

New York Core Curriculum Grades 5–8 Intermediate Level Science

Legend: **Green type** indicates *Glencoe Life Science, NY Ed.* • **Red type** indicates *Glencoe Earth Science, NY Ed.* • **Blue type** indicates *Glencoe Physical Science, NY Ed.* • **SE** = Student Edition • **TWE** = Teacher Wraparound Edition

MATHEMATICAL ANALYSIS *Key Idea 1:* Abstraction and symbolic representation are used to communicate mathematically.

M1.1 Extend mathematical notation and symbolism to include variables and algebraic expressions in order to describe and compare quantities and express mathematical relationships.

M1.1a identify independent and dependent variable

GLS SE: 28-29, 174-175, 200-201, 418-419, 446-447, 530-531, 558-559, 612-613, 702-703 **GES SE:** 10, 11, 24-25, 52-53, 200-201, 228-229, 260-261, 350-351, 680-681, 760

GPS SE: 9, 13, 24, 58-59

M1.1b identify relationships among variables including: direct, indirect, cyclic constant; identify non-related material

GLS SE: 292-293, 642-643 **GES SE:** 10, 11, 24-25, 52-53, 200-201, 228-229, 350-351, 680-681, 760

GPS SE: 7, 13, 24, 58-59, 180-181, 466-467

M1.1c apply mathematical equations to describe relationships among variables in the natural world

GLS SE: 44, 72, 131, 290, 313, 347, 374, 404, 487, 609, 623, 730-731, 756 **GES SE:** 24-25, 47, 200-201, 317, 522, 544, 590-591, 680-681

GPS SE: 13, 24, 58-59, 180-181

MATHEMATICAL ANALYSIS *Key Idea 2:* Deductive and inductive reasoning are used to reach mathematical conclusions.

M2.1 Use inductive reasoning to construct, evaluate, and validate conjectures and arguments, recognizing that patterns and relationships can assist in explaining and extending mathematical phenomena.

M2.1a interpolate and extrapolate from data

GLS SE: 37, 72, 80, 103, 116-117, 125, 128, 131, 133, 136, 144-145, 174-175, 187, 202, 247, 290, 310, 313, 347, 374, 404, 446-447, 487, 501, 530-531, 549, 567, 603, 609, 623, 632, 642-643, 651, 655, 690, 702-703, 730-731, 732, 832-846 **GES SE:** 5, 23, 24-25, 45, 47, 52-53,

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M2.1b quantify patterns and trends

80-81, 108, 192, 228-229, 230, 251, 279, 317, 322, 346, 378, 402, 407, 411, 416, 434, 457, 474-475, 522, 544, 548, 590-591, 602, 616-617, 636, 650-651, 695, 700, 733, 785-799 **GPS SE:** 16, 19, 24, 25, 27, 40, 42, 57, 58-59, 69, 86, 90-91, 102, 104, 106, 116-117, 128, 130, 147, 148-149, 162, 180-181, 211, 212, 277, 278-279, 299, 312-313, 342, 357, 463, 468, 487, 493, 496-497, 498, 548, 552, 558-559, 587, 617, 644, 669, 680, 686-687, 688, 788-779, 817-833
GLS SE: 642-643 **GES SE:** 140, 411, 430 **GPS SE:** 59, 116-117, 180-181, 214-215, 278-279, 592-593

MATHEMATICAL ANALYSIS *Key Idea 3:* Critical thinking skills are used in the solution of mathematical problems.

M3.1 Apply mathematical knowledge to solve real-world problems and problems that arise from the investigation of mathematical ideas, using representations such as pictures, charts, and tables.

M3.1a use appropriate scientific tools to solve problems about the natural world

GLS SE: 27, 28-29, 46, 56-57, 80, 86-87, 103, 174-475, 192, 200-201, 221, 230-231, 280, 292-293, 310, 318-319, 343, 350-351, 384-385, 398, 418-419, 471, 501, 522, 530-531, 558-559, 583, 584-585, 603, 612-613, 665, 672-673, 701, 702-703, 719, 730-731, 752, 787, 792-793 **GES SE:** 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 136, 171, 200-201, 221, 228-229, 259, 260-261, 279, 312, 320-321, 350-351, 376, 382-383, 444-445, 474-475, 503, 504-505, 531, 532-533, 585, 590-591, 608, 616-617, 634, 675, 680-

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681, 714-715, 733, 746-747 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 302, 312-313, 338, 344-345, 366, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 557, 558-559, 583, 592-593, 622-623, 651, 680, 686-687, 706, 716-717, 735, 748-749, 777, 778-779

SCIENTIFIC INQUIRY *Key Idea 1:* The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

S1.1 Formulate questions independently with the aid of references appropriate for guiding the search for explanations of everyday observations.

S1.1a formulate questions about natural phenomena

GLS SE: 28-29, 56-57, 144-145, 174-175, 200-201, 292-293, 350-351, 418-419, 558-559, 612-613, 672-673, 702-703 **GES SE:** 22, 23, 45, 52-53, 67, 80-81, 110-111, 136, 142-143, 171, 172-173, 195, 200-201, 221, 228-229, 259, 260-261, 279, 290-291, 312, 320-321, 344, 350-351, 376, 382-383, 407, 414-415, 434, 444-445, 473, 474-475, 503, 504-505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747, 756-759

S1.1b identify appropriate references to investigate a question

GPS SE: 171, 180-181, 227, 465
GLS SE: 113, 115, 116-117, 127, 200-201, 262-263, 472-473, 502-503
GES SE: 6, 8, 17, 22, 23, 52-53, 63, 80-81, 142-143, 172-173, 200-201, 225, 290-291, 320-321, 350-351, 382-383, 414-415, 444-445, 474-

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S1.1c refine and clarify questions so that they are subject to scientific investigation

475, 532-533, 562-563, 590-591,
616-617, 650-651, 746-747, 756, 757
GPS SE: 53, 278-279, 344-345, 701
GLS SE: 28-29, 56-57, 144-145,
174-175, 200-201, 292-293, 350-
351, 418-419, 558-559, 612-613,
672-673, 702-703 **GES SE:** 756
GPS SE: 28-29, 58-59, 116-117,
148-149, 214-215, 246-247, 344-
345, 406-407, 438-439, 466-467,
558-559, 592-593, 622-623, 716-717

S1.2 Construct explanations independently for natural phenomena, especially by proposing preliminary visual models of phenomena.

S1.2a independently formulate a hypothesis

GLS SE: 8, 28-29, 56-57, 144-145,
174-175, 200-201, 292-293, 350-
351, 418-419, 558-559, 612-613,
672-673, 702-703 **GES SE:** 52-53,
80-81, 98, 200-201, 228-229, 290-
291, 312, 320-321, 350-351, 376,
444-445, 562-563, 616-617, 695,
746-747, 759 **GPS SE:** 28-29, 58-59,
116-117, 214-215, 246-247, 344-
345, 406-407, 466-467, 592-593,
622-623, 716-717

S1.2b propose a model of a natural phenomenon

GLS SE: 200-201, 230-231, 418-
419, 472-473 **GES SE:** 142-143,
172-173, 217, 237, 285, 340, 382-
383, 391, 474-475, 525, 641, 659,
689, 704, 714-715, 763 **GPS SE:** 53,
116-117, 539, 552, 557, 558-559,
729

S1.2c differentiate among observations, inferences, predictions, and explanations

GES SE: 10, 20, 21, 52-53, 80-81,
142-143, 172-173, 200-201, 228-
229, 290-291, 320-321, 350-351,
382-383, 414-415, 444-445, 474-
475, 532-533, 562-563, 590-591,

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S1.3 Represent, present, and defend their proposed explanations of everyday observations so that they can be understood and assessed by others.

616-617, 650-651, 746-747, 756, 763, 764 **GPS SE:** 28-29, 148-149, 171, 180-181, 214-215, 505, 508, 592-593, 680, 716-717

GLS SE: 27, 28-29, 56-57, 86-87, 116-117, 144-145, 200-201, 262-263, 418-419 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 142-143, 200-201, 228-229, 259, 260-261, 285, 290-291, 320-321, 344, 350-351, 376, 382-383, 434, 444-445, 473, 474-475, 503, 504-505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747, 764 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 711, 716-717, 735, 748-749, 777, 778-779

S1.4 Seek to clarify, to assess critically, and to reconcile with their own thinking the ideas presented by others, including peers, teachers, authors, and scientists.

GLS SE: 262-263, 292-293, 702-703, 730-731 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 142-143, 200-201, 228-229, 259, 260-261, 285, 290-291, 320-321, 344, 350-351, 376, 382-383, 434, 444-445, 473, 474-475, 503, 504-505, 532-533, 548, 562-563, 585,

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590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747, 764 **GPS SE:** 28-29, 58-59, 116-117, 148-149, 171, 180-181, 344-345, 496-497, 652-653, 716-717

SCIENTIFIC INQUIRY *Key Idea 2:* Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

S2.1 Use conventional techniques and those of their own design to make further observations and refine their explanations, guided by a need for more information.

