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Safety in School Science Education

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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



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

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>

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



3.2 Disposal

- Neutralise acids and bases before pouring 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

4.1 Fire safety

- What is combustion?
 - Chemical reaction where oxygen combines with combustible substance, like methane gas:
$$\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g}) + \text{CO}_2(\text{g}) + \text{energy}$$
- 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



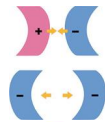
5.1 Electricity

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



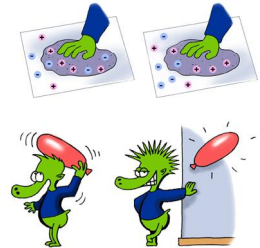
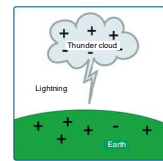
5.2 Electrical phenomena

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



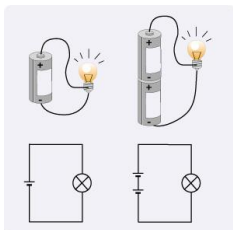
5.3 Electrical phenomena

- 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

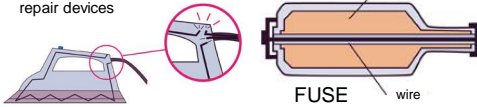
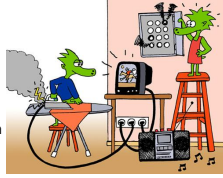
5.5 Electrical safety

- 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



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



References

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