New methods in didactics

2. What didactics is?

Part III „Classical” didactical means (subsidiaries)

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a/a 2020/2021

Forms of lessons/lectures

- transmission lesson
- repetition lesson
- checking lesson.
- problem lesson*
- practical lesson **
- exposition lesson
- method of projects
- self-teaching (=learning)
- e - lecture
- e – consultations
- web – surfing

* John Deway

Act of thinking:

1) sense of difficulty
2) making D explicit
3) possible solutions
4) deducing (reasoning) on expecting results from the chosen solution
5) Further experimental observations to check the expectations

** **F. Taylor cycle of work:**

1. Defining aim and plan
2. Preparation of tools
3. Preparation of materials
4. Performing work
5. Tide-up the workshop

GK i F. Bereźnicki, *Dydaktyka kształcenia ogólnego*

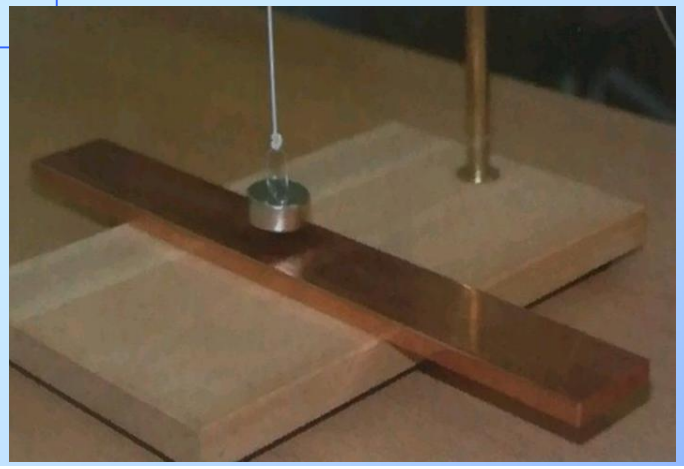
Traditional didactical subsidiaries

- textbook
- notes
- script
- thematic dictionary
- encyclopedia
- compendium
- novels
- synthetic
- anthology
- collection

of fragments
- etc.

- microscope samples
- herbarium
- aquarium
- terrarium
- illustrative poster
- stuffed animals
- models
- anatomic objects
- etc.

- collection of problems
- lab instructions
- set of experiments
- exhibit
- lab setup
- physical models
- simple objects
- experiment *ad hoc*
- printed schemes
- thematic posters
- etc.



- natural (minerals, leaves)
- technical
- symbolic

Real-object didactical subsidiaries

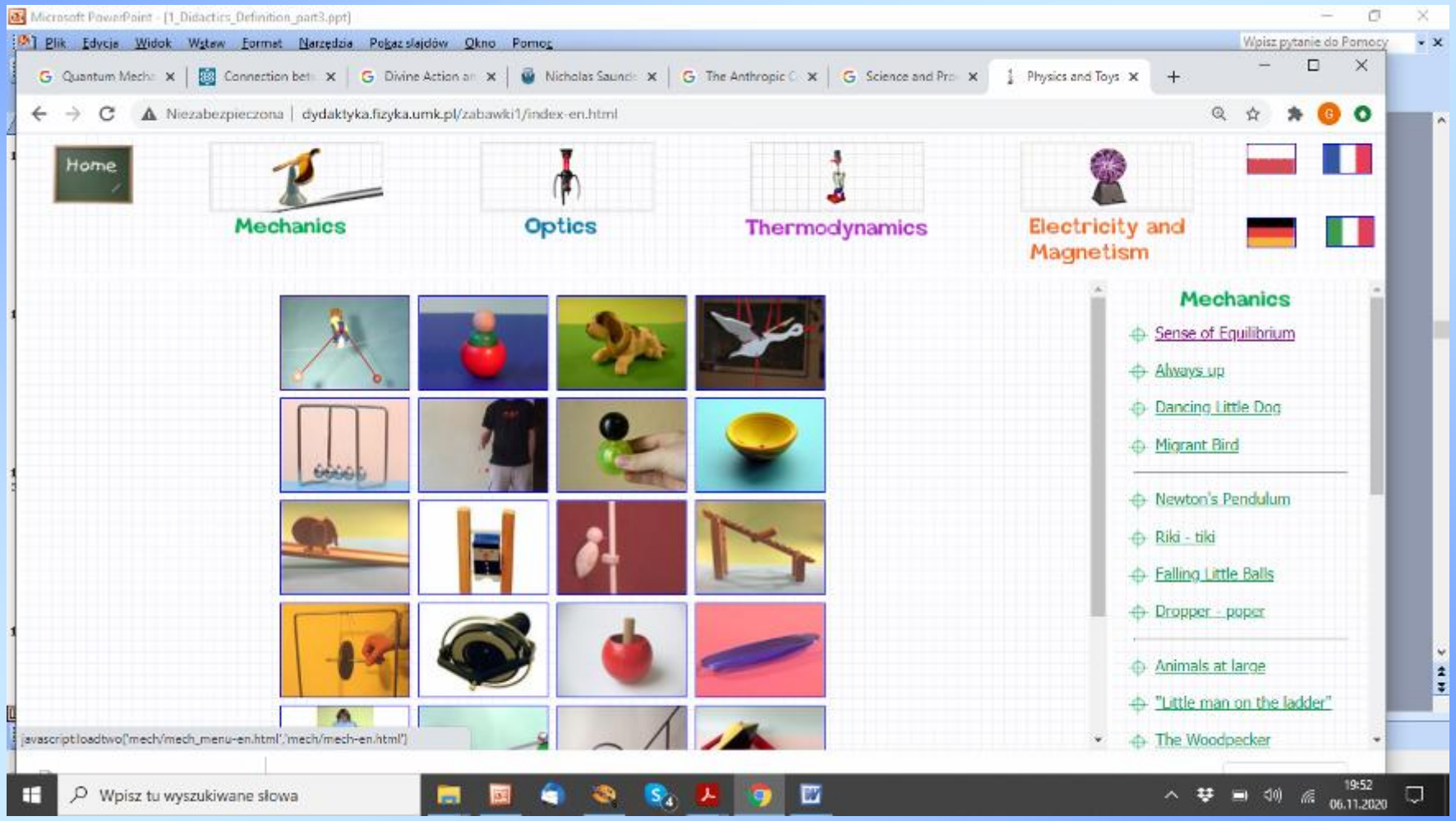
mini, table-top, giant
(subject: resonant frequency)

