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Safety in School Science Education

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SCIENCE HITS 4 KIDS
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General aspects

- EU and national laws
  - REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) 1st of June 2007, http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm
- Typical accidents
  - Gas
  - Fire
  - Glass
  - Chemical burning/corrosion
  - Electrical current overflow
  - Allergic reactions
  - (Radiation Hazards)

General aspects

1. Protective clothing
2. Dangerous substances
3. Hazardous waste
4. Fire safety
5. Electrical safety
6. Accidents and first aid

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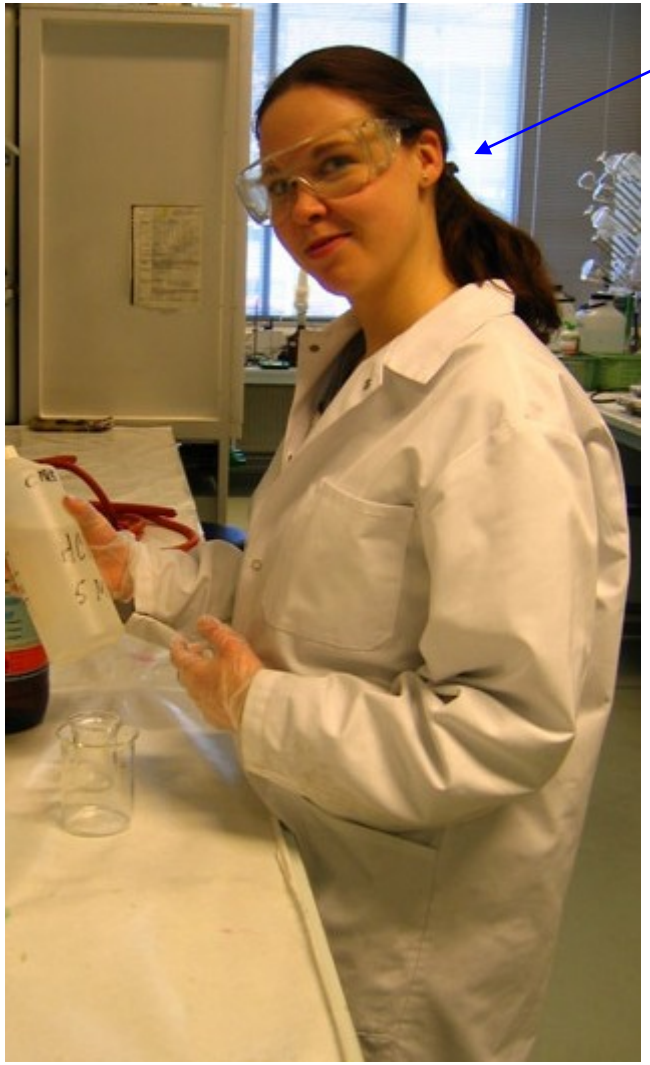
Protective clothing

1.1 Protective clothing



Hair fastened

Safety goggles

Safety gloves

Laboratory coat

1.2 Safety equipments

Fume hood

Emergency shower

Fire extinguisher

1.2 Safety equipments

Eye cleaner

Exercise

1. What safety equipments are in the classroom?
2. What safety equipments you need in current/particular laboratory work?
3. What are probable risks in the current practical work?
4. Why eye protection is especially important?

Laboratory test

Before: discussion of similarities of egg white and eye

Test:

- Brake an egg shell and separate egg white from yellow.
- Place egg white on a plate.
- Drop few drops of strong acid on the egg white and make observations.

Observations

Transparent egg white coagulates and turns into white and non transparent substance

After

Discussion: How eye shower works, why it minimises injuries

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Dangerous substances

2. GHS = Globally Harmonized System of Classification and Labelling of Chemicals

Old pictograms

New proposed GHS Pictograms

http://www.unece.org/trans/danger/publi/ghs/pictograms.html

Memory game

1. Make template of the GHS pictograms and their names.
2. Mix up names and pictograms and let pupils to combine them correctly

