Standard #: SC.912.P.10.11

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Explain and compare nuclear reactions (radioactive decay, fission and fusion), the energy changes associated with them and their associated safety issues.

General Information

Subject Area: Science

Grade: 912

Body of Knowledge: Physical Science

Idea: Level 3: Strategic Thinking & Complex Reasoning

Standard: Energy -
A. Energy is involved in all physical and chemical processes. It is conserved, and can be transformed from one form to another and into work. At the atomic and nuclear levels energy is not continuous but exists in discrete amounts. Energy and mass are related through Einstein's equation $E=mc^2$.

B. The properties of atomic nuclei are responsible for energy-related phenomena such as radioactivity, fission and fusion.

C. Changes in entropy and energy that accompany chemical reactions influence reaction paths. Chemical reactions result in the release or absorption of energy.

D. The theory of electromagnetism explains that electricity and magnetism are closely related. Electric charges are the source of electric fields. Moving charges generate magnetic fields.

E. Waves are the propagation of a disturbance. They transport energy and momentum but do not transport matter.

Date Adopted or Revised: 02/08

Content Complexity Rating: Level 3: Strategic Thinking & Complex Reasoning - More Information

Date of Last Rating: 05/08

Status: State Board Approved

Related Courses

Course Number	Course Title
2001350:	Astronomy Solar/Galactic (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2020910:	Astronomy Solar/Galactic Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003350:	Chemistry 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2001310:	Earth/Space Science (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2001320:	Earth/Space Science Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002440:	Integrated Science 3 (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002450:	Integrated Science 3 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003400:	Nuclear Radiation (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
2020710:	Nuclear Radiation Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003320:	Physical Science Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003410:	Physics 2 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2002330:	Space Technology and Engineering (Specifically in versions: 2014 - 2015, 2015 - 2018 (course terminated))
7920020:	Access Earth/Space Science (Specifically in versions: 2014 - 2015, 2015 - 2018, 2018 and beyond (current))
2002445:	Integrated Science 3 for Credit Recovery (Specifically in versions: 2014 - 2015, 2015 - 2020 (course terminated))
2003500:	Renewable Energy 1 Honors (Specifically in versions: 2014 - 2015, 2015 - 2022 (current), 2022 and beyond)
2003838:	Florida's Preinternational Baccalaureate Physics 2 (Specifically in versions: 2015 and beyond (current))

Related Access Points

Access Points Number	Access Points Title
SC.912.P.10.In.6:	Identify that atoms can be changed to release energy, such as in nuclear power plants, and recognize one related safety issue.
SC.912.P.10.Su.5:	Recognize that nuclear power plants generate electricity and can be dangerous.
SC.912.P.10.Pa.5:	Recognize the universal symbols for radioactive and other hazardous materials.

Related Resources

Lesson Plans

Name	Description
Life of the Party:	This activity teaches students how to determine the age of an atom using an onion, cabbage, and Brussels sprouts. Aliens from another planet left these items on our planet and need our assistance determining their age. Based on the number of layers or half lives of the "elements," the students will be able to determine their age. The students will also be able to differentiate between the three types of radioactive decay and understand why radioactive elements are harmful.
Radioactive Decay: Is It Safe for Us to Stay?:	Students will collect data using inexpensive split peas and black beans in order to model how to calculate the amount of a radioactive element remaining after a specific number of half-lives have passed. Students will then use this data to outline and create a response to a scenario-based writing prompt.

Text Resources

Name	Description
Where Do Chemical Elements Come From? :	This informational text resource is intended to support reading in the content area. What is that extremely bright light in the sky? It's a supernova: the result of a massive star collapsing in on itself. This explosion is more than just a pretty sight; it is the main source of the elements that make up our planets and all the other objects in the night sky.
How Nuclear Power Works:	This informational text is intended to support reading in the content area. Nuclear power has become a suggested solution to the issue of energy dependence, but what exactly is nuclear power? This article focuses on the many aspects of nuclear power including how it's created through fission and harnessed for electricity. Discussion of the pros and cons of nuclear energy and storage methods is also covered.
How Tumbleweeds Spread Radiation from Old Nuclear Sites:	This informational text resource is intended to support reading in the content area. The article describes how radioactive materials can be spread by biological vectors, such as tumbleweeds and rabbits, from decommissioned nuclear sites and nuclear waste storage facilities.
Explainer: The Difference Between Radioactivity and Radiation:	This informational text resource is intended to support reading in the content area. This text explains the difference between radioactivity (including radioactive decay, half-life, etc.) and radiation, and the connection between the two.
Oslo-Experiment May Explain Massive Star Explosions:	This informational text resource is intended to support reading in the content area. Some new findings about atomic nuclei may help astrophysicists create more realistic simulations of supernovae thus allowing us to see how heavier elements are formed in stars.
The New Alchemy:	This informational text is intended to support reading in the content area. This article, from the American Chemical Society, reviews the basics of radioactivity and transmutation as well as the history of discovering elements.

Virtual Manipulatives

Name	Description
Beta Decay:	This is a virtual manipulative to understand beta decay. In the Beta decay process, a neutron decays into a proton and an electron (beta radiation). The process also requires the emission of a neutrino to maintain momentum and energy balance. Beta decay allows the atom to obtain the optimal ratio of protons and neutrons.
Alpha decay:	This virtual manipulative will help you to understand the process of alpha decay. Watch alpha particles escape from a polonium nucleus, causing radioactive alpha decay. See how random decay times relate to the half life.
Nuclear Fission:	Complete this virtual manipulative to gain a better understanding of nuclear fission. Study the basic principles behind chain reactions and a nuclear reactor.

Student Resources

Virtual Manipulatives

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Beta Decay:	This is a virtual manipulative to understand beta decay. In the Beta decay process, a neutron decays into a proton and an electron (beta radiation). The process also requires the emission of a neutrino to maintain momentum and energy balance. Beta decay allows the atom to obtain the optimal ratio of protons and neutrons.
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Nuclear Fission:	Complete this virtual manipulative to gain a better understanding of nuclear fission. Study the basic principles behind chain reactions and a nuclear reactor.

Parent Resources

Virtual Manipulatives

Name	Description

Beta Decay:	This is a virtual manipulative to understand beta decay. In the Beta decay process, a neutron decays into a proton and an electron (beta radiation). The process also requires the emission of a neutrino to maintain momentum and energy balance. Beta decay allows the atom to obtain the optimal ratio of protons and neutrons.
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