Freie Universität Berlin, Faculty of Chemistry

Foto: Maria Karwasz, GK

Real objects: Physics and Toys

Small is beautiful

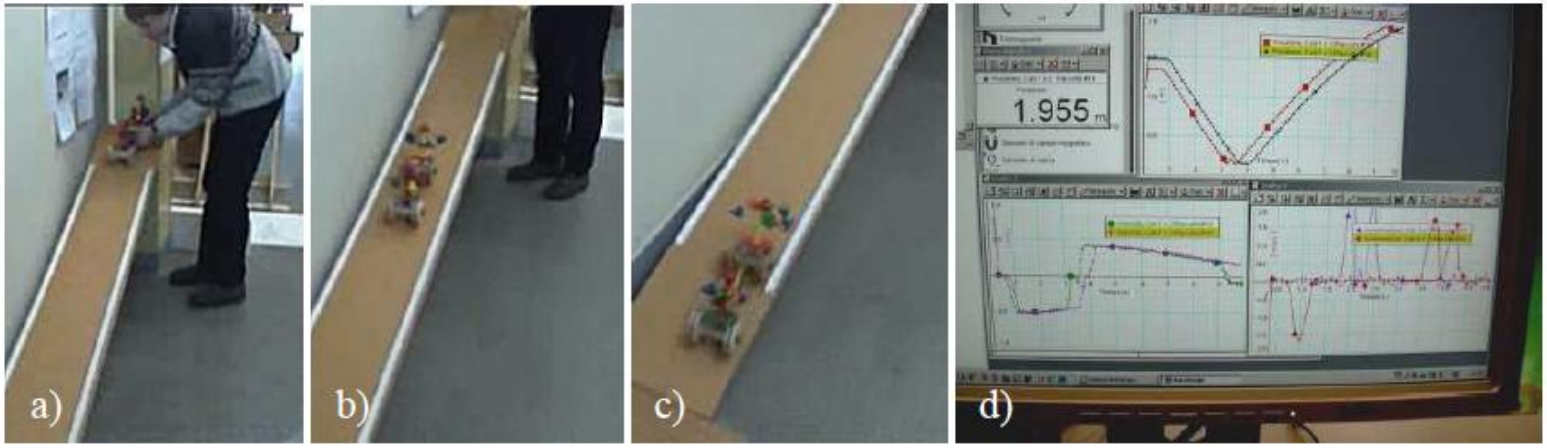


http://dydaktyka.fizyka.umk.pl/zabawki1/index-en.html

Set of experiments in sequence (didactical tunel)

How can we show a growing velocity in the accelerated motion?

„namacalną" – interfejs komputerowy przeprowadza wiele pośrednich operacji matematycznych, zanim wynik pojawi się w postaci wykresu na ekranie, a i sam pomiar dokonuje się nie za pomocą metrowej miarki, lecz czujnika ultradźwiękowego, zob. fot. 4.16d.



Fot. 4.16. Ontologia Kanta na wystawach interaktywnych: pojęcie (w umyśle człowieka) generuje rzeczywistość (obserwowalną). „Jak pokazać przyspieszenie, czyli przyrost prędkości w miarę upływu czasu?": **a) – c)** odchylające się koraliki w zabawkowym wózeczku dla małych dzieci ilustrują wzrastającą prędkość ruchu. Tunel dydaktyczny „Z górki na pazurki", UMK 2007. Koncepcja i konstrukcja GK, sekwencja filmowa KS[5], doświadczenie wykonuje mgr P. Miszta; **d)** ten sam pomiar - drogi, prędkości i przyspieszenia za pomocą konsoli komputera traci atrybut realności (Uniwersytet w Udine, źródło i fot. GK)

