:** Your voice makes air move. The phone microphone catches this movement. It turns the sound energy into an electrical signal.

- ✓ **Radio Waves in the Air:** The phone changes the electrical signal into invisible radio waves. These waves travel through the air to a nearby cell tower.

- ✓ **Signal Travel (Cables or Space):**
  - **Undersea Cables:** The tower sends the signal into ground wires. Huge fiber-optic cables under the ocean carry light pulses across continents.
  - **Satellites:** Some signals shoot up past the sky to a satellite in space. The satellite bounces the signal back down to a ground station in the USA.

- ✓ **Back to Sound:** The USA tower or receiver phone gets the signal. It turns the light or radio waves back into electrical energy. The phone speaker moves the air. The other person hears your voice.

SATGES OF THE STARS.

- ❖ **Stellar Nebula**: Giant interstellar clouds of gas (mainly hydrogen) and dust begin to contract under gravity.

- ❖ **Protostar**: The cloud fragments collapse into dense, hot cores. Gravitational potential energy converts into thermal energy.

- ❖ **Main Sequence**: Nuclear fusion begins, converting Hydrogen into Helium. The star achieves **hydrostatic equilibrium**, where inward gravity perfectly balances outward radiation pressure.

HOW A SYRING IS ABLE TO WORK.

- ✓ **Decreasing volume**: Pushing the plunger down decreases the volume inside the barrel.
- ✓ **Pressure spike**: This contraction drastically increases the pressure of the fluid inside.
- ✓ **Fluid exit**: The high internal pressure forces the liquid out through the narrow needle opening where external pressure is lower.BY THE HELP OF ATMOSPHRIC PRESSURE.