Low-Cost-Techniques for the Science Education Laboratory - An Introduction

Developed by Silvija Markic & Marc Stuckey for the SALiS-project

Content

- Why Low-cost experiments?
- Different techniques for Low-cost experiments

European Commission
TEMPUS

SALiS
Student Active Learning in Science

Why Low-Cost-Experiments?

Low – Cost Eyperiments are useful because …

- they keep down costs:
  - because a less need of chemical and
  - because of cheap materials for „one time use“ from e.g. everyday life, home improvement stores, medical technology

- they need lesser place requirement
- they save time (heating or cooling)
- they offer higher mobility (transport without special needs)
- After compliting the experiments, they are easy for disposal

Low - Cost experiments offer a possibility for inquiry because …

- of higher safety while using the smaller portions of chemicals (experiments for pupils)
- of a higher mobility (transport without special needs)
- experiment can be use as a home work
- they are easy for disposal

Smaller Portions of Chemicals

Less is more!!!

Method	**Portion**	
	solid	***fluid***
Macrotechnology	more than 0,1 g	more than 5 ml
Halfmicro	0,1-0,01 g	5 – 0,5 ml
Micro	0,01-0,001 g	0,5 – 0,05 ml
Ultramicro	less than 0,001 g	less than 0,05 ml

European Commission
TEMPUS

SALiS
Student Active Learning in Science

Microscale Experiments

„Microscale Chemistry is a laboratory-based, enviromentally safe, pollution-prevention approach accomplished by use in miniature glasseware and significantly reduced amonts of chemicals.“

(Singh, Szafran & Pike, 1999, p. 1684)

History of Microscale Experimenting

- Microscale experimenting starts in 1970s at different universities
- Use of microscale experiments also in schools
- In school usually Microscale-Kits

Different Microscale-Kits

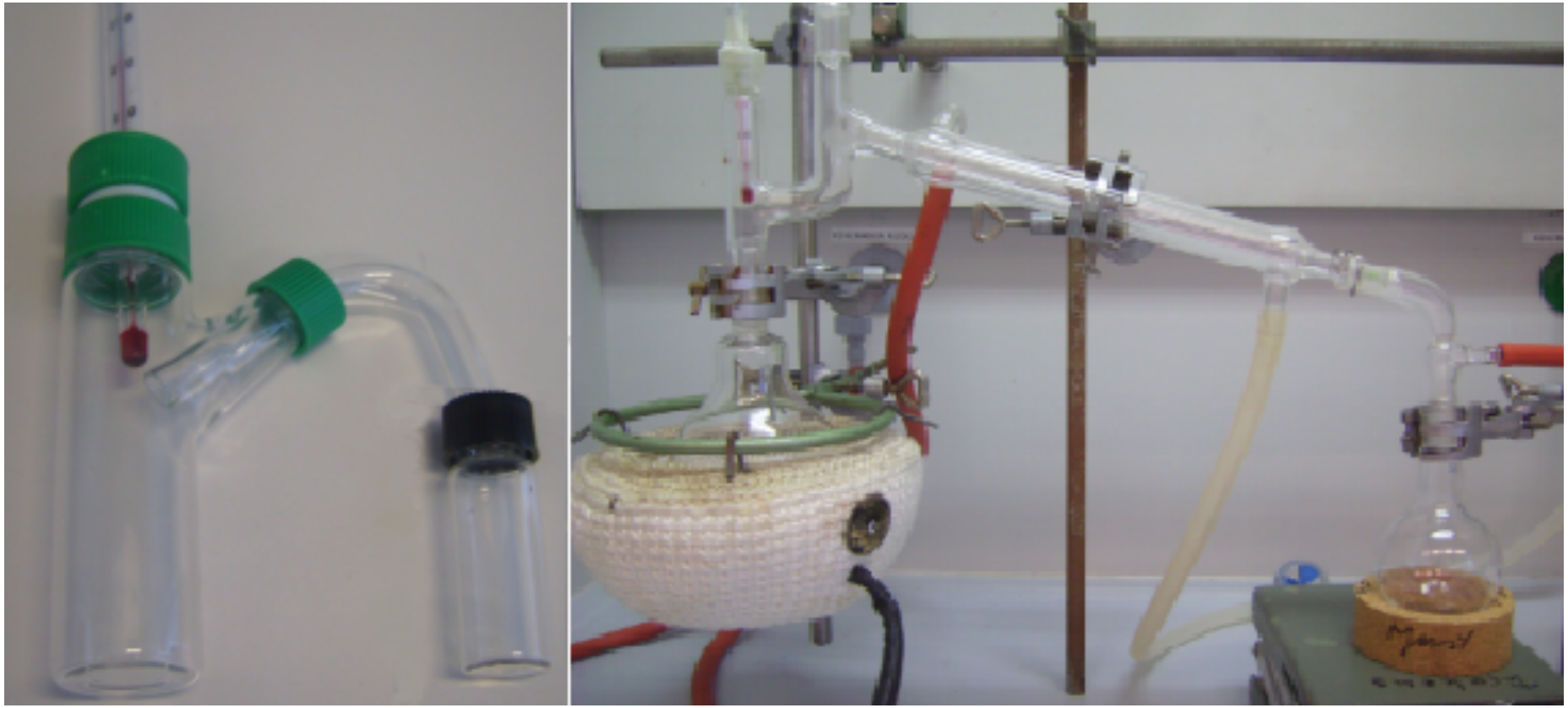
- Williamson Kit
- ACE Microscale-Glasware-Kit
- Chem-Pro-System
- Radmaste Microscience System
- Minilabor (German)
- Glasbaukasten nach Baumnach (German)

