

CITIES Final Report 4.3.2. Promoting Chemistry – List of Experiments-EN

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Analytical Chemistry

1. Spectroscopy

Spectroscopy demonstrated by flame coloring and a copper complex (tetrammin komplex). The copper complex can be compared to Dithizon or another complex with a high epsilon. Using a Spektroquant Test from Merck for example for the determination of sulfite in beverages an example related to practice can be given (The test kit can be purchased from Unger-Heumann). A prism and diffraction grating can be used as a model for the first publication from Bunsen and Kirchhoff in the Fresenius magazine.

2. COD

Garlic or wine reacting with permanganate as a model for the chemical oxygen demand (COD)

3. Titration

An acid-base titration with vinegar and sodium hydroxide (replace by sodium carbonate) using phenolphthalein as an indicator (model: screws and nuts); plastic pipette

4. Chromatography

Simple models for chromatography are demonstrated such as chalk, TLC-plates, or paper separating dyestuffs from daily objects as markers or vegetables.

Kitchen chemistry / groceries

5. Thickening a sauce with starch

Why shouldn't you add any acid to a sauce or heat it up after thickening the sauce with starch? Just by a thickener like starch or guar flour and dissolve in water. Look at viscosity, then take half of the solution and heat with vinegar, compare viscosities of the two samples

6. Cooking carrots

Why should carrots be steamed in lipids instead of just cooking them in water? Cut carrot into fine parts, suspend them in water. Add some oil, heat and shake. Where do you find the carrot colour? Why?

7. Apple and lemon

Why does an apple not become brownish anymore after being treated with lemon?

8. Carob tree seeds

Carob tree seeds as a thickening agent – explanation see 5

9. Spinach

Why is spinach not cooked with acids, but why cooked Apicius the spinach in a copper top?
Spinat mit Mixer kleinhacken; diesen Brei mitnehmen. Transfer some of the leave material to each of three test tubes, to one of them add vinegar, to the second copper(II)chloride solution, to the third just water. Observe colours, heat, observe again.

10. Underlying principle

Baking powder, spritzer and sherbet: Chemists see the „underlying principle“

11. Coloring an egg with quercetin

12. emulsifiers in convenience products

13. milk as an example for an emulsion

14. saturated and unsaturated fatty acids, the differences

Chemistry in daily life

15. Super absorbent polymer

The effect of a super absorbent polymer – absorption of water.

16. Liquid Crystal

Characteristics of a thermotropic liquid crystal (liquid crystals from Merck). Ice, cold water and maybe hot water are necessary.

17. Silly Putty

Characteristics of synthetic material balls (cross-linked and non cross-linked) in comparison to "Silly Putty" (US-toys). Interpretation of elastic properties.

18. Lime

Formation of insoluble lime consisting of calcium and a soap demonstrating an insoluble complex.

19. aluminum in deodorant

20. isolation of the DNA in fruits

21. hand warmer

Clinical chemistry

22. Blood lipids

Determination of blood lipids using a test kit for example from Diasys. With milk a red coloring can be achieved in 1-2 minutes.

23. Dialysis

Model of a dialysis diaphragm using an "exotic" cucumber skeleton, balls of different sizes, fibers and a dialysis cartouche.

Running the experiments

1. Spectroscopy (flame test)

materials:

- magnesia bacilli
- gas burner
- strontium
- barium
- lithium
- sodium
- HCl

procedure:

- moisturize the magnesia bacilli with HCl and coat it with salt
- put the coated magnesia bacilli in the non lightening flame

observation:

- flame coloring, the color is depending on the salt
- strontium = intensive red
- barium = green
- lithium = red/pink
- sodium = orange

2. COD

materials:

- permanganate solution
- white wine
- garlic
- filter paper
- garlic press

procedure:

- hackle the garlic using the garlic press
- give the hackled garlic into water
- filtrate the solution
- give permanganate solution in two test tubes
- to one test tube add the white wine
- and to the other test tube add the garlic filtrate

observation:

- the permanganate-solution is decolorated

3. Titration

4. Chromatography

materials:

- fresh green blade of grass or green leaves
- chalk
- little bowl
- methylated spirit or alcohol

procedure:

- hackle the blade of grass or leaves using for example a mortar
- add as much methylated spirit or alcohol as needed to cover the leaves (if you put the solution in a hot water bath the dyestuffs can better be extracted)

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- give the dark green solution in a flat bowl and put a piece of chalk vertically in it and let the solution soak for about 1 cm
- give the chalk into another bowl filled with methylated spirit or alcohol (less than 1 cm)

observation:

- a green and a yellow (above the green) zone occur

explanation:

- the dyestuffs contained in the leaves are extracted by the methylated spirit or alcohol
- leaves contain a mixture of dyestuffs, this indicates the separation of the two colors
- the green color occurs from the chlorophylls
- the yellow color occurs from the carotene and the xanthophylls

materials:

- filter (round)
- marker (water soluble)
- water
- flat bowl

procedure:

- cut a round hole (~5mm) in the middle of the round filter
- draw a circle around the hole in the distance of around 1 cm
- roll up another filter and put it through the hole
- fill the bowl with water and place the filter on the curb of the bowl, the rolled filter in the hole has to reach the water

observation:

- the water spreads equally to all sides
- the dyestuffs contained in the marker are separated

source: Experimentieranleitung Kosmos Chemie

5. Thickening a sauce with starch

6. Cooking carrots

7. Apple and lemon

materials:

- apple
- lemon juice

procedure:

- cut the apple into halves
- treat one half of the apple with lemon juice
- the other half remains untreated
- leave both pieces of apple to stand exposed to air

observation:

- the apple treated with lemon juice does not turn brownish while the apple remaining untreated turns brownish