F	
	Flammable
F+	
	Easily flammable
O	
	Oxidating
T	
	

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Hazardous waste

3.1 Hazardous wastes

- Storing, handling, disposal
- Problem wastes are, among others,
  - Oils
  - Acids, bases
  - Arsenic As, cadmium Cd, cobalt Co, chromium Cr, copper Cu, mercury Hg, manganese Mn, nickel Ni, lead Pb, thallium Tl, antimony Sb, tin Sn
  - PVC
  - Pesticides
  - pharmaceuticals

3.2 Disposal

- Collect similar substances to similar containers
  - Strong acids
  - Strong bases
  - Organic compounds
  - Oils
- Deliver hazardous waste to toxic waste disposal plant

3.3 Disposal

- Neutralise acids and bases before poring them in the drain
- In Finland, acids and bases pH = 6 – 10 can be poured in to the drain with excess of tap water

- Do not pour in the drain
  - Toxics
  - Corrosive substances
  - Substances insoluble to water
  - Oils

Exercises

- Investigate what is a eco-product?
- Investigate the life span of a waste
- Have a “Pick a trash” –day
- Find out ways to prevent wasting. Remember 3R:
  - Reduce – prevent waste formation
  - Reuse – one mans treasure is another mans trash
  - Recycle – collect, deliver, reuse
- Waste sorting game
  - Make a “Trash bag” containing 10 – 20 items
  - Make waste baskets for different wastes (tea bag, battery, glass, envelope, plastic peaces, yoghurt can, tin can…)
  - Evaluate which can be reused or recycled and how

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Fire safety

4.1 Fire safety

- What is combustion?
  - Chemical reaction where oxygen combines with combustible substance, like methane gas:
    $CH_4(g) + O_2(g) \rightarrow H_2O(g) + CO_2(g) + \text{energy}$
- Energy is released in forms of heat and light
- Products are hot, gaseous compounds which require large volume → possibility to explosion
- Source of oxygen are air and some oxidative chemicals like acids

4.2 Easily combustible substances

- Easily combustible substances are
  - Organic gases, like acetylene or butane
  - Organic liquids, like alcohols, petrol
  - Hydrogen gas
  - Clothes, hair
  - Dust

