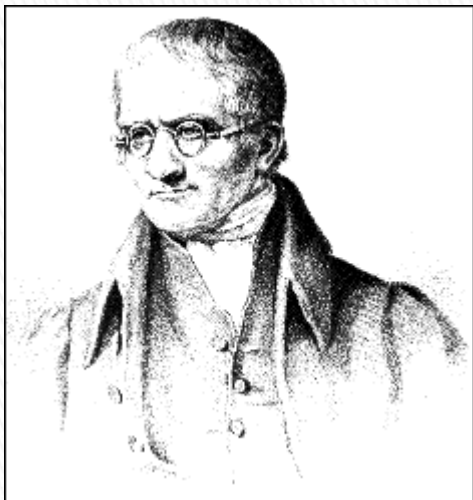




The role of modeling in teaching future teachers of science

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Models in teaching chemistry in the past



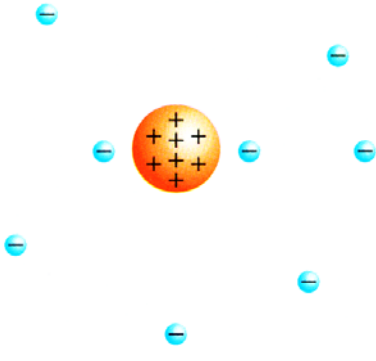
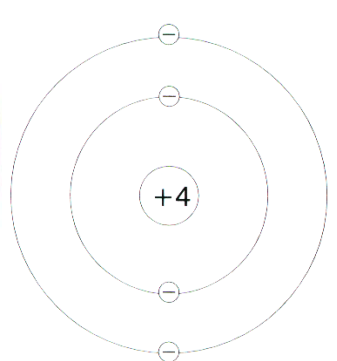
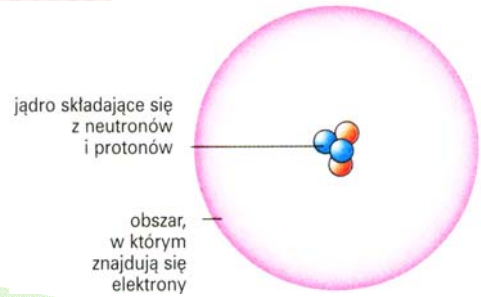
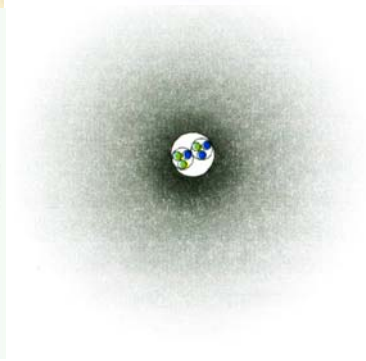
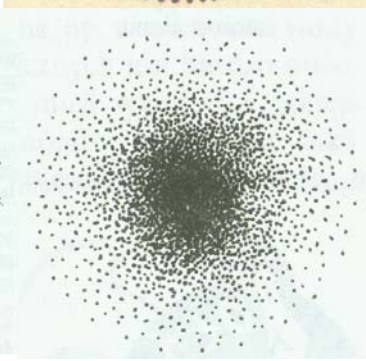
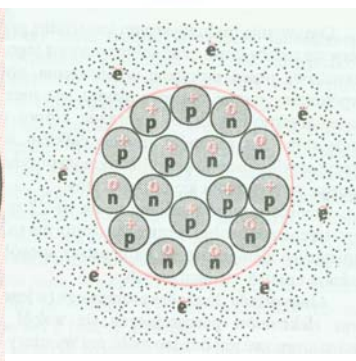
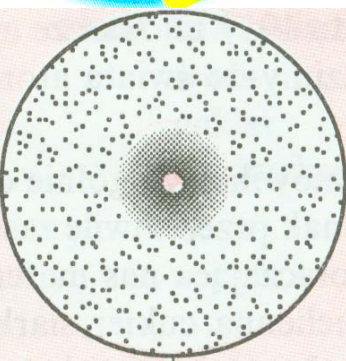
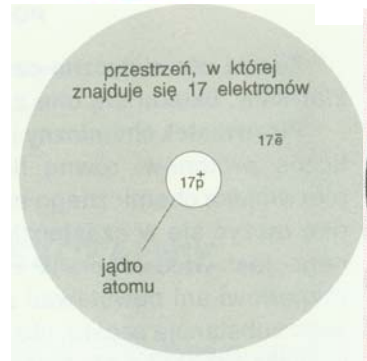
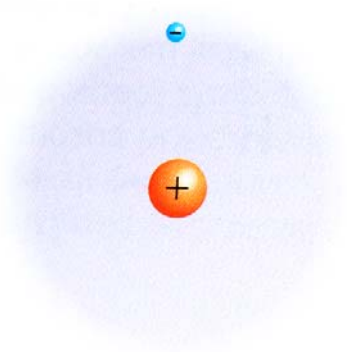