S2.1a demonstrate appropriate safety techniques

GLS SE: 27, 28-29, 46, 56-57, 65, 71, 75, 80, 86-87, 95, 103, 133, 162, 174-175, 185, 187, 192, 194, 200-201, 209, 221, 225, 230-231, 247, 253, 261, 271, 273, 280, 292-293, 301, 305, 310, 318-319, 329, 343, 346, 350-351, 359, 372, 379, 384-385, 398, 410, 418-419, 427, 430, 446-447, 465, 471, 498, 501, 515, 522, 528, 530-531, 541, 552, 558-559, 572, 579, 583, 584-585, 593, 612-613, 621, 655, 660, 665, 672-673, 683, 689, 693, 701, 702-703, 714, 719, 723, 730-731, 748, 752, 754, 769, 772, 779, 787, 792-793

GES SE: 19, 37, 52-53, 80-81, 200-201, 228-229, 318, 339, 350-351, 433, 444-445, 469, 532-533, 606, 616-617, 629, 746-747, 765, 766

GPS SE: 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 302, 312-313, 338, 366, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 558-559,

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S2.1b conduct an experiment designed by others

583, 592-593, 622-623, 651, 680, 686-687, 706, 716-717, 735, 748-749, 777, 778-779
GLS SE: 8, 71, 75, 80, 86-87, 103, 133, 318-319, 446-447, 530-531
GES SE: 5, 9, 19, 24-25, 104, 136, 139, 190, 195, 209, 211, 237, 247, 285, 318, 334, 340, 361, 378, 391, 425, 431, 434, 437, 453, 456, 471, 513, 525, 531, 553, 573, 579, 585, 599, 613, 634, 641, 659, 662, 677, 689, 699, 723 **GPS SE:** 7, 12, 28-29, 171, 180-181, 206, 245, 277, 302, 338, 366, 405, 423, 457, 484, 525, 557, 583, 607, 651, 680, 706, 735, 777

S2.1c design and conduct an experiment to test a hypothesis

GLS SE: 28-29, 56-57, 144-145, 174-175, 200-201, 292-293, 350-351, 418-419, 558-559, 612-613, 672-673, 702-703, 802-810 **GES SE:** 44, 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-617, 746-747, 756-764 **GPS SE:** 28-29, 58-59, 116-117, 148-149, 214-215, 246-247, 344-345, 406-407, 466-467, 592-593, 622-623, 716-717, 788-796

S2.1d use appropriate tools and conventional techniques to solve problems about the natural world, including: measuring, observing, describing, classifying, and sequencing.

GLS SE: 27, 28-29, 46, 56-57, 80, 86-87, 103, 116-117, 133, 144-145, 162, 174-175, 192, 200-201, 221, 230-231, 261, 262-263, 280, 292-293, 310, 318-319, 343, 350-351, 379, 384-385, 398, 418-419, 445, 446-447, 471, 472-473, 501, 502-503, 522, 530-531, 549, 558-559,

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583, 584-585, 603,612-613, 632, 642-643, 665, 672-673, 701, 702-703, 719, 730-731, 752, 760-761, 787, 792-793 **GES SE:** 5, 15, 38, 45, 47, 52-53, 79, 80-81, 97, 108, 109, 129, 163, 192, 194, 200-201, 228-229, 251, 258, 278, 311, 314, 317, 346, 349, 350-351, 381, 410, 413, 444-445, 455, 457, 461, 471, 474-475, 487, 517, 522, 532-533, 544, 547, 602, 616-617, 633, 636, 642, 649, 674, 690, 698, 700, 701, 713, 714-715, 727, 739, 746-747, 764 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 711, 716-717, 735, 748-749, 777, 778-779

S2.2 Develop, present, and defend formal research proposals for testing their own explanations of common phenomena, including ways of obtaining needed observations and ways of conducting simple controlled experiments.

S2.2a include appropriate safety procedures

GLS SE: 27, 28-29, 46, 56-57, 65, 71, 75, 80, 86-87, 95, 103, 133, 162, 174-175, 185, 187, 192, 194, 200-201, 209, 221, 225, 230-231, 247, 253, 261, 271, 273, 280, 292-293, 301, 305, 310, 318-319, 329, 343, 346, 350-351, 359, 372, 379, 384-385, 398, 410, 418-419, 427, 430, 446-447, 465, 471, 498, 501, 515,

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S2.2b design scientific investigations (e.g., observing, describing, and comparing; collecting samples; seeking more information, conducting a controlled experiment; discovering new objects or phenomena; making models)

S2.2c design a simple controlled experiment

522, 528, 530-531, 541, 552, 558-559, 572, 579, 583, 584-585, 593, 612-613, 621, 655, 660, 665, 672-673, 683, 689, 693, 701, 702-703, 714, 719, 730-731, 748, 752, 754, 769, 772, 779, 787, 792-793 **GES**
SE: 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-617, 746-747, 765, 766 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 302, 312-313, 338, 366, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 558-559, 583, 592-593, 622-623, 651, 680, 686-687, 706, 716-717, 735, 748-749, 777, 778-779
GLS SE: 28-29, 56-57, 144-145, 174-175, 200-201, 230-231, 292-293, 350-351, 418-419, 472-473, 558-559, 584-585, 612-613, 672-673, 702-703, 792-793 **GES SE:** 8, 9, 10, 44, 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-617, 746-747 **GPS SE:** 28-29, 58-59, 116-117, 148-149, 214-215, 246-247, 344-345, 406-407, 438-439, 466-467, 557, 558-559, 592-593, 622-623, 716-717
GLS SE: 9, 174-175, 198, 200-201, 292-293, 418-419, 558-559, 612-613, 702-703 **GES SE:** 8, 9, 10, 11, 44, 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-

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S2.2d identify independent variables (manipulated), dependent variables (responding), and constants in a simple controlled experiment

617, 746-747 **GPS SE:** 28-29, 58-59, 116-117, 148-149, 214-215, 246-247, 344-345, 406-407, 438-439, 466-467, 558-559, 592-593, 622-623, 716-717

S2.2e choose appropriate sample size and number of trials

GLS SE: 28-29, 174-175, 198, 200-201, 292-293, 418-419, 446-447, 558-559, 612-613, 702-703 **GES SE:** 9, 10, 11, 24-25, 52-53, 200-201, 228-229, 260-261, 350-351, 680-681, 760 **GPS SE:** 5, 58-59, 180-181, 406-407, 466-467

S2.3 Carry out their research proposals, recording observations and measurements (e.g., lab notes, audiotape, computer disk, videotape) to help assess the explanation.

S2.3a use appropriate safety procedures

GLS SE: 174-175, 198, 200-201, 230-231, 418-419, 612-613 **GES SE:** 761 **TWE:** 4E **GPS SE:** 28-29, 58-59, 116-117, 148-149, 214-215, 246-247, 344-345, 406-407, 438-439, 466-467, 558-559, 592-593, 622-623, 716-717

GLS SE: 27, 28-29, 46, 56-57, 65, 71, 75, 80, 86-87, 95, 103, 133, 162, 174-175, 185, 187, 192, 194, 200-201, 209, 221, 225, 230-231, 247, 253, 261, 271, 273, 280, 292-293, 301, 305, 310, 318-319, 329, 343, 346, 350-351, 359, 372, 379, 384-385, 398, 410, 418-419, 427, 430, 446-447, 465, 471, 498, 501, 515, 522, 528, 530-531, 541, 552, 558-559, 572, 579, 583, 584-585, 593, 612-613, 621, 655, 660, 665, 672-673, 683, 689, 693, 701, 702-703, 714, 719, 723, 730-731, 748, 752,

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S2.3b conduct a scientific investigation

754, 769, 772, 779, 787, 792-793
GES SE: 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-617, 746-747, 765, 766
GPS SE: 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 302, 312-313, 338, 366, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 558-559, 583, 592-593, 622-623, 651, 680, 686-687, 706, 716-717, 735, 748-749, 777, 778-779
GLS SE: 27, 28-29, 46, 56-57, 80, 86-87, 103, 116-117, 133, 144-145, 162, 174-175, 192, 200-201, 221, 230-231, 261, 262-263, 280, 292-293, 310, 318-319, 343, 350-351, 379, 384-385, 398, 418-419, 445, 446-447, 471, 472-473, 501, 502-503, 522, 530-531, 549, 558-559, 583, 584-585, 603, 612-613, 632, 642-643, 665, 672-673, 701, 702-703, 719, 730-731, 752, 760-761, 787, 792-793 **GES SE:** 5, 19, 24-25, 44, 52-53, 80-81, 104, 136, 139, 190, 195, 200-201, 209, 211, 228-229, 237, 247, 285, 318, 334, 340, 350-351, 361, 378, 391, 425, 431, 434, 437, 444-445, 453, 456, 471, 513, 525, 531, 532-533, 553, 573, 579, 585, 599, 613, 616-617, 634, 641, 659, 662, 677, 689, 699, 723, 746-747 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-