European Commission
TEMPUS

SALiS
Student Active Learning in Science

Radmaste-Kit for Water

Destillation with Minilabor and classical Method



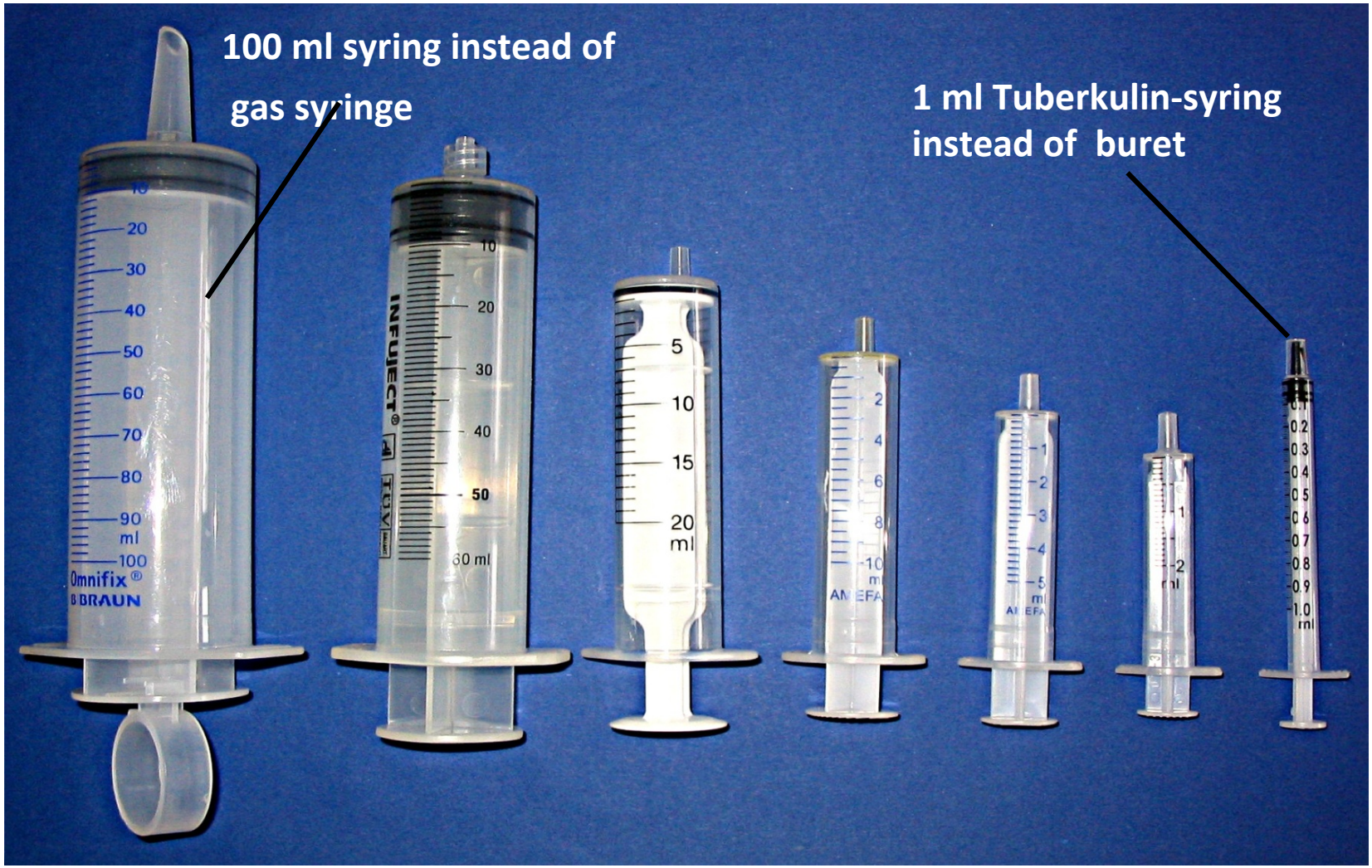
Equipement from the medicine

Cheap alternatives for laboratory equipement from medicine technology

- Syringe

- Canula

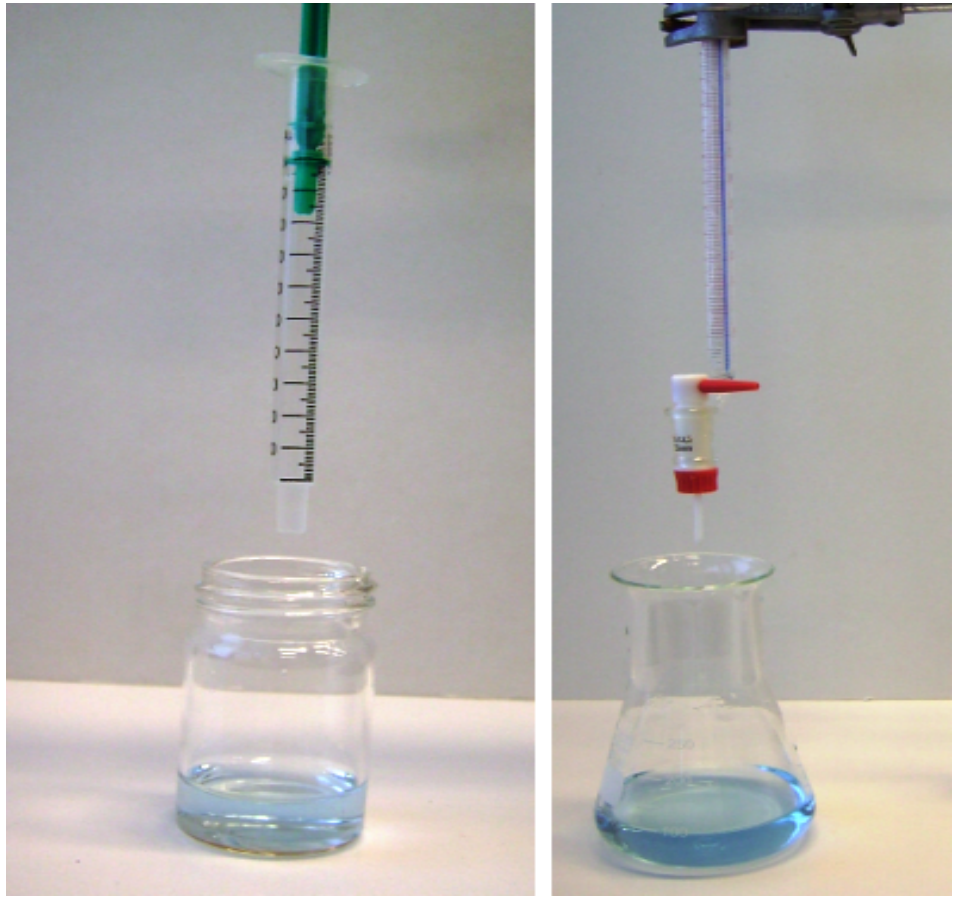
Use of syringe in science experiments



Syringe instead of a burete

Low-cost (left): 1 Euro