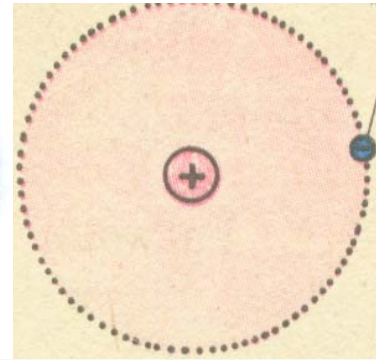
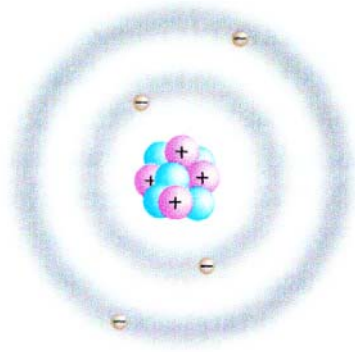
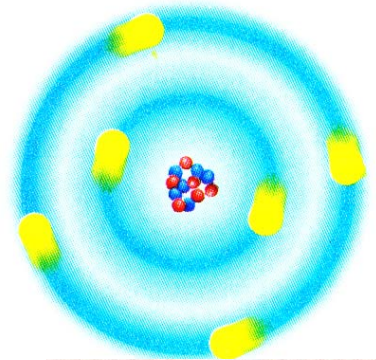
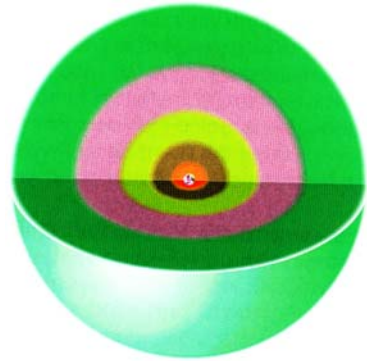
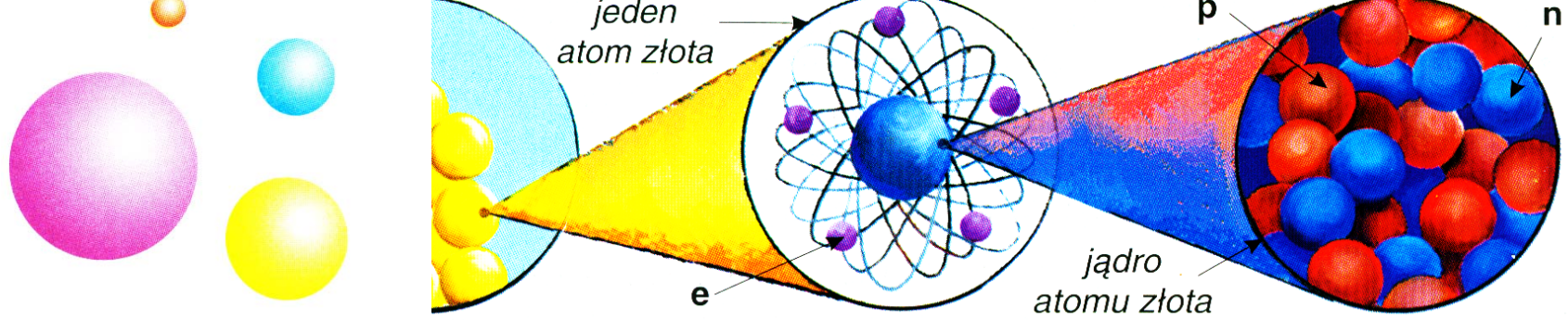
- ▶ Since the times of John Dalton, who was the first to suggest a set of standard graphic symbols for chemical elements and compounds to illustrate the structure of particular chemical compounds, chemists have been constantly trying to propose new models that would help pupils at all stages of education understand the structure of chemical compounds as well as processes of chemical reactions.

