

# NGSS Correlation to Experience Chemistry

The Experience Chemistry program provides comprehensive coverage and assessment of the Next Generation Science Standards. Use this chart to track where the standards are covered in the Student Edition, Labs, and the Digital Course.

**KEY:** SE = Experience Handbook; TG = Teacher Guide; INV = Investigation; EXP = Experience; Experiences are abbreviated in the format 4-2, where 4 = Investigation number and 2 = Experience number. The Teacher Guide is divided into two volumes; Volume 1 = pp. 1–343; Volume 2 = pp. 344–765.

## HS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

PERFORMANCE EXPECTATION HS-PS1-1	WHERE YOU WILL FIND IT
Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	INV 1 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 4–5, 11, 25, 33, 40, 50; TG support on pp. 16–17, 24, 32, 40, 47, 55) INV 2 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 52–53, 59, 65, 74; TG support on pp. 64–65, 72, 79, 87) Claim-Evidence-Reasoning 2-2 (TG p. 76) Peer Review Rubric 2-2 (TG p. 78) Three-Dimensional Transfer Task Storyline 1 (TG p. 197)
DISCIPLINARY CORE IDEAS	
<b>PS1.A Structure and Properties of Matter</b> Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. [PS1.A-H1]	SE 1-1 (pp. 6–11), 1-2 (pp. 12–25), 1-3 (pp. 26–33), 1-4 (pp. 34–40), 1-5 (pp. 41–50), 2-1 (pp. 54–59), 2-2 (pp. 60–65) TG 1-1 (p. 22), 1-2 (p. 29), 1-3 (pp. 36–37), 1-4 (pp. 44–45), 1-5 (p. 52), 2-1 (p. 70), 2-2 (p. 77)
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. [PS1.A-H2]	SE 1-4 (pp. 34–40), 1-5 (pp. 41–50), 2-1 (pp. 54–59), 2-2 (pp. 60–65), 2-3 (pp. 66–74), 3-5 (pp. 107–116) TG 1-4 (pp. 44–45), 1-5 (p. 52), 2-1 (p. 70), 2-2 (p. 77), 2-3 (p. 84), 3-5 (p. 134)
SCIENCE AND ENGINEERING PRACTICES	
<b>SEP-2 Developing and Using Models</b> Use a model to predict the relationships between systems or between components of a system. [SEP-2-H3]	Inquiry Lab 1-2 (TG p. 27); 1-4 (TG p. 43); 1-5 (TG p. 50); 2-2 (TG p. 75); 2-3 (TG p. 82) Analyzing Data 1-2 (TG p. 27); 2-1 (TG p. 68) Claim-Evidence-Reasoning 1-4 (TG p. 44); 2-1 (TG p. 69); 2-2 (TG p. 76) Discussion Rubric 1-2 (TG p. 31); 1-4 (TG p. 46); 2-1 (TG p. 71) Modeling 1-2 (TG p. 28); 1-5 (TG p. 52) Peer Review Rubric 2-2 (TG p. 78) Writing About Science 2-1 (TG p. 71)

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## CROSSCUTTING CONCEPTS

### CCC-1 Patterns

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. [CCC-1-H1]

Inquiry Lab 1-4 (TG p. 43); 2-2 (TG p. 75); 2-3 (TG p. 82)  
 Claim-Evidence-Reasoning 2-1 (TG p. 69); 2-2 (TG p. 76)  
 Discussion Rubric 2-1 (TG p. 71)  
 Writing About Science 1-5 (TG p. 54); 2-1 (TG p. 71)  
 Peer Review Rubric 2-2 (TG p. 78)

## PERFORMANCE EXPECTATION HS-PS1-2

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.

## WHERE YOU WILL FIND IT

Storyline 1 Anchoring Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 2–3, 51, 75, 117, 179; Reflection; TG support on pp. 6–7, 57, 89, 139, 197)  
 INV 2 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 52–53, 59, 65, 74; TG support on pp. 64–65, 72, 79, 87)  
 INV 6 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 224–225, 236, 250, 258; TG support on pp. 250–251, 259, 267, 275)  
 INV 15 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 590–591, 603, 612, 624; TG support on pp. 640–641, 647, 655, 663)  
 SE 2-3 (pp. 66-74, partial)  
 Inquiry Lab 3-1 (TG p. 102); 6-2 (TG p. 261); 16-1 (TG p. 676); 16-2 (TG p. 684)  
 Claim-Evidence-Reasoning 6-2 (TG p. 263)  
 Discussion Rubric 6-2 (TG p. 266)  
 Writing About Science 6-2 (TG p. 266)  
 Three-Dimensional Transfer Task Storyline 1 (TG p. 197); Storyline 2 (TG p. 343)

<b>DISCIPLINARY CORE IDEAS</b>	
<p><b>PS1.A Structure and Properties of Matter</b></p> <p>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. [PS1.A-H2]</p>	<p>SE 3-1 (pp. 78–86), 3-2 (pp. 87–90), 3-3 (pp. 91–100), 3-4 (pp. 101–106), 6-2 (pp. 237–250), 13-1 (pp. 510–518), 15-2 (pp. 604–612)</p> <p>TG 3-1 (p. 104), 3-2 (p. 112), 3-3 (p. 120), 3-4 (p. 126–127), 6-2 (p. 264–265), 13-1 (pp. 553–554), 15-2 (p. 652)</p>
<p><b>PS1.B Chemical Reactions</b></p> <p>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. [PS1.B-H3]</p>	<p>Storyline 1 Anchoring Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 2–3, 51, 75, 117, 179; Reflection; TG support on pp. 6–7, 57, 89, 139, 197)</p> <p>SE 2-3 (pp. 66–74), 3-1 (pp. 78–86), 3-2 (pp. 87–90), 3-3 (pp. 91–100), 6-1 (pp. 226–236), 6-2 (pp. 237–250), 6-3 (pp. 251–258), 13-1 (pp. 510–518), 15-1 (pp. 592–603), 15-2 (pp. 604–612), 16-2 (pp. 643–655)</p> <p>TG 2-3 (p. 84), 3-1 (p. 104), 3-2 (p. 112), 3-3 (p. 120), 6-1 (pp. 255–256), 6-2 (pp. 264–265), 6-3 (p. 272), 13-1 (pp. 553–554), 15-1 (p. 644), 15-2 (p. 652), 16-2 (p. 686)</p>
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<p><b>SEP-6 Constructing Explanations and Designing Solutions</b></p> <p>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. [SEP-6-H2]</p>	<p>Inquiry Lab 15-1 (TG p. 642)</p> <p>Analyzing Data 3-3 (TG p. 118)</p> <p>Claim-Evidence-Reasoning 15-3 (TG p. 659); 16-1 (TG p. 677); 16-3 (TG p. 693)</p> <p>Discussion Rubric 15-3 (TG p. 662); 16-1 (TG p. 680); 16-3 (TG p. 696)</p> <p>Modeling 3-1 (TG p. 103); 13-1 (TG p. 553)</p> <p>Peer Review Rubric 3-1 (TG p. 105)   13-1 (TG p. 555)</p> <p>Writing About Science 3-1 (TG p. 106); 15-1 (TG p. 646); 15-3 (TG p. 662); 16-3 (TG p. 696)</p>
<b>CROSCUTTING CONCEPTS</b>	
<p><b>CCC-1 Patterns</b></p> <p>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. [CCC-1-H1]</p>	<p>Inquiry Lab 3-1 (TG p. 102); 3-4 (TG p. 125); 16-1 (TG p. 676); 16-2 (TG p. 684)</p>