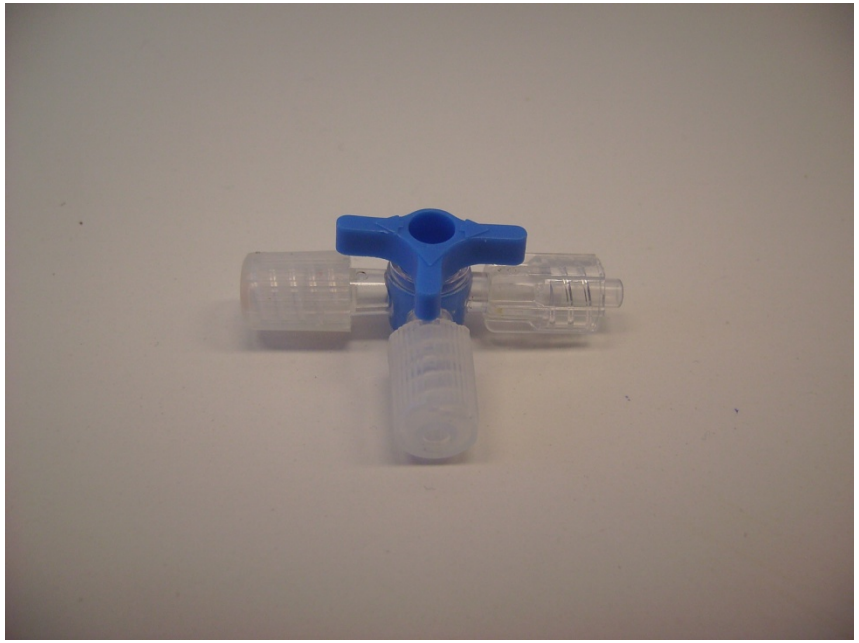
Classical (right): more than 50 Euro



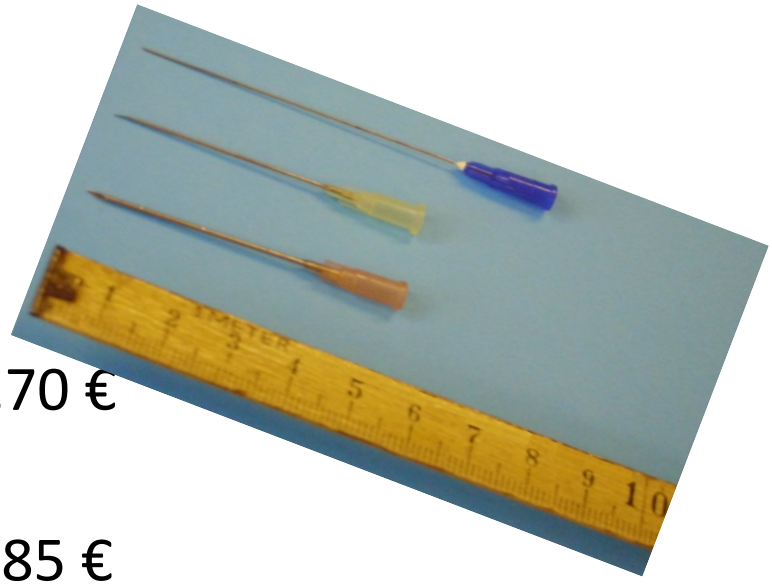
Different seals for different experiments

Simple seal	Double seal	No seal
	As gas receiver	for fluids
ONCE	HWS-Softject Braun Omnifix	HSW Normject Braun Inject

More medicine technology



Costs



Syringe

- 1 ml 100 pieces 10,70 €
- 2 ml 100 pieces 2,85 €
- 5 ml 100 pieces 4,20 €
- 10 ml 100 pieces 6,20 €
- 20 ml 100 pieces 9,40 €

Canula (1,2 / 40)