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S2.3c collect quantitative and qualitative data

149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 711, 716-717, 735, 748-749, 777, 778-779

GLS SE: 27, 28-29, 86-87, 144-145, 174-175, 200-201, 262-263, 612-613

GES SE: 5, 19, 24-25, 44, 52-53, 80-81, 104, 136, 139, 142-143, 172-173, 190, 195, 200-201, 209, 211, 228-229, 237, 247, 285, 290-291, 318, 334, 340, 350-351, 361, 378, 382-383, 391, 425, 431, 434, 437, 444-445, 453, 456, 471, 513, 525, 531, 532-533, 553, 562-563, 573, 579, 585, 599, 613, 616-617, 634, 641, 650-651, 659, 662, 677, 689, 699, 723, 746-747 **GPS SE:** 5, 28-29, 58-59, 116-117, 148-149, 180-181, 278-279

SCIENTIFIC INQUIRY *Key Idea 3:* The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

S3.1 Design charts, tables, graphs, and other representations of observations in conventional and creative ways to help them address their research question or hypothesis.

S3.1a organize results, using appropriate graphs, diagrams, data tables, and other models to show relationships

GLS SE: 27, 28-29, 56-57, 80, 86-87, 103, 116-117, 144-145, 174-175, 192, 200-201, 225, 230-231, 292-293, 418-419, 446-447, 472-473, 558-559, 583, 612-613, 632, 672-673, 702-703, 772 **GES SE:** 52-53, 80-81, 142-143, 172-173, 200-201,

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228-229, 290-291, 320-321, 350-351, 382-383, 414-415, 444-445, 474-475, 532-533, 562-563, 590-591, 616-617, 636, 650-651, 746-747

GPS SE: 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 711, 716-717, 735, 748-749, 777, 778-779

S3.1b generate and use scales, create legends, and appropriately label axes

GLS SE: 174-175, 230-231, 292-293, 642-643 **GES SE:** 167, 168, 172-173, 317, 329, 472, 473, 542, 636, 678, 806 **GPS SE:** 58-59, 76, 148-149, 180-181, 558-559, 680

S3.2 Interpret the organized data to answer the research question or hypothesis and to gain insight into the problem.

S3.2a accurately describe the procedures used and the data gathered

GLS SE: 28-29, 230-231, 292-293, 672-673, 802-810 **GES SE:** 10, 20, 21, 52-53, 80-81, 142-143, 172-173, 200-201, 228-229, 290-291, 320-321, 350-351, 382-383, 414-415, 444-445, 474-475, 532-533, 562-563, 590-591, 616-617, 636, 650-651, 746-747, 756-764 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467,

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S3.2b identify sources of error and the limitations of data collected

484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 711, 716-717, 735, 748-749, 777, 778-779, 788-796

GLS SE: 230-231, 262-263, 472-473, 672-673, 802-813 **GES SE:** 10, 20, 21, 52-53, 80-81, 142-143, 172-173, 200-201, 228-229, 290-291, 320-321, 350-351, 382-383, 414-415, 444-445, 474-475, 532-533, 562-563, 590-591, 616-617, 636, 650-651, 746-747, 756-764 **GPS SE:** 28-29, 58-59, 148-149, 716-717, 788-796

S3.2c evaluate the original hypothesis in light of the data

GLS SE: 9, 144-145, 200-201, 558-559, 612-613 **GES SE:** 52-53, 200-201, 228-229, 290-291, 414-415, 444-445, 532-533, 616-617, 714-715, 746-747, 760 **GPS SE:** 28-29, 58-59, 116-117, 148-149, 214-215, 246-247, 344-345, 406-407, 466-467, 716-717

S3.2d formulate and defend explanations and conclusions as they relate to scientific phenomena

GLS SE: 10, 28-29, 80, 86-87, 144-145, 174-175, 292-293, 318-319, 530-531 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 136, 142-143, 171, 172-173, 195, 200-201, 221, 228-229, 259, 260-261, 279, 290-291, 312, 320-321, 344, 350-351, 376, 407, 414-415, 434, 444-445, 473, 503, 504-505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747

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S3.2e form and defend a logical argument about cause-and-effect relationships in an investigation

GPS SE: 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 711, 716-717, 735, 748-749, 777, 778-779

GLS SE: 174-175, 292-293, 318-319, 418-419 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 136, 142-143, 171, 172-173, 195, 200-201, 209, 221, 228-229, 237, 259, 260-261, 279, 290-291, 312, 320-321, 344, 350-351, 376, 407, 414-415, 425, 434, 444-445, 453, 473, 503, 504-505, 513, 532-533, 548, 562-563, 573, 585, 590-591, 608, 616-617, 632, 634, 650-651, 675, 680-681, 695, 699, 714-715, 733, 746-747 **GPS SE:** 171, 180-181, 558-559, 716-717

S3.2f make predictions based on experimental data

GLS SE: 116-117, 133, 144-145, 174-175, 200-201, 225, 418-419, 471, 530-531, 558-559, 584-585, 612-613, 672-673 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 136, 142-143, 171, 172-173, 195, 200-201, 221, 228-229, 259, 260-261, 279, 290-291, 312, 320-321, 344, 350-351, 376, 407, 414-415, 434, 444-445, 473, 503, 504-

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S3.2g suggest improvements and recommendations for further studying

505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747 **GPS SE:** 7, 106, 148-149, 171, 206, 214-215, 245, 405, 652-653, 680, 716-717, 735, 748-749 **GLS SE:** 174-175, 230-231, 584-585 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 136, 142-143, 171, 172-173, 195, 200-201, 221, 228-229, 259, 260-261, 279, 290-291, 312, 320-321, 344, 350-351, 376, 407, 414-415, 434, 444-445, 473, 503, 504-505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747 **GPS SE:** 148-149, 438-439, 466-467 **GLS SE:** 28-29, 174-175, 558-559, 702-703 **GES SE:** 24-25, 80-81, 136, 141, 221, 223, 228-229, 260-261, 312, 314, 320-321, 380, 414-415, 430, 434, 486, 548, 575, 580, 581, 586, 606, 611, 613, 614, 636, 638, 714-715 **GPS SE:** 8, 15, 18, 19, 22, 23, 25, 26, 27, 39, 41, 43, 50, 58-59, 89, 90-91, 106, 110, 115, 148-149, 161, 180-181, 213, 228, 241, 246-247, 257, 261, 262, 263, 277, 278-279, 312-313, 323, 329, 368, 422, 423, 426, 427, 456, 457, 468, 480, 492, 494, 496-497, 498, 506, 512, 513, 514, 515, 541, 543, 544, 550, 583, 603, 616, 618, 619, 621, 635, 672, 673, 684, 686-687, 697,

S3.2h use and interpret graphs and data tables

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S3.3 Modify their personal understanding of phenomena based on evaluation of their hypothesis.

699, 708, 728, 729, 744, 761, 766, 771, 778-779

GLS SE: 292-293 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 136, 142-143, 171, 172-173, 195, 200-201, 221, 228-229, 259, 260-261, 279, 290-291, 312, 320-321, 344, 350-351, 376, 407, 414-415, 434, 444-445, 473, 503, 504-505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747 **GPS SE:** 28-29, 58-59, 116-117, 148-149, 344-345

ENGINEERING DESIGN *Key Idea 1:* Engineering design is an iterative process involving modeling and optimization (finding the best solution within given constraints); this process is used to develop technological solutions to problems within given constraints.

T1.1 Identify needs and opportunities for technical solutions from an investigation of situations of general or social interest.

T1.1a identify a scientific or human need that is subject to a technological solution which applies scientific principles

GLS SE: 55, 141, 142, 143, 262-263, 760-761 **GES SE:** 22, 23, 45, 52-53, 67, 80-81, 98, 110-111, 136, 142-143, 171, 195, 200-201, 221, 228-229, 259, 260-261, 290-291, 312, 320-321, 344, 350-351, 376, 382-383, 407, 414-415, 434, 444-445, 473, 474-475, 503, 504-505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747 **GPS SE:** 3, 148-149, 180-181, 278-279, 344-345

T1.2 Locate and utilize a range of printed, electronic, and human information resources to obtain ideas.