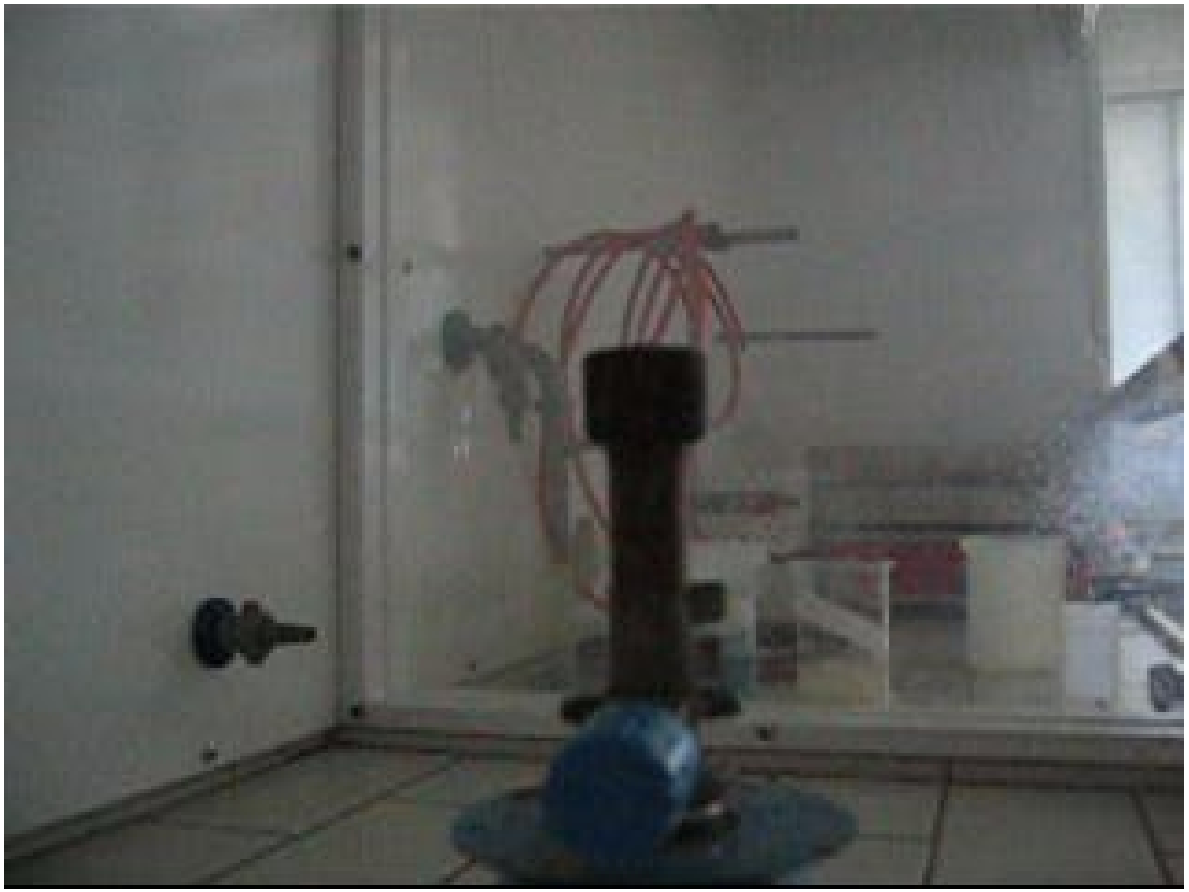
4.3 Extinguishing fire

- Cover the flame
- Stop material supply
- Cut heating
- Cool down the burning material
  - pour water, use fire extinguisher

- Burning oil
  - Use fire blanket or fire extinguisher
  - DO NOT THROW WATER, it can evaporate quickly and hot oil is spread all around

Exercise

- Rehears lighting of a Bunsen lamp



Exercise

- Heating a test tube

Laboratory work

Extinguishing burning oil

Test

- Light SMALL amount of oil
- Place very carefully one drop of water on the burning oil. Observe
- Put lid on the burning oil. Observe

Observations

Water evaporates quickly and oil sparks but does not suffocate. Lid extinguishes the flames.

Discussion: what equipments should be place on laboratory, on kitchen?

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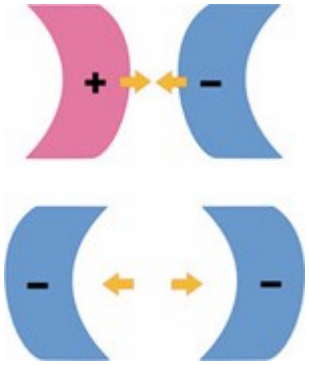
Electric safety

5.1 Electricity

- Covers variety of natural phenomena
  - Current
  - Electric energy
  - Batteries
  - Light
  - Heat
  - Magnetism
  - Motors

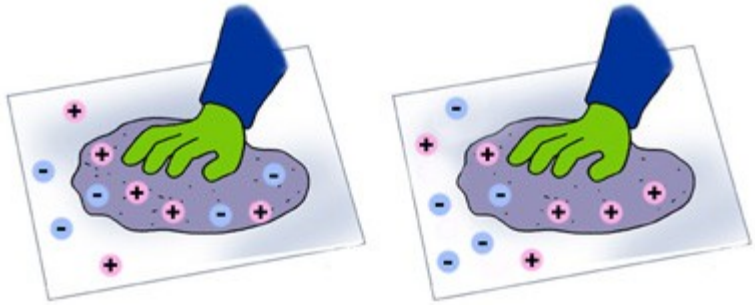
5.2 Electrical phenomena

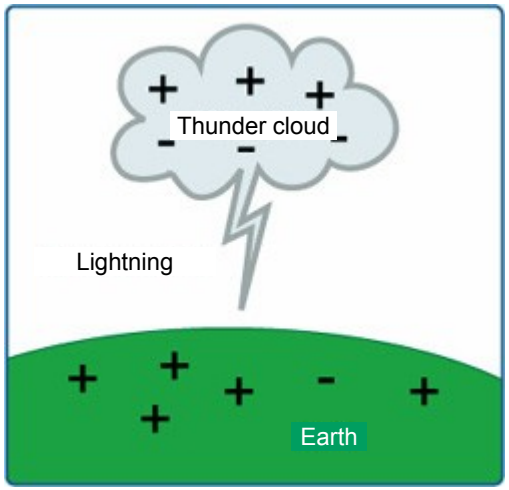
- Creates attraction
- Matter is charged either positively (+) or negatively (-)