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PERFORMANCE EXPECTATION HS-PS1-3	WHERE YOU WILL FIND IT
<p>Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</p>	<p>INV 3 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 76–77, 86, 90, 100, 106, 116; TG support on pp. 98–99, 107, 115, 122, 129, 137)            INV 4 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 118–119, 132, 143, 148, 155, 168, 178; TG support on pp. 148–149, 158, 165, 173, 180, 188, 195)            Inquiry Lab 3-3 (TG p. 118); 3-4 (TG p. 125); 4-1 (TG p. 152); 4-3 (TG p. 168); 4-6 (TG p. 191); 13-1 (TG p. 552); 13-2 (TG p. 559); 16-1 (TG p. 676); 16-2 (TG p. 684)</p>
DISCIPLINARY CORE IDEAS	
<p><b>PS1.A Structure and Properties of Matter</b>            The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. [PS1.A-H3]</p>	<p>Storyline 1 Anchoring Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 2–3, 51, 75, 117, 179; Reflection; TG support on pp. 6–7, 57, 89, 139, 197)            SE 3-1 (pp. 78–86), 3-2 (pp. 87–90), 3-3 (pp. 91–100), 3-4 (pp. 101–106), 4-1 (pp. 120–132), 4-2 (pp. 133–143), 4-3 (pp. 144–148), 4-6 (pp. 169–178), 9-1 (pp. 322–326), 9-2 (pp. 327–338), 9-3 (pp. 339–346), 9-4 (pp. 347–356), 13-1 (pp. 510–518), 13-2 (pp. 519–527), 15-2 (pp. 604–612), 16-1 (pp. 628–642), 16-2 (pp. 643–655), 16-3 (pp. 656–670)            TG 3-1 (p. 104), 3-2 (p. 112), 3-3 (p. 120), 3-4 (p. 126–127), 4-1 (pp. 154–155), 4-2 (p. 163), 4-3 (p. 170), 4-6 (p. 194), 9-1 (p. 362), 9-2 (p. 368), 9-3 (p. 377), 9-4 (p. 384), 13-1 (pp. 553–554), 13-2 (p. 561), 15-2 (p. 652), 16-1 (p. 678), 16-2 (p. 686), 16-3 (p. 695)</p>
<p><b>PS2.B Types of Interactions</b>            Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. [PS2.B-H1]</p>	<p>SE 2-1 (pp. 54–59), 2-2 (pp. 60–65), 2-3 (pp. 66–74), 3-2 (pp. 87–90), 3-4 (pp. 101–106), 4-3 (pp. 144–148), 4-4 (pp. 149–155), 4-5 (pp. 156–168), 9-1 (pp. 322–326), 9-2 (pp. 327–338), 9-3 (pp. 339–346), 9-4 (pp. 347–356), 16-1 (pp. 628–642), 16-2 (pp. 643–655), 16-3 (pp. 656–670)            TG 2-1 (p. 70), 2-2 (p. 77), 2-3 (p. 84), 3-2 (p. 112), 3-4 (pp. 126–127), 4-3 (p. 170), 4-4 (p. 179), 4-5 (pp. 184–185), 9-1 (p. 362), 9-2 (p. 368), 9-3 (p. 377), 9-4 (p. 384), 16-1 (p. 678), 16-2 (p. 686), 16-3 (p. 695)</p>

## SCIENCE AND ENGINEERING PRACTICES

### SEP-3 Planning and Carrying Out Investigations

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. [SEP-3-H2]

Inquiry Lab 4-4 (TG p. 176); 4-5 (TG p. 183); 9-1 (TG p. 360); 9-2 (TG p. 367); 9-3 (TG p. 375); 16-3 (TG p. 692)

## CROSSCUTTING CONCEPTS

### CCC-1 Patterns

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. [CCC-1-H1]

Analyzing Data 3-2 (TG p. 110)  
Writing About Science 4-1 (TG p. 157); 4-6 (TG p. 194)

## PERFORMANCE EXPECTATION HS-PS1-4

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.

## WHERE YOU WILL FIND IT

INV 6 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 224–225, 236, 250, 258; TG support on pp. 250–251, 259, 267, 275, partial)  
INV 8 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 290–291, 300, 308, 316; TG support on pp. 320–321, 327, 334, 341)  
INV 16 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 626–627, 642, 655, 670; TG support on pp. 674–675, 681, 689, 697)  
Inquiry Lab 8-2 (TG p. 330)  
Discussion Rubric 8-1 (TG p. 325)  
Modeling 8-1 (TG p. 323)

## DISCIPLINARY CORE IDEAS

### PS1.A Structure and Properties of Matter

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. [PS1.A-H4]

SE 6-1 (pp. 226–236), 8-1 (pp. 292–300), 8-2 (pp. 301–308), 16-1 (pp. 628–642)  
TG 6-1 (pp. 255–256), 8-1 (p. 324), 8-2 (p. 332), 16-1 (p. 678)

### PS1.B Chemical Reactions

Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. [PS1.B-H1]

SE 6-1 (pp. 226–236), 6-2 (pp. 237–250), 8-2 (pp. 301–308), 8-3 (pp. 309–316), 12-2 (pp. 484–489), 16-1 (pp. 628–642)  
TG 6-1 (pp. 255–256), 6-2 (pp. 264–265), 8-2 (p. 332), 8-3 (p. 339), 12-2 (p. 520), 16-1 (p. 678)

## SCIENCE AND ENGINEERING PRACTICES

### SEP-2 Developing and Using Models

Develop a model based on evidence to illustrate the relationships between systems or between components of a system. [SEP-2-H3]

Inquiry Lab 8-2 (TG p. 330)  
Modeling 8-1 (TG p. 323)  
Discussion Rubric 8-1 (TG p. 325)

## CROSSCUTTING CONCEPTS

### CCC-5 Energy and Matter

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. [CCC-5-H2]

Inquiry Lab 8-1 (TG p. 322)  
Writing About Science 8-3 (TG p. 340)

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PERFORMANCE EXPECTATION HS-PS1-5	WHERE YOU WILL FIND IT
<p>Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p>	<p>INV 12 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 474–475, 483, 489, 496, 506; TG support on pp. 508–515, 515, 523, 531, 539) SE 12-4 (pp. 497–506, partial) Inquiry Lab 12-1 (TG p. 510)</p>
DISCIPLINARY CORE IDEAS	
<p><b>PS1.B Chemical Reactions</b> Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. [PS1.B-H1]</p>	<p>INV 12 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 474–475, 483, 489, 496, 506; TG support on pp. 508–515, 515, 523, 531, 539) SE 12-2 (pp. 484–489), 14-1 (pp. 546–553), 14-3 (pp. 562–575) TG 12-2 (p. 520), 14-1 (p. 594), 14-3 (p. 611)</p>
SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-6 Constructing Explanations and Designing Solutions</b> Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. [SEP-6-H3]</p>	<p>Inquiry Lab 12-4 (TG p. 534) Claim-Evidence-Reasoning 12-2 (TG p. 519); 14-1 (TG p. 594); 14-3 (TG p. 610) Discussion Rubric 12-2 (TG p. 521); 14-1 (TG p. 596); 14-3 (TG p. 613) Writing About Science 12-1 (TG p. 514)</p>
CROSSCUTTING CONCEPTS	
<p><b>CCC-1 Patterns</b> 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. [CCC-1-H1]</p>	<p>SE 12-1 Question 5 (p. 479), 12-1 Question 6 (p. 480)</p>

