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Medical applications of particle physics: Global Teaching Perspectives

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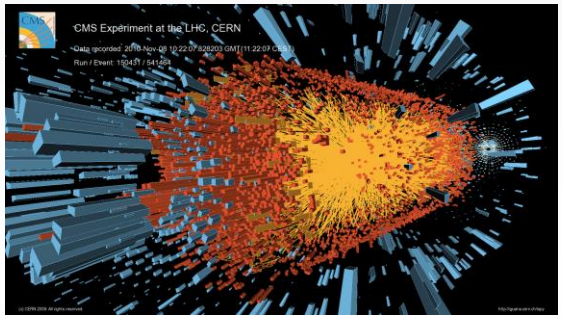
Curriculum & classroom connections

- It should be mandatory for all students to have at least basic exposure to particle physics topics, specifically applications to medicine
- A motivating factor for students to pursue careers in related fields



Curriculum & classroom connections

Physics curricula of the 5 different countries:

- Effects of radioactivity in living organisms, diagnostic tools (X-rays, CAT, MRI) and their operating principles with the advantages and disadvantages of these three methods (English subsystem of education in Cameroon, for the Cambridge system in Romania, for the Ontario provincial curriculum in Canada and for the Latvian system)
- Includes PET (Ontario - Canada)
- Greece briefly mentions the basic concepts associated with such technologies

Curriculum & classroom connections

Missing in the **Physics curricula** of the 5 different countries:

- the most recent advances in the field such as hadron therapy and carbon ions

- economic and political aspects of the medical applications

Proposal:

- the curricula should be revised more often in order to include updated content

- the research facilities should have a stronger focus on sharing recent findings with the teaching community, through websites, workshops and the development of teaching materials.

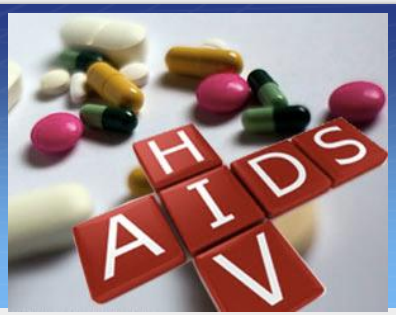
Key ideas

For medical application of particle physics to have meaningful instruction in high schools it is imperative for students to know why particle physics matters.

Particle physics has revolutionized the way we look at the universe.

Along the way, it has made significant impacts on other fields of science including medicine. In particular, CT, MRI and PET scans now allow doctors to peer inside the human body to see what is wrong.

Key ideas / Medications



- Many **medications** evolved out of particle physics research.
- Once a disease is diagnosed, it is up to the doctors to determine how best to treat it. Prescription medications are often the first choice of doctors
- Drugs developed:

  - Kaletra, one of the most prescribed AIDS medications

  - Tamiflu, an antiviral treatment that slows the spread of influenza

Key ideas / Treatment options

- Classroom:

  - the basic physics concepts associated with the technologies, their medical purposes and effectiveness

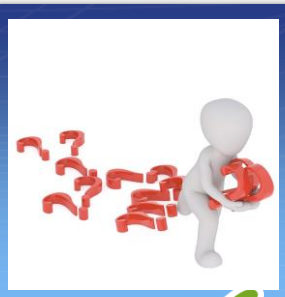
  - the costs involved for the patients and the health care providers and general challenges in the implementation and distribution of technology

  - exploration of career paths in the field and the main functioning centers around the globe

  - a brief discussion of cancer,

  - a brief historical and conceptual discussion of antimatter might be helpful in teaching PET

Potential student conceptions & challenges



- Most students seem to relate to the concept of X-ray imaging
- Challenges:

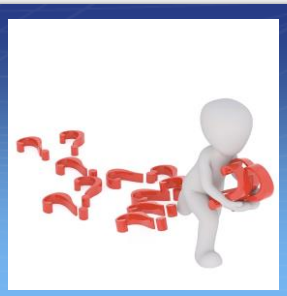
  - how the images are obtained

  - the construction and operation of the equipment

  - understanding which particles react with matter and how, according to their properties (mass, charge etc.)