5.3 Electrical phenomena

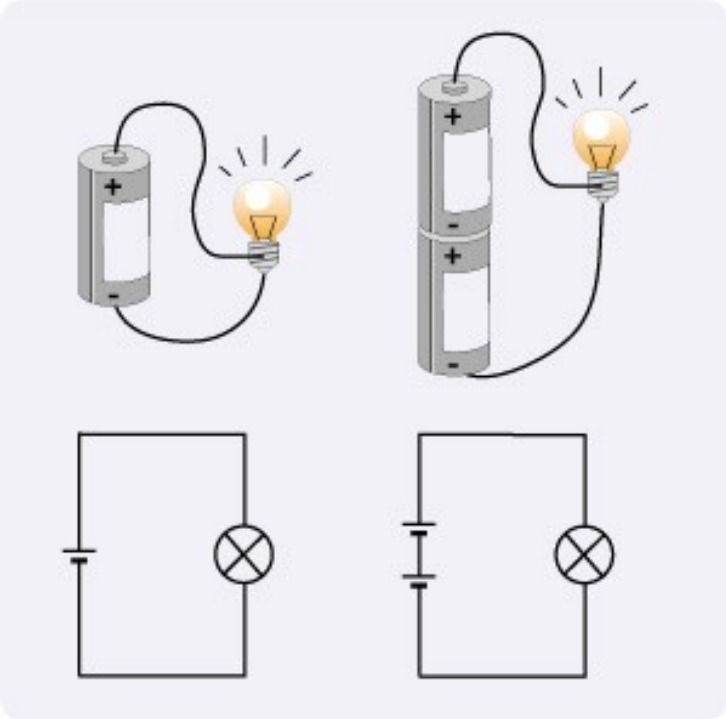
- Friction creates static electricity





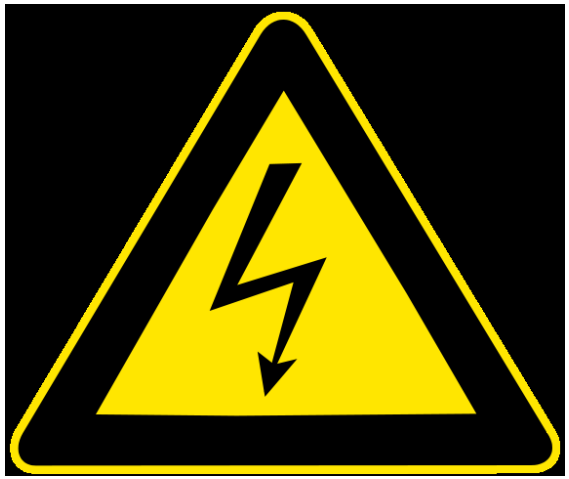
5.4 Voltage and current

- Voltage and current are interrelated: greater voltage creates more current



- Chemical reactions in a battery creates the potential difference between battery poles → electric current