G. Karwasz, J. Kruk, *Idee i realizacje dydaktyki interaktywnej*, UMK 2011

Traditional didactical subsidiaries

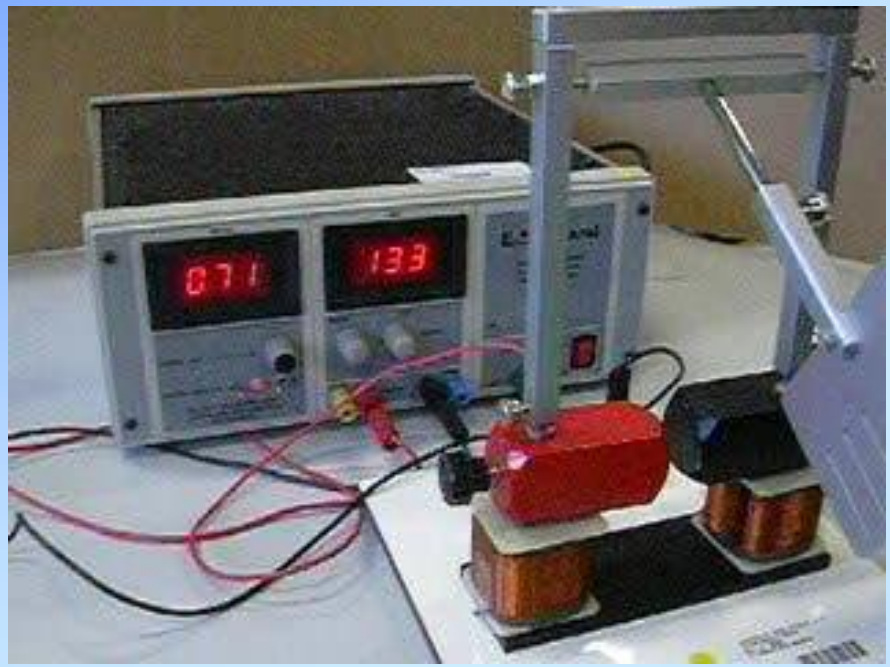
UMK Supercomet video

Kazakh National University
Photo: Zh. Akhimhanova.

School-like experiment
(Subject: Electromagnetic induction, Ohm’s law)

Traditional didactical subsidiaries

Foucault currents



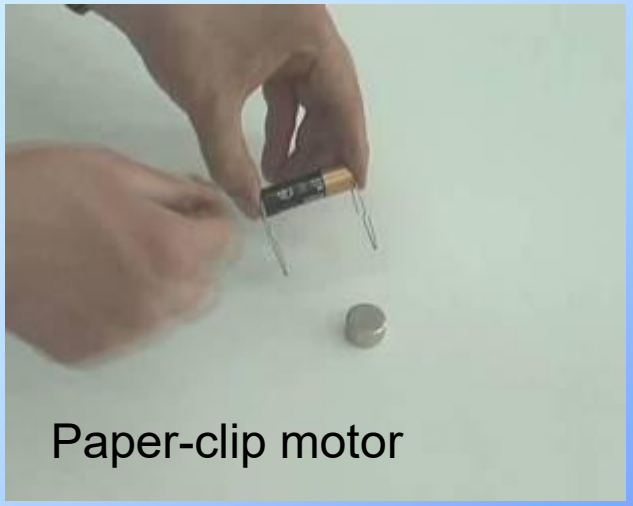
Milikan's experiment

See film at: http://dydaktyka.fizyka.umk.pl/Physics_is_fun/conf/UDINE/fou1.mov
http://dydaktyka.fizyka.umk.pl/Physics_is_fun/conf/UDINE/dscn0724.mov

University didactical experiments (Uni Udine, lesson by GK)
Subject: Electromagnetic induction

Portable experiments

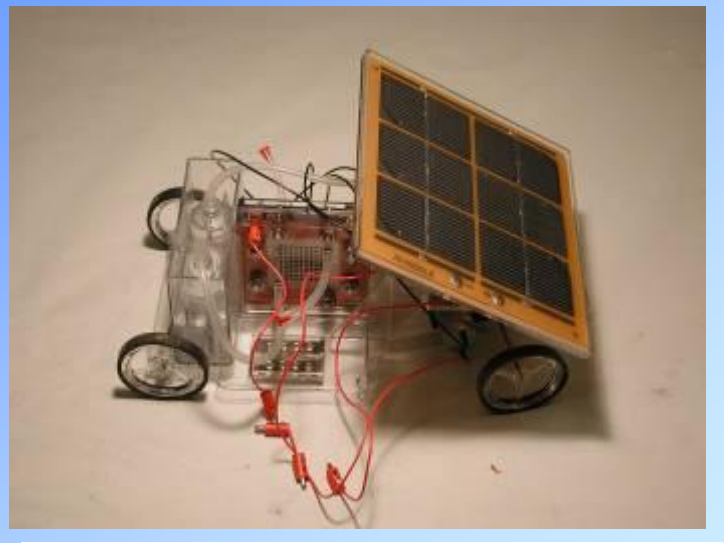
Drunken magnet



Paper-clip motor

Self-made experiments (A. Karbowski, K. Służewski, W. Peters)
(Subject: Electromagnetic induction)

Traditional subsidiaries: „sets”



