How does Research in Science Education support the practicing Science teacher?

International Expert Seminar: Impact of research in science education addressing the need for a knowledge-based society

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Challenges for Science Education

A gap between different science subjects.

Broken link with other lessons.

Compartmentalised subjects taught by teachers isolated within and across departments.

The intensive curriculum but insufficient time allocation for science education.

The instruction within lessons tends to be at an information level and students passive recipients' (only listening and writing), teachers are active (writing on the board and teaching in a classical way).

Students generally lack motivation and have low self confidence in learning.

Etc.

How we can move towards more meaningful learning in science education?

Centre for Science Education, UT

Focus on ways to make science education more equitable and inclusive.

Promote collaborations and partnerships among those involved in science education (e.g., teachers, school board members, university faculty, informal science educators) as they research science teaching and when possible, the degree to which student learning is affected.

Address areas that have either been insufficiently investigated or not investigated at all and have the potential to improve science teaching and learning.

Share research results with the wider science education community inside and outside the classroom.

Research on science teaching and learning plays an important role in helping all students become proficient in science and making science education more equitable and inclusive.

Key terms with the respect in the Centre for Science Education

Scientific literacy (incl. Health and Biological literacy);

E-testing;

Science-related career awareness;

Learning-scenarios;

Learning modules;

Motivation, interest and relevance;

Socioscientific issues;

Science teachers professional development;

Core ideas;

21st century skills

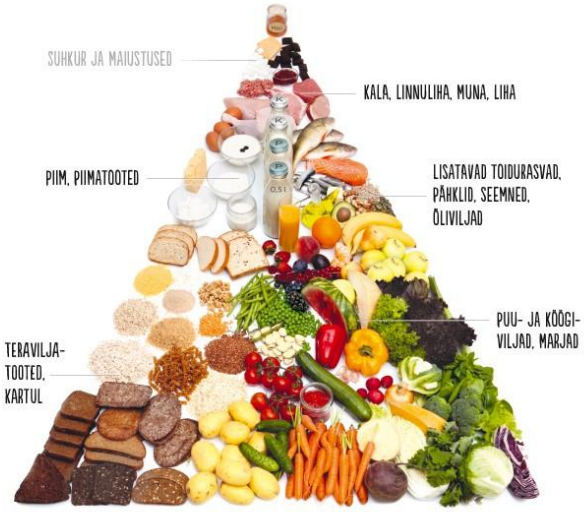
Etc.

How I tried to find solutions for the challenges?

Students tend to have low perceived self-efficacy towards core ideas (especially core ideas related to chemistry and physics) and 21st century skills – limiting application of their actual science competence.

Interdisciplinary science learning can play role in conceptualising a framework of core ideas and promoting students’ 21st century skills.

Perceived self-efficacy is seen as a person’s evaluation of their abilities to organize and perform activities that require the use of skills (Bandura, 1986).



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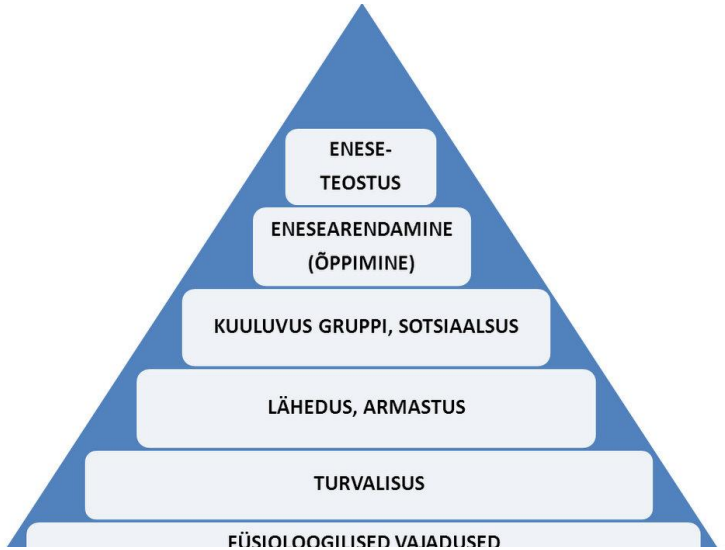
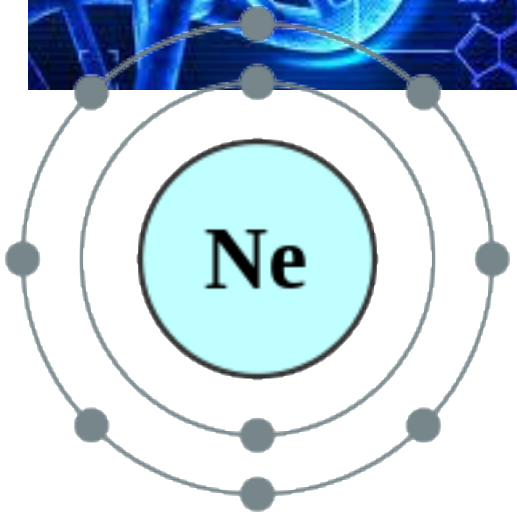


