BPS Science Department Chemistry – Unit 15

Chemistry Unit 15 – Nuclear Chemistry

Unit Overview: In this unit students will learn what makes an element radioactive or unstable. Students will be able to use the chemistry reference tables and transmutation reactions to determine the type of decay for a given isotope. Students will learn that nuclear reactions produce tremendous amounts of energy. Students will be able to solve problems involving half -life of an element. Students will be able to list some benefits and risks of nuclear reactions.

Essential Questions:

- What is radioactivity?
- How is a nuclear equation written?
- What is half-life?
- Why is half-life important in nuclear chemistry?
- How do nuclear reactions produce energy?
- What are some of the benefits and risks of radioisotopes?

MST Standard 4 - Science
Key Idea 3: Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.
Key Idea 4: Energy exists in many forms and when these forms change energy is conserved.
Key Idea 5: Energy and Matter interact through forces that result in changes of motion.

New York State Science Learning Standards Performance Expectations:
HS-PS 1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
HS-PS 1-7 Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
HS-PS 1-12 Use evidence to illustrate that some chemical reactions involve the transfer of electrons as an energy conversion occurs within a system.
HS-PS 3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS 3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-ETS 1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS 1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS 1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS-ETS 1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

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Time Frame	Skills, Practices, or Expectations	Specific Standards / Performance Indicators	Resources	Content Vocabulary	Measurement of Student Learning
05.08.23 - 05.19.23 **5.10.23 Early Release** **5.11.23 Superinten-dent Conference Day**	**dioactivity** Understand what makes an isotope unstable/radioactive. Recognize modes of decay and their properties. Compare and contrast energy produced from nuclear reactions with energy produced from chemical reactions. **Transmutation Reactions** Compare and contrast artificial and natural transmutations. Balance nuclear equations. Identify fission and fusion reactions. **Half-Life** Understand the concept of half-life. Given data, calculate initial amount, fraction remaining, elapsed time, or half-life of a radioisotope. **Benefits and Risks** Compare penetration and ionizing power of alpha, beta, and gamma rays. Understand risks of isotopes. Identify common radioisotopes and their uses.	**MST Standard 4 Science Key Idea 3** **3.1 –** Explain the properties of materials in terms of the arrangement and properties of the atoms that compose them. **3.1o** – Stability of an isotope is based on the ration of neutrons and protons in its nucleus. Although most nuclei are stable, some are unstable and spontaneously decay, emitting radiation. **3.1p** – Spontaneous decay can involve the release of alpha particles, beta particles, positrons, and/or gamma radiation from the nucleus of an unstable isotope. These emissions differ in mass, charge, ionizing power, and penetrating power. **4.4** – Explain the benefits and risks of radioactivity **4.4a** – Each radioactive isotope has a specific mode and rate of decay (half-life). **4.4b** – Nuclear reactions include natural and artificial transmutation, fission, and fusion. **4.4c** – Nuclear reactions can be represented by equations that include symbols which represent atomic nuclei (with mass number and atomic number), subatomic particles (with mass number and charge), and/or emissions such as gamma radiation. **4.4d -** Radioactive isotopes have many beneficial uses. Radioactive isotopes are used in medicine and industrial chemistry for radioactive	Castle Learning- Access through Clever BPS Science Department Recommended Virtual Labs – must be logged into BPS google document account through BPS Gmail account to access *Holt NY Chemistry* Textbook Chapters 18 Regents Chemistry Reference Tables - Tables N, O Dynamic Periodic Table BPS Science K-12 Schoology Folder -12 Resources Chemistry Resources **PhET Interactives** Alpha Decay ● Single & Multiple atom modes - visualize half-life/ alpha decay of polonium-211 or a custom atom Radioactive Dating Game ● Half-Life - Visualize half-life of a variety of molecules ● Decay Rates - Observe graphic representation of decay rates (% remaining) for Carbon-14 and Uranium -238 ● Measurement - Measure percent of Carbon -14 in a tree or Uranium -238 in a rock over time ● Dating Game - Move the sensor for Carbon -14 or Uranium -238 to various objects; slide green arrow in graph to match the percent and record the estimated age Nuclear Fission ● Fission: One Nucleus - Hit Uranium -235 with a neutron and visualize decay	● alpha ● Band of Stability ● beta ● chain reaction ● fission ● fusion ● gamma ● half-life ● nucleon ● positron ● radiation ● radioactive decay ● radioactivity ● radioisotopes ● stable ● transmutation	● Ticket Out ● Think-Pair –Share ● Formative Assessment ● Weekly Quiz ● Unit Test ● Homework ● Review Questions ● DDI process using data from Edoctrina & Castle Learning to generate data **Higher Level Questions**: Regents Exams: January 2020 Questions 64-65 June 2019 Question 54