Clementoni, *Chimica*
https://it.clementoni.com/collections/giochi-scientifici

model to be mounted, set of elements („lego”), chemistry set

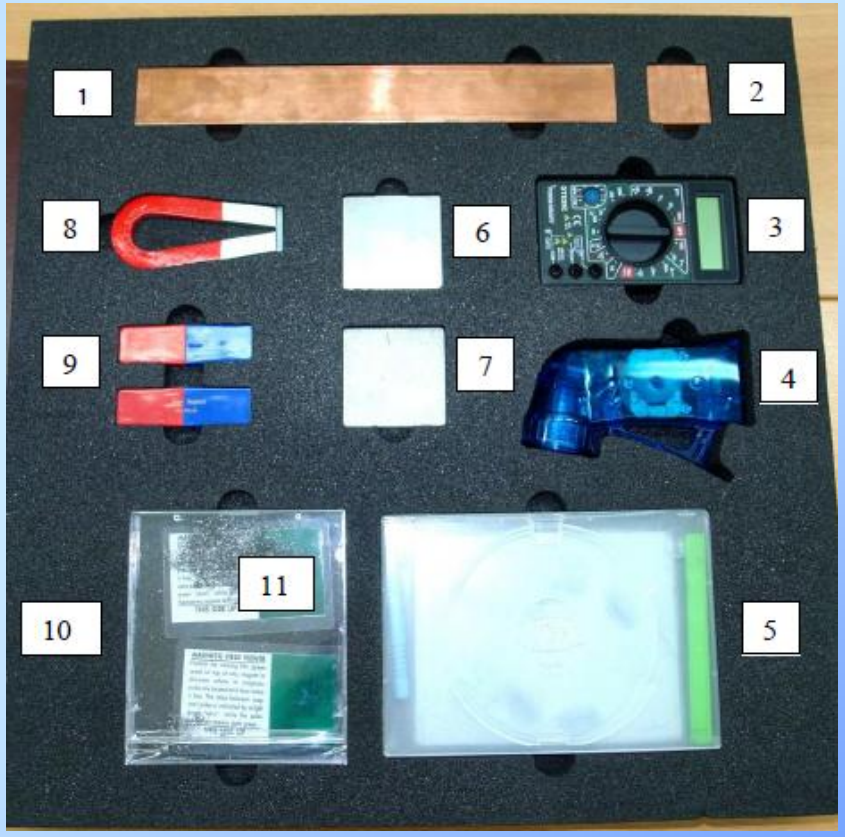
Traditional subsidiaries: „sets”

MOSEM Low-Tech kit educational path
Minds-on 40 simple experiments

1. Magnets and magnetic materials
1.1. Magnetic beetles
1.2. Magnetic dog
1.3. Magnetic materials [SC2 guide page 56]
1.4. Magnets floating on the water

2. Magnetic fields
2.1. Study of magnetic field with filings [SC2 guide page 54]
2.2. Set of toy magnets + fluxdetector
2.3. Magnetic sticks and balls (Geomag) + magnetic micro-fillings table
2.4. Series of compasses hanging above a magnet

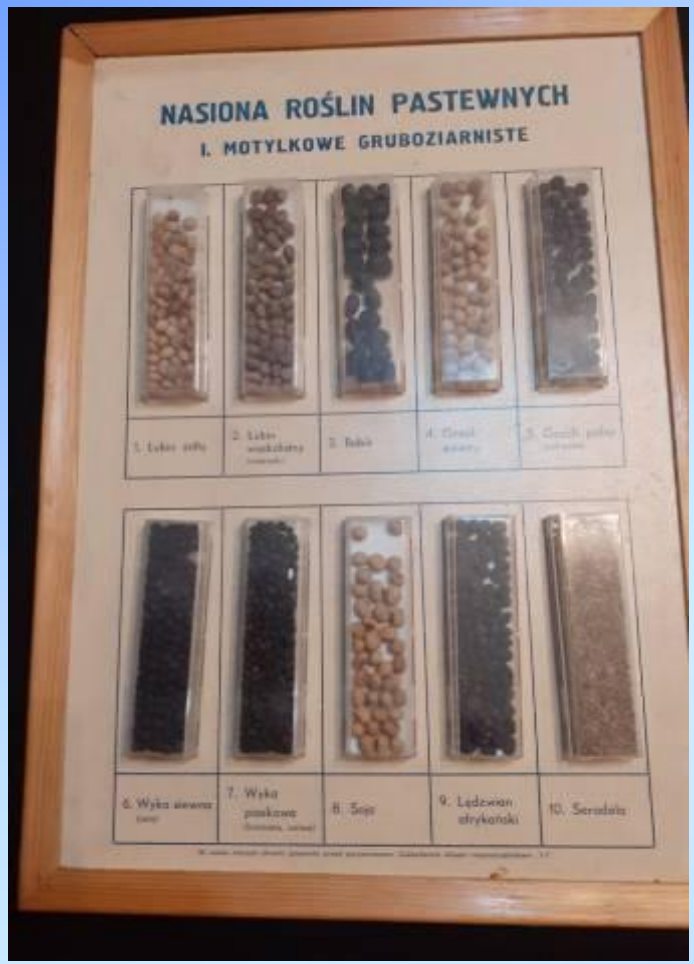
3. Magnetic interactions
3.1. Magnetic sticks and dipole magnets – attraction and repulsion
3.2. Tile of 5 magnetic rings around a stick
3.3. Tile of many magnetic rings in a tube
3.4. Attracting force: measurement with springs
3.5. Repelling force: measurement based on gravity
3.6. “Ski jumping” in a magnetic field