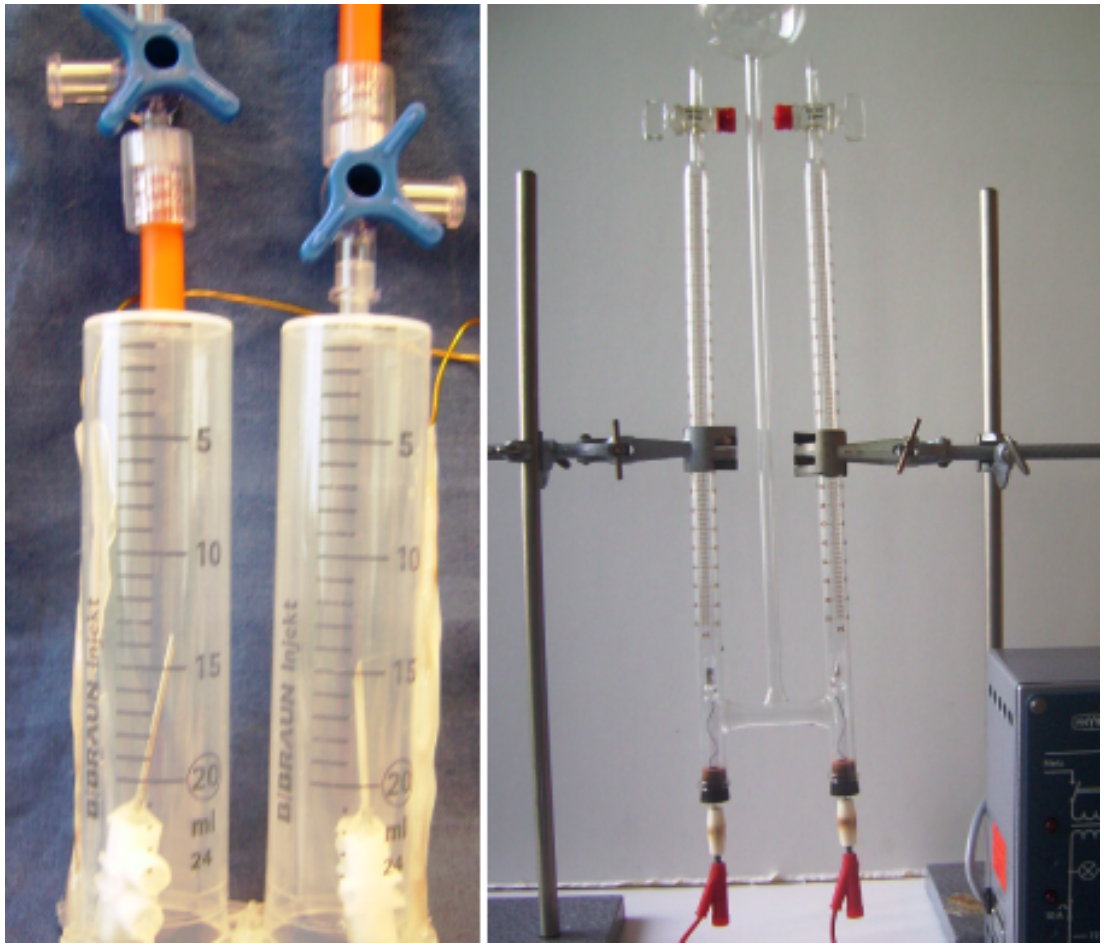
- Terumo 100 pieces 5,20 €

An example: the Hofmann apparatus

made of syringes and classical

Low Cost: 3 Euro

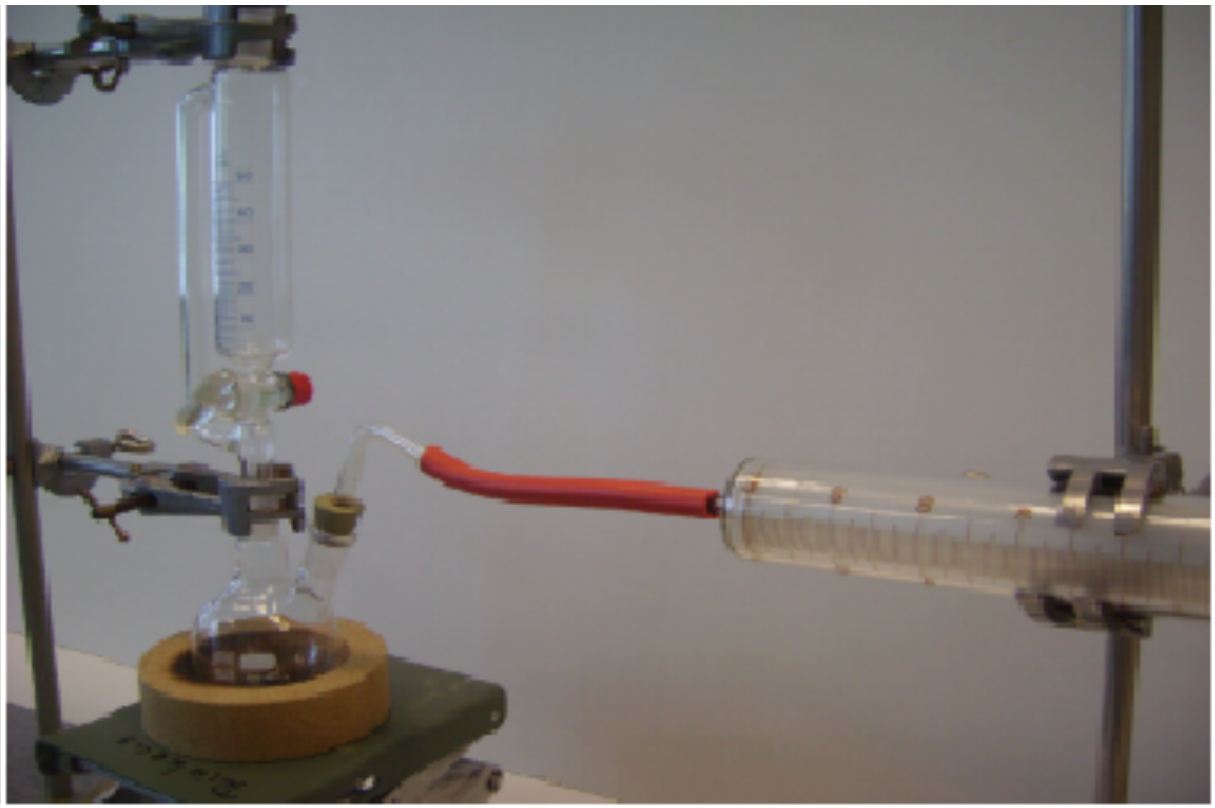
Classical: 70 Euro



A second example: Producing hydrogen

made of syringes and classical

Low Cost: 1,50 Euro Classical: 200 Euro



ChemZ Kit for Students

- It is possible to buy a kit
- Or more easier:
  Develop your own low-cost experimental kit

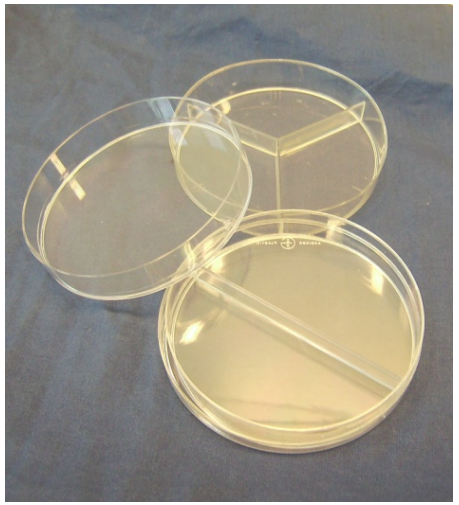
European Commission
TEMPUS

SALiS
Student Active Learning in Science

Experiments with Petri-Dishes

Cheap alternatives from the lab

- Petri dish (2- or 3-chambered)