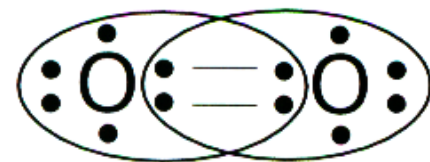
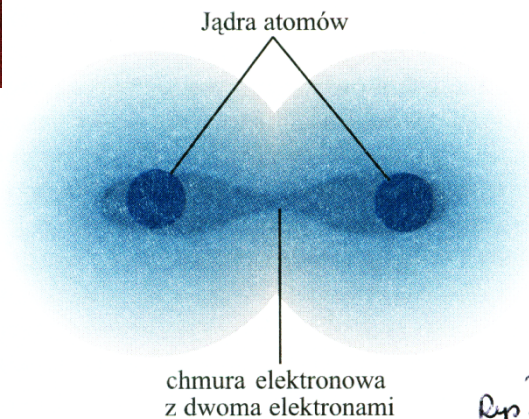
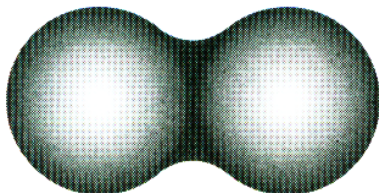
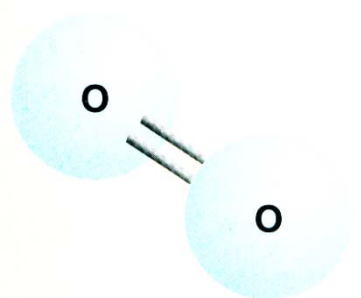
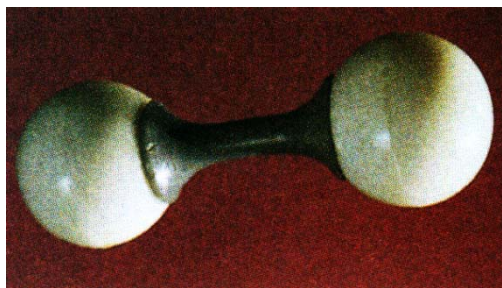
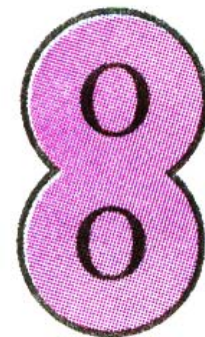
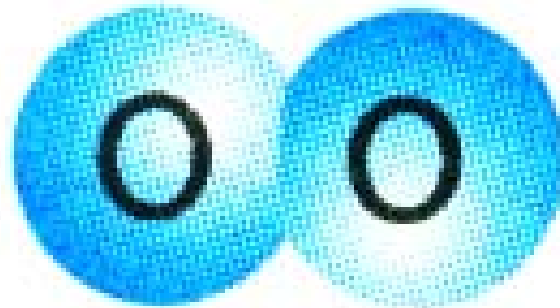
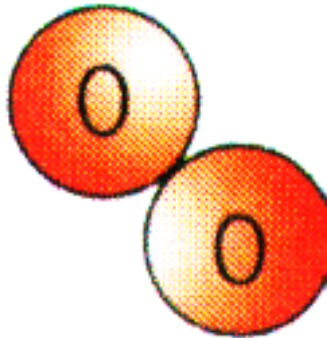
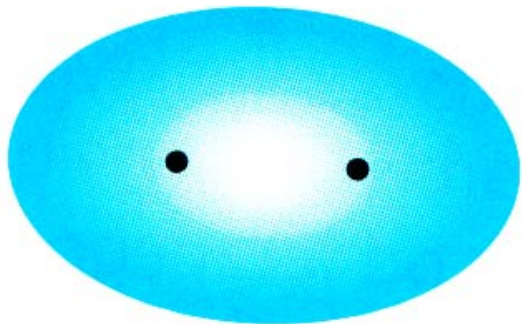
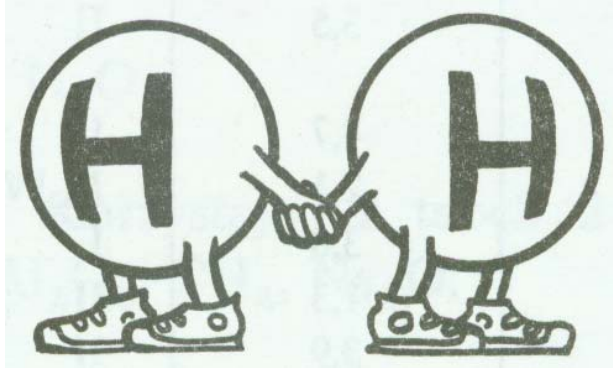
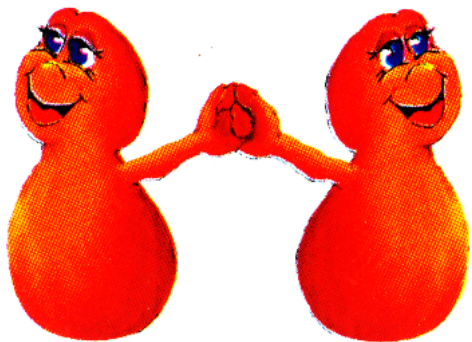
ELEMENTS			
Hydrogen 1	Strontian 46		
Azure 5	Barites 68		
Carbon 56	Iron 50		
Oxygen 7	Zinc 56		
Phosphorus 9	Copper 56		
Sulphur 13	Lead 90		
Magnesia 20	Silver 190		
Limbe 24	Gold 190		
Soda 28	Platina 190		
Potash 42	Mercury 167		