Didactical set of experiments in electromagnetism © UMK 2009

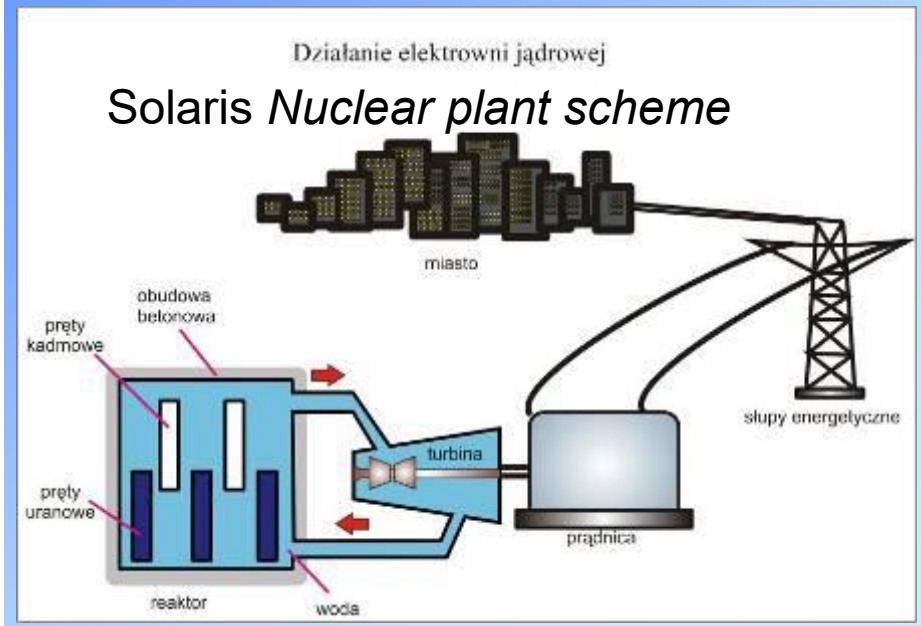
http://dydaktyka.fizyka.umk.pl/Pliki/Zestaw_doswiadczalny_do_elektromagnetyzmu.pdf

Traditional subsidiaries: „sets”

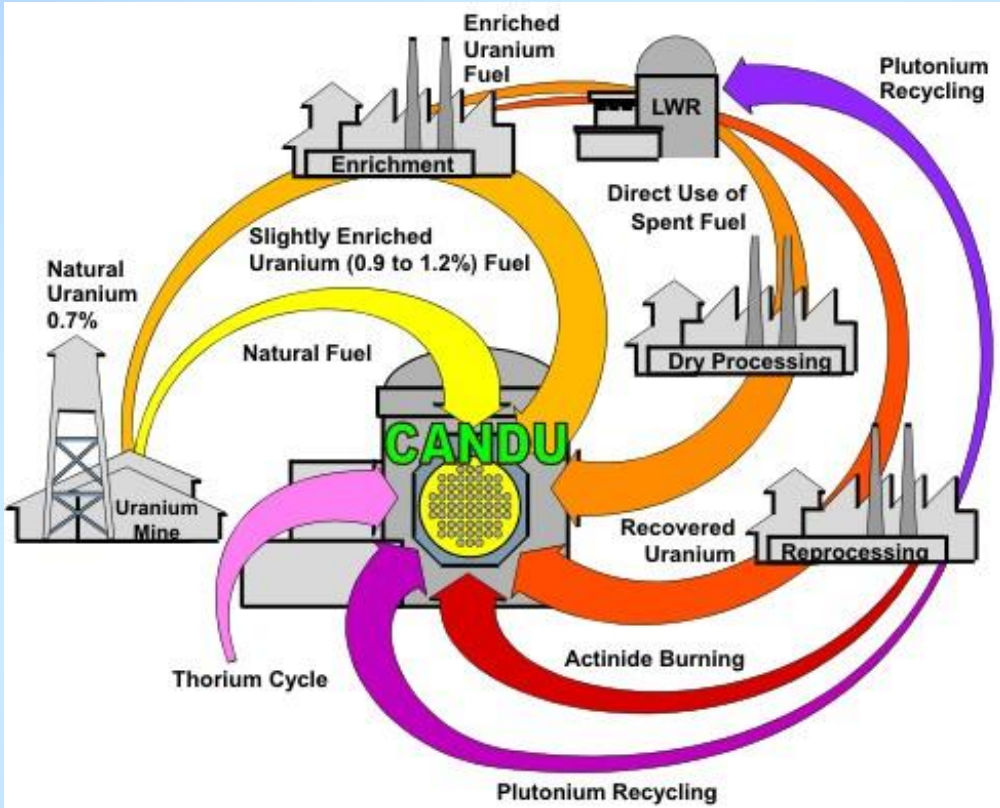


Didactical collections of seeds © Stanisław Karwasz 1968
Pig’s heart: anatomical preparation © St. Karwasz 1960