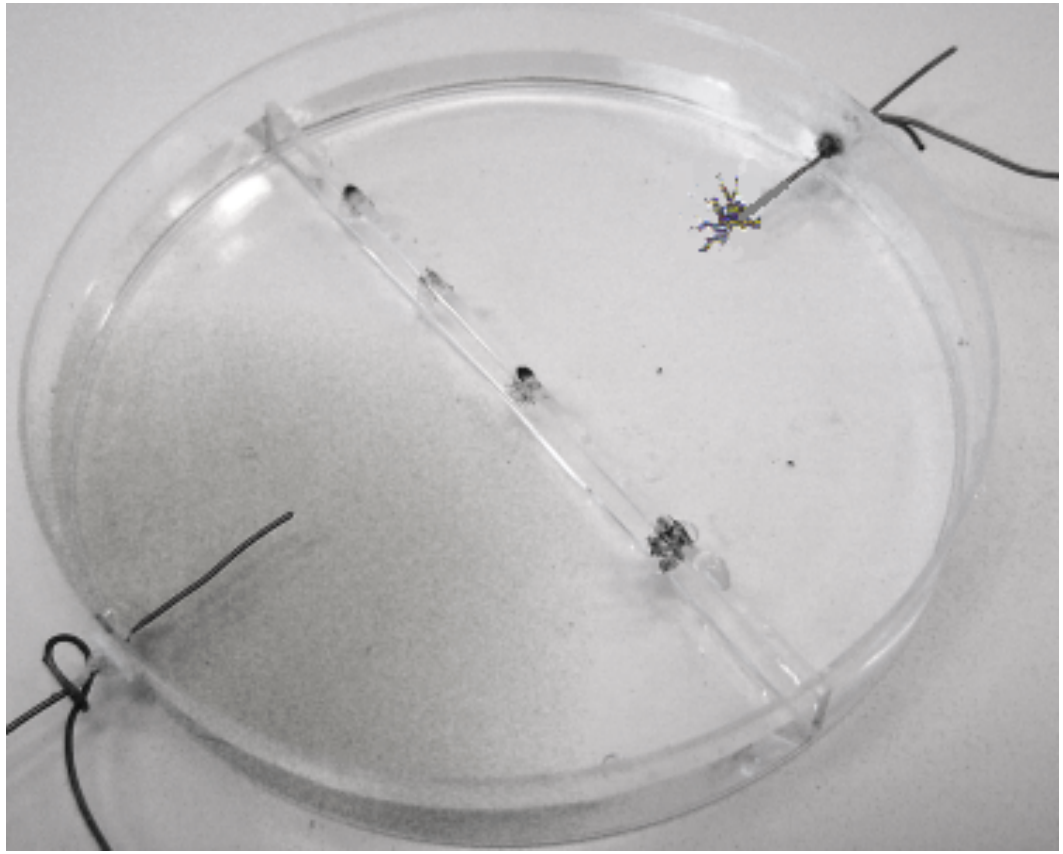


- Small ampoule

- Eppendorfcups
- Plastic pipett

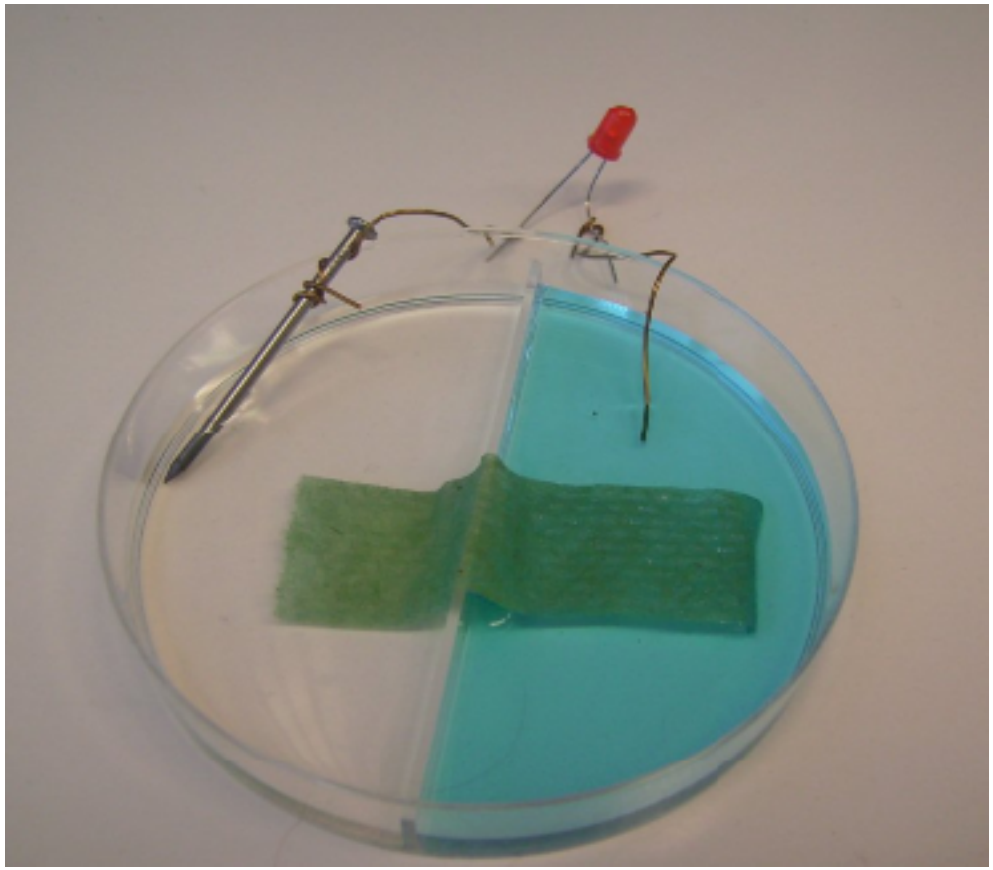
An example: electrochemical cell

Making a petri dish and some needles an electrochemical cell



A second example: Daniell cell

made of petri-dish and luminous diode



Or recycling waste for experiments

- Cans
- Glasses
- Pill packagings
- Film containers
- …

An example: Serial dillution with milk

Palette of colors of an indicator

- Use of an indicator from the supermarket: red cabbage.
- Easy to make this indicator byself.
- Use different liquids from the supermarket as acids (e.g. lemon juice) and bases (some drain pipe cleaner)

An example: Microscale-Blower

- 2 mL ampoul is filled with spirit (grain alcohol)
- A piece of handkerchief is rolled in a form of a wick and is 0,5 cm longer then a ampouls
- Such a blower can reach a temperature of 800°C.

