



CITIE 2016

Congreso Internacional de
Tendencias en Innovación Educativa

Modeling with ICT in Science Education

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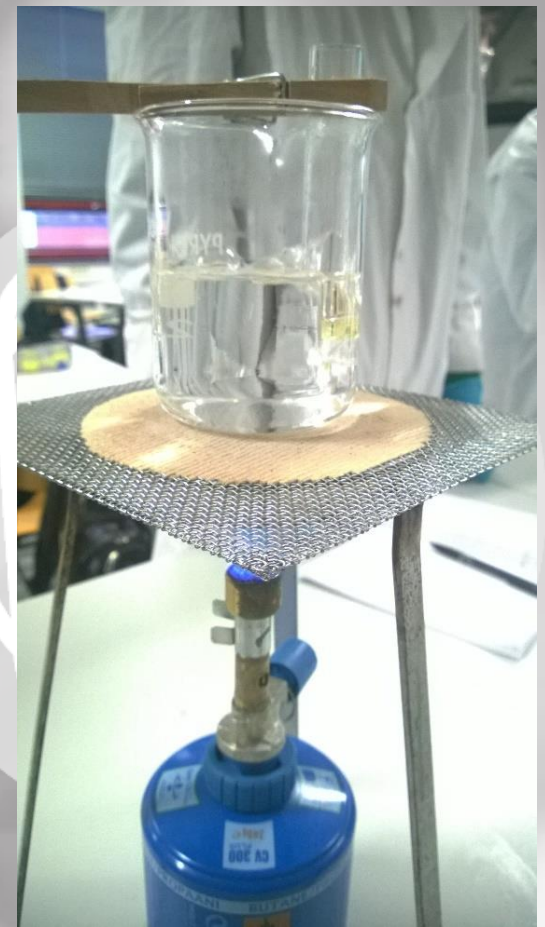
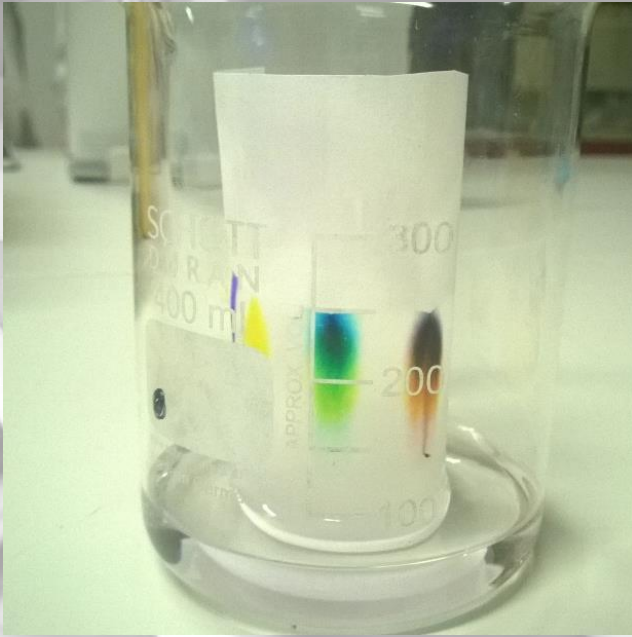
Viikki Teacher Training School of Helsinki University



About 1000 pupils and students
About 100 teachers
About 250 student teachers



Chemistry is an experimental science – where we need ICT?



Modeling – theoretical and research approaches

- “A model is a readily perceptible entity by means of which the abstractions of a theory may be brought to bear on some aspects of the world-as-experienced in an attempt to understand it.” (Gilbert). There are two types of models:
 - **mental models**
 - Mental models are representations that we build in order to explain or predict a situation, they are often “forerunners of misconceptions” (Kind, 2004). Mental models are created in the moment when they are needed and are then discarded when they are no longer needed.
 - **material models.**
 - Material models are expressed mental models (Gilbert et al., 2000) that are built to communicate with other individuals. Material models can be **symbolic, experimental, or iconic.**