Traditional tools: printed matter



Solaris *Nuclear plant scheme*



CanDU at Quinsham

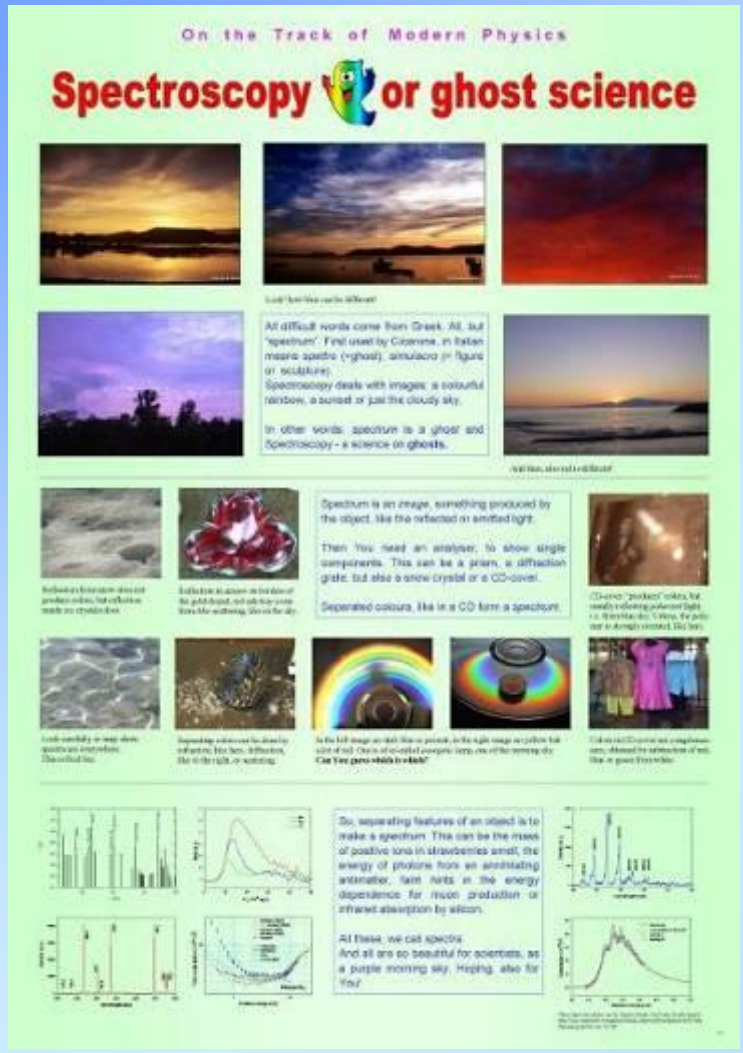
Scheme & Photo

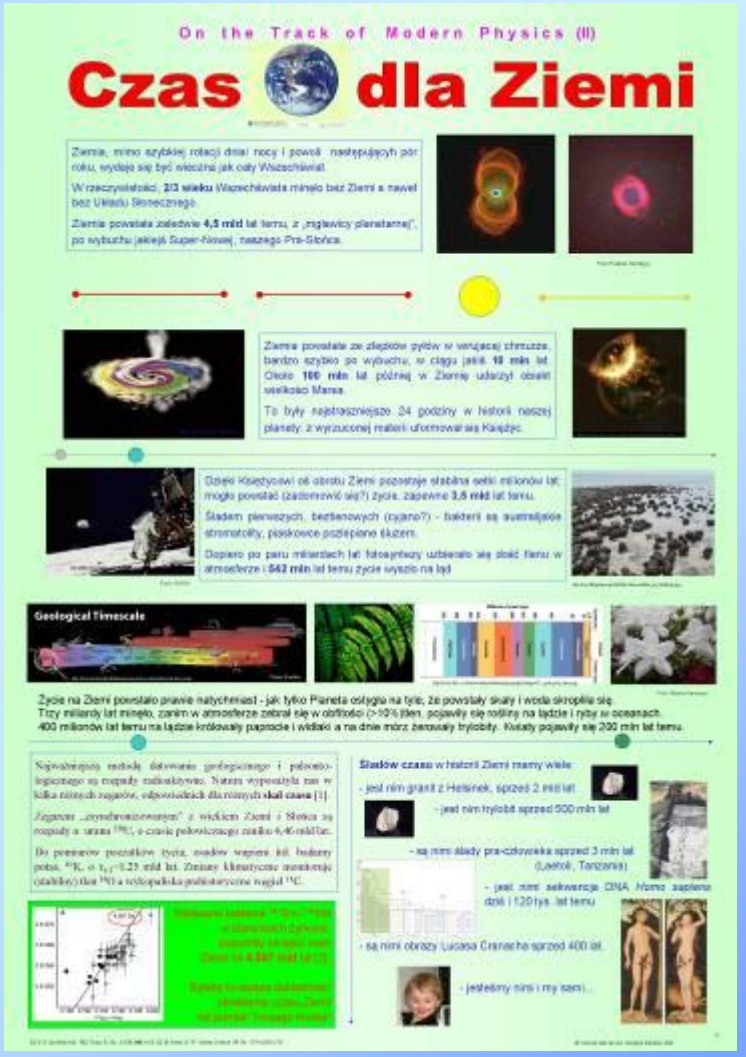
Traditional tools: printed matter

Ilustrated table (see Comenius)

Even drinking tea is
a good moment for teaching

Didactical (narrative) poster





GK, „Time fo Earth" Science Picnic Warsaw, 2014

G. Karwasz *On the track of Modern Physics*

http://dydaktyka.fizyka.umk.pl/Physics_is_fun/posters/ghost5.ppt

Multimedia in didactics

Rys. 1. Przykłady zbiorów multimedialnych. 1a – lewitron, 1b – balansujący ptak, 1c – schemat

Źródło: G. Karwasz, A. Okoniewska, Fizyka i zabawki, PAP, Słupsk 2006.

Multimedia files

- photos
- drawings
- schemes
- animation
- simulations
- analogies
- narration
- registration
- sounds
- sequence
- etc.

Rys. 6. Encyklopedia Tysiąclecia jest przykładem tematycznej ścieżki historycznej

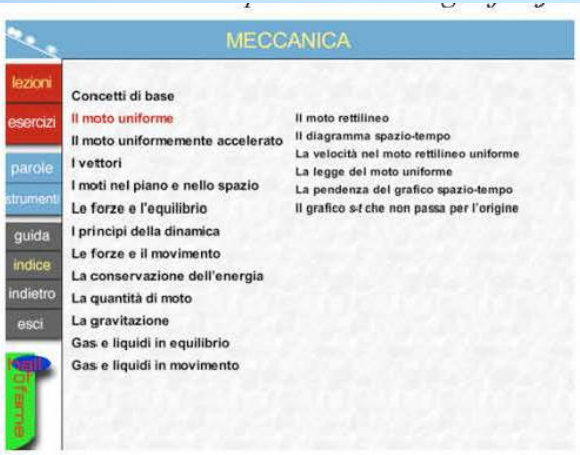
Źródło: Enciclopedia del Millennio Arnaldo Mondadori Editore 1999.

