New York Science

HS. Chemical Reactions

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A Performance Expectations HS.PS1.CR

1. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. HS.PS1.2
2. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. HS.PS1.4
3. Apply scientific principles and evidence to explain how the rate of a physical or chemical change is affected when conditions are varied. HS.PS1.5
4. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. HS.PS1.6
5. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. HS.PS1.7
6. Plan and conduct an investigation to compare properties and behaviors of acids and bases. HS.PS1.11
7. Use evidence to illustrate that some chemical reactions involve the transfer of electrons as an energy conversion occurs within a system. HS.PS1.12

B Science and Engineering Practices HS.CR.SEP

1. Developing and Using Models HS.CR.SEP.1
   - a. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4) HS.CR.SEP.1A
2. Planning and Carrying Out Investigations HS.CR.SEP.2
   - a. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-11) HS.CR.SEP.2A
   - b. Select appropriate tools to collect, record, analyze, and evaluate data. (HS-PS1-11) HS.CR.SEP.2B
3. Using Mathematics and Computational Thinking HS.CR.SEP.3
   - a. Use mathematical representations of phenomena to support claims. (HS-PS1-7) HS.CR.SEP.3A

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4 Constructing Explanations and Designing Solutions HS.CR.SEP.4

a Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5) HS.CR.SEP.4A

b Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2) HS.CR.SEP.4B

c Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6) HS.CR.SEP.4C

5 Engaging in Argument from Evidence HS.CR.SEP.5

a Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS1-12) HS.CR.SEP.5A

C Disciplinary Core Ideas HS.CR.DCI

1 PS1.A: Structure and Properties of Matter HS.CR.DCI.PS1.A

a The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HSPS1-2) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.) HS.CR.DCI.PS1.A.1

b A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4) HS.CR.DCI.PS1.A.2

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2 PS1.B: Chemical Reactions HS.CR.DCI.PS1.B

a The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1- 7) HS.CR.DCI.PS1.B.1

b (NYSED) Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of particles and the rearrangements of particles into new substances, with consequent changes in the sum of all bond energies in the set of substances that are matched by changes in energy. (HS-PS1-4),(HS-PS1-5) HS.CR.DCI.PS1.B.2

c (NYSED) In many situations, a dynamic and condition dependent balance between a reaction and the reverse reaction determines the numbers of all types of particles present. (HSPS1-6) HS.CR.DCI.PS1.B.3

d (NYSED) Acids and bases play an important role in the daily lives of humans and other organisms (e.g. agricultural applications, environmental impacts (acid rain), animal and plant physiology). (HS-PS1-11) HS.CR.DCI.PS1.B.4

e (NYSED) Oxidation-reduction reactions are the prevailing source of power for many of today's modern conveniences. (HS-PS1-12) HS.CR.DCI.PS1.B.5

3 ETS1.C: Optimizing the Design Solution HS.CR.DCI.ETS1.C

a Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS1-6) HS.CR.DCI.ETS1.C.1

D Crosscutting Concepts HS.CR.CC

1 Patterns HS.CR.CC.1

a Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HSPS1-2),(HS-PS1-5),(HS-PS1-11) HS.CR.CC.1A

2 Energy and Matter HS.CR.CC.2

a The total amount of energy and matter in closed systems is conserved. (HS-PS1 7),(HS-PS1-12) HS.CR.CC.2A

b Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1- 4),(HS-PS1-12) HS.CR.CC.2B

3 Stability and Change HS.CR.CC.3

a Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6) HS.CR.CC.3A

4 Connections to Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems HS.CR.CC.4

a Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7) HS.CR.CC.4A