T1.2a use all available information systems for a preliminary search that addresses the need

GLS SE: 200-201, 262-263, 472-473, 502-503, 760-761 **GES SE:** 290-291, 414-415, 562-563, 650-651, 756 **GPS SE:** 148-149, 278-

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279, 344-345, 374-375, 622-623

T1.3 Consider constraints and generate several ideas for alternative solutions, using group and individual ideation techniques (group discussion, brainstorming, forced connections, role play); defer judgment until a number of ideas have been generated; evaluate (critique) ideas; and explain why the chosen solution is optimal.

T1.3a generate ideas for alternative solutions

GLS SE: 472-473, 584-585, 760-761 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 142-143, 200-201, 228-229, 259, 260-261, 285, 290-291, 320-321, 344, 350-351, 376, 382-383, 434, 444-445, 473, 474-475, 503, 504-505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747
GPS SE: 148-149, 344-345, 438-439, 466-467

T1.3b evaluate alternatives based on the constraints of design

GLS SE: 472-473 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 136, 141, 142-143, 200-201, 221, 223, 228-229, 259, 260-261, 285, 290-291, 312, 314, 320-321, 344, 350-351, 376, 380, 382-383, 414-415, 430, 434, 444-445, 473, 474-475, 486, 503, 504-505, 532-533, 548, 562-563, 575, 580, 581, 585, 586, 590-591, 606, 608, 611, 613, 614, 616-617, 634, 636, 638, 650-651, 675, 680-681, 695, 714-715, 733, 746-747, 764 **GPS SE:** 148-149, 344-345, 438-439, 466-467

T1.4 Develop plans, including drawings with measurements and details of construction, and construct a model of the solution, exhibiting a degree of craftsmanship.

T1.4a design and construct a model of the product or process

GLS SE: 230-231, 472-473, 584-585, 772, 787 **GES SE:** 5, 19, 24-25, 44, 52-53, 80-81, 104, 136, 139, 142-

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T1.4b construct a model of the product or process

143, 172-173, 190, 195, 200-201, 209, 211, 228-229, 237, 247, 285, 318, 334, 340, 350-351, 361, 378, 382-383, 391, 425, 431, 434, 437, 444-445, 453, 456, 471, 474-475, 513, 525, 531, 532-533, 553, 573, 579, 585, 599, 613, 616-617, 634, 641, 659, 662, 677, 689, 699, 714-715, 723, 746-747, 759 **GPS SE:** 3, 116-117, 148-149, 438-439, 557, 558-559, 729

GLS SE: 230-231, 472-473, 584-585, 772, 787, 792-793 **GES SE:** 5, 19, 24-25, 44, 52-53, 80-81, 104, 136, 139, 142-143, 172-173, 190, 195, 200-201, 209, 211, 228-229, 237, 247, 285, 318, 334, 340, 350-351, 361, 378, 382-383, 391, 425, 431, 434, 437, 444-445, 453, 456, 471, 474-475, 513, 525, 531, 532-533, 553, 573, 579, 585, 599, 613, 616-617, 634, 641, 659, 662, 677, 689, 699, 714-715, 723, 746-747, 759 **GPS SE:** 3, 116-117, 148-149, 438-439, 557, 558-559, 729, 778-779

T1.5 In a group setting, test their solution against design specifications, present and evaluate results, describe how the solution might have been modified for different or better results, and discuss trade-offs that might have to be made.

T1.5a test a design

GLS SE: 584-585 **GES SE:** 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-617 **GPS SE:** 28-29, 58-59, 116-117, 148-149, 214-215, 246-247, 344-345, 406-407, 438-439, 466-467, 558-559, 592-593, 622-623, 716-717

T1.5b evaluate a design

GLS SE: 584-585 **GES SE:** 52-53,

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80-81, 142-143, 172-173, 200-201, 228-229, 290-291, 320-321, 350-351, 382-383, 414-415, 444-445, 474-475, 532-533, 562-563, 590-591, 616-617, 650-651, 714-715
GPS SE: 28-29, 58-59, 116-117, 148-149, 214-215, 246-247, 344-345, 406-407, 438-439, 466-467, 558-559, 592-593, 622-623, 716-717

Key Idea 1: Information technology is used to retrieve, process, and communicate information as a tool to enhance learning.

1.1 Use a range of equipment and software to integrate several forms of information in order to create good-quality audio, video, graphic, and text-based presentations.

GLS SE: 472-473 **GES SE:** 781-784 **GPS SE:** 3, 25, 53, 59, 148-149, 189, 278-279, 287, 374-375, 447, 525, 558-559, 567, 661, 778-779, 816

1.2 Use spreadsheets and database software to collect, process, display, and analyze information. Students access needed information from electronic databases and on-line telecommunication services.

GLS SE: 9, 15, 23, 54, 84, 113, 115, 116-117, 127, 223, 248, 259, 262-263, 274, 282, 306, 316, 368, 382, 432, 446-447, 459, 472-473, 502-503, 514, 654, 663, 692, 717, 757, 760-761, 829-830 **GES SE:** 9, 17, 40, 48, 76, 96, 100, 125, 133, 144, 157, 168, 185, 197, 220, 224, 242, 246, 273, 282, 307, 316, 337, 347, 370, 374, 380, 404, 409, 428, 440, 463, 466, 499, 501, 527, 543, 554, 575, 606, 612, 640, 645, 647, 663, 668, 669, 691, 700, 729, 736, 782-783 **GPS SE:** 278-279, 374-375, 526-527, 652-653, 814-815

1.3 Systematically obtain accurate and relevant information pertaining to a particular topic from a range of sources, including local and national media, libraries, museums, governmental agencies, industries, and individuals.

GLS SE: 262-263, 472-473, 702-703, 802-810, 829-830 **GES SE:** 23, 756-764, 782-783 **GPS SE:** 278-279, 374-375, 526-527, 652-653, 788-

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1.4 Collect data from probes to measure events and phenomena.

1.4a collect the data, using the appropriate, available tool

796, 814-815

GLS SE: 28-29, 103, 174-175, 187, 253, 418-419, 501, 603, 612-613, 719 **GES SE:** 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-617, 746-747 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 711, 716-717, 735, 748-749, 777, 778-779

1.4b organize the data

GLS SE: 80, 86-87, 103, 418-419 **GES SE:** 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-617, 746-747, 756-758 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 716-717, 735, 748-749, 777, 778-779

1.4c use the collected data to communicate a scientific concept

GLS SE: 27, 28-29, 80, 86-87, 418-419 **GES SE:** 22, 24-25, 45, 52-53,

New York Core Curriculum Grades 5–8 Intermediate Level Science

67, 80-81, 98, 110-111, 142-143, 200-201, 228-229, 259, 260-261, 285, 290-291, 320-321, 344, 350-351, 376, 382-383, 434, 444-445, 473, 474-475, 503, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 716-717, 735, 748-749, 777, 778-779 **GES SE:** 217, 237, 285, 340, 382-383, 391, 474-475, 525, 641, 659, 689, 704

1.5 Use simple modeling programs to make predictions.
Blank in Physical Science.

Key Idea 2: Knowledge of the impacts and limitations of information systems is essential to its effectiveness and ethical use.

2.1 Understand the need to question the accuracy of information displayed on a computer because the results produced by a computer may be affected by incorrect data entry.

2.1a critically analyze data to exclude erroneous information

GES SE: 763-764 **GPS SE:** 28-29
TWE: 29, 716-717

2.1b identify and explain sources of error in a data collection

GES SE: 764 **GPS SE:** 10, 28-29,
TWE: 717

2.2 Identify advantages and limitations of data-handling programs and graphics programs.

GPS SE: 11, 13, 35, 816

2.3 Understand why electronically stored personal information has greater potential for misuse than records kept in conventional form.

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ny.earth.msscience.com
ny.gpscience.com

Key Idea 3: Information technology can have positive and negative impacts on society, depending upon how it is used.

3.1 Use graphical, statistical, and presentation software to present projects to fellow classmates.

GPS SE: 278-279, 374-375, 735,
816 **TWE:** 59, 117, 147, 277, 279,

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3.2 Describe applications of information technology in mathematics, science, and other technologies that address needs and solve problems in the community.

439, 497

[GPS SE:](#) 6, 278-279, 374-375, 652-653

3.3 Explain the impact of the use and abuse of electronically generated information on individuals and families

[GPS SE:](#) 6, 278-279, 374-375, 652-653

SYSTEMS THINKING *Key Idea 1:* Through systems thinking, people can recognize the commonalities that exist among all systems and how parts of a system interrelate and combine to perform specific functions.

1.1 Describe the differences between dynamic systems and organizational systems.

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1.2 Describe the differences and similarities among engineering systems, natural systems, and social systems.

[GPS SE:](#) 9, 27

1.3 Describe the differences between open- and closed-loop systems.

[GPS SE:](#) 175, 179

1.4 Describe how the output from one part of a system (which can include material, energy, or information) can become the input to other parts.