A second example: battery

Making a cola can to become a battery

An example: electrochemical cell

Making an electrochemical cell with a film canister, pencil sharpener and a copper paper clip

More Alternatives

- Glass with treaded lid

- Plastic flask with spray block

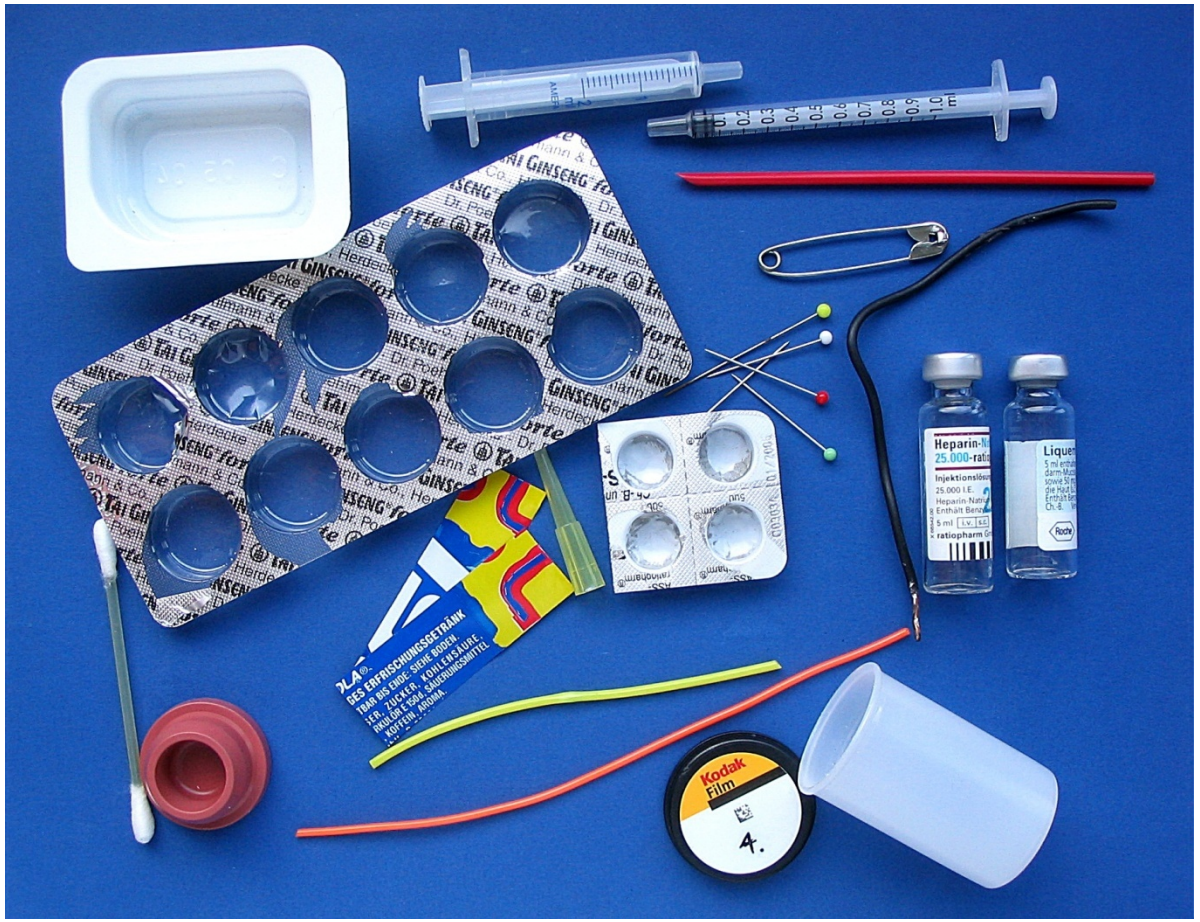
- Coupling

„Chemicals“ in everyday life

- Food and Products in Supermarket
  - Milk / Cream
  - Spirit
  - Drain pipe cleaner

- Medical products
  - Fizzy tablets
  - Aspirin
  - Ascorbic acid (Vitamin C)

A complete lab?



A lab guide and more examples are available at www.salislab.org