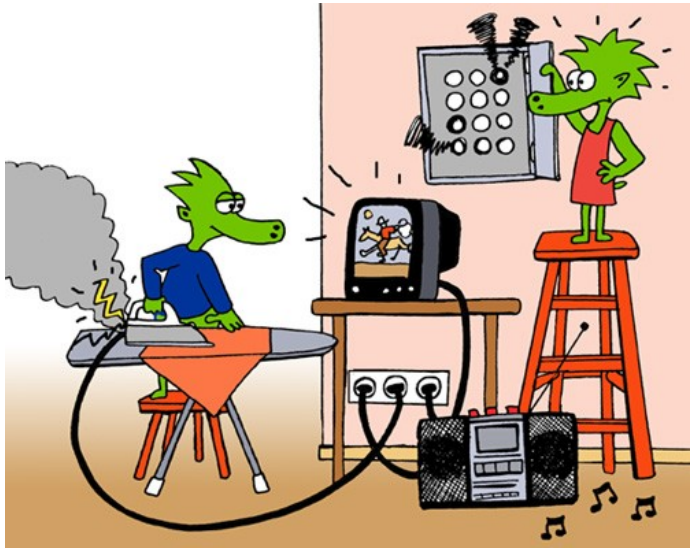
5.5 Electric safety

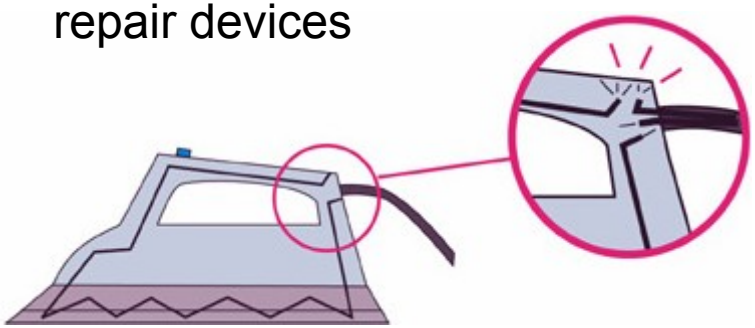


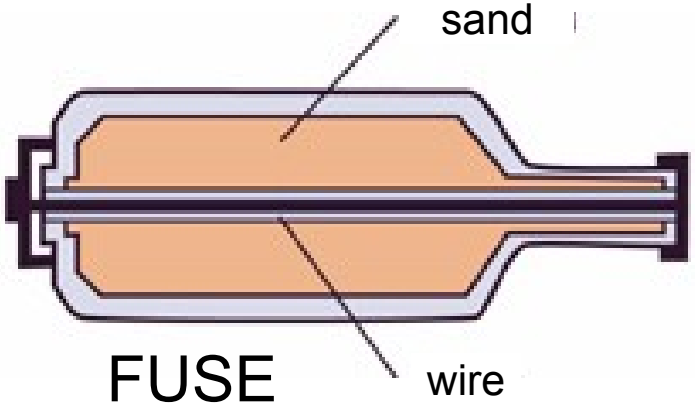
- Typical accidents
  - Electric shock
  - Electric arc
- 1 – 8mA current is safe
  >8 – 50 mA current is dangerous,
  >200 mA can be lethal
- Causes
  - Heart stop
  - Skin burns
  - Tissue fluid aggregation in to the lungs

5.6 Preventing electrical accidents

- Equipments are stored properly
- Avoid moisture and dust formation
- Disconnect devices when not used
- Localisation of the master switch is known
- Use fuse systems
- Ask professional repairmen to repair devices







