RESET EDU

Resetting education for the digital age

Ljubljana, 8 - 9 November 2021

The use of ICT to support the development of high order thinking skills

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Abstract

Using ICT, especially modeling has been begun a crucial part of chemistry education. While the content and dimensions of the chemistry education have been broadening the need for deeper understanding of ICT and the use of ICT has begun almost requirement for chemistry teachers.

More experimental works (and more authentic approach) in chemistry is not enough - school chemistry is not only exciting phenomenas or making cool things.

Modeling and animations support learning when we are focusing and describing the sub-microscopic level of chemistry world.

To support all this, you need to focus seriously teacher´s further education.

There is a huge need for professional development and support for chemistry teachers.

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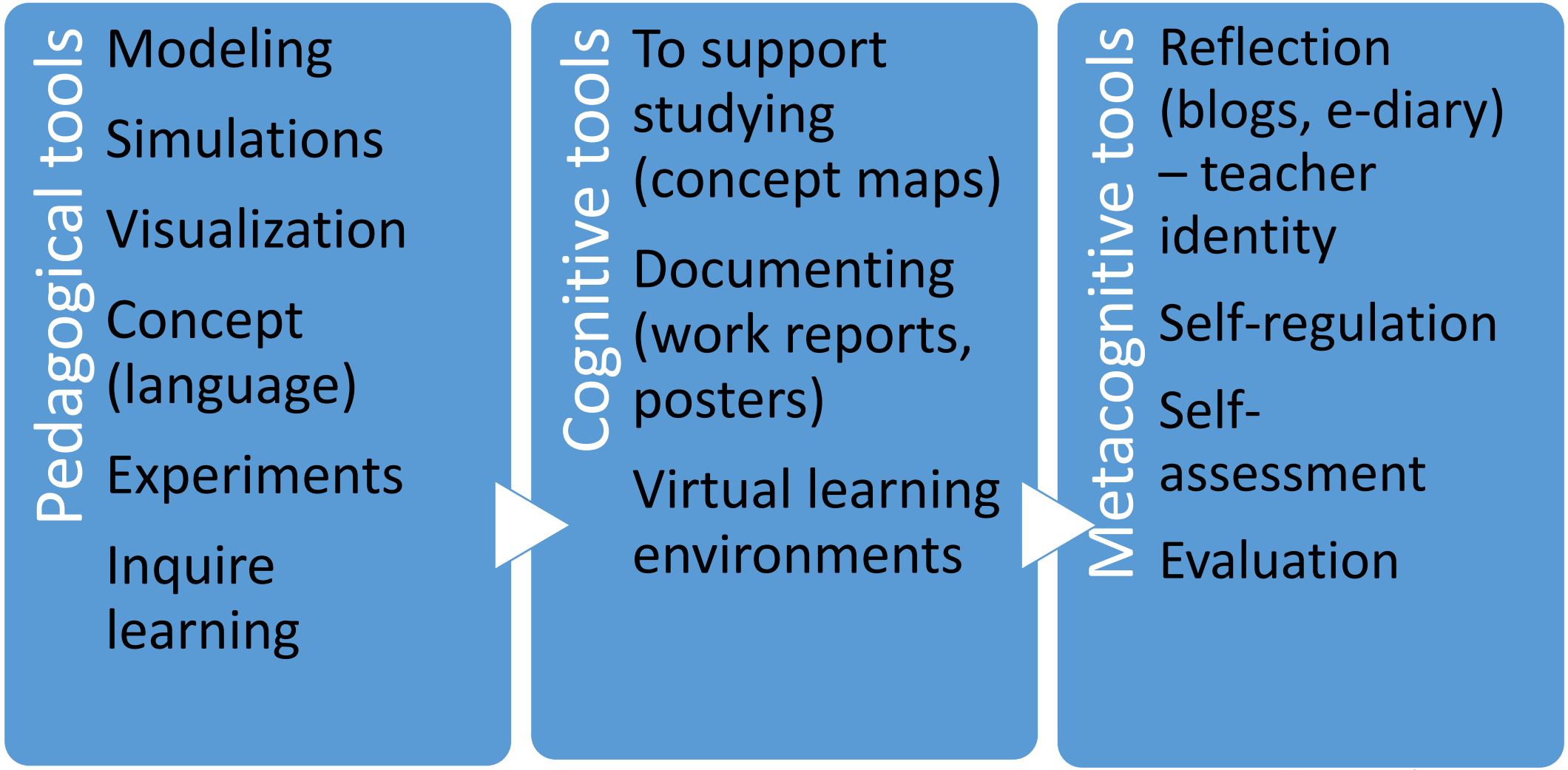
The whole picture of Chemistry education



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THE SAMR MODEL

Dr. Ruben R. Puentedura

Videos
Voice

S **SUBSTITUTION**
Technology acts as a direct substitute, with no functional change

A **AUGMENTATION**
Technology acts as a direct substitute, with functional improvement

M **MODIFICATION**
Technology allows for significant task redesign

R **REDEFINITION**
Technology allows for the creation of new tasks, previously inconceivable