[GPS SE:](#) 137, 146, 147, 148-149

MODELS *Key Idea 2:* Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.

2.1 Select an appropriate model to begin the search for answers or solutions to a question or problem.

[GLS SE:](#) 101, 230-231, 472-473, 584-585, 772, 787 [GES SE:](#) 217, 237, 285, 340, 382-383, 391, 474-475, 525, 641, 659, 689, 704 [GPS SE:](#) 148-149, 509, 558-559

2.2 Use models to study processes that cannot be studied directly (e.g., when the real process is too slow, too fast, or too dangerous for direct observation).

[GLS SE:](#) 101, 230-231, 472-473, 584-585, 772 [GES SE:](#) 217, 237, 285, 340, 382-383, 391, 474-475, 525, 641, 659, 689, 704 [GPS SE:](#) 11, 509, 510, 511, 557, 558-559

2.3 Demonstrate the effectiveness of different models to represent the same thing and the same model to represent different things.

[GES SE:](#) 217, 237, 285, 340, 382-383, 391, 474-475, 525, 641, 659, 689, 704 [GPS SE:](#) 148-149, 509, 510, 511

MAGNITUDE AND SCALE *Key Idea 3:* The grouping of magnitudes of size, time, frequency, and pressures or other units of measurement into a series of relative order provides a useful way to deal with the immense range and the changes in scale that affect the behavior and design of systems.

3.1 Cite examples of how different aspects of natural and designed systems change at different rates

[GPS SE:](#) 45

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with changes in scale.

3.2 Use powers of ten notation to represent very small and very large numbers.

[GPS SE: 357, 359, 829](#)

EQUILIBRIUM AND STABILITY *Key Idea 4:* Equilibrium is a state of stability due either to a lack of change (static equilibrium) or a balance between opposing forces (dynamic equilibrium).

4.1 Describe how feedback mechanisms are used in both designed and natural systems to keep changes within desired limits.

[GLS SE: 626](#) [GPS SE: 175, 463](#)

4.2 Describe changes within equilibrium cycles in terms of frequency or cycle length and determine the highest and lowest values and when they occur.

[GPS SE: 299, 301, 312-313](#)

PATTERNS OF CHANGE *Key Idea 5:* Identifying patterns of change is necessary for making predictions about future behavior and conditions.

5.1 Use simple linear equations to represent how a parameter changes with time.

[GPS SE: 48, 49, 50, 51, 58-59, 86, 90-91](#)

5.2 Observe patterns of change in trends or cycles and make predictions on what might happen in the future.

[GPS SE: 7, 148-149, 171, 214-215, 680](#)

OPTIMIZATION *Key Idea 6:* In order to arrive at the best solution that meets criteria within constraints, it is often necessary to make trade-offs.

6.1 Determine the criteria and constraints and make trade-offs to determine the best decision.

[GES SE: 434](#) [GPS SE: 278-279, 344-345, 652-653, 713](#)

6.2 Use graphs of information for a decision-making problem to determine the optimum solution.

[GES SE: 636](#) [GPS SE: 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 716-717, 735, 748-749, 777, 778-779](#)

CONNECTIONS *Key Idea 1:* The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.

1.1 Analyze science/technology/society problems and issues at the local level and plan and carry out

[GLS SE: 760-761, 774, 775, 776,](#)

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a remedial course of action.

1.2 Make informed consumer decisions by seeking answers to appropriate questions about products, services, and systems; determining the cost/benefit and risk/benefit tradeoffs; and applying this knowledge to a potential purchase.

1.3 Design solutions to real-world problems of general social interest related to home, school, or community using scientific experimentation to inform the solution and applying mathematical concepts and reasoning to assist in developing a solution.

1.4 Describe and explain phenomena by designing and conducting investigations involving systematic observations, accurate measurements, and the identification and control of variables; by inquiring into relevant mathematical ideas; and by using mathematical and technological tools and procedures to assist in the investigation.

788, 789, 790, 791, 792-793 **GPS SE:** 278-279, 344-345, 652-653, 713, 718

GES SE: 434 **GPS SE:** 278-279, 652-653, 713

GLS SE: 760-761, 788, 789, 790, 791, 792-793 **GES SE:** 22, 23, 45, 52-53, 67, 80-81, 98, 110-111, 136, 142-143, 171, 195, 200-201, 221, 228-229, 259, 260-261, 290-291, 312, 320-321, 344, 350-351, 376, 382-383, 407, 414-415, 434, 444-445, 473, 474-475, 503, 504-505, 532-533, 548, 562-563, 585, 590-591, 608, 616-617, 634, 650-651, 675, 680-681, 695, 714-715, 733, 746-747 **GPS SE:** 28-29, 58-59, 116-117, 148-149, 214-215, 246-247, 344-345, 406-407, 466-467, 592-593, 622-623, 716-717

GLS SE: 9, 27, 28-29, 71, 75, 80, 86-87, 103, 116-117, 133, 174-175, 198, 200-201, 261, 292-293, 343, 346, 350-351, 379, 381, 384-385, 398, 403, 410, 418-419, 430, 445, 446-447, 460, 465, 471, 472-473, 498, 501, 515, 522, 527, 541, 549, 552, 579, 603, 610, 612-613, 632, 642-643, 655, 665, 693, 701, 702-703, 714, 719, 748, 754, 760-761, 772, 787, 782, 792-793 **GES SE:** 52-53, 80-81, 200-201, 228-229, 350-351, 444-445, 532-533, 616-617, 746-747 **GPS SE:** 28-29, 58-59,

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116-117, 148-149, 214-215, 246-247, 278-279, 344-345, 374-375, 406-407, 438-439, 466-467, 558-559, 592-593, 622-623, 652-653, 716-717

STRATEGIES *Key Idea 2:* Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits; gathering and processing information; generating and analyzing ideas; realizing ideas; making connections among the common themes of mathematics, science, and technology; and presenting results.

2.1 Students participate in an extended, culminating mathematics, science, and technology project. The project would require students to:

- **Working Effectively:** Contributing to the work of a brainstorming group, laboratory partnership, cooperative learning group, or project team; planning procedures; identify and managing responsibilities of team members; and staying on task, whether working alone or as part of a group.
- **Gathering and Processing Information:** Accessing information from printed media, electronic databases, and community resources and using the information to develop a definition of the problem and to research possible solutions.
- **Generating and Analyzing Ideas:** Developing ideas for proposed solutions, investigating ideas, collecting data, and showing relationships and patterns in the data.
- **Common Themes:** Observing examples of common unifying themes, applying them to the problem, and using them to better understand the dimensions of the problem.
- **Realizing Ideas:** Constructing components or models, arriving at a solution, and evaluating the result.

- **Presenting Results:** Using a variety of media to present the solution and to communicate the results.

GLS SE: 9, 27, 28-29, 71, 75, 80, 86-87, 103, 116-117, 133, 174-175, 198, 200-201, 261, 292-293, 343, 346, 350-351, 379, 381, 384-385, 398, 403, 410, 418-419, 430, 445, 446-447, 460, 465, 471, 472-473, 498, 501, 515, 522, 527, 541, 549, 552, 579, 603, 610, 612-613, 632, 642-643, 655, 665, 693, 701, 702-703, 714, 719, 748, 754, 760-761, 772, 787, 782, 792-793 **GPS SE:** 27, 28-29, 57, 58-59, 89, 90-91, 106, 116-117, 147, 148-149, 171, 180-181, 206, 214-215, 245, 246-247, 277, 278-279, 302, 312-313, 338, 344-345, 366, 374-375, 405, 406-407, 423, 438-439, 457, 466-467, 484, 496-497, 525, 526-527, 557, 558-559, 583, 592-593, 607, 622-623, 651, 652-653, 680, 686-687, 706, 716-717, 735, 748-749, 777, 778-779