  - what is their effect on living organisms

Potential student conceptions & challenges/ Terms

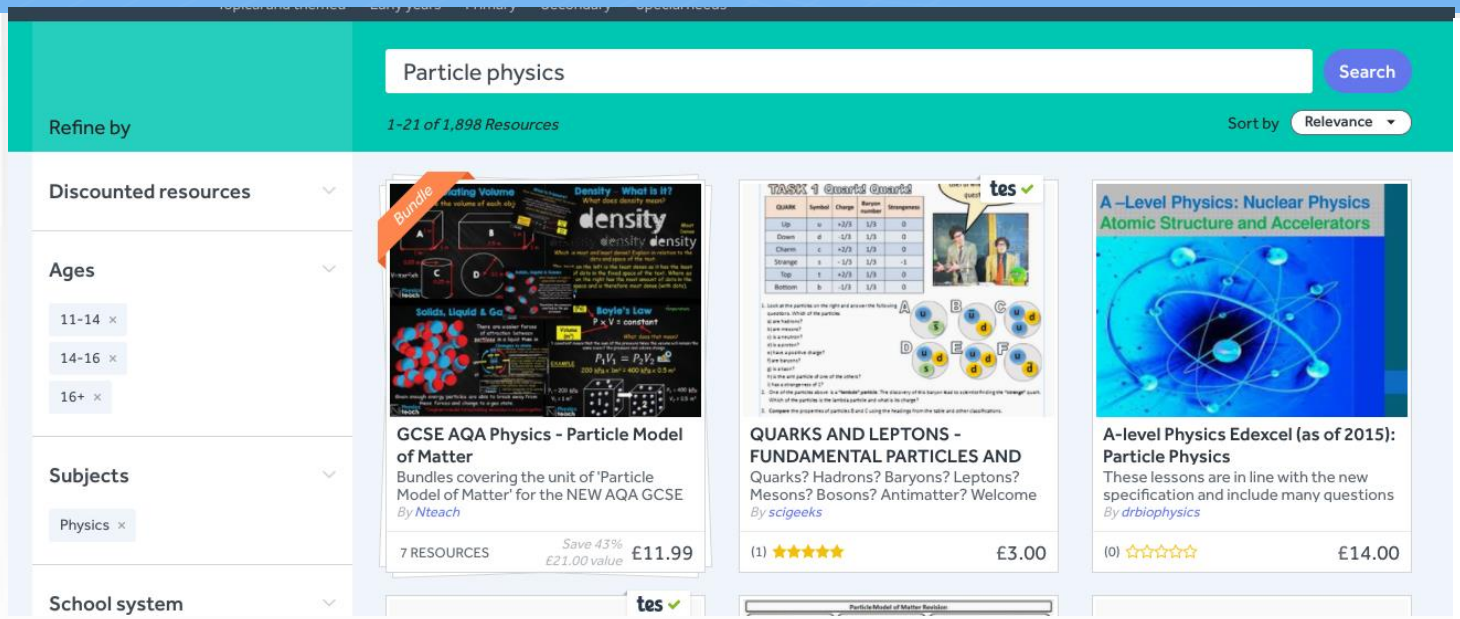


- CAT, MRI and PET in particular are more challenging

  - understand which physical properties are being applied to diagnose and cure

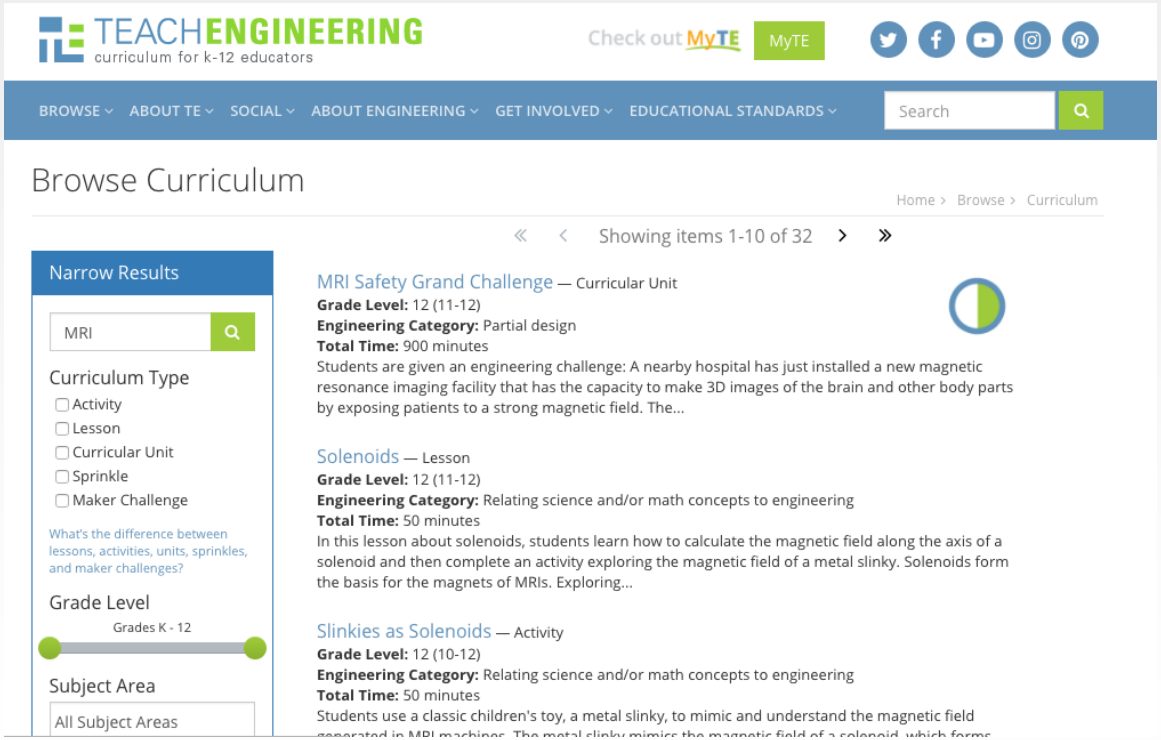
- Certain terms are also unfamiliar for most students, in particular “resonance”, “axial tomography” and “positron”, among others