ENHANCEMENT

TRANSFORMATION

TPACK-approach

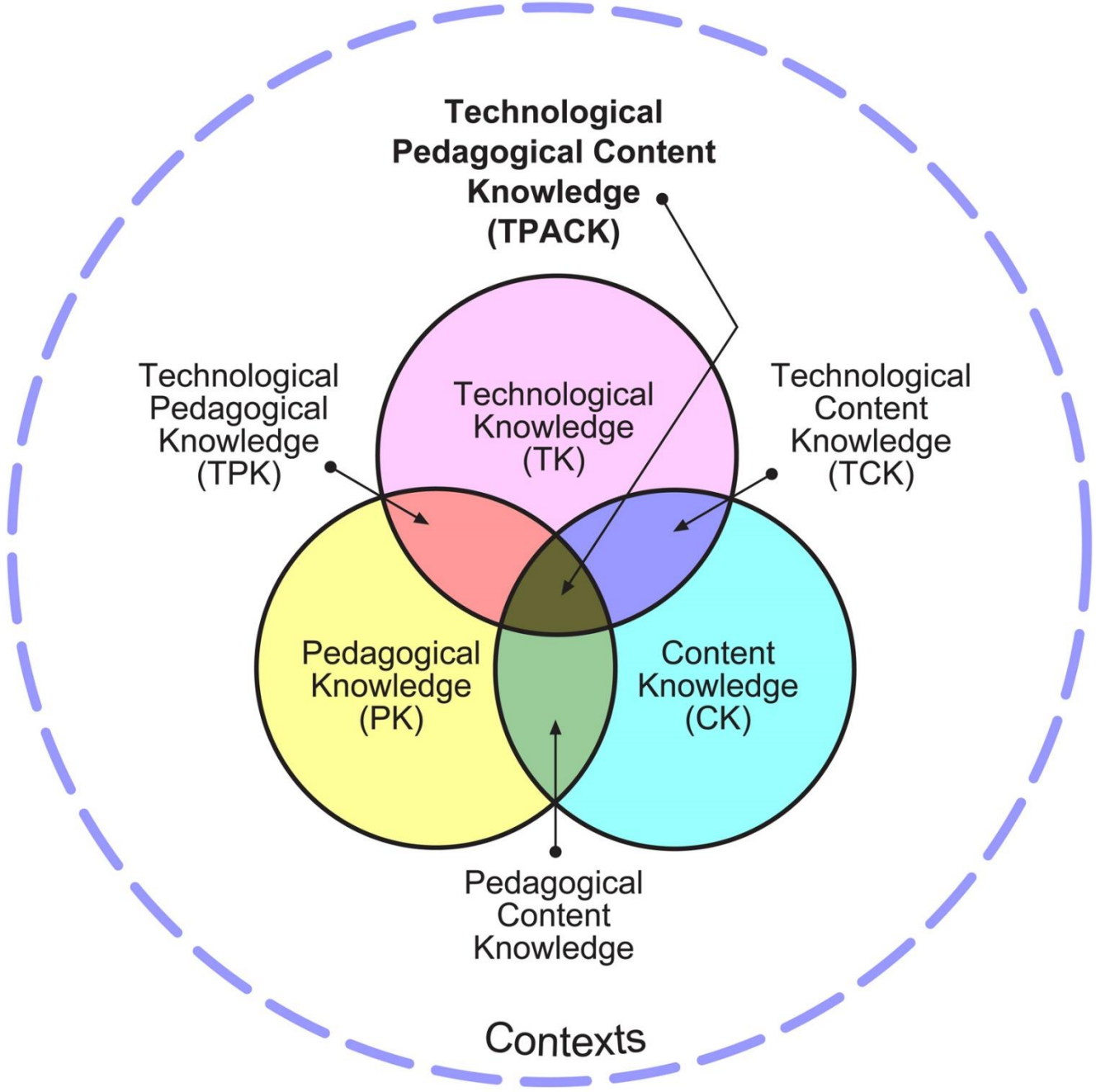
TK, PK, and CK – are thus combined and recombined in various ways within the TPACK framework.

Technological pedagogical knowledge (TPK) describes relationships and interactions between technological tools and specific pedagogical practices, while

pedagogical content knowledge (PCK) describes the same between pedagogical practices and specific learning objectives; finally,

technological content knowledge (TCK) describes relationships and intersections among technologies and learning objectives.

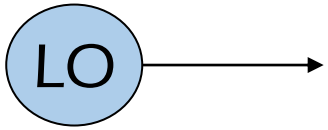
These triangulated areas then constitute TPACK, which considers the relationships among all three areas and acknowledges that educators are acting within this complex space.



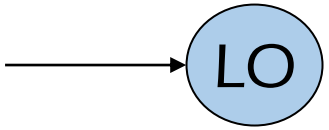
Kurt, S. "TPACK: Technological Pedagogical Content Knowledge Framework," in *Educational Technology*, May 12, 2018. Retrieved from https://educationaltechnology.net/technological-pedagogical-content-knowledge-tpack-framework/

Theory about Learning Objects

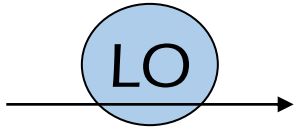
1) LO as a starter for a process



2) LO as a target

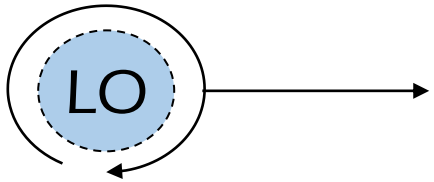


3) Mind tools, which support learning processes and guide information processing



a) Context-based tools
b) Context-free tools

4) Editable materials – Teachers (and perhaps students) can edit LO:s



Contextual
Situated in real life
Scaffolding
Constructing
Modeling

Silander & Koli, 2003, s.68
Revised by MYA

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Teachers Professional Development

(Loughran, 2002; Lavonen, et al., 2006; Borg, 2011; Avalos, 2011; van den Bergh, Ros, & Beijaard, 2015)

Professional Development (PD) should

- be teacher-led,
- be continuous (long term),
- be situated in or connected to the classroom context,
- be collaborative (**Community of Practices**)
- include reflective practices

Many short-term PD projects fail to foster teachers' deep understanding of instructional practices and their influence on students' learning and engagement: teachers do not have enough time to reflect on and discuss their experiences of different instructional practices in different contexts

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ICT in teaching and learning

Headlines yesterday and already learned

- BYOD, Cloud computing
- Social networks, Collaboration tools, Sharing knowledge, (Community of Practice, CoP)
- Curation tools, Personal info systems
- Blogging
- Flipped learning (classroom)

Headlines today and tomorrow

- Gamification
- Augmented reality, virtual reality and mixed reality
- Internet of Things, IoT
- Hybrid teaching (F2F and online)
- Computational thinking

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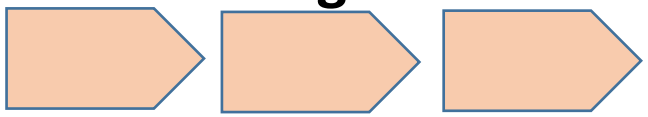
Hybrid teaching

Now:

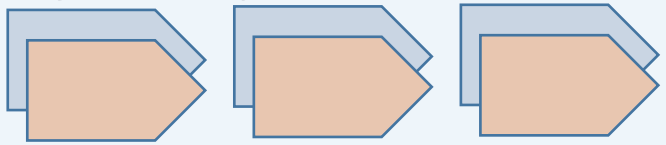
F2F-teaching



Online teaching

Blended learning

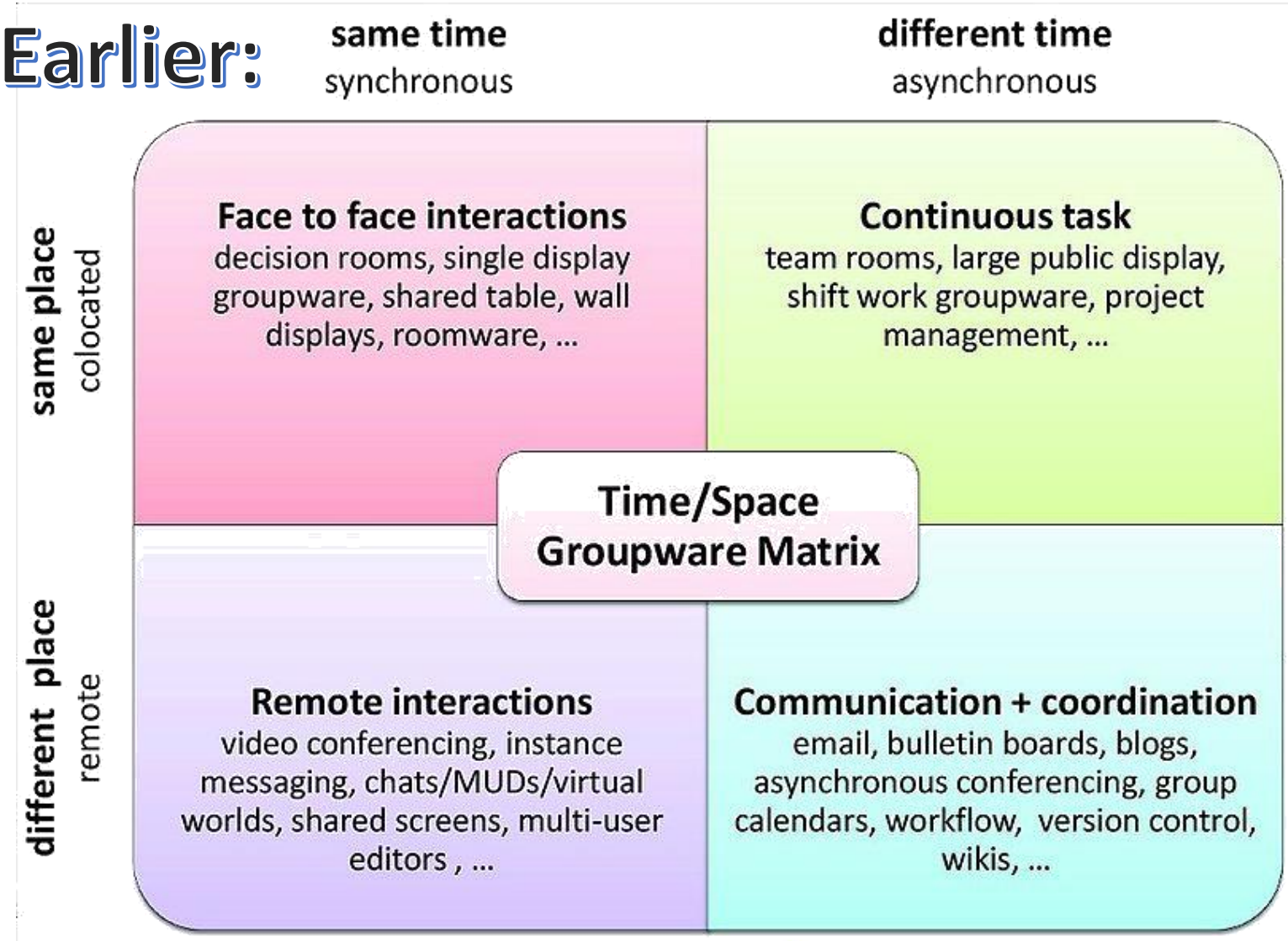
Hybridiopetus



F2F-teaching

Online teaching

Earlier:



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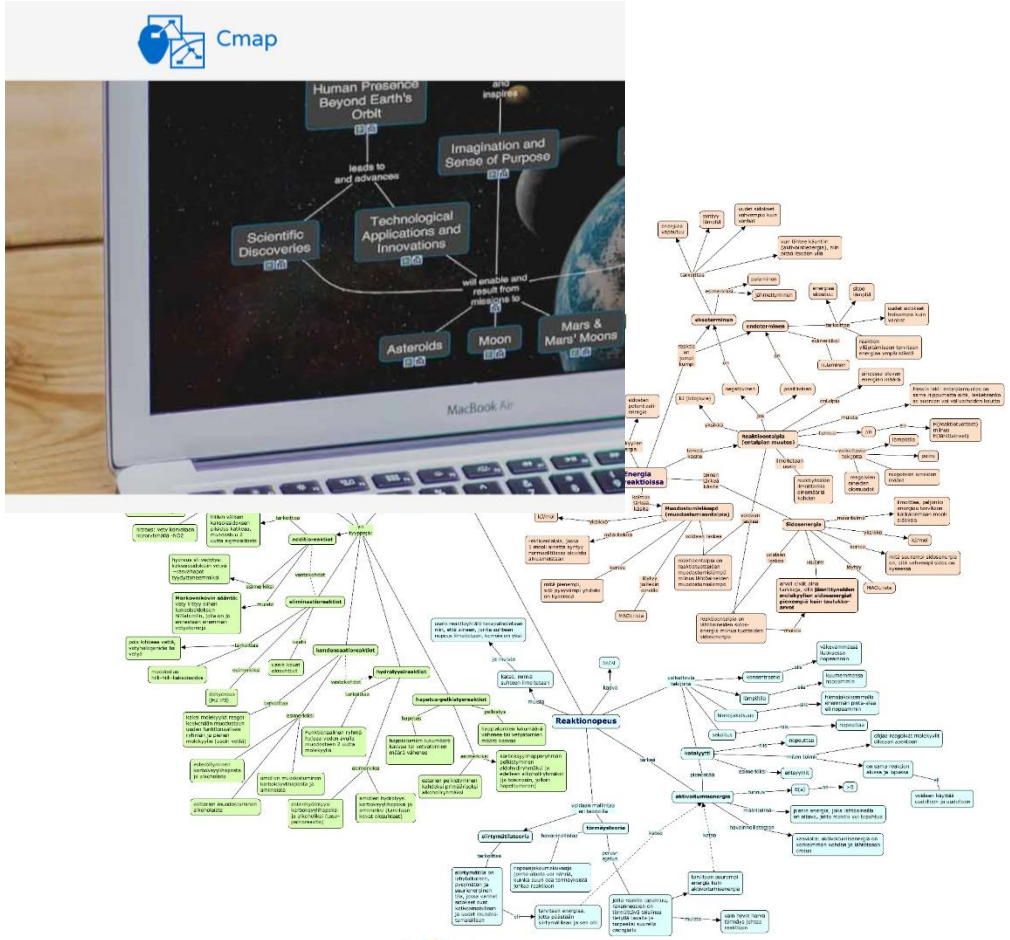
Digital Tools – Pedagogical reasoning

- Cognitive tools – Conceptual thinking
  - Concept maps – CmapsTools
  - MindMaps – FreeMind
- Modeling – Animating
  - 3D-modeling programs (MarvinSketch)
  - Animations – ChemSense Amimator (Java)
  - Simulations – PhET – Algodoo
  - Videos
- Augmented / Virtual reality