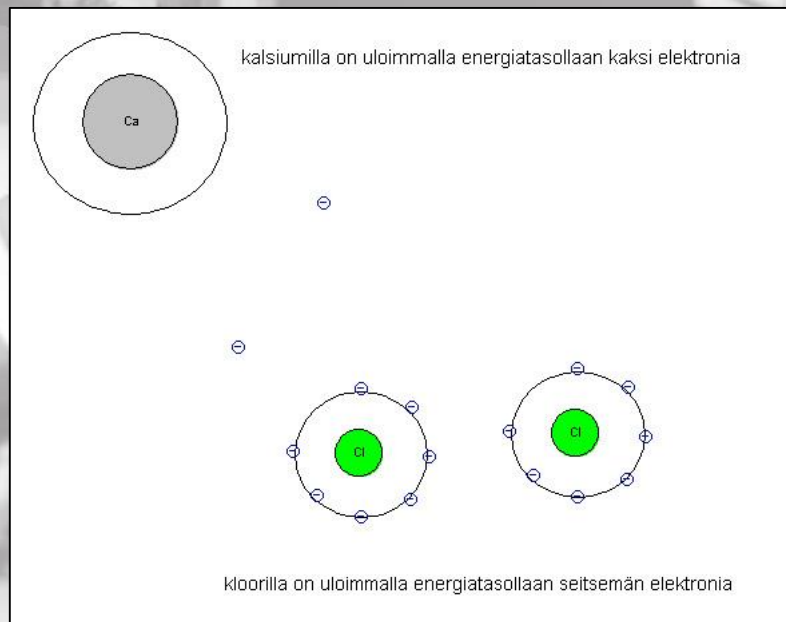
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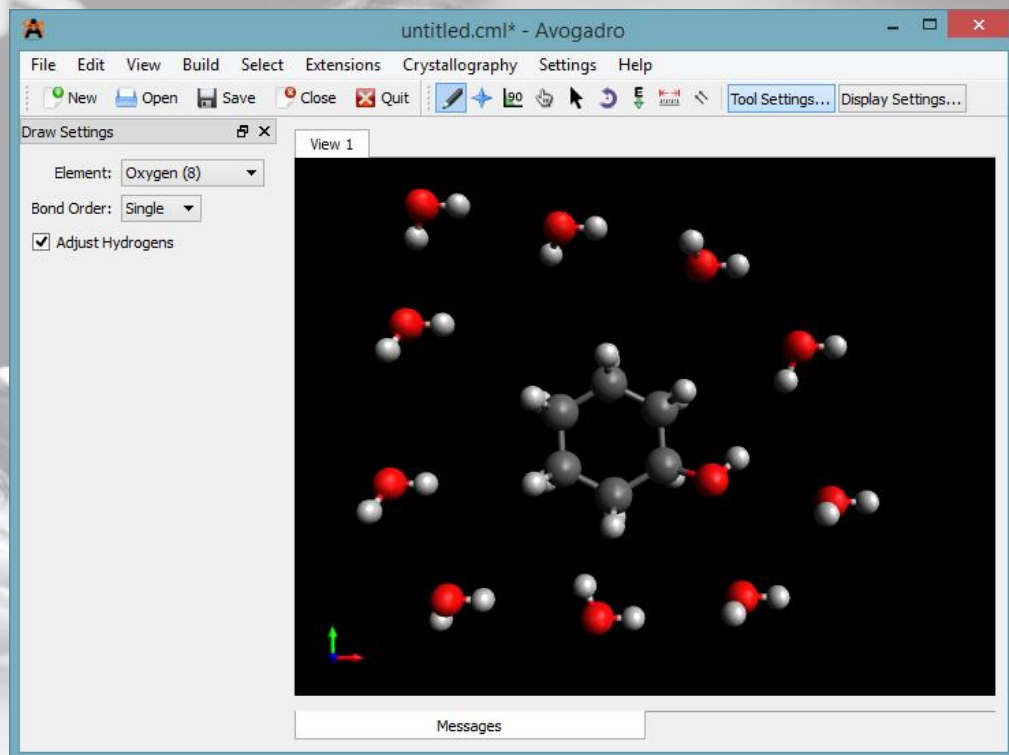
Modeling – theoretical and research approaches

- The use of modern computer-based molecular modelling has proven to be **highly productive in chemical research** (Justi & Gilbert, 2002).
- Computer-based molecular modelling opens various possibilities for teaching chemistry (Aksela & Lundell, 2008). Barak and Dori (2005) found that using computer-based models helped promote students' understanding of chemistry at four levels: the macroscopic, microscopic, symbolic and chemical process levels.
- They also found that computer based visual models helped students **understand chemical concepts, theories, and molecular structures.**

