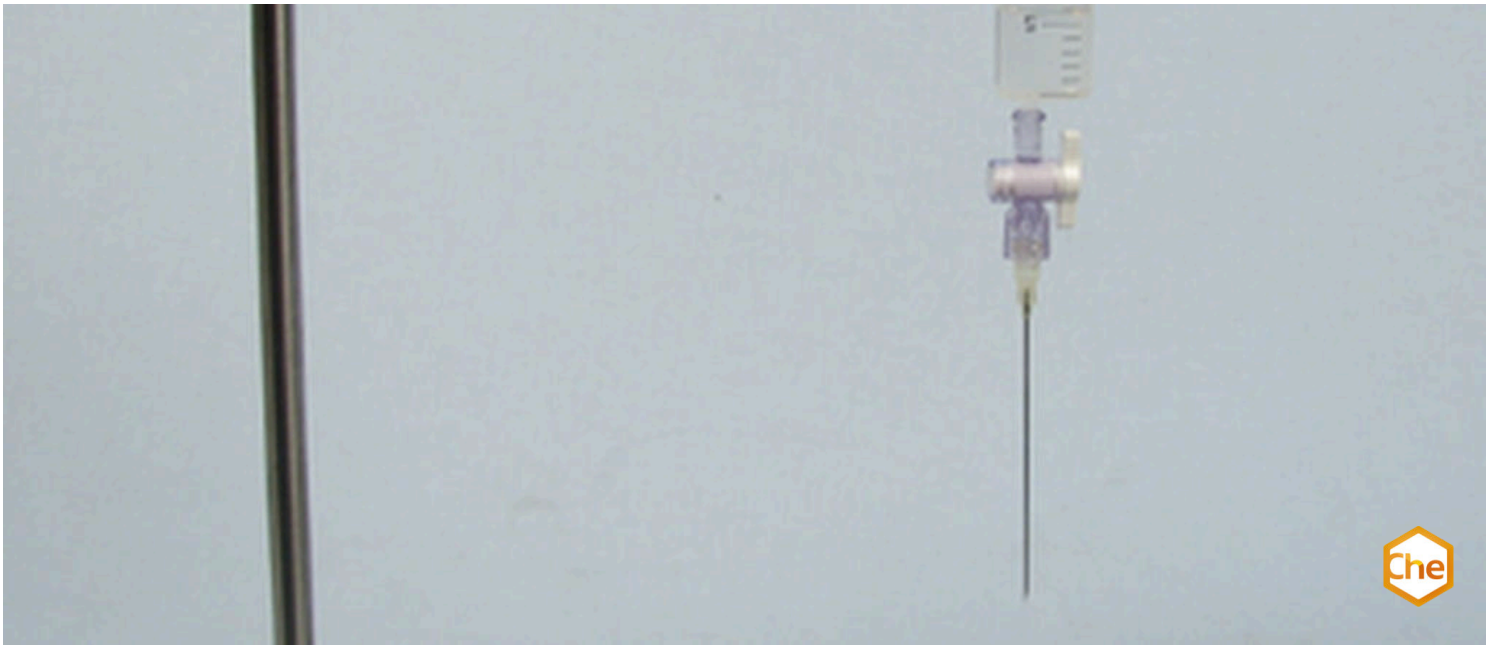
Dipole properties



Chemistry > General Chemistry > Chemical reactions > Chemical reactions (polar, non-ploar, ionic, covalent)

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f56551a742d0c00034be21c

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Teacher information

Application

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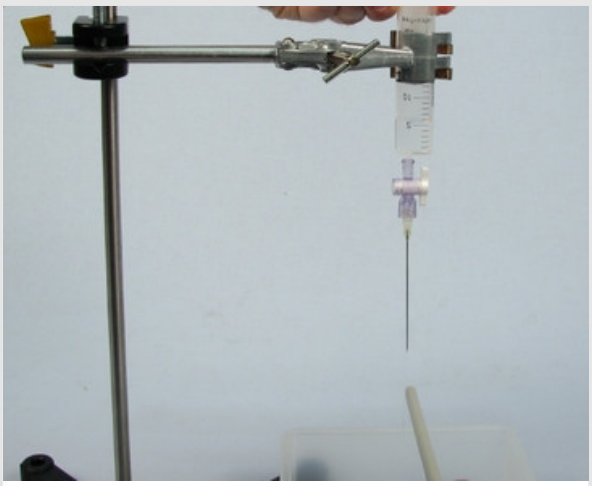

Deflection of a water jet by an electric field

Molecules with dipole properties are very important in nature and technology, so molecules with dipole properties have a higher boiling point than molecules without dipole properties (at comparable mass). Furthermore, compounds with dipole properties align themselves in the electric field.