PhET INTERACTIVE SIMULATIONS

Algodoo by algoryx

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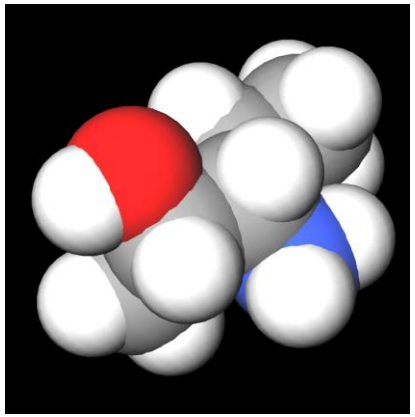
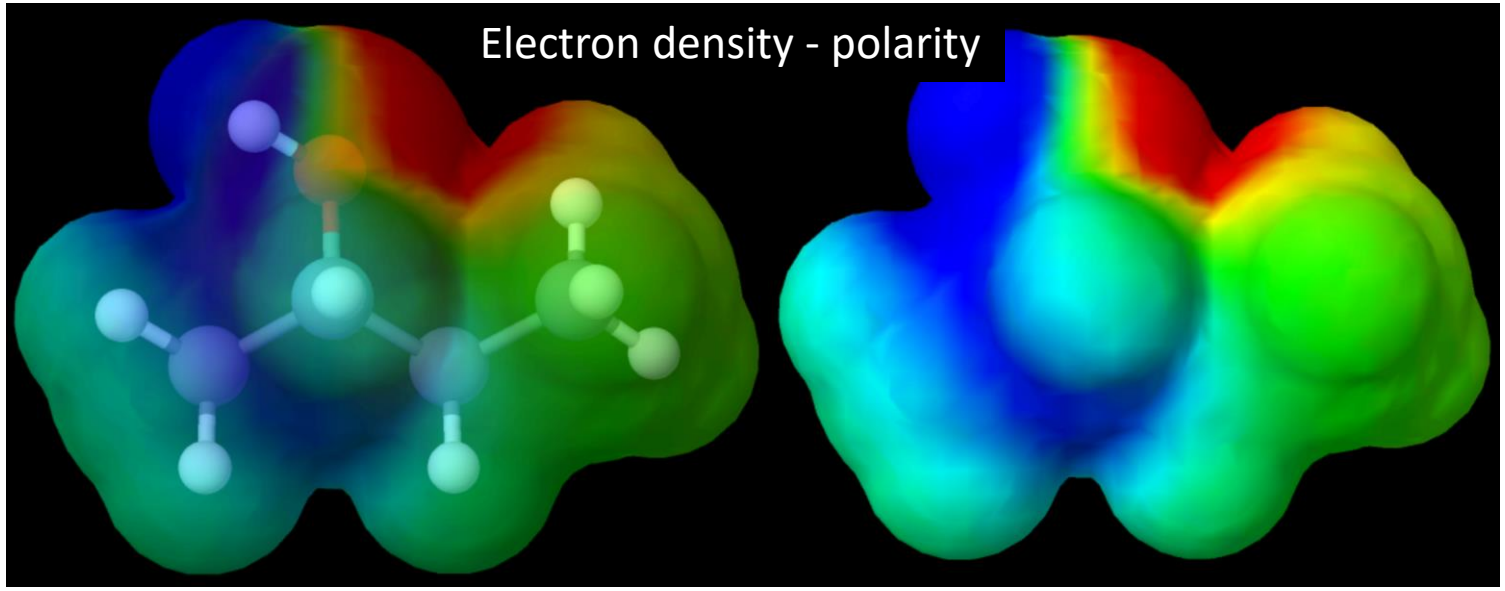
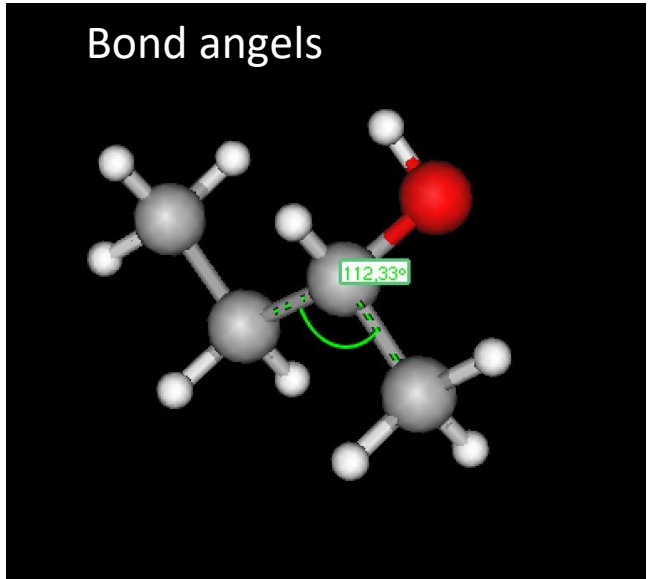
Modeling in Chemistry (3D-modeling)