General Skills

1. follow safety procedures in the classroom and laboratory

GLS SE: 5, 9, 13, 25, 27, 28-29, 37, 40, 46, 50, 56-57, 65, 71, 75, 80, 86-87, 95, 101, 103, 111, 116-117, 125,

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128, 133, 136, 144-145, 153, 159, 162, 171, 174-175, 185, 187, 192, 194, 200-201, 209, 218, 221, 225, 230-231, 239, 247, 253, 261, 262-263, 271, 273, 280, 288, 292-293, 301, 305, 310, 314, 318-319, 329, 332, 343, 346, 350-351, 359, 372, 379, 381, 384-385, 393, 398, 403, 410, 418-419, 427, 430, 438, 445, 446-447, 455, 460, 465, 471, 472-473, 483, 494, 498, 501, 502-503, 511, 515, 522, 528, 530-531, 539, 541, 549, 552, 558-559, 567, 572, 579, 583, 584-585, 593, 603, 608, 610, 612-613, 621, 630, 632, 636, 642-643, 651, 655, 660, 665, 672-673, 683, 689, 693, 701, 702-703, 711, 714, 719, 723, 730-731, 739, 748, 752, 754, 760-761, 769, 772, 779, 787, 792-793, 811-813 **GES**
SE: 5, 11, 19, 23, 24-25, 33, 35, 43, 45, 52-53, 61, 63, 67, 72, 80-81, 89, 91, 98, 104, 110-111, 119, 127, 136, 139, 142-143, 153, 156, 161, 171, 172-173, 181, 186, 190, 195, 200-201, 209, 211, 221, 224, 228-229, 237, 247, 250, 259, 260-261, 271, 274, 279, 285, 290-291, 299, 309, 312, 318, 320-321, 329, 334, 340, 344, 350-351, 361, 363, 376, 378, 382-383, 391, 402, 407, 412, 414-415, 425, 431, 434, 437, 444-445, 453, 456, 471, 473, 474-475, 483, 485, 493, 503, 504-505, 513, 521, 525, 531, 532-533, 545, 548, 553,

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562-563, 573, 579, 585, 587, 590-591, 599, 608, 611, 613, 616-617, 627, 632, 634, 641, 650-651, 659, 662, 675, 677, 680-681, 689, 695, 699, 704, 714-715, 723, 725, 733, 742, 746-747, 765-767 **GPS SE:** 5, 19, 25, 27, 28-29, 37, 42, 54, 57, 58-59, 67, 71, 81, 89, 90-91, 99, 103, 106, 112, 116-117, 125, 129, 134, 147, 148-149, 157, 168, 169, 171, 180-181, 191, 198, 202, 206, 214-215, 223, 227, 229, 245, 246-247, 255, 259, 272, 277, 278-279, 289, 297, 302, 311, 312-313, 321, 323, 330, 338, 344-345, 353, 356, 361, 366, 374-375, 383, 387, 395, 405, 406-407, 415, 419, 423, 435, 438-439, 449, 453, 457, 460, 466-467, 475, 484, 486, 494, 496-497, 505, 509, 517, 525, 526-527, 535, 539, 552, 557, 558-559, 569, 574, 580, 583, 592-593, 601, 607, 612, 620, 622-623, 631, 636, 648, 651, 652-653, 663, 668, 680, 683, 686-687, 695, 698, 706, 711, 716-717, 725, 729, 735, 739, 748-749, 757, 759, 765, 777, 778-779, 797-799
GLS SE: 28-29, 174-175, 187, 253, 501, 603, 612-613, 719 **GES SE:** 5, 24-25, 45, 110-111, 136, 171, 200-201, 221, 228-229, 260-261, 279, 312, 329, 444-445, 531, 532-533, 695, 746-747 **GPS SE:** 71, 134, 147, 801, 802, 804, 807
GLS SE: 9, 522, 530-531, 730-731

- metric ruler

2. safely and accurately use

- balance

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the following measurement tools:

- stopwatch
- graduated cylinder
- thermometer
- spring scale
- voltmeter

3. use appropriate units for measured or calculated values

4. recognize and analyze patterns and trends

5. classify objects according to an established scheme and a student-generated scheme

6. develop and use a dichotomous key

GES SE: 45, 52-53, 532-533 **GPS SE:** 27, 57, 90-91, 106, 147
GLS SE: 381, 541, 549, 792-793
GES SE: 136, 260-261 **GPS SE:** 37, 42, 58-59, 89, 90-91, 129, 302, 312-313, 496-497, 557
GLS SE: 247, 292-293, 522, 558-559, 719 **GES SE:** 45, 52-53, 80-81, 532-533 **GPS SE:** 19, 27, 466-467, 496-497, 601, 651, 686-687, 716-717, 735, 748-749, 777
GLS SE: 292-293, 398, 418-419, 430, 530-531, 787, 792-793 **GES SE:** 45, 136, 444-445, 503, 680-681 **GPS SE:** 25, 180-181, 255, 277, 361, 395, 484, 680, 686-687, 748-749, 802
GPS SE: 57, 148-149, 778-779
See ancillaries
GLS SE: 12, 44, 716, 730-731, 756
GES SE: 5, 24-25, 45, 52-53, 80-81, 110-111, 136, 171, 200-201, 221, 228-229, 260-261, 279, 312, 329, 444-445, 503, 531, 532-533, 680-681, 695, 746-747 **GPS SE:** 5, 14, 15, 16, 17, 18, 19, 20, 21, 27, 28-29, 102, 128, 130, 162, 312-313, 329, 490, 704
GLS SE: 221 **GPS SE:** 22, 23, 24, 42-43, 50, 480
GLS SE: 22-26, 27, 211-213, 244, 245, 334-335, 359, 361-363, 493
GPS SE: 28-29, 456, 457, 518-519, 525, 582, 591
GLS SE: 26

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7. sequence events

GPS SE: 25, 42, 484, 557, 558-559, 601

8. identify cause-and-effect relationships

GLS SE: 174-175, 292-293, 318-319, 418-419 **GES SE:** 22, 24-25, 45, 52-53, 67, 80-81, 98, 110-111, 136, 142-143, 171, 172-173, 195, 200-201, 209, 221, 228-229, 237, 259, 260-261, 279, 290-291, 312, 320-321, 344, 350-351, 376, 407, 414-415, 425, 434, 444-445, 453, 473, 503, 504-505, 513, 532-533, 548, 562-563, 573, 585, 590-591, 608, 616-617, 632, 634, 650-651, 675, 680-681, 695, 699, 714-715, 733, 746-747

9. use indicators and interpret results

GLS SE: 9, 247, 501, 558-559, 672-673, 752, 779, 787 **GPS SE:** 245, 583, 698, 706, 710, 711, 716-717, 759

1. manipulate a compound microscope to view microscopic objects

GLS SE: 46, 103, 192, 221, 310

GES SE: 553, 616-617

2. determine the size of a microscopic object, using a compound microscope

GLS SE: 48- 49, 50, 103 **GES SE:** 616-617

3. prepare a wet mount slide

GLS SE: 46, 221, 280, 310 **GES SE:** 553

4. use appropriate staining techniques

ny.life.msscience.com

5. design and use a Punnett square or a pedigree chart to predict the probability of certain traits

GLS SE: 131, 132, 133, 135, 140

6. classify living things according to a student-generated scheme and an established scheme

GLS SE: 23, 27, 221, 261, 330, 335
TWE: 331

7. interpret and/or illustrate the energy flow in a food chain, energy pyramid, or food web

GLS SE: 697, 727, 728, 729

8. identify pulse points and pulse rates

GLS SE: 541, 549

9. identify structure and function relationships in organisms

GLS SE: 211, 242, 243, 254, 255, 303-304, 306, 307, 330, 337-338, 339-341, 360, 362, 363, 365-366,

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371, 380, 382, 383, 394-395, 399-400, 402, 403, 407, 410, 412, 414, 415, 429, 430, 431, 432, 437, 438-440

GES SE: 160, 161, 163, 484

GES SE: 63-65, 68-72, 80-81

GES SE: 91, 92, 93, 109

GES SE: 269, 282, 300, 301, 307-308, 312-314, 330, 333, 334

GES SE: 662

ny.earth.msscience.com

GES SE: 544, 650-651

GES SE: 164-170, 171, 172-173, 317, 329, 472, 473, 542, 678, 679, 800

GES SE: 439-443, 462, 463, 464

GES SE: 15, 16, 17, 439-443, 455, 457, 461, 463, 474-475

GES SE: 46, 47, 51, 52-53, 522

GPS SE: 19, 21, 34, 35, 501, 503

GES SE: 52-53

GLS SE: 67, 852, 853 **GES SE:** 37, 38, 40, 804-805 **GPS SE:** 516-523, 570-576, 579-580, 582, 584-585, 587-589

GES SE: 40, 137, 138, 139, 140, 141, 804-805

GES SE: 43, 44 **GPS SE:** 453, 459, 574

GPS SE: 206, 583, 759

GPS SE: 42, 51, 58-59

1. given the latitude and longitude of a location, indicate its position on a map and determine the latitude and longitude of a given location on a map
2. using identification tests and a flow chart, identify mineral samples
3. use a diagram of the rock cycle to determine geological processes that led to the formation of a specific rock type
4. plot the location of recent earthquake and volcanic activity on a map and identify patterns of distribution
5. use a magnetic compass to find cardinal directions

6. measure the angular elevation of an object, using appropriate instruments
7. generate and interpret field maps including topographic and weather maps

8. predict the characteristics of an air mass based on the origin of the air mass
9. measure weather variables such as wind speed and direction, relative humidity, barometric pressure, etc.
10. determine the density of liquids, and regular- and irregular-shaped solids

11. determine the volume of a regular- and an irregular-shaped solid, using water displacement
12. using the periodic table, identify an element as a metal, nonmetal, or noble gas

13. determine the identity of an unknown element, using physical and chemical properties

14. using appropriate resources, separate the parts of a mixture

15. determine the electrical conductivity of a material, using a simple circuit
16. determine the speed and acceleration of a moving object

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Key Idea 1: Living things are both similar to and different from each other and from nonliving things.