		dating, tracing chemical and biological processes, industrial measurement, nuclear power, and detection and treatment of diseases. **4.4e –** There are inherent risks associated with radioactivity and the use of radioactive isotopes. Risks can include biological exposure, long-term storage and disposal, and nuclear accidents. **4.4f –** There are benefits and risks associated with fission and fusion reactions. **5.3 -** Compare energy relationships within an atom's nucleus to those outside the nucleus. **5.3a -** A change in the nucleus of an atom that converts it from one element to another is called transmutation. This can occur naturally or can be induced by the bombardment of the nucleus with high-energy particles. **5.2b** – Energy released in a nuclear reaction (fission or fusion) comes from the fractional amount of mass that is converted into energy. Nuclear changes convert matter into energy. **5.3c** – Energy released during nuclear reactions is much greater than the energy released during chemical reactions.	• Chain Reaction - Visualize chain reaction and multiple nuclei of uranium • Nuclear Reactor - Visualize the chain reaction in a nuclear reactor and energy produced Molecules and Light - Visualize how various wavelengths interact with a variety of molecules Beta Decay • Single & Multiple atom modes - visualize half-life/ beta decay of Hydrogen -3, Carbon-14 or a custom atom **Rocket science, served up soggy (Lonnie G. Johnson)*** • Article: Mr. Johnson is the inventor of the super soaker, known as the world's most powerful and popular water gun. With lots of tinkering with air compression, his innovations lead to the invention of the water-based cooling machine. **Life and work of the great Visionary, Homi J. Bhabha*** • Article: Bhabha was the first to do a proper quantum theoretic calculation of the process of electron-positron annihilation and creation – one of the basic processes in quantum electro dynamics using Dirac's theory. This process, known as the Bhabha Scattering, is even today used as a luminosity monitor in electron-positron collider physics experiments. **Z Space Activities (code)** **Does it Glow in the Dark?** (334) Identify naturally radioactive elements Describe the process of radioactive decay Teacher Resource pdf Student Resource pdf		

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Resources

http://ngss.nsta.org/Classroom-Resources.aspx - Searchable NYSSLS/NGSS aligned resources curated by NSTA
Buffalo Public Schools Science Department Chemistry Webpage – BPS chemistry curriculum resource hub
BPS Science Department Recommended Virtual Labs – Virtual lab resources with embedded links to virtual labs and student sheets. Must be logged into BPS google document account through BPS Gmail account to access.
NYS Regents Chemistry Exams 2012-2020 NYSED's Office of State Assessment webpage for released Regents Chemistry Examinations
NYS MST Science Learning Standards Physical Setting/Chemistry – Current NYS Physical Setting/Chemistry Standards
NYS P-12 Science Learning Standards (HS) – NYSSLS High School Standards
Regents Chemistry Reference Tables – Reference Tables for Regents Chemistry