- Molview.org –program





- MarvinSketch -program



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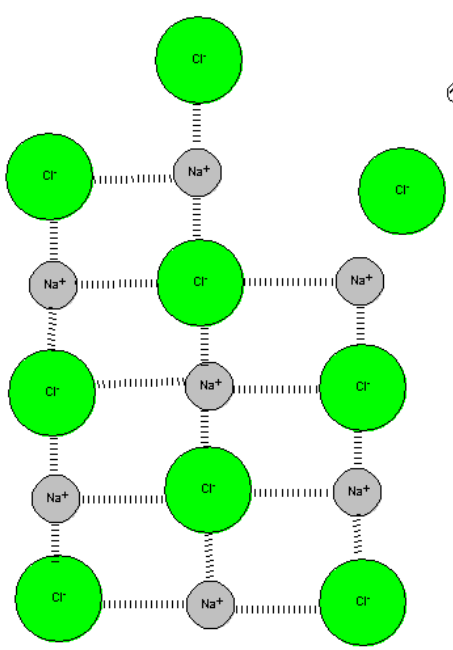
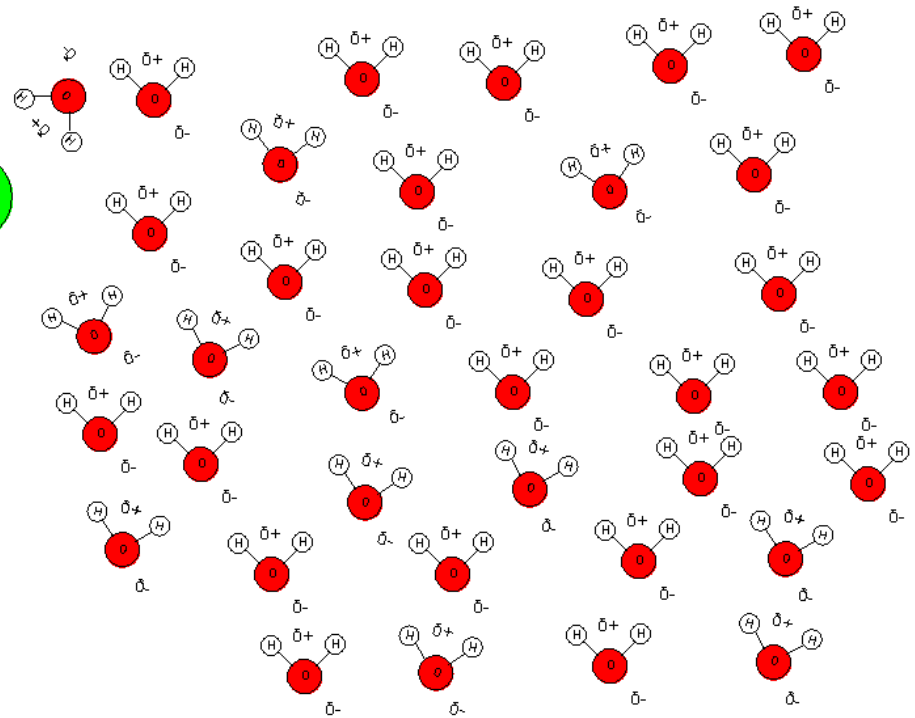
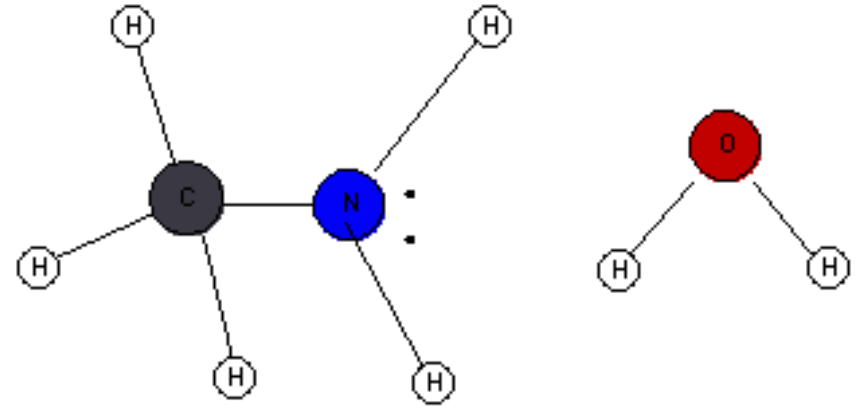
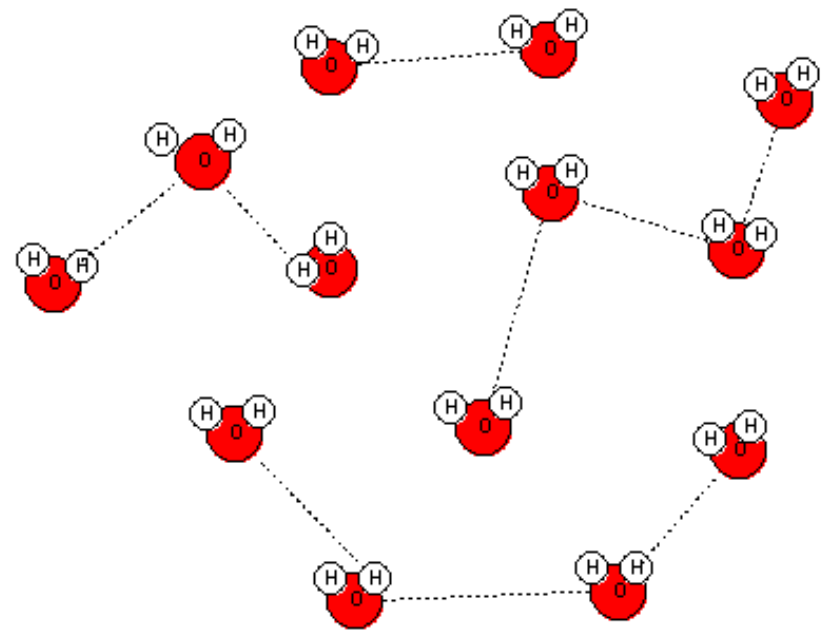








Animation – ChemSence Animator

(Computational thinking)

Spectroscopy and use of data (spectral) libraries

uusi

Spectral Database for Organic Compounds SDBS

Japanese | Introduction | Disclaimer | HELP | Contact | What's New | RIO-DB | FAQ | LINK | AIST

SDBS Compounds and Spectral Searc

Compound Name: match partial

Atoms: C(Carbon) to

Spectral Database for Organic Compounds SDBS

Japanese | Introduction | Disclaimer | HELP | Contact | What's New | RIO-DB | FAQ | LINK | AIST

SDBS Search Results:

ling Order Search

man	ESR	Compound Name
Y	N	3-ethoxypropylamine
N	N	3-amino-2,2-dimethyl-1-propanol
Y	N	5-amino-1-pentanol
Y	N	1-(methoxymethyl)propylamine
Y	N	3-dimethylamino-1-propanol
N	N	1-dimethylamino-2-propanol
N	N	2-methoxydiethylamine
Y	N	L-2-amino-3-methyl-1-butanol
N	N	2-isopropoxyethylamine
N	N	2-propoxyethylamine
N	N	DL-2-amino-1-pentanol
N	N	2-(propylamino)ethanol
N	N	(+-)-2-amino-2-methyl-1-butanol oxalate (1:1)
N	N	(S)-2-amino-2-methyl-1-butanol oxalate (1:1)
N	N	2-(isopropylamino)ethanol
N	N	(R)-4-amino-2-methylbutanol
N	N	4-amino-2-methylbutanol
N	N	n-(trimethylsilyl)acetamide
N	N	L-2-amino-4-methylthio-1-butanol

SDBS Information

SDBS No.: 7931

Compound Name:
5-amino-1-pentanol

Molecular Formula: $C_5H_{13}NO$

Molecular Weight: 103.2

CAS Registry No.:
2508-29-4

Spectral Code:
Mass :
^{13}C NMR : in $CDCl_3$
^{1}H NMR : 90 MHz in $CDCl_3$
IR : liquid film
Raman : 4880 A,200 M,liquid

Chemical Information:

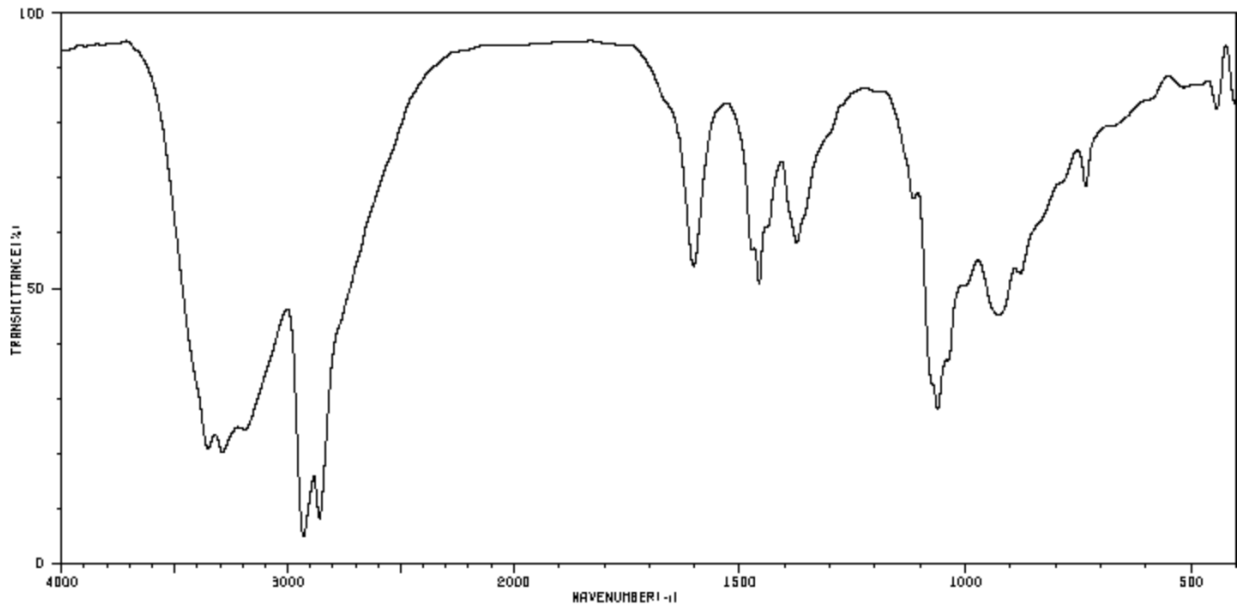
Return to Search:
Return to Result:

URL for this Compound:

HIT-NO=3868 | SCORE= ( ) | SDBS-NO=7931 | IR-NIDA-58119 : LIQUID FILM

5-AMINO-1-PENTANOL

$C_5H_{13}NO$



3354	20	1374	66
3289	19	1115	64
2930	4	1062	25
2868	7	926	43
1602	52	734	66
1474	55	443	79
1457	49		

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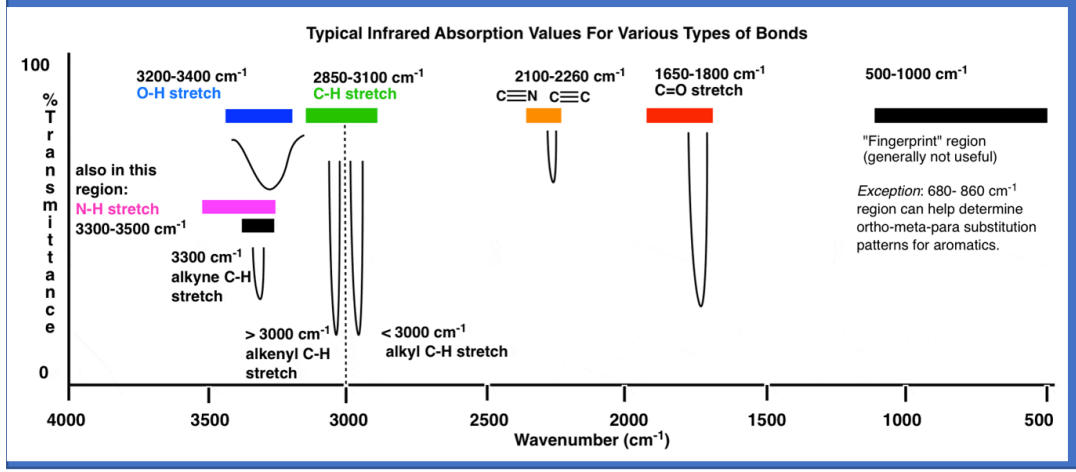
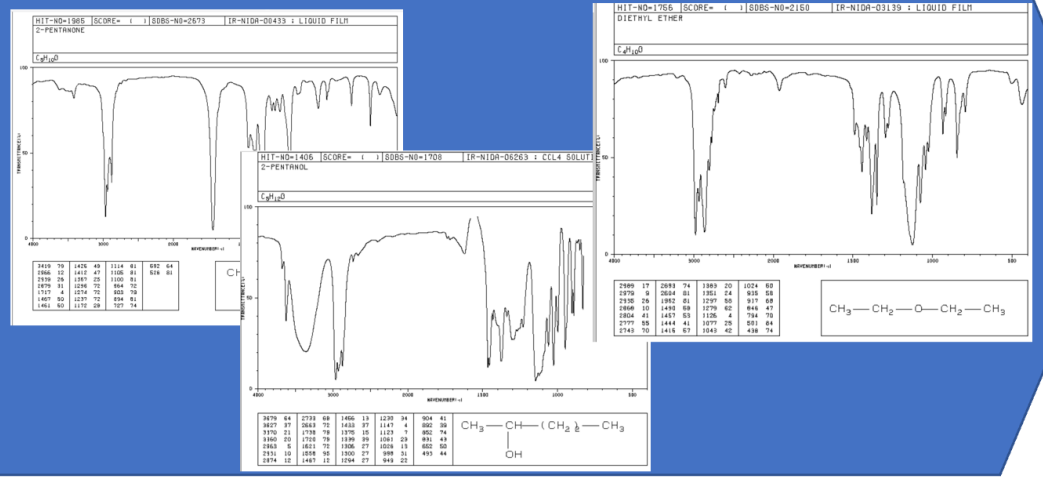
Traditional

Spectral library (ready made)