PERFORMANCE EXPECTATION HS-PS1-6	WHERE YOU WILL FIND IT
Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	Inquiry Lab 12-3 (TG p. 526); 14-4 (TG p. 617)
<b>DISCIPLINARY CORE IDEAS</b>	
<b>PS1.B Chemical Reactions</b> In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. [PS1.B-H2]	SE 12-3 (pp. 490–496), 13-2 (pp. 519–527), 13-4 (pp. 538–542) TG 12-3 (p. 529), 13-2 (p. 561), 13-4 (p. 577)
<b>ETS1.C Optimizing The Design Solution</b> 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. [ETS1.C-H1]	SE 12-3 (pp. 490–496), 13-4 (pp. 538–542) TG SE 12-3 (pp. 490–496), 13-4 (p. 577)
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<b>SEP-6 Constructing Explanations and Designing Solutions</b> Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. [SEP-6-H5]	Inquiry Lab 12-3 (TG p. 526) Claim-Evidence-Reasoning 12-3 (TG p. 528) Discussion Rubric 12-3 (TG p. 530)
<b>CROSSCUTTING CONCEPTS</b>	
<b>CCC-7 Stability and Change</b> Much of science deals with constructing explanations of how things change and how they remain stable. [CCC-7-H1]	Modeling 13-2 (TG p. 560) Peer Review Rubric 13-2 (TG p. 562)

PERFORMANCE EXPECTATION HS-PS1-7	WHERE YOU WILL FIND IT
Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	Storyline 2 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 180–181, 223, 259, 289, 317; Reflection; TG support on pp. 202–203, 243, 277, 311, 343) INV 5 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 182–183, 192, 201, 212, 222; TG support on pp. 210–211, 219, 226, 233, 241, partial) INV 7 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 260–261, 268, 278, 288; TG support on pp. 284–285, 294, 302, 309) SE 5-1 (pp. 184–192, partial), 5-2 (pp. 193–201, partial), 5-3 (pp. 202–212, partial) Inquiry Lab 6-1 (TG p. 254) Claim-Evidence-Reasoning 15-1 (TG p. 643) Modeling 6-1 (TG p. 255) Peer Review Rubric 6-1 (TG p. 258) Writing About Science 7-1 (TG p. 293) Storyline 2 Three-Dimensional Transfer Task (TG p. 343)
<b>DISCIPLINARY CORE IDEAS</b>	
<b>PS1.B Chemical Reactions</b> 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. [PS1.B-H3]	SE 7-1 (pp. 262–268), 7-2 (pp. 268–278), 7-3 (pp. 279–288), 13-3 (pp. 528–537), 13-4 (pp. 538–542), 15-1 (pp. 592–603), 15-2 (pp. 604–612) TG 7-1 (p. 290), 7-2 (p. 299), 7-3 (pp. 307–308), 13-3 (p. 569), 13-4 (p. 577), 15-1 (p. 644), 15-2 (p. 652)

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## SCIENCE AND ENGINEERING PRACTICES

### SEP-5 Using Mathematics and Computational Thinking

Use mathematical representations of phenomena to support claims. [SEP-5-H2]

Inquiry Lab 5-3 (TG p. 229); 13-3 (TG p. 566); 13-4 (TG p. 575)  
 Claim-Evidence-Reasoning 13-4 (TG p. 576)  
 Discussion Rubric 13-4 (TG p. 578); 15-1 (TG p. 646)  
 Modeling 13-3 (TG p. 567)  
 Peer Review Rubric 13-3 (TG p. 570)

## CROSSCUTTING CONCEPTS

### CCC-5 Energy and Matter

The total amount of energy and matter in closed systems is conserved. [CCC-5-H1]

Inquiry Lab 15-2 (TG p. 650)  
 Modeling 7-1 (TG p. 290)  
 Peer Review Rubric 7-1 (TG p. 292)

### NOS-6 Scientific Knowledge Assumes an Order and Consistency in Natural Systems.

Science assumes the universe is a vast single system in which basic laws are consistent. [NOS-6-H2]

SE 5-3 Question 28 (p. 210), 5-4 Question 40 (p. 219), 7-1 Question 9 (p. 268), 13-1 Question 9 (p. 518)

## PERFORMANCE EXPECTATION HS-PS1-8

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.

## WHERE YOU WILL FIND IT

Inquiry Lab 17-1 (TG p. 710)  
 Modeling 17-1 (TG p. 711)  
 Discussion Rubric 17-1 (TG p. 714)  
 Three-Dimensional Transfer Task Storyline 5 (TG p. 765)

## DISCIPLINARY CORE IDEAS

### PS1.C Nuclear Processes

Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. [PS1.C-H1]

SE 17-1 (pp. 674–688), 17-2 (pp. 689–702), 17-3 (pp. 703–716)  
 TG 17-1 (p. 712), 17-2 (p. 719), 17-3 (p. 727)

## SCIENCE AND ENGINEERING PRACTICES

### SEP-2 Developing and Using Models

Develop a model based on evidence to illustrate the relationships between systems or between components of a system. [SEP-2-H3]

Inquiry Lab 17-1 (TG p. 710); 17-2 (TG p. 718)  
 Modeling 17-1 (TG p. 711)  
 Discussion Rubric 17-1 (TG p. 714)

## CROSSCUTTING CONCEPTS

### CCC-5 Energy and Matter

In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. [CCC-5-H5]

Inquiry Lab 17-1 (TG p. 710)  
 Claim-Evidence-Reasoning 17-2 (TG p. 719)  
 Modeling 17-1 (TG p. 711)  
 Discussion Rubric 17-1 (TG p. 714); 17-2 (TG p. 721)

# HS-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

PERFORMANCE EXPECTATION HS-PS2-6	WHERE YOU WILL FIND IT
<p>Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</p>	<p>INV 3 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 76–77, 86, 90, 100, 106, 116; TG support on pp. 98–99, 107, 115, 122, 129, 137) SE 4-6 (pp. 169–178, partial)</p>
<b>DISCIPLINARY CORE IDEAS</b>	
<p><b>PS2.B Types of Interactions</b> Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. [PS2.B-H3]</p>	<p>SE 4-3 (pp. 144–148), 4-4 (pp. 149–155), 4-5 (pp. 156–168), 16-2 (pp. 643–655) TG 4-3 (p. 170), 4-4 (p. 179), 4-5 (pp. 184–185), 16-2 (p. 686)</p>
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<p><b>SEP-8 Obtaining, Evaluating, and Communicating Information</b> Communicate scientific and technical information (e.g., about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). [SEP-8-H5]</p>	<p>Performance-Based Assessment INV 3 Inquiry Lab 4-4 (TG p. 176) Analyzing Data 16-1 (TG p. 676)</p>
<b>CROSCUTTING CONCEPTS</b>	
<p><b>CCC-6 Structure and Function</b> Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. [CCC-6-H1]</p>	<p>SE 4-4 Question 28 (p. 152), 4-5 Question 38 (p. 163), 16-2 Question 22 (p. 652)</p>

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## HS-PS3 Energy

Students who demonstrate understanding can:

PERFORMANCE EXPECTATION HS-PS3-1	WHERE YOU WILL FIND IT
Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	INV 8 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 290–291, 300, 308, 316; TG support on pp. 320–321, 327, 334, 341, partial)
DISCIPLINARY CORE IDEAS	
<b>PS3.A Definitions of Energy</b> Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. [PS3.A-H1]	SE 1-4 (pp. 34–40), 1-5 (pp. 54–59), 8-1 (pp. 292–300), 8-2 (pp. 301–308), 8-3 (pp. 309–316) TG 1-4 (pp. 44–45), 1-5 (p. 52), 8-1 (p. 324), 8-2 (p. 332), 8-3 (p. 339)
<b>PS3.B Conservation of Energy and Energy Transfer</b> Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. [PS3.B-H1]	SE 8-1 (pp. 292–300), 8-2 (pp. 301–308), 8-3 (pp. 309–316) TG 8-1 (p. 324), 8-2 (p. 332), 8-3 (p. 339)
Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. [PS3.B-H2]	SE 8-1 (pp. 292–300), 8-2 (pp. 301–308), 8-3 (pp. 309–316) TG 8-1 (p. 324), 8-2 (p. 332), 8-3 (p. 339)
Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g., relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. [PS3.B-H3]	SE 8-1 (pp. 292–300), 8-2 (pp. 301–308) TG 8-1 (p. 324), 8-2 (p. 332)
The availability of energy limits what can occur in any system. [PS3.B-H4]	SE 8-1 (pp. 292–300), 8-2 (pp. 301–308), 8-3 (pp. 309–316) TG 8-1 (p. 324), 8-2 (p. 332), 8-3 (p. 339)
SCIENCE AND ENGINEERING PRACTICES	
<b>SEP-5 Using Mathematics and Computational Thinking</b> Create a computational model or simulation of a phenomenon, designed device, process, or system. [SEP-5-H1]	SE 8-1 Question 7 (p. 296), 8-2 Question 12 (p. 302), 8-3 Question 13 (p. 303)
CROSSCUTTING CONCEPTS	
<b>CCC-4 Systems and System Models</b> Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. [CCC-4-H4]	INV 8 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 290–291, 300, 308, 316; TG support on pp. 320–321, 327, 334, 341, partial)

PERFORMANCE EXPECTATION HS-PS3-3	WHERE YOU WILL FIND IT
Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	Engineering Design Challenge 8-1 (TG p. 326) Inquiry Lab 15-3 (TG p. 658) Performance-Based Assessment INV 15 (TG p. 664)
DISCIPLINARY CORE IDEAS	
<b>PS3.A Definitions of Energy</b> At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. [PS3.A-H2]	SE 8-1 (pp. 292–300), 8-2 (pp. 301–308), 8-3 (pp. 309–316) TG 8-1 (p. 324), 8-2 (p. 332), 8-3 (p. 339)
<b>PS3.D Energy in Chemical Processes and Everyday Life</b> Although energy cannot be destroyed, it can be converted to less useful forms — for example, to thermal energy in the surrounding environment. [PS3.D-H4]	SE 15-3 (pp. 613–624) TG 15-3 (p. 660)
<b>ETS1.A Defining and Delimiting Engineering Problems</b> Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. [ETS1.A-H1]	Engineering Design Challenge 8-1 (TG p. 326)
SCIENCE AND ENGINEERING PRACTICES	
<b>SEP-6 Constructing Explanations and Designing Solutions</b> Design, evaluate, and/or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. [SEP-6-H5]	Engineering Design Challenge 8-1 (TG p. 326) Performance-Based Assessment INV 15 (TG p. 664)
CROSSCUTTING CONCEPTS	
<b>CCC-5 Energy and Matter</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. [CCC-5-H2]	Inquiry Lab 15-3 (TG p. 658) Claim-Evidence-Reasoning 15-3 (TG p. 659) Discussion Rubric 15-3 (TG p. 662) Writing About Science 15-3 (TG p. 662) Performance-Based Assessment INV 15 (TG p. 664)
<b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b> Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. [STSE-2-H1]	Engineering Design Challenge 8-1 (TG p. 326)

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## HS-ESS1 Earth’s Place in the Universe

Students who demonstrate understanding can:

PERFORMANCE EXPECTATION HS-ESS1-1	WHERE YOU WILL FIND IT
Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy that eventually reaches Earth in the form of radiation.	INV 17 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 672–673, 688, 702, 716; TG support on pp. 708–709, 715, 722, 729, partial) Claim-Evidence-Reasoning 17-2 (TG p. 719, partial) Discussion Rubric 17-2 (TG p. 721, partial) Analyzing Data 10-5 (TG p. 434), 17-2 (TG p. 721, partial)
<b>DISCIPLINARY CORE IDEAS</b>	
<b>ESS1.A The Universe and Its Stars</b> The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. [ESS1.A-H1]	SE 17-2 (pp. 689–702) TG 17-2 (p. 719)
<b>PS3.D Energy in Chemical Processes and Everyday Life</b> Nuclear fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. [PS3.D-H1]	SE 17-2 (pp. 689–702) TG 17-2 (p. 719)
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<b>SEP-2 Developing and Using Models</b> Develop a model based on evidence to illustrate the relationships between systems or between components of a system. [SEP-2-H3]	Inquiry Lab 17-1 (TG p. 710); 17-2 (TG p. 718) Modeling 17-1 (TG p. 711) Discussion Rubric 17-1 (TG p. 714)
<b>CROSCUTTING CONCEPTS</b>	
<b>CCC-3 Scale, Proportion, Quantity</b> The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. [CCC-3-H1]	SE 17-2 Question 13 (p. 690), SE 17-2 Question 20 (p. 700)

PERFORMANCE EXPECTATION HS-ESS1-2	WHERE YOU WILL FIND IT
Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.	SE 17-2 Question 15 (p. 693, partial) Analyzing Data 17-2 (TG p. 721, partial)
<b>DISCIPLINARY CORE IDEAS</b>	
<b>ESS1.A The Universe and Its Stars</b> The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. [ESS1.A-H2]	SE 17-2 (pp. 689–702) TG 17-2 (p. 719)
The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and nonstellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. [ESS1.A-H3]	SE 17-2 (pp. 689–702) TG 17-2 (p. 719)
Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. [ESS1.A-H4]	SE 17-2 (pp. 689–702) TG 17-2 (p. 719)
<b>PS4.B Electromagnetic Radiation</b> Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. [PS4.B-H4]	SE 1-3 (pp. 26–33), 17-2 (pp. 689–702) TG 1-3 (pp. 36–37), 17-2 (p. 719)
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<b>SEP-6 Constructing Explanations and Designing Solutions</b> Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, 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. [SEP-6-H2]	Claim-Evidence-Reasoning 17-2 (TG p. 719) Discussion Rubric 17-2 (TG p. 721)
<b>NOS-2 Scientific Knowledge is Based on Empirical Evidence.</b> A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. [NOS-2-H4]	SE 17-2 (pp. 689–702) TG 17-2 (p. 719)
<b>CROSCUTTING CONCEPTS</b>	
<b>CCC-5 Energy and Matter</b> Energy cannot be created or destroyed—only moved between one place and another place, between objects and/or fields, or between systems. [CCC-5-H3]	SE 17-2 Question 13 (p. 690), SE 17-2 Question 18 (p. 696)
<b>STSE-1 Interdependence of Science, Engineering, and Technology</b> Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. [STSE-1-H1]	SE 17-2 Question 16 (p. 694), 18-1 Question 3 (p. 721)
<b>NOS-6 Scientific Knowledge Assumes an Order and Consistency in Natural Systems.</b> Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. [NOS-6-H1]	SE 17-2 Question 15 (p. 693), SE 17-2 Question 22 (p. 702)
Science assumes the universe is a vast single system in which basic laws are consistent. [NOS-6-H2]	SE 17-2 Question 15 (p. 693), SE 17-2 Question 22 (p. 702)