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Summary

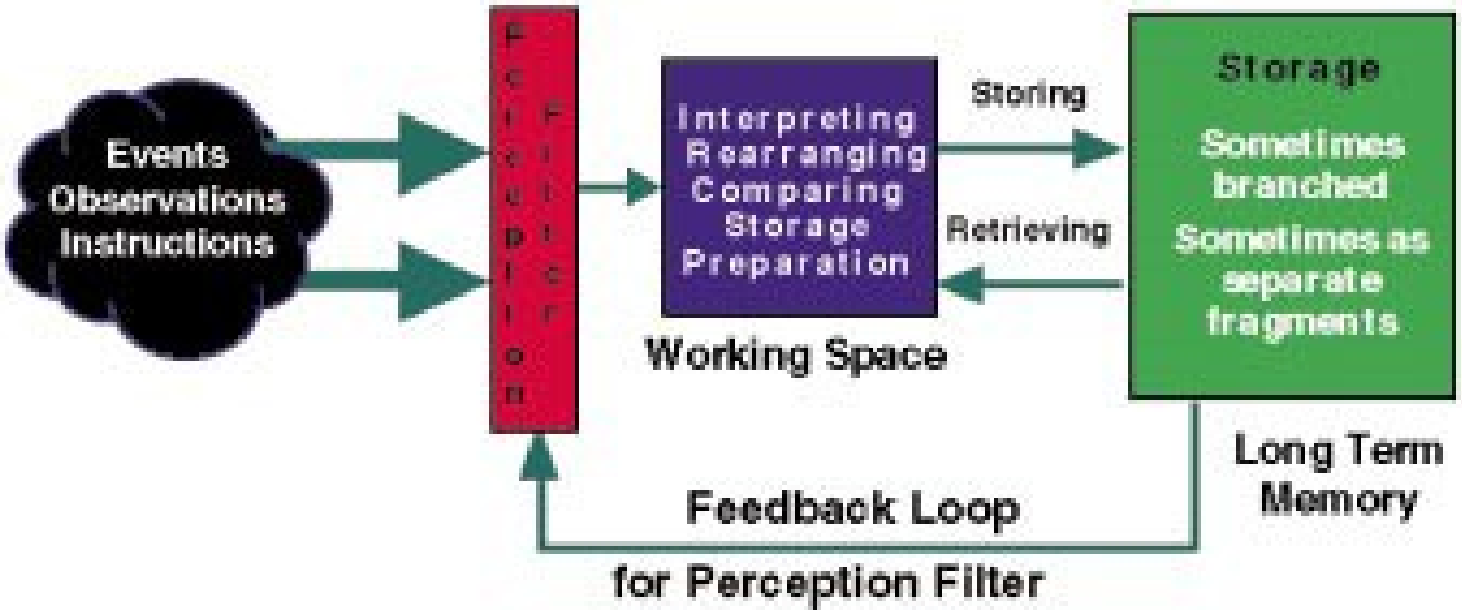
6.1 General guidelines

- Preventing accidents
  - Work procedure is clear
  - First aid procedure is clarified
  - First aid equipments are familiar
  - Equipments and chemicals are stored properly
  - Equipments and chemicals are familiar
  - Laboratory protection is used constantly
  - No food or drinks in to the laboratory
- Place emergency number on visible place