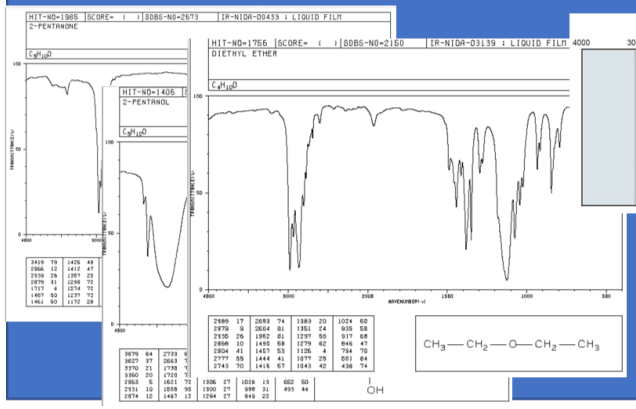


Spectral interpretation



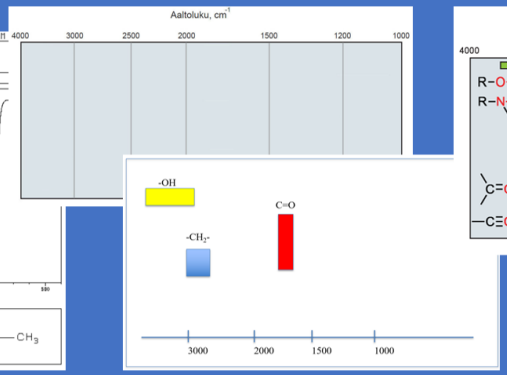
Modeling – Algorithmic thinking

Spectral interpretation
Spectral database

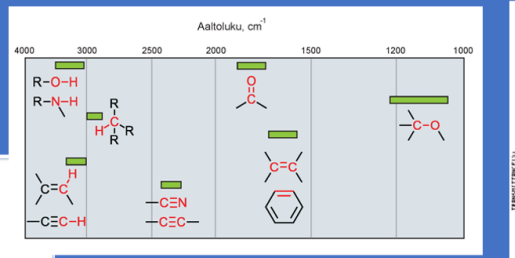


Scientific Practice - Modeling

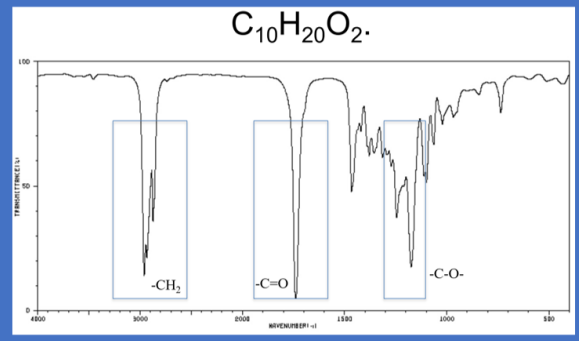
Spectral library (own)



Spectral library (group)



Spectral library (testing)



Spectroscopy – new approach

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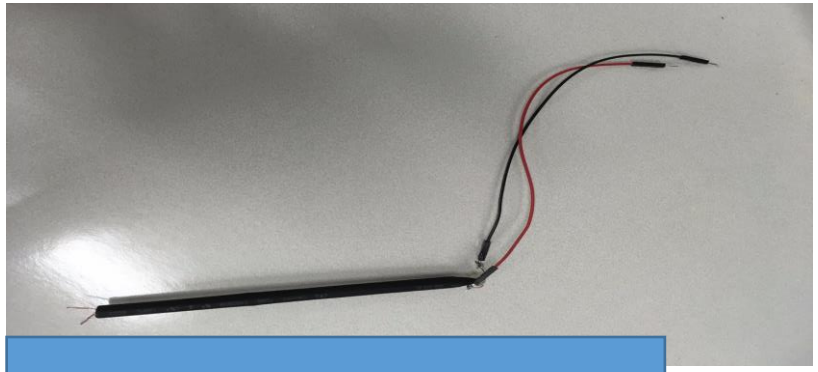
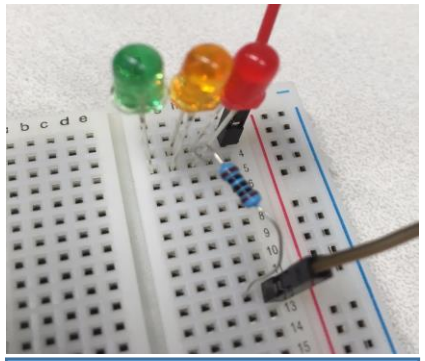
Making Electrical Conductivity Sensor and use it

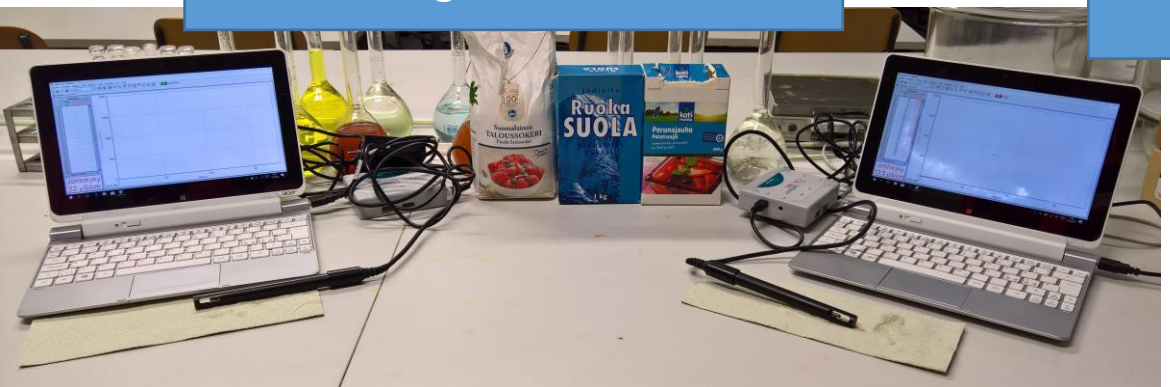
PROBLEM, DRIVING QUESTION: We have some glasses of water-like liquids.
Can You drink them?