ELL Enhancements To access hyperlinked material, you must be logged into your BPS Google Drive	**Listening** • **Cross- Linguistic Practices:** Gives students opportunities to make connections between what they hear and their home language (For example, allow students to listen to a passage and identify cognates.) • **Build background knowledge** • **Activating Prior Knowledge** Activating prior knowledge means both eliciting from students what they already know and building initial knowledge that they need in order to access upcoming content • **Activating Prior Knowledge** • **Visuals** - GIFs, pictures- will assist students in understanding what they are listening to. Use **visual thinking strategies** to set the lens for learning. • Video to review or introduce a topic – use **closed captioning** to help students see the words and pronunciations while they listen to the content. • **Word stretching / Vowel stretching** when instructing allows student to listen closely to the pronunciation of the word • **Performance Level Descriptors** this document provides teachers with a description of what output they can expect from students based on earned	**Speaking** • **Sentence Frames** - to begin a sentence - such as *Evolution is…* or *I think that evolution is…* • **Academic Conversation Starters:** Have a visual of a list of academic sentence starters that students can refer to in a discussion. Examples include- I expect ____ to happen. My data shows that… This helps students have a more science focused dialogue. • **Choral Reading** - To build fluency, self-confidence and motivation with reading/speaking • Create **movement** to go with the word. Movement can be a motivating factor, as well as a kinesthetic tool for conceptualizing the rhythm and flow of fluent reading while triggering brain function for optimal learning • **Performance Level Descriptors** This document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in	**Reading** • **Supplementary Text** to help reinforce concepts. If necessarily, use lower Lexile levels to ensure comprehension. • **Visual Aids** - Pictures or models to support vocabulary words and concepts • Video to review or introduce a topic - use **closed captioning** to help students read along while they listen to the content • **4 Square / Frayer models** to help students gain a deeper understanding of vocabulary. • **Highlighting** important text to assist students in answering questions after the reading. • **Chunking**-Break reading of text into chunks or paragraphs • **Vocabulary Morphology**- Morphology relates to the segmenting of words into affixes (prefixes and suffixes) and roots or base words, and the origins of words. Understanding that words connected by meaning can be connected by spelling can be critical to expanding a student's vocabulary • **Performance Level Descriptors** this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of reading. Scroll for grades 9-12.	**Writing** • **Sentence Frames** - to begin a sentence- such as *Biodiversity is…* or *An example of competition is….* • **Cloze passages** with word banks • **Word banks** • **Graphic Organizers** to help break down the writing process and organize thoughts • **Standards-based sentence stems** • **Performance Level Descriptors** this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of writing. Scroll for grades 9-12.	**Instructional Accommodations (depending on the student's needs)** • **Extended time** for tests in class, projects and assignments • **Directions read.** Broken down as necessary • **Model** how to complete the activity in the lesson • **Oral simplification** of directions or questions • **Translated version** of test when available. Student may have both version English and native language version • Use of **approved bilingual glossaries** from NYS in each subject

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	NYSESLAT levels in the modality of listening Scroll for grades 9-12.	the modality of speaking. Scroll for grades 9-12			

Special Education Modifications Special Education students must have accommodations as per Individual Educational Plan (IEP)	**Instructional** ● **Pre-teach** vocabulary ● Use **picture vocabulary** ● Scaffold **Depth of Knowledge** questions ● Provide copy of notes/**notes in "cloze"** form ● Use of **Think, Pair, and Share** strategy to help process information ● **Scaffold** written assignments with the use of **graphic organizers** ● Allow for **multiple ways to respond** (verbal, written, response board) ● Provide **model of performance task** ● **Modify informational text** to fit the needs of the students ● Provide a digital or paper i**nteractive notebook** ● Present complex **tasks in multiple ways** ● Provide **mnemonic strategies** for Chemistry concepts	**Technology:** ● **Audio** reading of text ● **Text to type** functions ● **Videos** to clarify/visualize Chemistry concepts ● **Record class lecture/discussions** and make accessible to student ● **Nearpod**- interactive presentations of notes ● **Playposit** - show a video clip about the topic and add your own questions for them to answer as they watch ● Allow students to type answers in chat on **Teams** **Other:** ● Arrange seating for maximum engagement and minimum distraction ● Accessible lab space (counter level)	**In Class Assessments** ● Provide **review packet or review sheet** of concepts covered on the test ● Practice similar questions prior to the test ● Provide **multiple options** for projects ● Give a **timeline** of when things are due and remind them of the process often. ● **Use of timer** in class ● Break all complex tasks into chunks
Step Up to Writing Step Up to Writing materials can be found in BPS Science K-12 Schoology Folder 9-12 Resources Chemistry Resources Curriculum Materials	**SUTW Strategy** ● Informal Outline ● Color-Coding – Informative/Explanatory Text ● Two-column notes ● I-V-F Topic Sentence progressing to Four Step Summary Paragraph ● CUPS – Capitalization, Usage, Punctuation, Spelling ● Transitions		
Culturally and Linguistically Responsive Teaching (CLRT) in the Science Classroom	Materials, resources, and/or discussions address diverse cultural backgrounds and real-world applications ● Artifacts (posters, charts, etc.) in the science classroom are representative of the cultures of the student population ● All students are given an opportunity to engage in science discourse ● Teacher demonstrates high expectations for all students CLRT resources which align to Science content are denoted with a *		