Introduction: Living things are similar to each other yet different from nonliving things. The cell is a basic unit of structure and function of living things (cell theory). For all living things, life activities are accomplished at the cellular level. Human beings are an interactive organization of cells, tissues, organs, and systems. Viruses lack cellular organization.

PERFORMANCE INDICATOR 1.1 *Compare and contrast the parts of plants, animals, and one-celled organisms.*

Major Understandings:

- 1.1a Living things are composed of cells. Cells provide structure and carry on major functions to sustain life. Cells are usually microscopic in size. **GLS SE:** 28-29, 38-44, 45, 51
- 1.1b The way in which cells function is similar in all living things. Cells grow and divide, producing more cells. Cells take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs. **GLS SE:** 14, 211, 241, 246, 303, 305, 306
- 1.1c Most cells have cell membranes, genetic material, and cytoplasm. Some cells have a cell wall and/or chloroplasts. Many cells have a nucleus. **GLS SE:** 38, 39-41, 42-43, 46, 187, 211, 212, 215, 241, 243, 252-253, 303, 306
- 1.1d Some organisms are single cells; others, including humans, are multicellular. **GLS SE:** 45, 211, 222
- 1.1e Cells are organized for more effective functioning in multicellular organisms. Levels of organization for structure and function of a multicellular organism include cells, tissues, organs, and organ systems. **GLS SE:** 45, 211, 222, 303, 306
- 1.1f Many plants have roots, stems, leaves, and reproductive structures. These organized groups of tissues are responsible for a plant's life activities. **GLS SE:** 210, 240, 241, 242, 243, 252, 254, 255, 256, 257, 302, 303
- 1.1g Multicellular animals often have similar organs and specialized systems for carrying out major life activities. **GLS SE:** 211, 502-503
- 1.1h Living things are classified by shared characteristics on the cellular and organism level. In classifying organisms, biologists consider details of internal and external structures. Biological classification systems are arranged from general (kingdom) to specific (species). **GLS SE:** 22, 23, 24, 25, 26, 211, 245, 330, 334, 337, 361, 370, 380, 394, 395-397, 399, 407, 412, 428, 436

PERFORMANCE INDICATOR 1.2 *Explain the functioning of the major human organ systems and their interactions.*

Major Understandings:

- 1.2a Each system is composed of organs and tissues which perform specific functions and interact with each other, e.g., digestion, gas exchange, excretion, circulation, locomotion, control, coordination, reproduction, and protection from disease. **GLS SE:** 484, 490-491, 496-497, 498, 523, 525, 528, 540, 557, 568-570, 571-573, 556-577, 578-580, 581, 594, 595, 597, 598, 599, 600, 601, 604, 608, 622, 623, 624-625, 652, 653

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1.2b Tissues, organs, and organ systems help to provide all cells with nutrients, oxygen, and waste removal.

GLS SE: 523, 524, 525, 526, 527, 528, 529, 540, 541, 542, 543, 544, 546, 568, 569, 570, 571, 572, 577-578, 579, 580, 581

1.2c The digestive system consists of organs that are responsible for the mechanical and chemical breakdown of food. The breakdown process results in molecules that can be absorbed and transported to cells.

GLS SE: 523, 524, 525, 526, 527, 528, 529, 530-531

1.2d During respiration, cells use oxygen to release the energy stored in food. The respiratory system supplies oxygen and removes carbon dioxide (gas exchange).

GLS SE: 83, 85, 568, 569, 570, 571, 572

1.2e The excretory system functions in the disposal of dissolved waste molecules, the elimination of liquid and gaseous wastes, and the removal of excess heat energy.

GLS SE: 497, 498, 529, 577, 578, 579, 580, 581

1.2f The circulatory system moves substances to and from cells, where they are needed or produced, responding to changing demands.

GLS SE: 540, 541, 542, 543, 544, 546, 550, 551

1.2g Locomotion, necessary to escape danger, obtain food and shelter, and reproduce, is accomplished by the interaction of the skeletal and muscular systems, and coordinated by the nervous system.

GLS SE: 212, 484, 485, 486, 487, 489, 490, 491, 493, 494, 495, 594, 595, 597, 598, 599, 600, 601

1.2h The nervous and endocrine systems interact to control and coordinate the body's responses to changes in the environment, and to regulate growth, development, and reproduction. Hormones are chemicals produced by the endocrine system; hormones regulate many body functions.

GLS SE: 594, 595, 597, 598, 599, 600, 601, 604, 622, 623, 624-625, 626, 627

1.2i The male and female reproductive systems are responsible for producing sex cells necessary for the production of offspring.

GLS SE: 104, 105-107, 627, 628, 629, 630, 631, 633

1.2j Disease breaks down the structures or functions of an organism. Some diseases are the result of failures of the system. Other diseases are the result of damage by infection from other organisms (germ theory). Specialized cells protect the body from infectious disease. The chemicals they produce identify and destroy microbes that enter the body.

GLS SE: 547, 548, 550, 552, 555, 557, 574, 575, 576, 581, 582, 652, 653, 654, 655, 663, 664, 657, 658, 662, 666, 667, 668, 669

Key Idea 2: Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.

Introduction: Every organism requires a set of instructions for specifying its traits. This information is found in the genes of cells. As organisms reproduce, these instructions are passed from one generation to the next.

PERFORMANCE INDICATOR 2.1 *Describe sexual and asexual mechanisms for passing genetic materials from generation to generation.*

Major Understandings:

2.1a Hereditary information is contained in genes. Genes are composed of DNA that makes up the chromosomes of cells.

GLS SE: 110, 111, 112, 141, 142, 169

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2.1b Each gene carries a single unit of information. A single inherited trait of an individual can be determined by one pair or by many pairs of genes. A human cell contains thousands of different genes.

GLS SE: 112, 126, 135, 139, 141

2.1c Each human cell contains a copy of all the genes needed to produce a human being.

GLS SE: 98, 106, 109, 112

2.1d In asexual reproduction, all the genes come from a single parent. Asexually produced offspring are genetically identical to the parent.

GLS SE: 101, 210, 223, 224, 272, 273

2.1e In sexual reproduction typically half of the genes come from each parent. Sexually produced offspring are not identical to either parent.

GLS SE: 104, 105, 223, 272, 273, 274

PERFORMANCE INDICATOR 2.2 *Describe simple mechanisms related to the inheritance of some physical traits in offspring.*

Major Understandings:

2.2a In all organisms, genetic traits are passed on from generation to generation.

GLS SE: 127, 128, 129, 134, 135, 136, 138, 139, 154, 155, 168

2.2b Some genes are dominant and some are recessive. Some traits are inherited by mechanisms other than dominance and recessiveness.

GLS SE: 128, 130, 131, 132, 133, 134, 135, 138, 139

2.2c The probability of traits being expressed can be determined using models of genetic inheritance. Some models of prediction are pedigree charts and Punnett squares.

GLS SE: 130, 131, 135, 139, 140

Key Idea 3: Individual organisms and species change over time.

Introduction: Evolution is the change in a species over time. Millions of diverse species are alive today. Generally this diversity of species developed through gradual processes of change occurring over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations (natural selection). Biological adaptations are differences in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

PERFORMANCE INDICATOR 3.1 *Describe sources of variation in organisms and their structures and relate the variations to survival.*

Major Understandings:

3.1a The processes of sexual reproduction and mutation have given rise to a variety of traits within a species.

GLS SE: 109, 114, 115, 137, 138, 139

3.1b Changes in environmental conditions can affect the survival of individual organisms with a particular trait. Small differences between parents and offspring can accumulate in successive generations so that descendants are very different from their ancestors. Individual organisms with certain traits are more likely to survive and have offspring than individuals without those traits.

GLS SE: 136, 137, 156, 157, 159, 158, 161, 211, 331, 332, 333

3.1c Human activities such as selective breeding and advances in genetic engineering may affect the variations of species.

GLS SE: 141, 142, 143

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PERFORMANCE INDICATOR 3.2 *Describe factors responsible for competition within species and the significance of that competition.*

Major Understandings:

3.2a In all environments, organisms with similar needs may compete with one another for resources.