Currently used models in teaching chemistry



- ▶ Nowadays, numerous models that show the structure of atoms, particles or crystals of chemical compounds are used.
- ▶ Some of these models are “material” – pupils can touch them, while other are just pictures in textbooks or on the computer screen.
- ▶ These models, however, are very often inaccurate, contradictory to one another, and they lead to many misconceptions among pupils.
- ▶ During their chemical instruction at all levels, pupils come across different models of the micro-world structure.
- ▶ It sometimes happens that even within one textbook different types of pictures are used, which leads to a negative transfer.





Rep?
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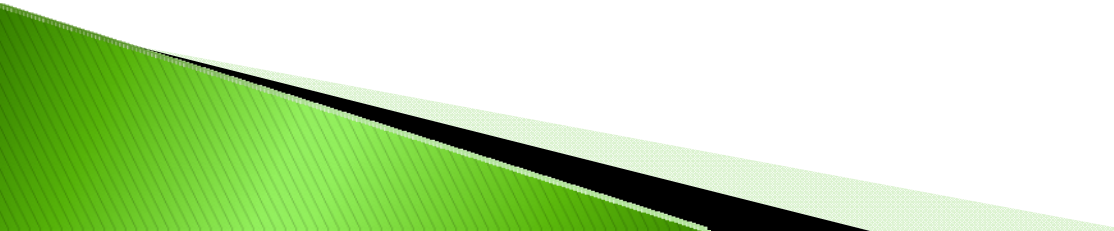
New models in teaching chemistry

- ▶ Due to this fact, in 2004 in a coherent concept of computer animated models that allow to present the micro-world was suggested by the Department of Chemistry of Pedagogical University of Cracow.
- ▶ This concept consists of the following research:
 - *Koncepcja tworzenia modeli dynamicznych do stosowania w procesie kształtowania pojęć dotyczących struktury materii na poziomie mikroświata,*
 - *Nowe podejście do modelowania reakcji kwasów z wodorotlenkami ,*
 - *Koncepcja wizualizacji powstawania cząsteczek z atomów,*
- ▶ After 2004 this concept has been developed in:
 - *Wizualizacja procesów chemicznych,*
 - *Komputerowe modele dynamiczne w nauczaniu przedmiotów przyrodniczych,*
 - *Jak uczyć o strukturze materii?*



New models in teaching chemistry

The models, created in accordance with this concept, are simple enough to be used at the first stages of education but also detailed enough to be used at more advanced stages of chemical instruction.

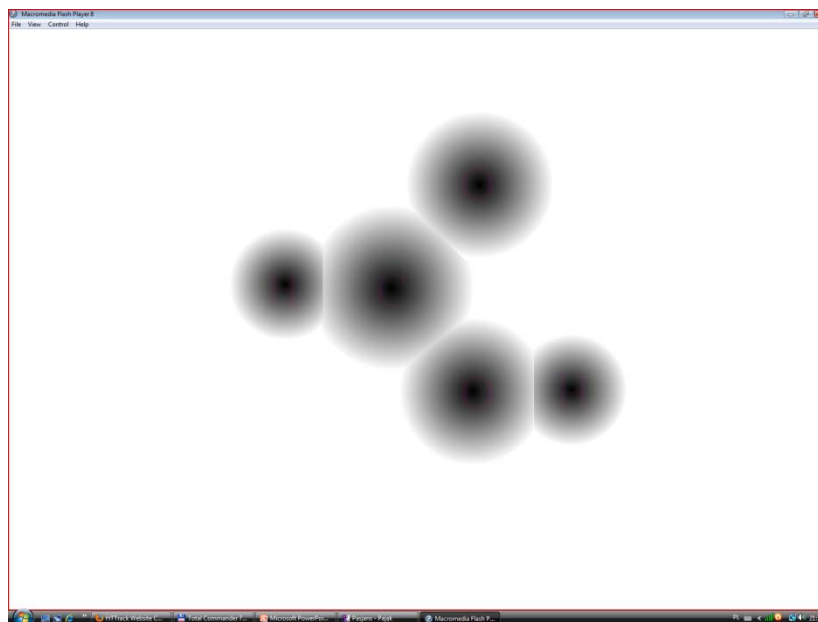




The main assumptions of the computer animated models include:



- they show spatial structure on the micro-world level,
- they show movements of chemical individuals in solids, liquids, and gases,
- in these models, proportions between individual atoms in particles as well as between ions are maintained,
- chemical individuals do not have clear-cut boundary, and the computer models show the structure of electron cloud in a blurred way, without boundaries,
- they take into account the theory of Brownian motion,
- they show that atoms, ions, and particles are colourless,
- they make it possible to repeat the reaction with pointing to its particular stages,
- they make allowances for simplifications which are due to the pupils' level of knowledge.

Modelling the transition from the molecular model for the chemical structural formula

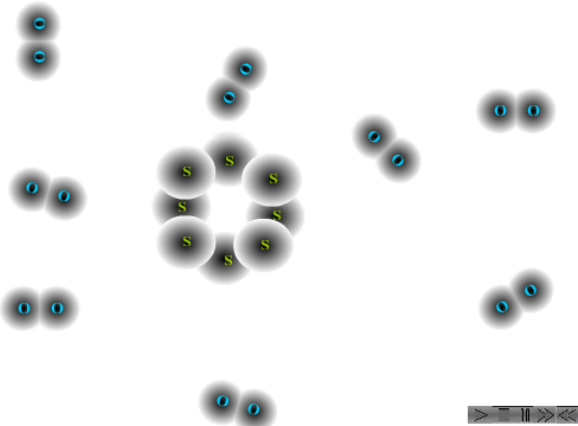


Przejdźcie do animacji

Modeling the chemical reaction of combustion of sulfur



 

$S_8 + 8O_2 \rightarrow 8SO_2$



Opis:
Animacja przedstawiająca w skali mikro łączenie się siarki z tlenem.

Autor: Budźko Magdalena

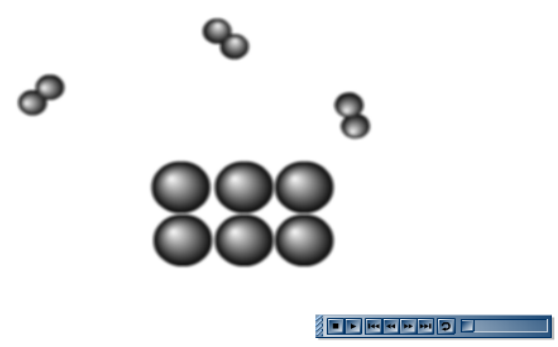
[Przejdź do animacji](#)

Modelling of chemical reaction of magnesium with oxygen

KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY

2MgO



Opis:
Animacja przedstawiająca w skali mikro łączenie się magnezu z tlenem.