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PERFORMANCE EXPECTATION HS-ESS1-3	WHERE YOU WILL FIND IT
<p>Communicate scientific ideas about the way stars, over their life cycle, produce elements.</p>	<p>INV 17 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 672–673, 688, 702, 716; TG support on pp. 708–709, 715, 722, 729, partial)            Claim-Evidence-Reasoning 17-2 (TG p. 719, partial)            SE 17-2 Questions 21–22 (p. 702, partial)            Analyzing Data 17-2 (TG p. 721, partial)</p>
DISCIPLINARY CORE IDEAS	
<p><b>ESS1.A The Universe and Its Stars</b>            The study of stars’ light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. [ESS1.A-H2]</p>	<p>SE 17-2 (pp. 689–702)            TG 17-2 (p. 719)</p>
<p>Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. [ESS1.A-H3]</p>	<p>SE 17-2 (pp. 689–702)            TG 17-2 (p. 719)</p>
SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-8 Obtaining, Evaluating, and Communicating Information</b>            Communicate scientific ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). [SEP-8-H5]</p>	<p>Analyzing Data 17-2 (TG p. 721)</p>
CROSSCUTTING CONCEPTS	
<p><b>CCC-5 Energy and Matter</b>            In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. [CCC-5-H5]</p>	<p>Inquiry Lab 17-1 (TG p. 711)            Modeling 17-1 (TG p. 711)            Claim-Evidence-Reasoning 17-2 (TG p. 719)            Discussion Rubric 17-1 (p. 714), 17-2 (p. 721)</p>

PERFORMANCE EXPECTATION HS-ESS1-6	WHERE YOU WILL FIND IT
Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	SE 17-1 Question 11 (p. 688, partial) Analyzing Data 17-1 (TG, p. 714, partial)
<b>DISCIPLINARY CORE IDEAS</b>	
<p><b>ESS1.C The History of Planet Earth</b></p> <p>Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. [ESS1.C-H2]</p>	SE 17-1 (pp. 674–688) TG 17-1 (p. 712)
<p><b>PS1.C Nuclear Processes</b></p> <p>Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. [PS1.C-H2]</p>	SE 17-1 (pp. 674–688) TG 17-1 (p. 712)
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<p><b>SEP-6 Constructing Explanations and Designing Solutions</b></p> <p>Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. [SEP-6-H4]</p>	SE 17-1 Question 11 (p. 688) Analyzing Data 17-1 (TG, p. 714)
<p><b>NOS-4 Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena.</b></p> <p>A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. [NOS-4-H2]</p>	SE 17-1 Question 11 (p. 688) Analyzing Data 17-1 (TG, p. 714)
<p><b>NOS-4 Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena.</b></p> <p>Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. [NOS-4-H3]</p>	SE 17-1 Question 11 (p. 688) Analyzing Data 17-1 (TG, p. 714)
<b>CROSCUTTING CONCEPTS</b>	
<p><b>CCC-7 Stability and Change</b></p> <p>Much of science deals with constructing explanations of how things change and how they remain stable. [CCC-7-H1]</p>	SE 17-1 Question 11 (p. 688) Analyzing Data 17-1 (TG, p. 714)

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## HS-ESS2 Earth's Systems

Students who demonstrate understanding can:

PERFORMANCE EXPECTATION HS-ESS2-2	WHERE YOU WILL FIND IT
Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.	<p>Storyline 4 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 472–473, 507, 543, 587; Reflection; TG support on pp. 500–501, 541, 581, 625)</p> <p>INV 14 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 544–545, 553, 561, 575, 586; TG support on pp. 590–597, 597, 606, 614, 623)</p> <p>Inquiry Lab 10-1 (TG p. 402); (TG p. 592); 14-1 (TG p. 592); 14-2 (TG p. 600)</p> <p>Claim-Evidence-Reasoning 14-4 (TG p. 619)</p>
DISCIPLINARY CORE IDEAS	
<p><b>ESS2.A Earth Materials and Systems</b></p> <p>Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. [ESS2.A-H1]</p>	<p>SE 10-1 (pp. 360–370), 10-3 (pp. 382–391), 10-4 (pp. 392–400), 10-5 (pp. 401–412), 14-1 (pp. 546–553), 14-2 (pp. 554–561), 14-4 (pp. 576–586)</p> <p>TG 10-1 (p. 404), 10-3 (p. 418), 10-4 (p. 425), 10-5 (p. 433), 14-1 (p. 594), 14- (p. 602), 14-4 (p. 620)</p>
<p><b>ESS2.D Weather and Climate</b></p> <p>The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's reradiation into space. [ESS2.D-H1]</p>	<p>SE 10-1 (pp. 360–370), 10-2 (pp. 371–381), 10-3 (pp. 382–391), 10-4 (pp. 392–400), 10-5 (pp. 401–412)</p> <p>TG 10-1 (p. 404), 10-2 (p. 412), 10-3 (p. 418), 10-4 (p. 425), 10-5 (p. 433)</p>
SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-4 Analyzing and Interpreting Data</b></p> <p>Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. [SEP-4-H1]</p>	<p>Inquiry Lab 10-4 (TG p. 424)</p> <p>Discussion Rubric 14-4 (TG p. 622)</p>
CROSSCUTTING CONCEPTS	
<p><b>CCC-7 Stability and Change</b></p> <p>Feedback (negative or positive) can stabilize or destabilize a system. [CCC-7-H3]</p>	<p>Claim-Evidence-Reasoning 10-1 (TG p. 403)</p> <p>Writing About Science 14-2 (TG p. 605)</p>
<p><b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <p>New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. [STSE-2-H3]</p>	<p>Storyline 4 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 472–473, 507, 543, 587; Reflection; TG support on pp. 500–501, 541, 581, 625)</p> <p>Problem-Based Learning Storyline 4</p>