TOITU MITMEKESISELT:

- Söö iga päev midagi viiest põhitoidugrupist!
- Varieeri toite toidugruppide sees!

PEA MEELES!



Interdisciplinary Model

Interdisciplinary Energy

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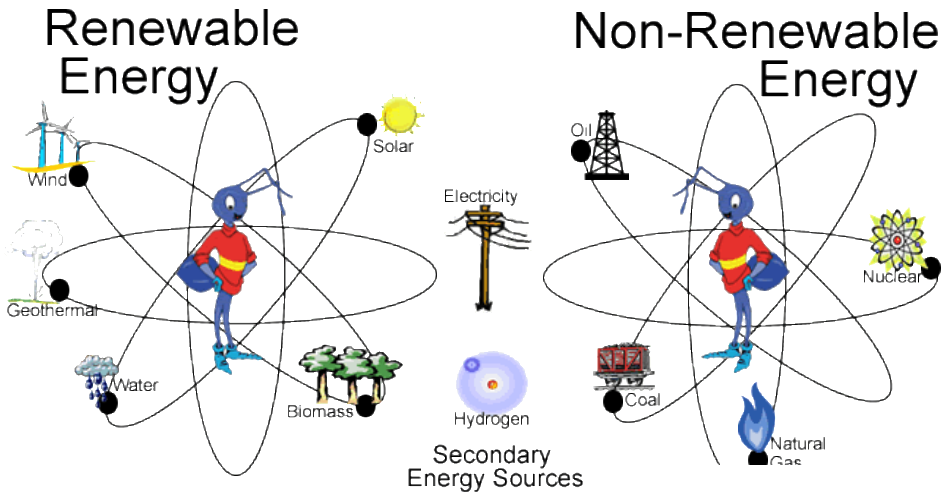

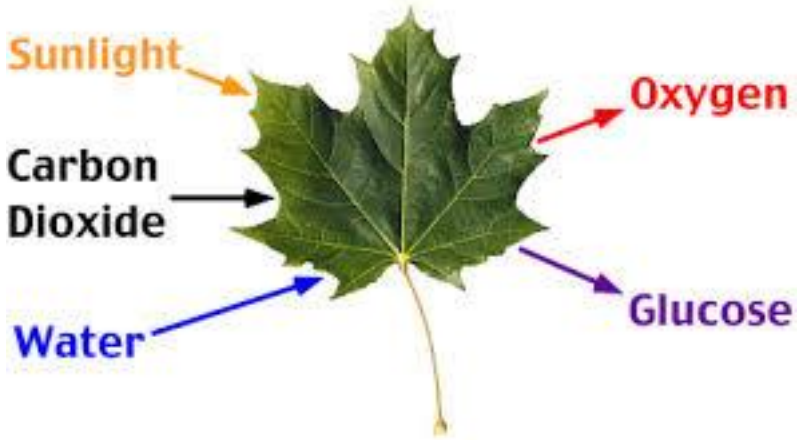

Core idea (through) maps

The core idea maps are intended to depict the development of important, conceptualised fundamental ideas in science, including due attention to the science-related knowledge and appropriate 21st century skills.

These core ideas can be drawn together in form of a maps.