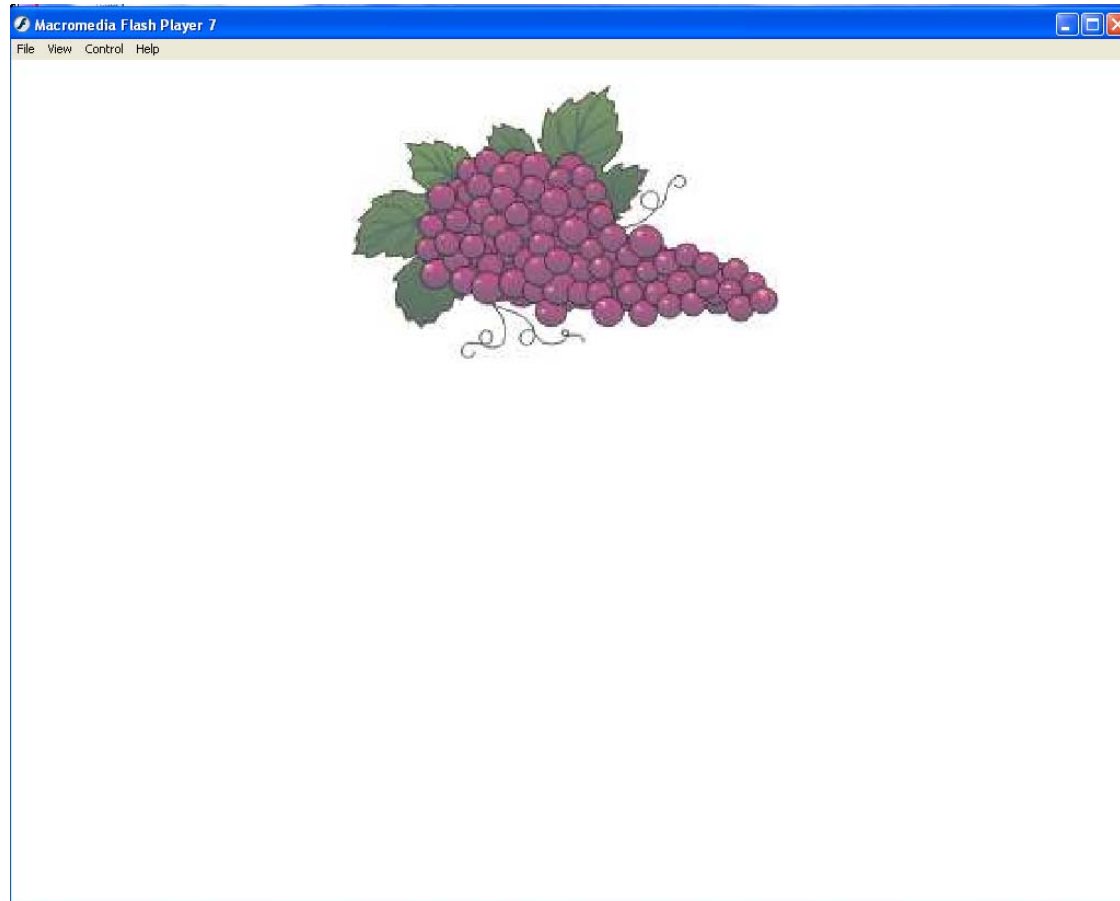
Autor: **Gorcowski Lucjan**

KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY

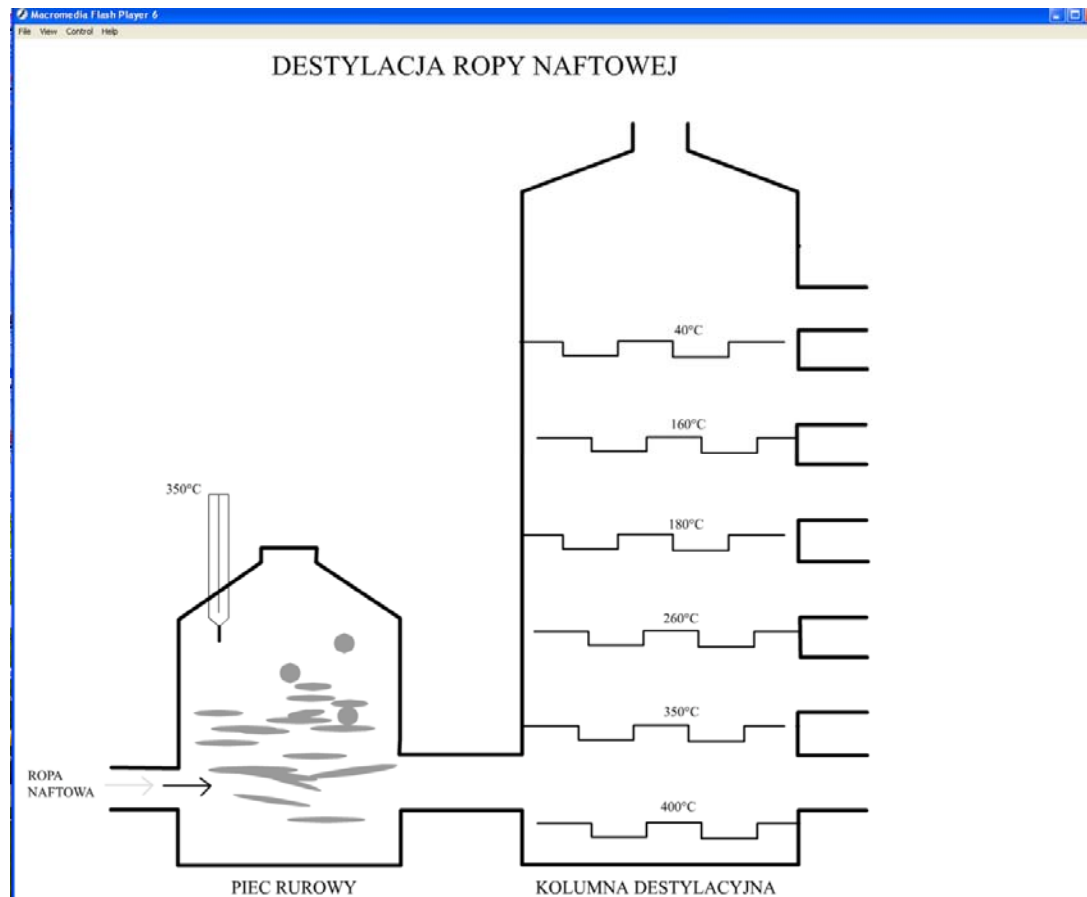
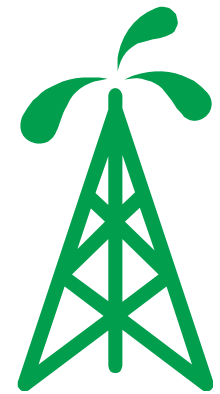
[Przejdźcie do animacji](#)