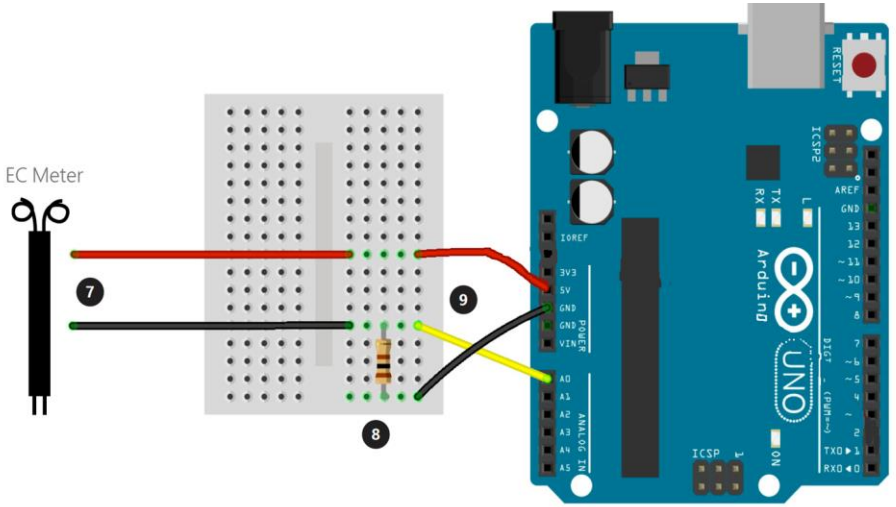


Building a sensor stick



Using LEDs





Using Arduino and programming

loitsu | Arduino 1.8.3

File Edit Sketch Tools Help

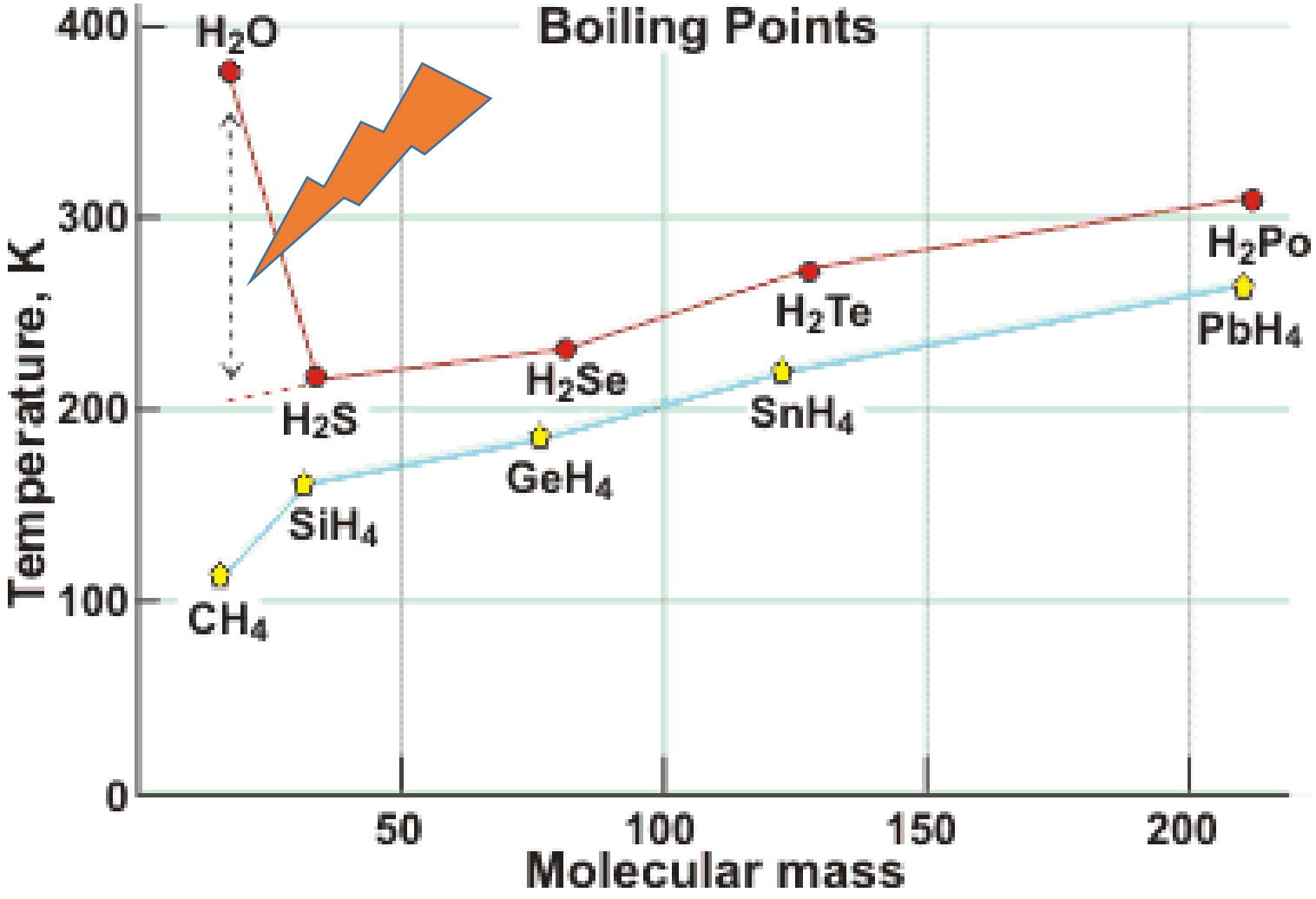
loitsu

```
int sensorPin = A0;
int sensorValue = 0;

void setup() {
  Serial.begin(57600);
}

void loop() {
  sensorValue = analogRead(sensorPin);
  Serial.println(sensorValue);
  delay(50);
}
```

Analyzing and interpreting data



Different Compunds with hydrogen

Different boiling points and huge exceptions of water molecule

Explain the data?

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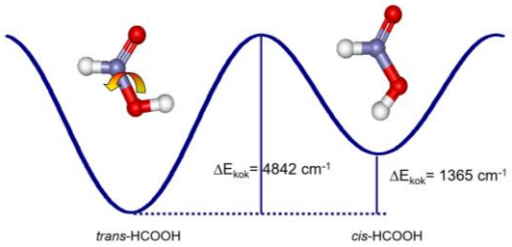
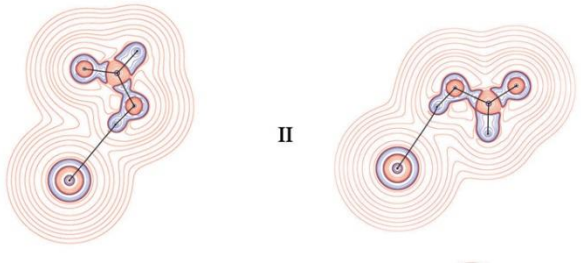
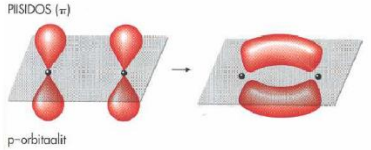
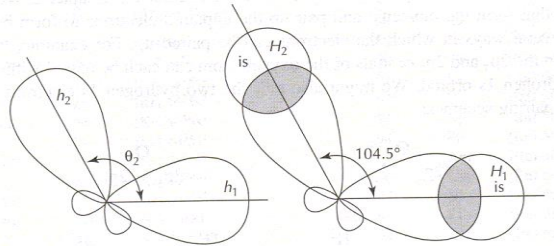
Computational chemistry in teaching and learning



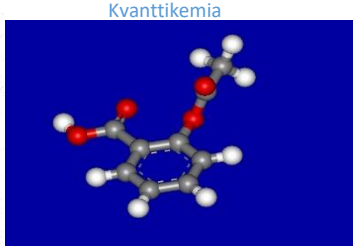


- Symmetry ja conformation
- Chemical bond theories - modeling
- Orbital Theory and Hybridization
  - Atomic orbitals, hybridization,
  - Molecular orbitals

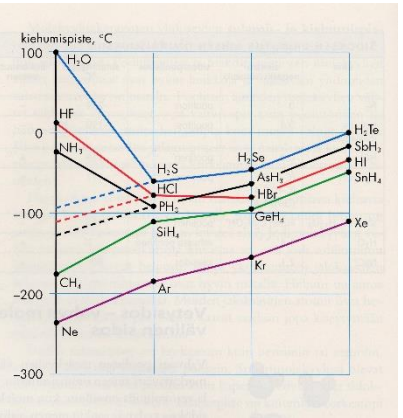




Kvanttikemia



- Spectroscopy – spectral databases
- Quantum Mechanics (quantum chemical calculation)
- IT IS NOT just Computer Aided Chemistry
  - simulations, measuring machines, internet
  - searching, producing, analysing and reporting of data



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Thanks for Your attention

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