In this student experiment, an electric field is used to deflect a jet of water and a jet of petrol. A charged plastic rod is held against the respective jet and the deflection of the jet is observed. The water jet shows a deflection in an electric field, the petrol jet does not.

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Other teacher information (1/2)

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Prior knowledge

- The students should be familiar with electronegativity and the principle of covalent bonding.
- Each element has a different electronegativity and in a covalent bond can draw the electron closer to it on average over time, resulting in partial charges.

Scientific principle

- In this student experiment, the principle of a dipole moment is investigated by means of the deflection of water in an electric field. The water is self-sufficient to explain the properties of a molecule necessary for the formation of a dipole moment.
- Gasoline shows no deflection in the electric field, since the properties defined for water do not apply to gasoline and it is therefore not a dipole molecule.

Other teacher information (2/2)

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Learning objective

- Due to high electronegativity differences of atoms in a molecule, the colvalent bonds are polarized, resulting in partial charges that form a dipole moment.
- The partial dung inside the molecule must be distributed asymmetrically in order to form a dipole moment. Since this is the case with water, it is deflected.

Tasks

- Investigate the behaviour of water and petrol in relation to an electric field.
- The students observe whether water and petrol can be deflected in an electric field.
- The consequences and explanations of the observations are to be formulated, whereby the students also grasp the properties of a dipole.

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Safety instructions

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- Petrol and petrol vapours are highly flammable. Extinguish all open flames during the test!
- In case of skin contact the affected area must be washed immediately with plenty of water and soap !
- Petrol and petrol vapours are highly toxic, work carefully with the chemicals !
- Put on protective goggles !
- For this experiment the general instructions for safe experimentation in science lessons apply !
- For H- and P-phrases please consult the safety data sheet of the respective chemical !

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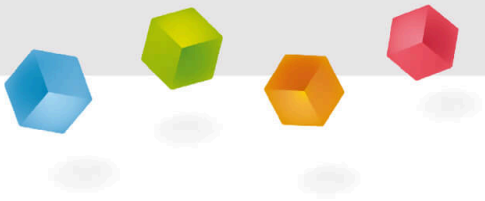

Student Information

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Additional methodological comments

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- To ensure a smooth flow during the experiment, check the valves of the syringes for tightness and flow before starting the student experiment.
- Do not use smaller tubs, as the distraction effect is relatively strong and water can flow past. Make sure that the plastic rods are dry, otherwise charging will not occur.
- Pay more attention to the careful and proper handling of the fuel by the students.
- Make sure that all open flames and other flammable sources have been extinguished and removed.
- Show the charging of the plastic rod with the help of an electroscope or by the attraction of paper particles.
- Daylight recorder film is also well suited for this purpose.

Motivation

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The gecko, an animal user of the dipole moment.

The principle of dipolarity surrounds us at all times. The earth forms a magnetic field from the north pole to the south pole, which is what makes a compass work. This principle is of great use in industry, for example in the wounding of bar magnets. A conventional battery also has two poles and it is impossible to imagine our everyday life without it. Another example of this fundamental importance can be found in the human body. In order for metabolic processes and many other biochemical processes to take place in our bodies, there is an unequal distribution of ions on membranes, which also results in two charged poles. The principle of dipolarity can therefore be observed in many areas of our everyday life. In this experiment, the students learn about the properties of a dipole molecule.

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Tasks

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How do molecules behave in an electric field?

- Investigate the behaviour of water and petrol in relation to an electric field.
- Observe whether both liquids can be deflected.
- Write down your observations.
- Clarify the consequences that can be deduced for the molecular structure of both compounds.
- Sketch the processes involved in the approach of the polypropylene rod to the water molecules.
- Derive the two classes of binding types from the results.

The importance of electronegativity.

If two adjacent atoms in a molecule that are connected by a covalent bond have different electronegativity, the atom with the lower electronegativity can attract the bond electron closer to it.

wrong

correct

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Equipment

Position	Material	Item No.	Quantity
1	Protecting glasses, clear glass	39316-00	1
2	Rubber gloves, size M (8), one pair	39323-00	1
3	Support base, variable	02001-00	1
4	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
5	Boss head	02043-00	1
6	Universal clamp	37715-01	1
7	Dish, plastic, 150x150x65 mm	33928-00	1
8	Funnel, diameter = 60 mm, plastic (PP)	47318-00	1
9	Syringe 20ml, Luer, 100 pcs	02591-10	1
10	Stopcock, 1-way, Luer-Lock	02594-00	1
11	Cannula 0.9x70mm, Luer, 20 pcs	02597-10	1
12	Polypropylene rod, l=175mm, d=10 mm	13027-09	1
13	Stand.petrol b.p.60-95 C 1000 ml	31311-70	1

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Set-up (1/2)

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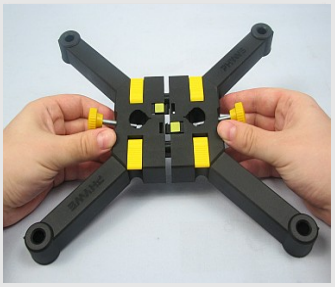
- Assemble the tripod from the tripod base and the tripod rod according to the illustrations above left and above right.
- Attach the double socket to the upper end of the stand rod (Fig. bottom left).
- Attach the universal clamp to it (Fig. bottom right).
- Make sure that both the double socket and the universal clamp are well secured.
- Only set up the tripod on level surfaces.