6.2 If an accident happens

- Do not panic, you are in charge, give direct orders
- Prevent new accidents
  - guide people out
  - extinguish fire
  - cut electric power off
  - use emergency shower
  - open doors, windows
- Give first aid
- Call help
  - Tell who you are
  - Tell what has happened
  - Tell where you are
- Inform colleagues

6.3 Information processing theory



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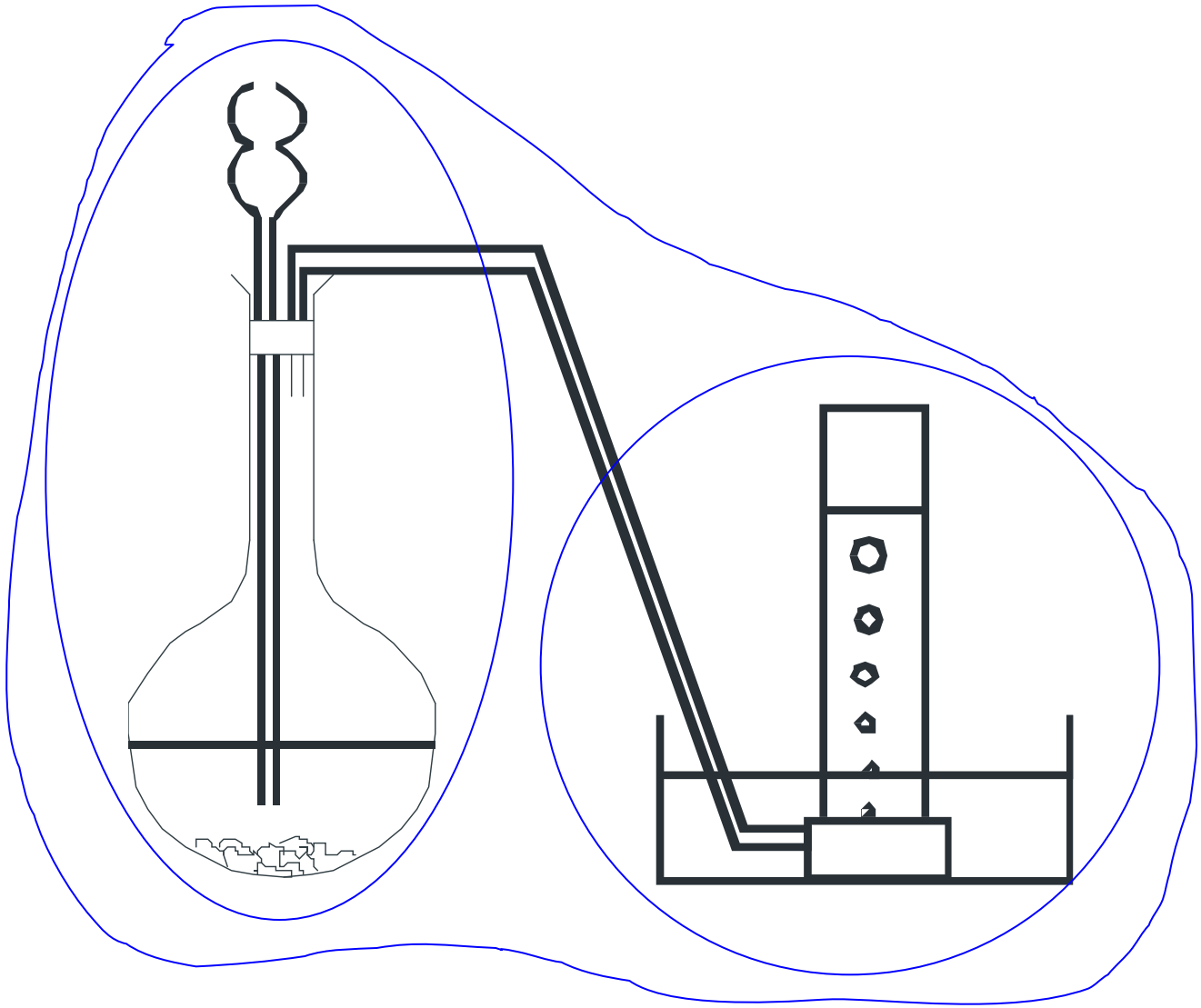
Experts' view