Modeling and simulations – pedagogical point of view



ChemSenseAnimator
PhET



Avogadro (ChemSketch, MarvinSketch)
MolView (online)



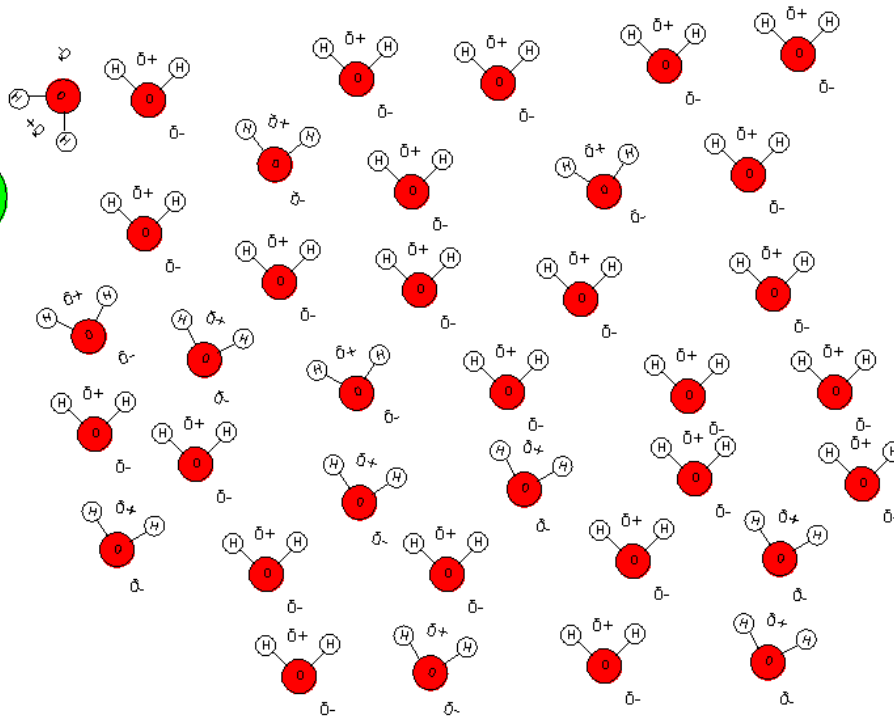
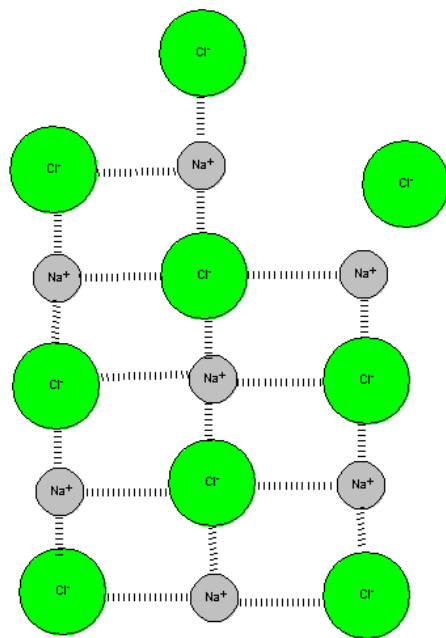
ChemSenseAnimator

Program for making animations in chemistry

Collecting concepts

Making on models of reactions, phenomena in microscopic scale







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HTML5 Sims



Etusivu

► Simulaatiot

Uudet simulaatiot

Fysiikka

► Biologia

► Kemia

► Yleinen kemia

Kvanttikemia

► Maantiede

Matematiikka

Kouluasteen mukaan

Alakoulu

► Yläkoulu

► Lukio

► Yliopisto

By Device

► iPad/Tablet

► Chromebook

Poikkitieteelliset

Kaikki simulaatiot

Käännetyt simulaatiot

Opettajille

Miten ajan simulaation?