8. Carob tree seeds

9. Spinach

10. underlying principle

materials:

- baking powder
- sherbet
- mineral water
- juice

procedure:

- give mineral water into three test tubes
- add in one test tube juice, in one baking powder and in the last one sherbet

observation

- it starts to effervesce

“Bullrich Salze” (Sodium Bicarbonate) for the treatment of acid-related stomach complaints

materials:

- Bullrich-salt-pills or simply Sodium Bicarbonate
- Acetic acid
- Indicator: Methyl yellow (Methylgelb) (color turns from red to yellow at a pH value of 2,9–4,0)

procedure:

- add the indicator to the acetic acid
- add the “Bullrich-Salz” or sodium Bicarbonate

observation:

- the color of the solution changes
- it effervesces

Source: Georg Schwedt: Experimente mit Supermarktprodukten

11. Coloring eggs

materials:

- quercetin
- eggshell

procedure:

- give some quercetin in water, this solution is yellow colored
- cook the eggshell in this solution
- the eggshell turns yellow or brownish depending on the cooking time

source: Georg Schwedt: Chemie für alle Jahreszeiten

12. Emulsifier in convenience food

materials:

- mashed potatoes powder
- cooking oil
- paprika flavoring (hot)

procedure:

- give some cooking oil into a test tube
- add paprika flavoring and heat the test tube with hot water (out of the water conduit) up
- give the red colored solution into a second test tube (without the left over paprika flavoring) and add twice as much water
- shake the test tube, two layers are observable, the colored oil-layer is the upper one

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- add two to three spatulas mashed potatoes powder and shake again
- the dispersion of the red paprika flavoring can be observed

explanation:

- the red paprika dyestuff is only soluble in oil, therefore a red colored oil layer can be observed
- the emulsifiers in the mashed potatoes powder interact with the oil and the water, therefore the oil is dispersed in the water phase
- the red paprika dyestuff indicates the dispersion of the oil

Source: Georg Schwedt: Experimente mit Supermarktprodukten

13. Milk as an example for an emulsion

materials

- Methylene blue (water soluble dyestuff), Sudan red (fat soluble dyestuff), milk

procedure

- fill two test tubes with some milk
- add to one test tubes a tip of a spatula of methylene blue (a water soluble dyestuff) and to the second test tube a tip of a spatula of Sudan red (a fat soluble dyestuff)

observation

- in the test tube with methylene blue an intensive blue coloring can be observed
- in the test tube with Sudan red a weak red coloring will occur

explanation:

the different intensities of the colorings can be explained with the different amount of fat and water in the milk

milk contains about 96% water and only 4% fat

Source: Georg Schwedt: Experimente mit Supermarktprodukten

14. saturated and unsaturated fatty acids

materials:

- cooking oil
- Palmin
- iodine-solution
- acetic acid
- starch-solution

procedure:

- add to the cooking oil and palmin acetic acid, some water and a few drops of the iodine-solution
- shake the mixture
- finally add a few drops of the starch-solution

observation:

- in the test tube with palmin a blue coloring occurs

explanation

- the cooking oil (unsaturated fatty acids) reacts with the iodine-solution in an addition reaction, no iodine is left over

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- Palmin (saturated fatty acids) does not react with Iodine, with starch it forms the blue iodine-starch-complex

Source: Georg Schwedt: Experimente mit Supermarktprodukten

15. Super absorbent polymer

materials:

- Hysorb (from BASF)
- water

procedure:

- give some of the Hysorb to the water

16. Liquid crystal

17. silly putty

18. lime

materials:

- soap
- calcium-salt
- filter paper

procedure:

- scrape some of the soap off and give it into water
- filtrate the soap-solution
- solve calcium-salt in water and add the filtrate of the soap-solution

observation:

- lime flocculates

19. aluminum in deodorants

materials:

- Sodium-Alizarinsulfonate-solution (0,1g Sodium-Alizarinsulfonate in 100 ml distilled water, longe stable)
- Deodorant containing Aluminum-Chlorohaydrate

procedure:

- give/spray some deodorant into a test tube
- dilute it 1:20 with distilled water
- add ammonia to alkanize the solution
- add a couple of drops of the Sodium-Alizarinsulfonate-solution and mix it

observation:

- a red/purple coloring can be observed

explanation:

- the red/purple coloring indicates aluminum
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alternative: add to a deodorant-sample an indicator, that changes color in acidic solutions

precipitation of albumen through aluminum-salts

materials:

- egg-white
- 0,9% NaCl-solution
- Aluminum-chloride-Hexahydrate-solution or an Alum-solution

procedure:

- solve some egg white in the 0,9% sodium-chlorid-solution
- add a little bit of the Aluminum-chloride-Hexahydrate-solution or an Alum-solution

observation:

the egg-white precipitates

explanation:

- Aluminium-hexahydrate-salts give an acid reaction, therefore the egg-white (protein) is denaturized

Source: http://chemieunterricht.de:80/dc2/tip/08_06.htm

20. Isolation of DNA

materials:

- fruits or vegetables (tomato, kiwi fruit)
- mixer or mortar
- dish detergent
- common salt
- water
- filter
- isopropanol

procedure:

- mix 5 mL dish detergent, 2g (1 teaspoon) common salt and 45 mL water, until the salt is dissolved
- hackle either the fruit or the vegetables and mix it
- add the solution of water, common salt and dish detergent to the hackled fruit or vegetables and mix it with the mixer or mortar for about 5 seconds (not to long otherwise the DNA can be destroyed)
- filtrate the solution
- add the same amount of isopronal and mix it carefully
- the DNA appears like a ball of wool

source: <http://www.dialog-gentechnik.at/binaries/108927.pdf>

21. blood lipids

22. Dialysis