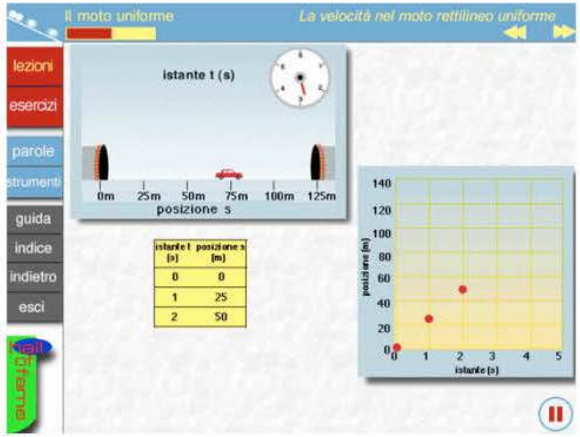
Thematic pathways

GK, *W kierunku powszechności dydaktycznej multimediów,* 2011

Multimedia in didactics

Thematic encyclopedia





Multimedia textbooks

Źródło: Amaldi U., „Fisica Interattiva. Meccanica", Zanichelli Editore SpA, Bologna 1997.

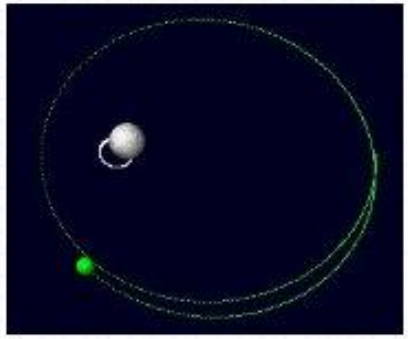
Multimedia in didactics

Multimedia files

photos

sounds

movies



simulations

GK, *Physics is Fun*, S&S EU, 2004
http://dydaktyka.fizyka.umk.pl/Physics_is_fun/html/index-en.html

„Physics around us”

„spectroscopy, or ghost science”

Shop window in London

Snow in Folgaria

Cadine (Trento)

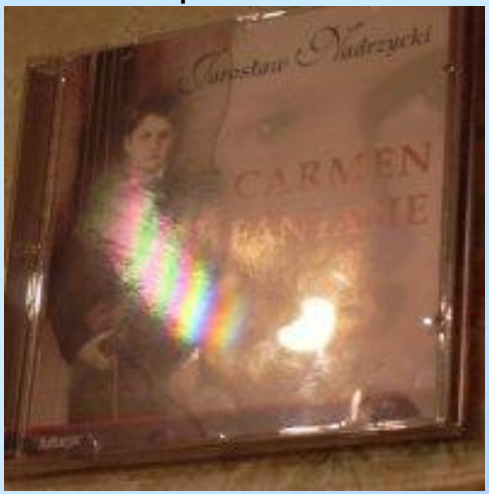


Foto GK

Shop window in Berlin

The whole world is around us, it is enough to watch (& think) [GK]

New methods in didactics

2. What didactics is?

Part IV Goals of the education

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a/a 2020/2021

But both the principles, methods and means are subjected to the goal

- that is to give the young people the eduction (i.e. the knowledge plus formation)
- -------
- This, obviously, is a noble goal, so very general i.e. enigmatic
- (In Polish one says that with good intents the hell is paved)
- In the real life, different goals are defined in different *realities*
- One must choose these goals, i.e. valorize one and resign of other

and so these real, instant goals may be very different

- that as many as possible pupils pass the entrance exam to the university (= high level, to everybody)
- that school „produced” as many as possible laureates from Olympian games
- that school achieves 100% rate of maturity exam
- that the school is well classified in rankings [who organizes these rankings and what kind of qualification he/she represents in pedagogy, didactics, science?]
- that the teacher gets job for the next year what is not the best from the point of view of the pupil/ parent/ society”

A much better goal would be:

- assure the student, in his/her adult life, a civilisation success, where by „civilisation” we understand both:
- economic one (i..e. the possibility of welfare for her/him and their family), and
- cultural one, i.e. ability to participate, support, and possibly create cultural goods: artifacts – arts, music, literature etc.

In other words, the individual, particular goal of the pupil and his/her parents, coincides with the broader, global and social goal.

Never in the education the goal can be: „we want more students to enter Physics Faculty (see Weber’s law of sociology)” or „we want more scientists”.

And didactics of physics has smth in common with all these principles?

Quite a lot! The aim is not to teach Newton's laws themselves, but practical ability to „use" them in practical life: like it is done by an infant as soon as he/she starts to understand the law of gravity, of the center of mass, of the point of support, of the dynamic and static friction – i.e. as soon as he starts practicing a bi-pedal, vertical locomotion position.

In a way, that he/she understands that on the curve the the centrifugal force rises as the square of the velocity $F=mv^2/r$

that the coefficient of friction is less than 1, so the breaking path is linger

that frozen, winter air is dry, so it is worth opening the window in winter not in summer; but for a short time only, to exchange the air, and in this way to pump-out water vapour, but open for a short time, not to make the walls cold, what would bring an opposite effect.