The design of these core idea maps to be developed follow the mind mapping method, which has been shown to support students' knowledge construction.

Knowledge progression from grade level 1-12

Core idea

GENETIC VARIATION

10-12...

A gene mutation is a permanent alteration in the DNA sequence that makes up the gene, such that the sequence differs from what is found in most people.

Mutations can occur as the result of exposure to environmental factors, such as smoking, sunlight and radiation. Mutations can also occur during DNA replication if errors are made and not corrected in time.

We can determine relatedness between organisms by: comparing proteins, nuclear DNA, mitochondrial DNA, the entire genome.

DNA is a molecule composed of two polynucleotide chains that coil around each other to form a double helix carrying genetic instructions for the development, functioning, growth and reproduction of all known organisms and many viruses. It is nucleic acid.

Genetic variation refers to diversity in gene frequencies. Genetic variation can refer to differences between individuals or to differences between populations.

A gene is a length of DNA that codes for a specific protein. Genome engineering (or genome editing) refers to altering an organism's genetic code. Alterations include deleting nucleotides to knock out a gene, adding nucleotides to knock in a protein, or editing nucleotides to create a mutation. Gene editing can occur at the DNA, RNA, or epigenetic level.

DNA is a complex molecule that consists of many components, a portion of which are passed from parent organisms to their offspring during the process of reproduction.

7-9...

In unicellular organisms, cell division is the means of reproduction; in multicellular organisms, it is the means of tissue growth and maintenance.

Heredity, also called inheritance or biological inheritance, is the passing on of traits from parents to their offspring; either through asexual reproduction or sexual reproduction, the offspring cells or organisms acquire the genetic information of their parents.

The single-celled zygote begins to divide into a solid ball of cells.

Like chromosomes, genes also come in pairs. Each of offspring parents has two copies of each of their genes, and each parent passes along just one copy to make up the genes that offspring has.

Each organism's traits are inherited from a parent through transmission of DNA.

During sexual reproduction, a male and female gamete will merge together to form a new organism. The two haploid cells will fuse together to form a diploid cell – zygote.

START-UP, GENOME RESERVE, BIOPANK, PATENT OFFICE, GREEN ECONOMY, TECHNOLOGY, BIOMETRY, MARKETING, BIOTECHNOLOGY, JOURNALISM, LAW

related careers

Biologist, genetic technologist, analyst, doctor, embryologist, veterinarian, pharmacist, food technologist, bio analyst, laboratory technician, zoologist, botanist, ecologist, biology teacher…

related skills

Analytical skills, critical thinking, laboratory skills, communication skills, collaboration skills, creativity and innovation, problem solving skills, planning skills, entrepreneurship, decision making, ICT, self-expression skills, research skills…

4-6

Offspring resemble their parents and each other.

Individual organisms inherit many traits from their parents. Some behavioural traits are learned through interactions with the environment and are not inherited.

interconnections

For offspring to inherit traits there must be a reliable mechanism for transferring genetic information from one generation to the next.

1-3

Offspring are very similar to their parents.

All animals have offspring's, usually with two parents involved.

VARIATION | SEXUAL REPRODUCTION | MECHANISMS OF INHERITANT VARIABILITY

Suggestions for practicing teachers (based on my study results)

It is important that the content of the teaching material is more closely related to everyday situations and the way how science content is connected and to interconnect it with 21st century skills and science-related careers.

To collaborate with your colleagues.

Students need to be provided with opportunities to construct their knowledge (such as by drawing mind maps) that are interconnected and contextualized in such a way that students are able to call upon the ideas being taught at a subsequent time.

Learning environment needs to support students learning with purposefully developed meaningful activities, such as implementing:

- Everyday life-related scenarios including:

1. Creating core idea maps (following mind mapping method);
2. Through active learning approaches (such as teamwork, argumentation, etc.)

Students' experience with maps

Students found creating core idea maps useful, explained that they liked it and found it novel, interesting and gave the possibility to actively participate.

Furthermore, in general, students:

- liked to collaborate with others;
- welcomed the opportunity to elaborate their understanding about science knowledge;
- perceived core idea maps as interesting and;
- recognised the maps promoted higher motivation towards science learning.

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