Few essential parts

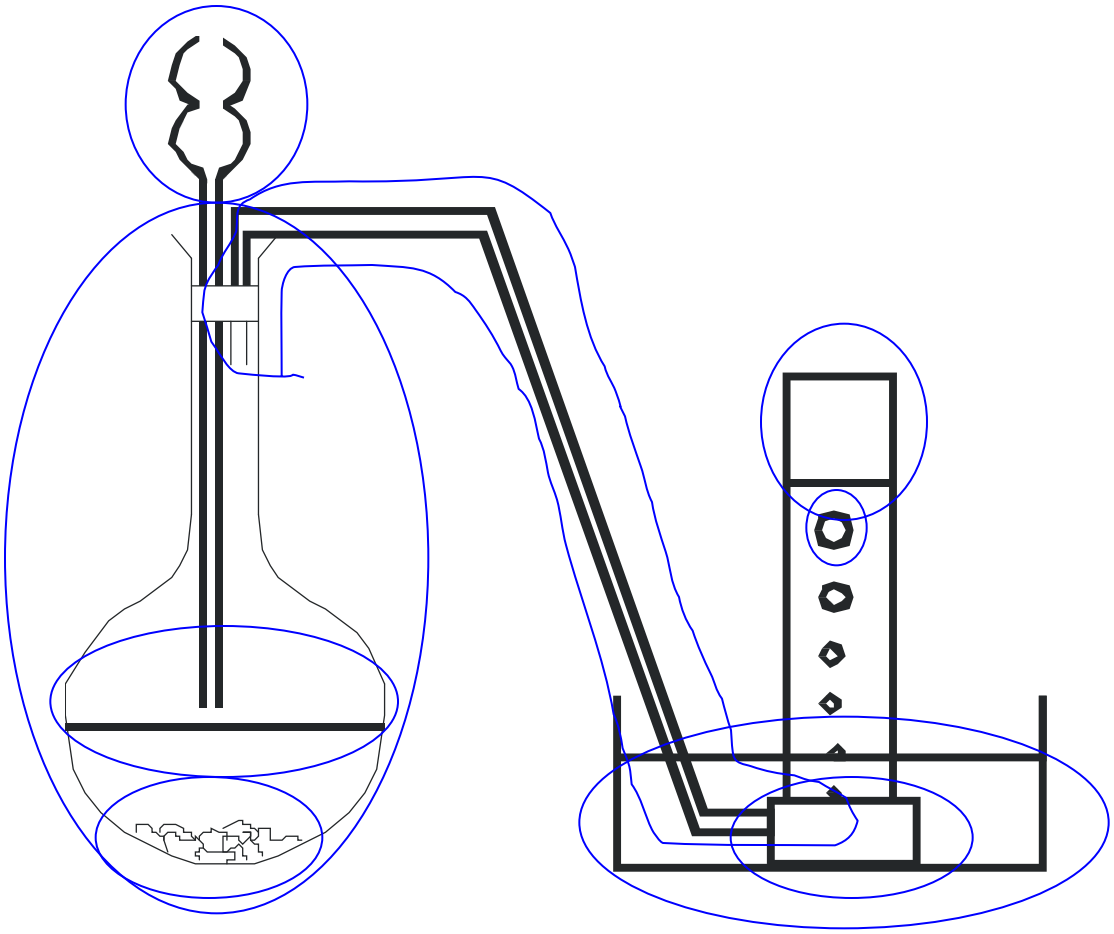
Coherent entirety



Novice's view

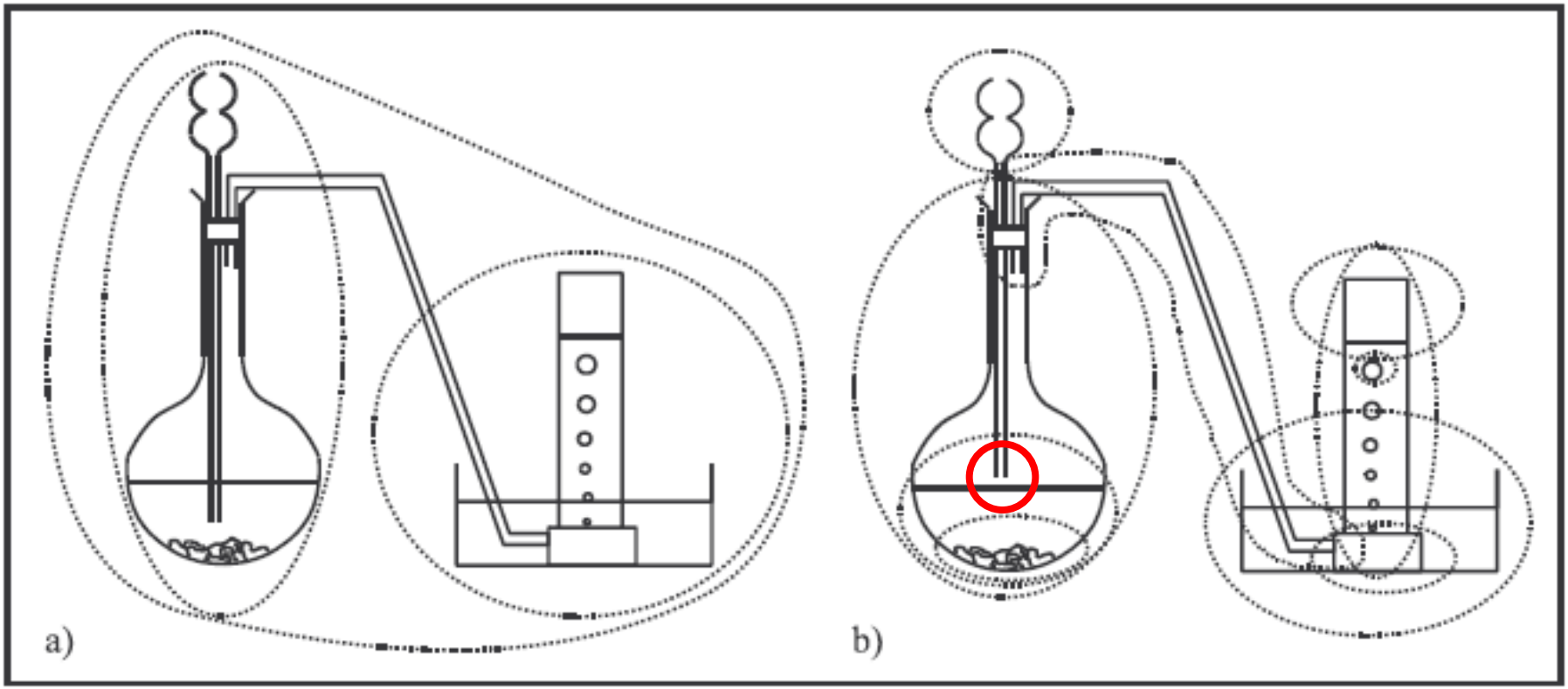
Many details

No entirety



Problem

Teacher presupposes that the pictures are identical, level of attentiveness decreases, important details are not noticed



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