Vianmääritys

Usein kysytyt kysymykset

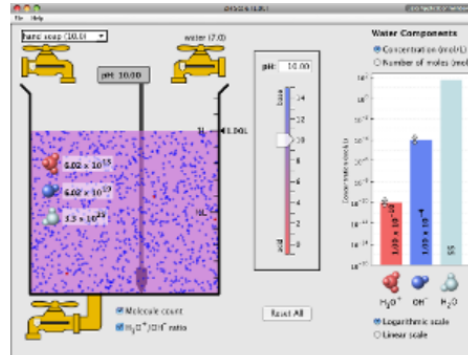
Kääntäjille

Tee lahjoitus

Tutkimus

Tietoja PhET-projektista

pH asteikko



Lataa

Käynnistä heti!

Run in HTML5

works in browsers/tablets

Upota

Version 1.04

Testaa mm. kahvin, syljen ja saippuan pH ja määrittele, ovatko ne happamia, emäksisiä vai neutraaleja. Visualisoi hydroksidi-ionien ja oksoniumionien suhteellinen määrä liuoksessa. Vaihda lineaarisen ja logaritmissen asteikon välillä. Tutki vaikuttaako tilavuuden muuttaminen tai vedellä laimentaminen pH:n arvoon. Voit myös suunnitella oman nesteen!

Donate

PhET-projektia tukevat



ja opettajat kuten sinä.
Kiitos!



OPETUSRESURSSIT

Keskeiset aiheet

- pH
- Laimeneminen
- Hapot
- Emäkset

Esimerkkejä oppimistavoitteista

- Määritä onko liuos hapan vai emäksinen.
- Aseta hapot ja emäkset suhteelliseen järjestykseen.
- Kuvaile molekyylitasolla, kuvien kanssa, miten vesitasapaino muuttuu pH:n myötä.
- Määritä hydroksidi-ionien, oksoniumionien ja veden konsentraatio annetussa pH:ssa.
- Yhdistä nesteen väri pH-arvoon.
- Ennusta (kvalitatiivisesti ja kvantitatiivisesti) miten laimentaminen ja tilavuus vaikuttavat pH-arvoon sekä hydroksidi-ionien, oksoniumionien ja veden konsentraatioon.

Katso alla

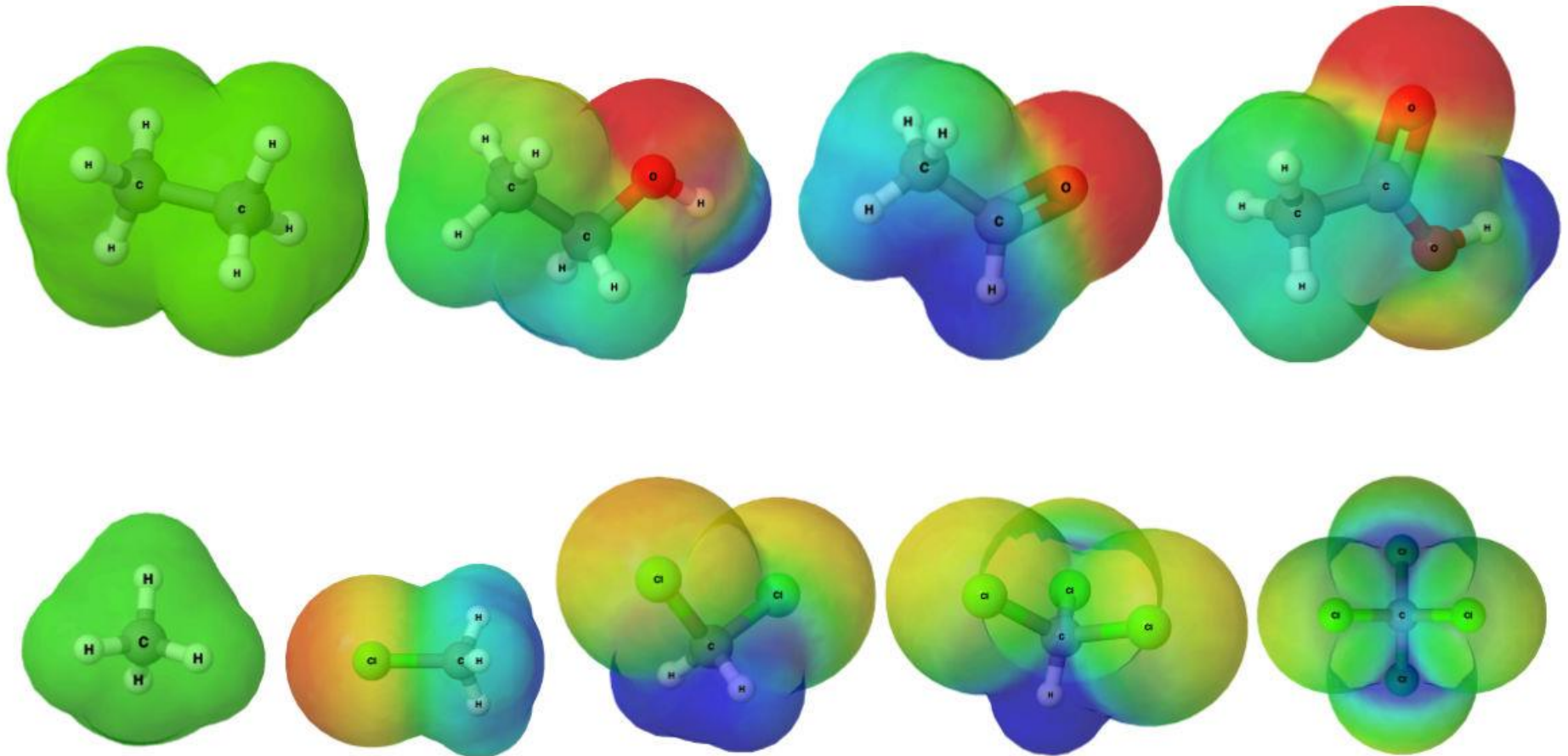
- [Samankaltaiset simulaatiot >>](#)
- [Käännetyt versiot >>](#)
- [Ohjelmistovaatimukset >>](#)
- [Tekijät >>](#)