Alcohol production



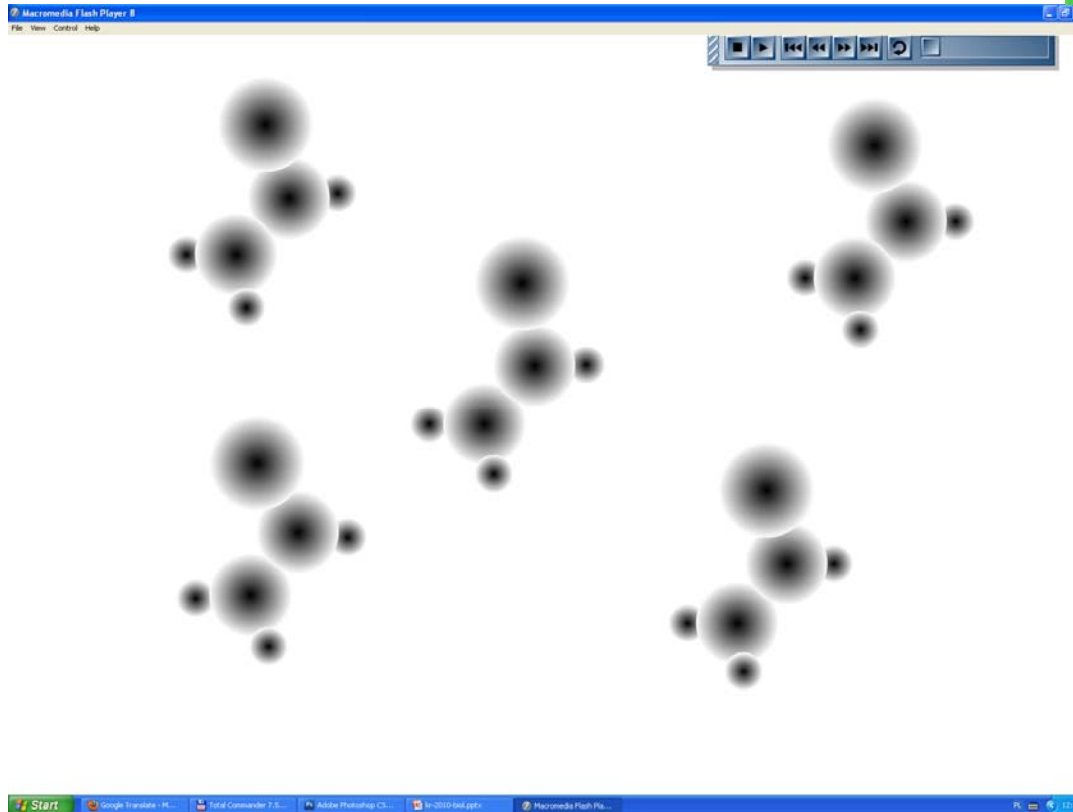
Przejdźcie do animacji

Distillation of crude oil



[Przejdź do animacji](#)

