(A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.

(B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.

(5) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

Breakouts

(i) engage respectfully in scientific argumentation using applied scientific explanations

(ii) engage respectfully in scientific argumentation using empirical evidence

(4) Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation on society. The student is expected to:

(A) analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;

Breakouts

(i) analyze scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(ii) analyze scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(iii) analyze scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(iv) analyze scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(v) evaluate scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(vi) evaluate scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(vii) evaluate scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(viii) evaluate scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(ix) critique scientific explanations and solutions by using empirical evidence so as to encourage critical thinking by the student

(x) critique scientific explanations and solutions by using logical reasoning so as to encourage critical thinking by the student

(xi) critique scientific explanations and solutions by using experimental testing so as to encourage critical thinking by the student

(xii) critique scientific explanations and solutions by using observational testing so as to encourage critical thinking by the student

(B) relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists as related to the content; and

Breakouts

(i) relate the impact of past research on scientific thought, including research methodology

(ii) relate the impact of past research on scientific thought, including cost-benefit analysis

(iii) relate the impact of past research on scientific thought, including contributions of diverse scientists as related to the content

(iv) ptreBn(es)-24 02 .8 (l)clie at

(ii) construct models using Thomson's discovery of electron properties to show the development of modern atomic theory over time

(iii) construct models using Rutherford's nuclear atom to show the development of modern atomic theory over time

(iv) construct models using Bohr's nuclear atom to show the development of modern atomic theory over time

(v) construct models using Heisenberg's Uncertainty Principle to show the development of modern atomic theory over time

(B) describe the structure of atoms and ions, including the masses, electrical charges, and locations of protons and neutrons in the nucleus and electrons in the electron cloud;

Breakouts

(i) describe the structure of atoms, including the masses

(ii) describe the structure of atoms, including the electrical charges

(iii) describe the structure of atoms, including the [location] of protons in the nucleus

(iv) describe the structure of atoms, including the [location] of neutrons in the nucleus

(v) describe the structure of atoms, including the locations of electrons in the electron cloud

(vi) describe the structure of ions, including the masses

(vii) describe the structure of ions, including the electrical charges

(viii) describe the structure of ions, including the [location] of protons in the nucleus

(E) construct models to express the arrangement of electrons in atoms of representative elements using electron configurations and Lewis dot structures.

Breakouts

(i) construct models to express the arrangement of electrons in atoms of representative elements using electron configurations

(ii) construct models to express the arrangement of electrons in atoms of representative elements using Lewis dot structures

(7) Science concepts. The student knows how atoms form ionic, covalent, and metallic bonds. The student is expected to:

(A) construct an argument to support how periodic trends such as electronegativity can predict bonding between elements;

Breakouts

(i) construct an argument to support how periodic trends can predict bonding between elements

(B) name and write the chemical formulas for ionic and covalent compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules;

Breakouts

(i) name the chemical [formula] for ionic compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules

(ii) name the chemical [formula] for covalent compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules

(iii) write the chemical [formula] for ionic compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules

(iv) write the chemical [formula] for covalent compounds using International Union of Pure and Applied Chemistry (IUPAC) nomenclature ruleasTm[((sTm[m

Breakouts

(i) investigate the process of heat transfer using calorimetry

(C) classify processes as exothermic or endothermic and represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis; and

Breakouts

(i) classify processes as exothermic or endothermic

(ii) represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis

(D) perform calculations involving heat, mass, temperature change, and specific heat.

Breakouts

(i) perform calculations involving heat

(ii) perform calculations involving mass

(iii) perform calculations involving temperature change

(iv) perform calculations involving specific heat

(14) Science concepts. The student understands the basic processes of nuclear chemistry. The student is expected to:

(A) describe the characteristics of alpha, beta, and gamma radioactive decay processes in