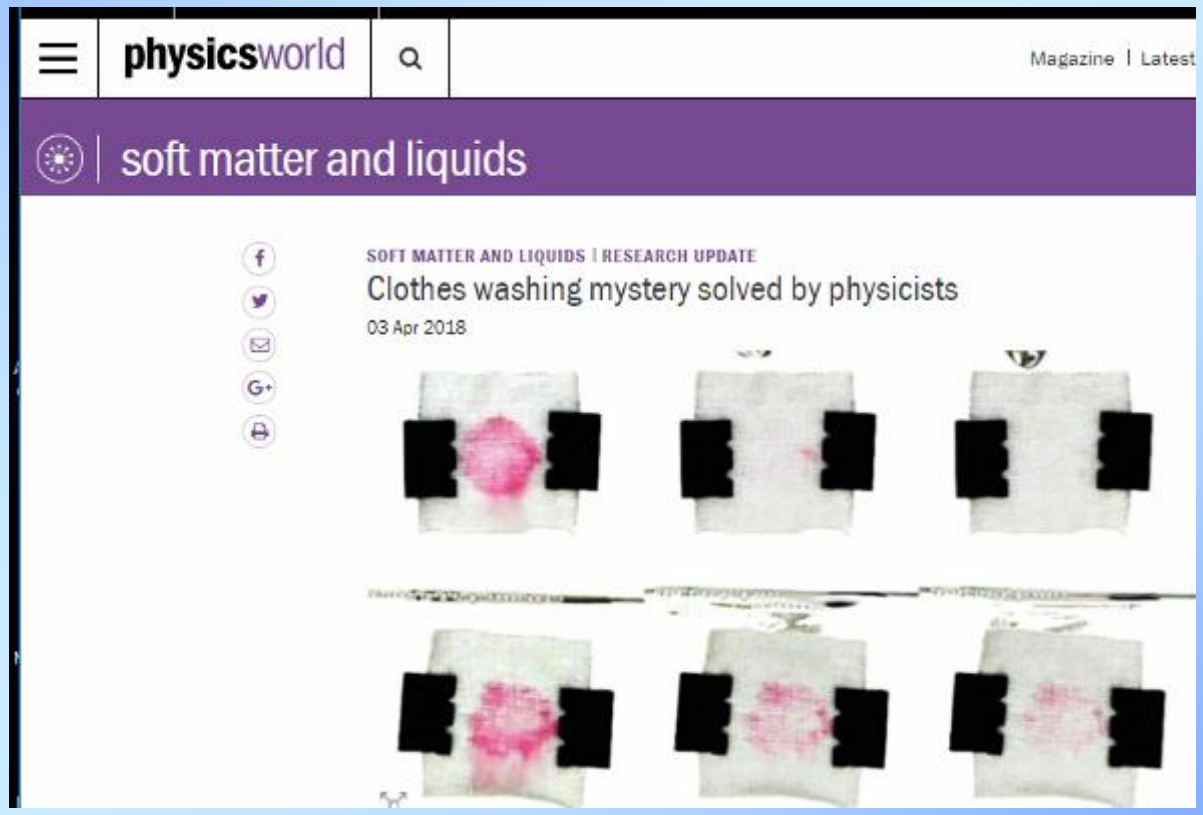
that a microwave oven does not worm-up dry food, so it can be even damaged, if there is not enough (liquid) water inside

that the traces on the sky behind the airplanes do forecast the change of the weather (in upper atmosphere wet air is arriving)

that in sauna one can die suffocated as the total pressure, according to Dalton's law) is the sum of partial pressures, etc.

Didactics of physics, both for triggering the research interest and for knowledge transmission and for opening minds may,

use all different achievements of the „professional" physics, like the scientific research in subject of washing clothes (in cold water)



https://physicsworld.com/a/clothes-washing-mystery-solved-by-physicists

So, didactix of physics should also assure three kinds of competences:

- **knowledge**: the friction depends on the on the coefficient *f* and the force of the pressure; in other words, for the truck and for the automobile the path of breaking is exactly the same; and as the coefficient of the friction is smaller than 1, the path of breaking can not be smaller than _ _ _
- **abilities**: find the force components on the ropes and supports of a bridge; finding the systems of breaking that taking into account that the coefficient of the static friction is higher than the coefficient of the dinamic friction (i.e. an ABS system)
- **social competences**: nothings will save us from „falling out" from the curve, if we do not reduce the velocity down to the value indicated on the road sign (especially with the rain) and not obeying it we risk not only own life but also of the passengers.

https://www.youtube.com/watch?v=j-zczJXSxnw
https://www.youtube.com/watch?v=qPNxMGu9XII
https://www.youtube.com/watch?v=25Lt6ulrdtg

The fundamental requirement of effective didaxis, i.e. practical teaching based on a reasonable didactics is teaching:

- such subjects and questions
- with such methods
- and with using such measures (means),

→ that will allow

- formation in the student's mind the knowledge which is durable, useful and linked to positive emotions during the process of learning.

At the same time, no subject may gain sucha place in (always limited) curriculum of the students that no place is left for other subjects and/or the emotional/ intelectual/ physical harmony in his/her development is compomised. This requirement is a part of so-called Pedagogical Contents Knowledge (Shulman, 1987).

Resuming, didactics is not an enigmatic science on teaching (in Polish: „nauka o nauczaniu”) i.e.

- about some general and everywhere applicable methods, as these are well defined already from times of Comenius (it is worth consulting him)
- but practical, concrete, current and local capacity of *diagnosis of educational difficulties* (of the pupil, student, teacher, and the whole national system).
- However, diagnosis in itself is completely useless, and even irritating: *a recipe (i.e. a medicine) must be given*, i.e. concrete measures (methods, means, hierarchy of principles) to solve these local and current problems.

Thank you for your attention