Polymerization



Przejdźcie do animacji



Research

- ▶ Since 2004, the research whose aim is to check the influence of animation on the above-mentioned models on the pupils' comprehension of chemical reactions has been carried out. The research is conducted on different levels of education.
- ▶ Among pupils of primary school (aged 7 to 10) the following research have been carried:
 - *Wykorzystanie modeli tworzonych komputerowo we wczesnym okresie edukacji chemicznej na poziomie nauczania początkowego,*
 - *Wykorzystanie modeli w edukacji przyrodniczej,*
 - *Jak pokazać dziecku obraz mikroświata?*
- ▶ Among elder pupils of primary schools (aged 10–13) the following research have been carried:
 - *Wpływ wieku uczniów oraz efekty zastosowania animacji komputerowej na kształtowanie wyobrażeń wśród uczniów klas szkoły podstawowej,*
 - *Wyobrażenia o strukturze materii wśród uczniów klas szkoły podstawowej w świetle przeprowadzonych badań,*
 - *Zastosowanie modeli dynamicznych do nauczania o zmianach stanów skupienia.*
- ▶ The level of animation comprehension among primary school and lower secondary school pupils was compared in:
 - *Odbiór animacji procesów chemicznych przez uczniów V i VI klas szkoły podstawowej oraz I i II klas gimnazjum.*



Research

- ▶ In lower secondary school (pupils aged 13–16) the following research were conducted:
 - *Wpływ wizualizacji procesów zachodzących w roztworach wodnych na stopień ich przyswojenia przez uczniów ,*
 - *Wpływ różnych technik wizualizacji procesów chemicznych na poziomie mikroświata na wyobrażenia uczniów dotyczące budowy substancji chemicznych [Nodzyńska M., Paśko J.R. 2006],*
 - *The reception of various graphical presentations of chemical compounmolecule on the basic of research,*
 - *Wpływ wieku uczniów oraz efekty zastosowania animacji komputerowej na kształtowanie wyobrażeń wśród uczniów gimnazjum ,*
 - *Wpływ dynamicznych modeli komputerowych na wyobrażenia uczniów gimnazjum o wzorach strukturalnych tlenków .*
- ▶ From the funds of the International Visegrad Fund it was checked whether dynamic computer models are equally comprehensible to Polish, Czech, and Slovak pupils:
 - *The influence of computer animated models on pupils' understanding of natural phenomena in the micro-world level,*
 - *Metoda badań nad odbiorem dynamicznych modeli komputerowych przez uczniów,*
 - *Modele struktury substancji w procesie nauczania chemii .*
- ▶ The results of the research were published in two books:
 - *Vliv dynamických počítačových modelů na porozumění procesů z oblasti mikrosvěta u žáků zemí Visegrádského trojúhelníku,*
 - *Wpływ komputerowych modeli dynamicznych na rozumienie procesów zachodzących na poziomie mikroświata przez uczniów krajów Trójkąta Wyszehradzkiego .*
- ▶ The perception of animation among pupils is a frequent subject of many BS and MS theses and even of doctoral dissertations in our department.



Research

- ▶ Computer animated models are also used to correct assumptions concerning the structure of matter among chemistry teacher–trainees.
- ▶ It takes place when they are asked to create computer animated models, which is one of the requirements to pass the subject “didactics of chemistry.”
- ▶ The aim of such a task is to help students imagine the process of a chemical reaction – the shape of particles, the proportion of their size etc.
- ▶ As such it is the final verification of the previously acquired knowledge and an attempt to a holistic perception of quantum chemistry, crystallography, and chemical kinetics.
- ▶ The research on the influence of the animations created by students on the comprehension of chemical reactions began in 2005:
 - *Rola modelowania w procesie kształcenia przyszłych nauczycieli,*
 - *Modelowanie dynamiczne – jako jedno z zadań zaliczeniowych na przedmiocie 'Dydaktyka Chemii', Rola programu Macromedia Flash w diagnozowaniu wyobrażeń studentów o strukturze materii,*
 - *Od Presu do Flasha,*
 - *Pogram wizualizacyjny Macromedia Flash jako element kształcenia przyszłych nauczycieli.*



Conclusions and implication

- ▶ Summing up, ...

Creation of dynamic computer models of chemical processes in the training of future teachers meet the very important functions:

- ▶ Raise the skills in the use of different computer programs.
- ▶ Allows you to practice the ability to create educational programs.
- ▶ Contributes to the verification of ideas about the micro-world, so that they are close to the current views on the construction of matter and is a factor in shaping and correcting misconceptions about the structure of the micro-world.

Modeling can even be used as a testing of skills, because students, even having the correct theoretical knowledge of the structure of the micro-world – do not have the ability to transfer their imaginations to the computer animation.