Helpful material and resources / TES



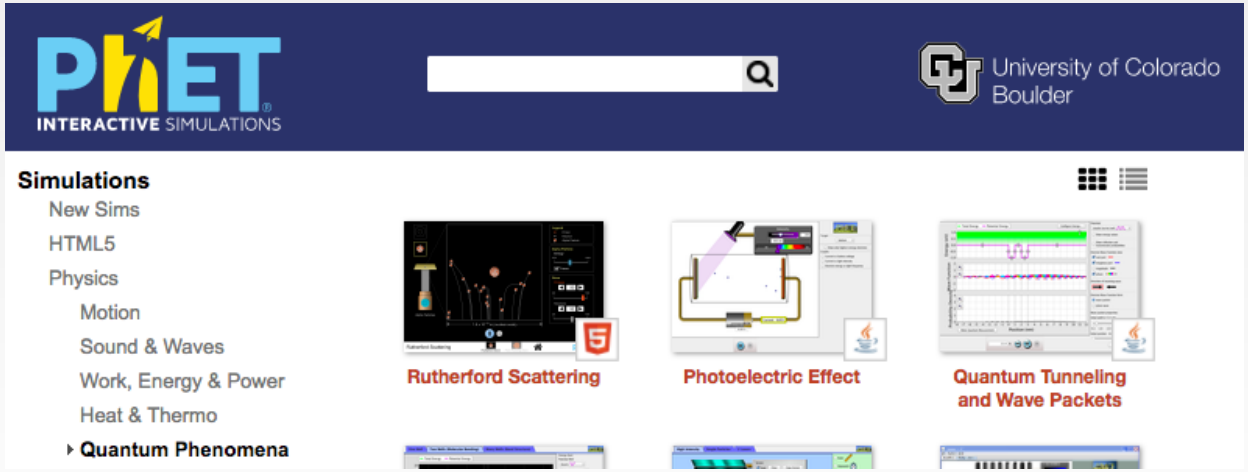
https://www.tes.com/teaching-resources

Helpful material and resources



ww.teachengineering.org

Helpful material and resources / UCB



https://phet.colorado.edu/en/simulations

Best practice example

- Simulations and videos
- Field trips
- Class discussion
- Interdisciplinary lessons
- CERN

Thank you CERN

- Merci 
- Mulțumesc 
- Paldies 
- Ευχαριστω 
- Thank you