PERFORMANCE EXPECTATION HS-ESS2-4	WHERE YOU WILL FIND IT
<p>Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.</p>	<p>INV 10 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 358–359, 370, 381, 391, 400, 412; TG support on pp. 400–401, 407, 414, 421, 428, 435)            Inquiry Lab 10-2 (TG p. 410)            Analyzing Data 11-1 (TG p. 453)            Modeling 10-5 (TG p. 432)            Peer Review Rubric 10-5 (TG p. 434)</p>
DISCIPLINARY CORE IDEAS	
<p><b>ESS1.B Earth and the Solar System</b>            Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. [ESS1.B-H2]</p>	<p>SE 11-1 (pp. 416–422), 11-2 (pp. 423–430)            TG 11-1 (p. 451), 11-2 (p. 460)            Modeling 10-5 (TG p. 432)            Peer Review Rubric 10-5 (TG p. 434)</p>
<p><b>ESS2.A Earth Materials and Systems</b>            The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. [ESS2.A-H3]</p>	<p>SE 11-1 (pp. 416–422), 11-2 (pp. 423–430), 14-3 (pp. 562–575)            TG 11-1 (p. 451), 11-2 (p. 460), 14-3 (p. 611)</p>
<p><b>ESS2.D Weather and Climate</b>            The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's reradiation into space. [ESS2.D-H1]</p>	<p>SE 10-1 (pp. 360–370), 10-2 (pp. 371–381), 10-3 (pp. 382–391), 10-4 (pp. 392–400), 10-5 (pp. 401–412), 11-1 (pp. 416–422), 11-2 (pp. 423–430)            TG 10-1 (p. 404), 10-2 (p. 412), 10-3 (p. 418), 10-4 (p. 425), 10-5 (p. 433), 11-1 (p. 451), 11-2 (p. 460)</p>
SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-2 Developing and Using Models</b>            Use a model to provide mechanistic accounts of phenomena. [SEP-6-H5]</p>	<p>Inquiry Lab 11-1 (TG p. 450); 14-3 (TG p. 609)</p>
<p><b>NOS-2 Scientific Knowledge is Based on Empirical Evidence.</b>            Science knowledge is based on empirical evidence. Science arguments are strengthened by multiple lines of evidence supporting a single explanation. [NOS-2-H1]</p>	<p>SE 11-2 (pp. 423–430), 14-3 (pp. 562–575)            TG 11-2 (p. 460), 14-3 (p. 611)</p>
CROSSCUTTING CONCEPTS	
<p><b>CCC-2 Cause and Effect</b>            Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. [CCC-2-H1]</p>	<p>Claim-Evidence-Reasoning 10-1 (TG p. 403); 10-2 (TG p. 411)            Discussion Rubric 10-2 (TG p. 413)</p>

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PERFORMANCE EXPECTATION HS-ESS2-6	WHERE YOU WILL FIND IT
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	SE 10-1 (pp. 360–370, partial) Inquiry Lab 11-3 (TG p. 466); 14-4 (TG p. 617)
<b>DISCIPLINARY CORE IDEAS</b>	
<b>ESS2.D Weather and Climate</b> Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. [ESS2.D-H2]	SE 11-3 (pp. 431–438), 14-2 (pp. 554–561), 14-4 (pp. 576–586) TG 11-3 (p. 468), 14-2 (p. 602), 14-4 (p. 620)
Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. [ESS2.D-H3]	INV 14 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 544–545, 553, 561, 575, 586; TG support on pp. 590–597, 597, 606, 614, 623) SE 11-3 (pp. 431–438) TG 11-3 (p. 468)
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<b>SEP-2 Developing and Using Models</b> Develop a model based on evidence to illustrate the relationships between systems or between components of a system. [SEP-2-H3]	SE 11-3 Question 17 (p. 432), 11-3 Question 20 (p. 435), 14-2 Question 12 (p. 561), 14-4 Question 32 (p. 584), 14-4 Question 33 (p. 585)
<b>CROSCUTTING CONCEPTS</b>	
<b>CCC-5 Energy and Matter</b> The total amount of energy and matter in closed systems is conserved. [CCC-5-H1]	SE 11-3 Question 20 (p. 435)

# HS-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

PERFORMANCE EXPECTATION HS-ESS3-1	WHERE YOU WILL FIND IT
<p>Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</p>	<p>Storyline 3 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 318–319, 357, 413, 471; Reflection; TG support on pp. 350–351, 389, 437, 493)            INV 11 Investigative Phenomenon (Video; Claim-Evidence-Reasoning; Discussion Board; SE pp. 414–415, 422, 430, 438, 448, 458, 470; TG support on pp. 448–449, 455, 463, 470, 477, 484, 491)            Inquiry Lab 10-4 (TG p. 424)            Claim-Evidence-Reasoning 11-5 (TG p. 481)            Analyzing Data 11-5 (TG p. 483)            Authentic Reading INV10 (TG p. 398)</p>
<h3>DISCIPLINARY CORE IDEAS</h3>	
<p><b>ESS3.A Natural Resources</b>            Resource availability has guided the development of human society. [ESS3.A-H1]</p>	<p>SE 11-2 (pp. 423–430), 11-4 (pp. 439–448), 11-5 (pp. 449–458)            TG 11-2 (p. 460), 11-4 (p. 475), 11-5 (p. 482)</p>
<p><b>ESS3.B Natural Hazards</b>            Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. [ESS3.B-H1]</p>	<p>INV 9 Investigative Phenomenon (Video; Modeling; Discussion Board; SE pp. 320–321, 326, 338, 346, 356; TG support on pp. 358–359, 364, 372, 379, 387)            SE 11-2 (pp. 423–430), 11-4 (pp. 439–448), 11-5 (pp. 449–458)            TG 11-2 (p. 460), 11-4 (p. 475), 11-5 (p. 482)</p>
<h3>SCIENCE AND ENGINEERING PRACTICES</h3>	
<p><b>SEP-6 Constructing Explanations and Designing Solutions</b>            Construct 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. [SEP-6-H2]</p>	<p>Inquiry Lab 11-2 (TG p. 458)            Claim-Evidence-Reasoning 11-2 (TG p. 459)            Discussion Rubric 11-2 (TG p. 461)</p>
<h3>CROSCUTTING CONCEPTS</h3>	
<p><b>CCC-2 Cause and Effect</b>            Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. [CCC-2-H1]</p>	<p>SE 11-5 Question 32 (p. 450), 11-5 Question 35 (p. 453), 11-5 Question 37 (p. 455), 11-5 Question 39 (p. 457)</p>
<p><b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b>            Modern civilization depends on major technological systems. [STSE-2-H1]</p>	<p>SE 11-4 Question 23 (p. 440), 11-4 Question 24 (p. 441), 11-4 Question 25 (p. 442)</p>

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PERFORMANCE EXPECTATION HS-ESS3-2	WHERE YOU WILL FIND IT
Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	Writing About Science 18-1 (TG p. 746)
<b>DISCIPLINARY CORE IDEAS</b>	
<b>ESS3.A Natural Resources</b> All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. [ESS3.A-H2]	SE 11-6 (p. 459–470), 18-1 (pp. 720–732) TG 11-6 (p. 489), 18-1 (p. 744)
<b>ETS1.B Developing Possible Solutions</b> When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. [ETS1.B-H1]	SE 11-6 (p. 459–470), 18-1 (pp. 720–732) TG 11-6 (p. 489), 18-1 (p. 744)
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<b>SEP-7 Engaging in Argument from Evidence</b> Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations). [SEP-7-H6]	Writing About Science 18-1 (TG p. 746)
<b>CROSCUTTING CONCEPTS</b>	
<b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b> Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. Analysis of costs and benefits is a critical aspect of decisions about technology. [STSE-2-H2]	Claim-Evidence-Reasoning 18-2 (TG p. 752) Discussion Rubric 18-2 (TG p. 755)
<b>NOS-8 Science Addresses Questions About the Natural and Material World.</b> Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. [NOS-8-H2]	SE 11-6 Question 41 (p. 460), SE 11-6 Question 46 (p. 467), SE 11-6 Question 47 (p. 468), SE 18-1 Question 6 (p. 725)
Science knowledge indicates what can happen in natural systems — not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. [NOS-8-H3]	SE 11-6 Question 41 (p. 460), SE 11-6 Question 46 (p. 467), SE 11-6 Question 47 (p. 468), SE 18-1 Question 6 (p. 725)
Many decisions are not made using science alone but rely on social and cultural contexts to resolve issues. [NOS-8-H4]	Claim-Evidence-Reasoning 18-1 (TG p. 743) Discussion Rubric 18-1 (TG p. 745) Writing About Science 11-6 (TG p. 490); 18-1 (TG p. 746)