Set-up (2/2)

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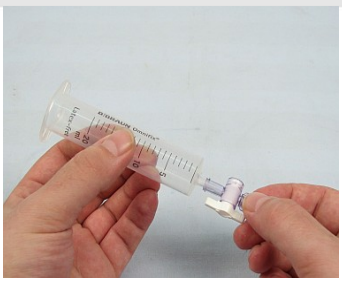
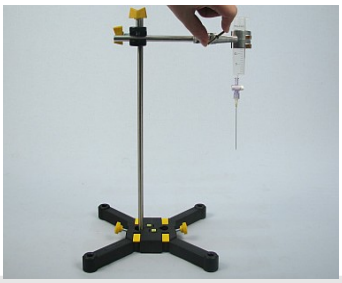
- Connect the syringe with the stopcock (fig. above left) and the cannula (fig. above right).
- Now fix the syringe in the universal clamp.
- Place the tub under the syringe in such a way that a leaking liquid flows into the tub at the edge of the tub if possible (fig. bottom right).
- When positioning the tub, be aware that a strong distraction may occur.
- Check your fully assembled tripod again for strength and stability.



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Procedure (1/2)

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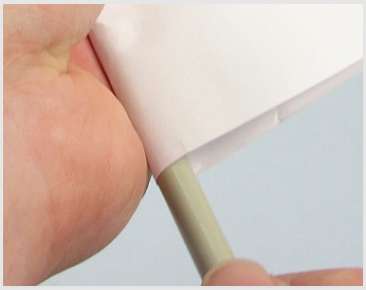

- Fill the syringe with petrol via the funnel (upper illustration).
- Move it upwards until the cannula is about 20 cm above the edge of the tub.
- Rub the plastic stick vigorously with the sheet of paper (lower illustration).

- As petrol is harmful to health, skin contact must be avoided at all costs. Be careful when filling the syringe !
- Make sure that there are no open flames in the working environment !

Procedure (2/2)

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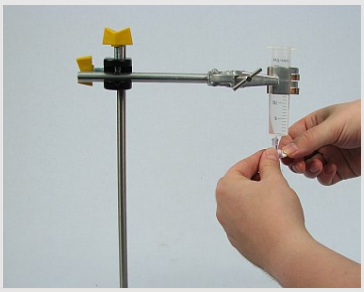

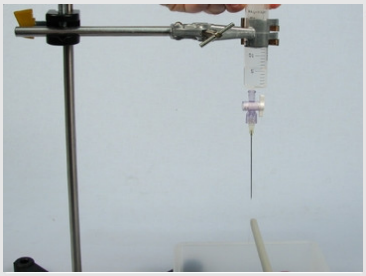

- Open the tap of the syringe until a thin stream of liquid flows into the tub (upper illustration).
- Guide the plastic rod close to the outflowing gasoline without touching it (lower picture).
- Close the tap and pour all the petrol into an appropriately marked container.
- Clean the syringe of any fuel residue, clamp it back in the stand and place the tub as before under the outlet opening. Fill the syringe with water.
- Guide the charged plastic rod near the outflowing water without touching it.

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Report

Monitoring

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Write down your observations for the water and the gasoline !

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Task 1

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Draw the conclusions from your observations !

Task 2

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What are the consequences for the spatial structure of the water molecule?

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Task 3

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Sketch the processes when the polypropylene rod approaches the water molecules !

Task 4

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In which classes can binding types be divided according to the result of this experiment?

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Task 5

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Criteria for the formation of a dipole moment.

For a dipole moment to be formed in the molecule, the molecule must have atoms with different _____. This results in the formation of _____ within the molecule. Furthermore, there must be an _____ distribution of these partial charges within the molecule. In water, the oxygen atom has a _____ and the two hydrogen atoms each have a _____. Dipoles can interact with each other, the so-called _____.

- dipole-dipole interactions
- partial charges
- negative partial charge
- asymmetrical
- positive partial charge
- electronegativities

Check

Slide	Score / Total
Slide 9: Dipole properties	0/1
Slide 21: Training of dipole moments	0/6

Total amount 0 / 7

Solutions | Repeat | Exporting text

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