Modeling – a new approach to science education?

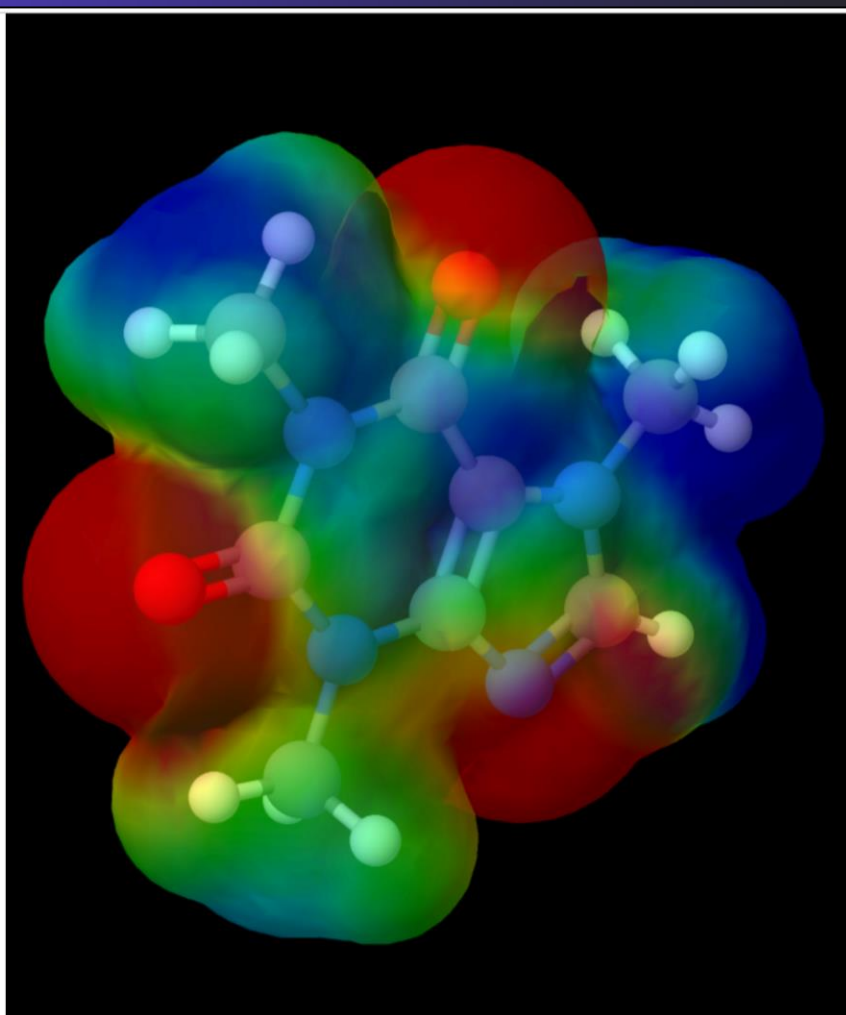
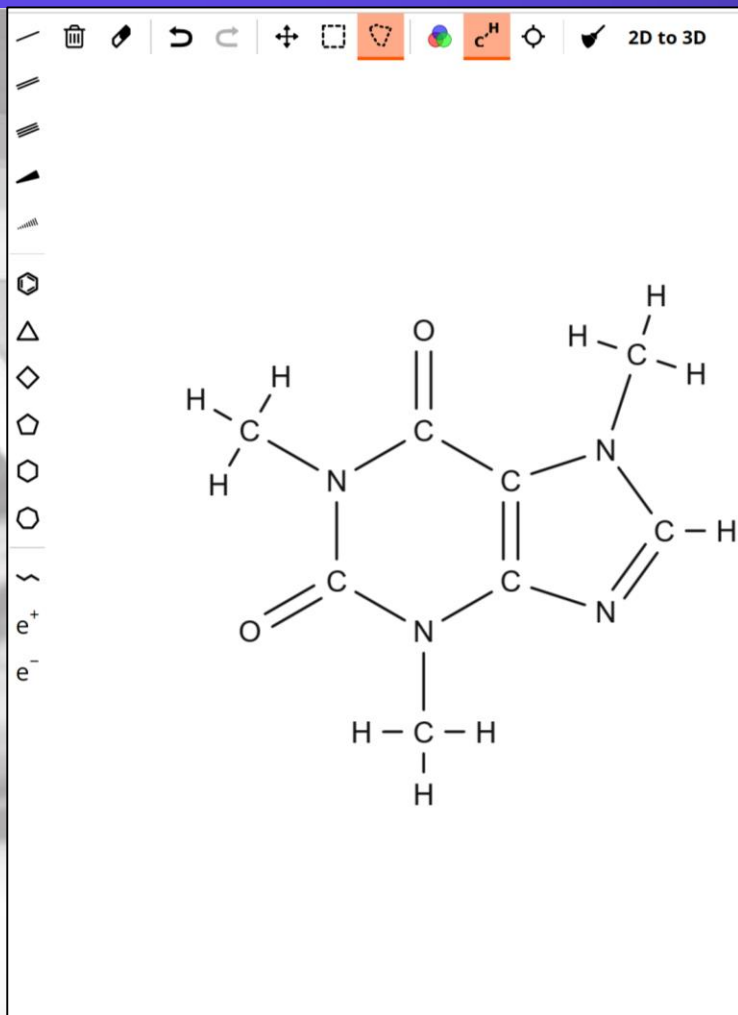
Bond theory (for example)

- Generally, it is possible to predict if a **compound has ionic or covalent bonds based on the difference in electronegativity**. (difference 1,8?)
- However, there are many exceptions
- Both types of bonding result from the **electrostatic attractions between the electrons and protons** of the atoms.
- Covalent and ionic bonding can be considered as a continuous pattern of bonding rather than a dichotomy. The difference merely being in **the electron distribution** (molecular electrostatic potential, MEP)

Modeling - Electronegativity



MolView.org



More about Bond Theory – Why modeling is about drawings

- **Research suggest that teachers avoid talking about atoms in relation to bonding.** Teachers are encouraged to **focus on molecules and ions rather than atoms**, on **how molecules and ions behave rather than on how they are formed**
- Chemical bonds should be understood as physical forces holding together chemical systems such as lattices and molecules. There are **electrostatic attractions** both **within molecules and between molecules**
- When talking about metallic bonding it is necessary to emphasise **the non-molecular nature of metallic bonding.**

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Modeling – a new approach to science education?

- The PIRE –project between Michigan State University and University of Helsinki
 - About project learning, engagement, optimal learning moment ...^{15/7} (crucial concepts)
- Scientific Practices –approach
 - Experimental work, Group work, Modeling and explaining
- ICT-tools for modeling



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More information – Tanks for our attention





WORKSHOP: MODELLING USING ICT

- Modeling programs in use
- Animation programs