PERFORMANCE EXPECTATION HS-ESS3-3	WHERE YOU WILL FIND IT
Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.	Modeling 18-3 (TG p. 760)
<b>DISCIPLINARY CORE IDEAS</b>	
<b>ESS3.C Human Impacts on Earth Systems</b> The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. [ESS3.C-H1]	SE 18-2 (pp. 733–746), 18-3 (pp. 747–754) TG 18-2 (p. 752), 18-3 (p. 761)
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<b>SEP-5 Using Mathematics and Computational Thinking</b> Create a computational model or simulation of a phenomenon, designed device, process, or system. [SEP-5-H1]	Inquiry Lab 18-2 (TG p. 750); 18-3 (TG p. 759)
<b>CROSCUTTING CONCEPTS</b>	
<b>CCC-7 Stability and Change</b> Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. [CCC-7-H2]	SE 11-6 Question 41 (p. 460), 11-6 Question 42 (p. 462), 11-6 Question 43 (p. 463)
<b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b> Modern civilization depends on major technological systems. [STSE-2-H1]	SE 11-6 Question 44 (p. 464)
<b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b> New technologies can have deep impacts on society and the environment, including some that were not anticipated. [STSE-2-H3]	SE 11-6 Question 44 (p. 464), 11-6 Question 46 (p. 466)
<b>NOS-7 Science is a Human Endeavor.</b> Science is a result of human endeavors, imagination, and creativity. [NOS-7-H1]	SE 11-6 Question 45 (p. 465), 11-6 Question 47 (p. 468)

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PERFORMANCE EXPECTATION HS-ESS3-4	WHERE YOU WILL FIND IT
Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	<p>Storyline 5 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 588–589, 625, 671, 717, 755; Reflection; TG support on pp. 632–633, 665, 699, 731, 765)</p> <p>INV 18 Investigative Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 718–719, 732, 746, 754; TG support on pp. 740–741, 747, 756, 763)</p> <p>Claim-Evidence-Reasoning 18-2 (TG p. 752)</p>
DISCIPLINARY CORE IDEAS	
<p><b>ESS3.C Human Impacts on Earth Systems</b></p> <p>Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. [ESS3.C-H2]</p>	<p>SE 11-6 (pp. 459–470), 18-2 (pp. 733–746), 18-3 (pp. 747–754)</p> <p>TG 11-6 (p. 489), 18-2 (p. 752), 18-3 (p. 761)</p>
<p><b>ETS1.B Developing Possible Solutions</b></p> <p>When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. [ESS1.B-H1]</p>	<p>SE 11-6 (pp. 459–470), 18-2 (pp. 733–746), 18-3 (pp. 747–754)</p> <p>TG 11-6 (p. 489), 18-2 (p. 752), 18-3 (p. 761)</p>
SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-6 Constructing Explanations and Designing Solutions</b></p> <p>Design or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. [SEP-6-H5]</p>	<p>Inquiry Lab 18-3 (TG p. 759)</p> <p>Discussion Rubric 18-2 (TG p. 755)</p>
CROSSCUTTING CONCEPTS	
<p><b>CCC-7 Stability and Change</b></p> <p>Feedback (negative or positive) can stabilize or destabilize a system. [CCC-7-H3]</p>	<p>SE 11-6 Question 45 (p. 465), 11-6 Question 46 (p. 466), 11-6 Question 47 (p. 468)</p>
<p><b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <p>Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. [STSE-2-H2]</p>	<p>Claim-Evidence-Reasoning 18-2 (TG p. 752)</p> <p>Discussion Rubric 18-2 (TG p. 755)</p>

PERFORMANCE EXPECTATION HS-ESS3-5	WHERE YOU WILL FIND IT
Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth’s systems.	<p>SE 11-4 (pp. 442–448)</p> <p>SE 11-4 Questions 25, 27, 30–31 (pp. 442, 444, 447–448)</p> <p>Modeling 11-4 (TG p. 474)</p> <p>Analyzing Data (TG p. 476)</p>
DISCIPLINARY CORE IDEAS	
<p><b>ESS3.D Global Climate Change</b></p> <p>Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. [ESS3.D-H1]</p>	<p>SE 11-4 (pp. 439–448)</p> <p>TG 11-4 (p. 475)</p>

SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-4 Analyzing and Interpreting Data</b> Analyze data using computational models in order to make valid and reliable scientific claims. [SEP-4-H1]</p>	SE 11-4 Question 25 (p. 442), 11-4 Question 27 (p. 444), 11-4 Question 28 (p. 445), 11-4 Question 30 (p. 447)
<p><b>NOS-1 Scientific Investigations Use a Variety of Methods.</b> Science investigations use diverse methods and do not always use the same set of procedures to obtain data. [NOS-1-H1]</p>	Inquiry Lab 11-4 (TG p. 473)
<p>New technologies advance scientific knowledge. [NOS-1-H2]</p>	SE 11-4 Question 23 (p. 440), Question 24 (p. 441)
<p><b>NOS-2 Scientific Knowledge is Based on Empirical Evidence.</b> Science knowledge is based on empirical evidence. [NOS-2-H1]</p>	SE 11-4 Question 25 (p. 442), 11-4 Question 27 (p. 444), 11-4 Question 28 (p. 445), 11-4 Question 30 (p. 447)
<p>Science arguments are strengthened by multiple lines of evidence supporting a single explanation. [NOS-2-H4]</p>	SE 11-4 Question 25 (p. 442), 11-4 Question 27 (p. 444), 11-4 Question 28 (p. 445), 11-4 Question 30 (p. 447)
CROSSCUTTING CONCEPTS	
<p><b>CCC-7 Stability and Change</b> Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. [CCC-7-H2]</p>	SE 11-4 Question 26 (p. 443), 11-4 Question 29 (p. 446)

PERFORMANCE EXPECTATION HS-ESS3-6	WHERE YOU WILL FIND IT
Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.	SE 14-1 Questions 7, 9 (pp. 553, 555) Modeling 11-4 (TG p. 474), 14-2 (TG p. 601) Analyzing Data 14-2 (TG p. 601), 14-3 (TG p. 609)

DISCIPLINARY CORE IDEAS	
<p><b>ESS2.D Weather and Climate</b> Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. [ESS2.D-H4]</p>	SE 11-3 (pp. 431–438), 11-4 (pp. 439–448), 11-5 (pp. 449–458) TG 11-3 (p. 468), 11-4 (p. 475), 11-5 (p. 482)
<p><b>ESS3.D Global Climate Change</b> Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. [ESS3.D-H2]</p>	SE 11-4 (pp. 439–448), 11-5 (pp. 449–458) TG 11-4 (p. 475), 11-5 (p. 482)

SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-5 Using Mathematics and Computational Thinking</b> Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. [SEP-5-H2]</p>	SE 11-3 Question 18 (p. 433), 11-4 Question 25 (p. 442), 11-4 Question 27 (p. 444), 11-4 Question 28 (p. 445), 11-4 Question 30 (p. 447), 11-5 Question 32 (p. 450), 11-5 Question 33 (p. 451), 11-5 Question 34 (p. 452), 11-5 Question 36 (p. 454), 11-5 Question 38 (p. 456)
CROSSCUTTING CONCEPTS	
<p><b>CCC-4 Systems and System Models</b> When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. [CCC-4-H2]</p>	Peer Review Rubric 11-4 (TG p. 476)

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## HS-ETS1 Engineering Design

Students who demonstrate understanding can:

PERFORMANCE EXPECTATION HS-ETS1-1	WHERE YOU WILL FIND IT
<p>Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p>	<p>Storyline 4 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 472–473, 507, 543, 587; Reflection; TG support on pp. 500–501, 541, 581, 625)</p> <p>Storyline 5 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 588–589, 625, 671, 717, 755; Reflection; TG support on pp. 632–633, 665, 699, 731, 765)</p> <p>INV 18 Investigative Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 718–719, 732, 746, 754; TG support on pp. 740–741, 747, 756, 763)</p> <p>Problem-Based Learning Storyline 4, Storyline 5, INV 18</p> <p>Interactivity 18-3 (TG p. 759)</p> <p>Three-Dimensional Transfer Task Storyline 2 (TG p. 343)</p>
<b>DISCIPLINARY CORE IDEAS</b>	
<p><b>ETS1.A Defining and Delimiting Engineering Problems</b></p> <p>Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. [ETS1.A-H1]</p>	<p>Problem-Based Learning Storyline 5</p> <p>Interactivity 18-3 (TG p. 759)</p>
<p>Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. [ETS1.A-H2]</p>	<p>INV 18 Investigative Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 718–719, 732, 746, 754; TG support on pp. 740–741, 747, 756, 763)</p> <p>Problem-Based Learning Storyline 4, Storyline 5, INV18</p> <p>Interactivity 18-3 (TG p. 759)</p>
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<p><b>SEP-1 Asking Questions (for Science) and Defining Problems (for Engineering)</b></p> <p>Analyze complex real-world problems by specifying criteria and constraints for successful solutions. [SEP-1-H9]</p>	<p>Problem-Based Learning Storyline 5</p> <p>Interactivity 18-3 (TG p. 759)</p>
<b>CROSCUTTING CONCEPTS</b>	
<p><b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <p>New technologies can have deep impacts on society and the environment, including some that were not anticipated.</p> <p>Analysis of costs and benefits is a critical aspect of decisions about technology. [STSE-2-H3]</p>	<p>Storyline 5 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 588–589, 625, 671, 717, 755; Reflection; TG support on pp. 632–633, 665, 699, 731, 765)</p> <p>INV 18 Investigative Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 718–719, 732, 746, 754; TG support on pp. 740–741, 747, 756, 763)</p> <p>Problem-Based Learning Storyline 5</p>

PERFORMANCE EXPECTATION HS-ETS1-2	WHERE YOU WILL FIND IT
<p>Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p>	<p>Storyline 2 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 180–181, 223, 259, 289, 317; Reflection; TG support on pp. 202–203, 243, 277, 311, 343)</p> <p>Storyline 4 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 472–473, 507, 543, 587; Reflection; TG support on pp. 500–501, 541, 581, 625)</p> <p>Storyline 5 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 588–589, 625, 671, 717, 755; Reflection; TG support on pp. 632–633, 665, 699, 731, 765)</p> <p>INV 18 Investigative Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 718–719, 732, 746, 754; TG support on pp. 740–741, 747, 756, 763)</p> <p>Problem-Based Learning Storyline 2, Storyline 4, Storyline 5, INV 18 Interactivity 18-3 (TG p. 759)</p>
DISCIPLINARY CORE IDEAS	
<p><b>ETS1.C Optimizing The Design Solution</b> 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. [ETS1.C-H1]</p>	<p>Problem-Based Learning Storyline 2, Storyline 4, Storyline 5, INV 18 Interactivity 18-3 (TG p. 759) Inquiry Lab 14-4 (p. 617)</p>
SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-6 Constructing Explanations and Designing Solutions</b> Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. [SEP-6-H5]</p>	<p>Problem-Based Learning Storyline 2, Storyline 4, Storyline 5, INV 18 Interactivity 18-3 (TG p. 759)</p>

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PERFORMANCE EXPECTATION HS-ETS1-3	WHERE YOU WILL FIND IT
<p>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.</p>	<p>Storyline 5 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 588–589, 625, 671, 717, 755; Reflection; TG support on pp. 632–633, 665, 699, 731. 765)</p> <p>INV 18 Investigative Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 718–719, 732, 746, 754; TG support on pp. 740–741, 747, 756, 763)</p> <p>Problem-Based Learning Storyline 4, Storyline 5, INV 18</p> <p>Interactivity 18-3 (TG p. 759)</p>
<b>DISCIPLINARY CORE IDEAS</b>	
<p><b>ETS1.B Developing Possible Solutions</b></p> <p>When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. [ETS1.B-H1]</p>	<p>Problem-Based Learning Storyline 4, Storyline 5, INV 18</p> <p>Inquiry Lab 18-3 (TG p. 617)</p>
<b>SCIENCE AND ENGINEERING PRACTICES</b>	
<p><b>SEP-6 Constructing Explanations and Designing Solutions</b></p> <p>Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. [SEP-6-H5]</p>	<p>Problem-Based Learning Storyline 4, Storyline 5, INV 18</p> <p>Interactivity 18-3 (TG p. 759)</p>
<b>CROSCUTTING CONCEPTS</b>	
<p><b>STSE-2 Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <p>New technologies can have deep impacts on society and the environment, including some that were not anticipated. [STSE-2-H3]</p>	<p>Storyline 5 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 588–589, 625, 671, 717, 755; Reflection; TG support on pp. 632–633, 665, 699, 731. 765)</p> <p>INV 18 Investigative Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 718–719, 732, 746, 754; TG support on pp. 740–741, 747, 756, 763)</p> <p>Problem-Based Learning Storyline 5</p>

PERFORMANCE EXPECTATION HS-ETS1-4	WHERE YOU WILL FIND IT
<p>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.</p>	<p>Storyline 2 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 180–181, 223, 259, 289, 317; Reflection; TG support on pp. 202–203, 243, 277, 311, 343)            Problem-Based Learning Storyline 2            Analyzing Data 18-3 (TG p. 762)</p>
DISCIPLINARY CORE IDEAS	
<p><b>ETS1.B Developing Possible Solutions</b>            Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. [ETS1.B-H2]</p>	<p>Storyline 2 Anchoring Phenomenon (Video; Problem-Based Learning; Discussion Board; SE pp. 180–181, 223, 259, 289, 317; Reflection; TG support on pp. 202–203, 243, 277, 311, 343)            Problem-Based Learning Storyline 2            Analyzing Data 18-3 (TG p. 762)</p>
SCIENCE AND ENGINEERING PRACTICES	
<p><b>SEP-5 Using Mathematics and Computational Thinking</b>            Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. [SEP-5-H5]</p>	<p>Problem-Based Learning Storyline 2            Analyzing Data 18-3 (TG p. 762)</p>
CROSSCUTTING CONCEPTS	
<p><b>CCC-4 Systems and System Models</b>            Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. [CCC-4-H3]</p>	<p>Problem-Based Learning Storyline 2            Analyzing Data 18-3 (TG p. 762)</p>