GLS SE: 157, 411, 688, 695 **GES SE:** 394, 395, 396

3.2b Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to permit its survival. Extinction of species is common. Fossils are evidence that a great variety of species existed in the past.

GLS SE: 241, 346, 363, 416, 417
GES SE: 362-369, 400-406, 408, 411

3.2c Many thousands of layers of sedimentary rock provide evidence for the long history of Earth and for the long history of changing life forms whose remains are found in the rocks. Recently deposited rock layers are more likely to contain fossils resembling existing species.

GLS SE: 163, 164, 165, 166, 167, 171, 241 **GES SE:** 366, 367, 370, 371, 374, 403

3.2d Although the time needed for change in a species is usually great, some species of insects and bacteria have undergone significant change in just a few years.

GLS SE: 158, 159, 160, 161 **GES SE:** 407, 413

Key Idea 4: The continuity of life is sustained through reproduction and development.

Introduction: The survival of a species depends on the ability of a living organism to produce offspring. Living things go through a life cycle involving both reproductive and developmental stages. Development follows an orderly sequence of events.

PERFORMANCE INDICATOR 4.1 *Observe and describe the variations in reproductive patterns of organisms, including asexual and sexual reproduction.*

Major Understandings:

4.1a Some organisms reproduce asexually. Other organisms reproduce sexually. Some organisms can reproduce both sexually and asexually.

GLS SE: 98, 100, 104, 105, 223, 224, 249, 272, 273, 276, 279, 281, 283, 284, 331, 339, 341, 345, 346, 347, 367, 401, 408, 413, 428, 439

4.1b There are many methods of asexual reproduction, including division of a cell into two cells, or separation of part of an animal or plant from the parent, resulting in the growth of another individual.

GLS SE: 52, 98, 100, 101, 217, 223, 224, 225, 273, 276, 278, 279, 284, 285, 345

4.1c Methods of sexual reproduction depend upon the species. All methods involve the merging of sex cells to begin the development of a new individual. In many species, including plants and humans, eggs and sperm are produced.

GLS SE: 104, 105, 217, 223, 273, 274, 279, 281, 282, 283, 284, 285, 287, 339, 341, 347, 367, 401, 408, 413, 428, 439, 628, 629

4.1d Fertilization and/or development in organisms may be internal or external.

GLS SE: 104, 105, 273, 274, 275, 276, 279, 281, 284, 285, 341, 367, 401, 408, 413, 439, 440, 441-442, 629, 633

PERFORMANCE INDICATOR 4.2 *Explain the role of sperm and egg cells in sexual reproduction.*

Major Understandings:

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4.2a The male sex cell is the sperm. The female sex cell is the egg. The fertilization of an egg by a sperm results in a fertilized egg. **GLS SE:** 104, 105, 367, 627, 628, 629

4.2b In sexual reproduction, sperm and egg each carry one-half of the genetic information for the new individual. Therefore, the fertilized egg contains genetic information from each parent. **GLS SE:** 104, 105, 127, 128, 129, 130, 132, 133, 633

PERFORMANCE INDICATOR 4.3 *Observe and describe developmental patterns in selected plants and animals (e.g., insects, frogs, humans, seed-bearing plants).*

Major Understandings:

4.3a Multicellular organisms exhibit complex changes in development, which begin after fertilization. The fertilized egg undergoes numerous cellular divisions that will result in a multicellular organism, with each cell having identical genetic information. **GLS SE:** 105, 106, 107, 109, 633

4.3b In humans, the fertilized egg grows into tissue which develops into organs and organ systems before birth. **GLS SE:** 633, 634, 635, 636

4.3c Various body structures and functions change as an organism goes through its life cycle. **GLS SE:** 218, 274, 275, 277, 278, 279, 283, 286, 287, 291, 302, 371, 430, 439, 638, 639, 640, 641

4.3d Patterns of development vary among animals. In some species the young resemble the adult, while in others they do not. Some insects and amphibians undergo metamorphosis as they mature. **GLS SE:** 372, 408, 409, 439, 440, 441, 638, 639, 640, 641

4.3e Patterns of development vary among plants. In seed-bearing plants, seeds contain stored food for early development. Their later development into adulthood is characterized by varying patterns of growth from species to species. **GLS SE:** 242, 243, 252, 255, 256, 257, 258, 259, 274, 275, 282, 283, 302, 303, 440

4.3f As an individual organism ages, various body structures and functions change. **GLS SE:** 218, 219, 274-275, 278, 279, 372, 439, 440, 638, 639, 640, 641

PERFORMANCE INDICATOR 4.4 *Observe and describe cell division at the microscopic level and its macroscopic effects.*

Major Understandings:

4.4a In multicellular organisms, cell division is responsible for growth, maintenance, and repair. In some one-celled organisms, cell division is a method of asexual reproduction. **GLS SE:** 96-97, 98, 100, 101, 106, 107

4.4b In one type of cell division, chromosomes are duplicated and then separated into two identical and complete sets to be passed to each of the two resulting cells. In this type of cell division, the hereditary information is identical in all the cells that result. **GLS SE:** 98, 99, 100, 101, 106, 107

4.4c Another type of cell division accounts for the production of egg and sperm cells in sexually reproducing organisms. The eggs and sperm resulting from this type of cell division contain one-half of the hereditary information. **GLS SE:** 104, 105, 106, 107, 628, 629

4.4d Cancers are a result of abnormal cell division. **GLS SE:** 668, 669, 670, 671

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Key Idea 5: Organisms maintain a dynamic equilibrium that sustains life.

Introduction: All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment. Organisms respond to internal or environmental stimuli.

PERFORMANCE INDICATOR 5.1 *Compare the way a variety of living specimens carry out basic life functions and maintain dynamic equilibrium.*

Major Understandings:

5.1a Animals and plants have a great variety of body plans and internal structures that contribute to their ability to maintain a balanced condition.

GLS SE: 211, 242, 243, 254, 255, 303, 306, 307, 330, 337, 338, 339, 340, 360, 362, 363, 365, 366, 371, 380, 382, 383, 384-385, 400, 402, 403, 407, 410, 412, 414, 415, 429, 430, 431, 432, 436, 437, 438, 440

5.1b An organism's overall body plan and its environment determine the way that the organism carries out the life processes.

GLS SE: 193, 194, 242-243, 302, 303, 306, 332, 333, 337, 360, 362, 363, 365, 366, 371, 381, 382, 394, 395, 402, 403, 407, 410, 412, 414, 415, 429, 430, 431, 432, 436, 437, 438, 440, 441

5.1c All organisms require energy to survive. The amount of energy needed and the method for obtaining this energy vary among cells. Some cells use oxygen to release the energy stored in food.

GLS SE: 15, 82, 83, 188, 189, 302, 306, 308, 331, 338, 361, 371, 377, 380

5.1d The methods for obtaining nutrients vary among organisms. Producers, such as green plants, use light energy to make their food. Consumers, such as animals, take in energy-rich foods.

GLS SE: 81, 82, 188, 190, 194, 211, 212, 213, 302, 304, 305, 306, 307, 308, 331, 361, 371, 373, 374, 375, 382

5.1e Herbivores obtain energy from plants. Carnivores obtain energy from animals. Omnivores obtain energy from both plants and animals. Decomposers, such as bacteria and fungi, obtain energy by consuming wastes and/or dead organisms.

GLS SE: 188, 189, 190, 191, 218, 219, 227, 228, 229, 331, 344, 380, 696, 697, 698, 699, 727, 728, 729

5.1f Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required for survival. Regulation includes a variety of nervous and hormonal feedback systems.

GLS SE: 311, 313, 314, 316, 457, 460, 465, 468, 469, 594, 595

5.1g The survival of an organism depends on its ability to sense and respond to its external environment.

GLS SE: 311, 312, 316, 317, 457, 458, 459, 460, 461, 470, 594, 595, 596, 601, 602, 603

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PERFORMANCE INDICATOR 5.2 *Describe the importance of major nutrients, vitamins, and minerals in maintaining health and promoting growth, and explain the need for a constant input of energy for living organisms.*

Major Understandings:

- 5.2a Food provides molecules that serve as fuel and building material for all organisms. All living things, including plants, must release energy from their food, using it to carry on their life processes. **GLS SE:** 15, 214, 216, 331, 338, 340, 512
- 5.2b Foods contain a variety of substances, which include carbohydrates, fats, vitamins, proteins, minerals, and water. Each substance is vital to the survival of the organism. **GLS SE:** 82, 83, 512, 513, 514, 515, 516, 517, 518, 519, 520 **GPS SE:** 744, 745, 746, 747
- 5.2c Metabolism is the sum of all chemical reactions in an organism. Metabolism can be influenced by hormones, exercise, diet, and aging. **GLS SE:** 81, 85, 512
- 5.2d Energy in foods is measured in Calories. The total caloric value of each type of food varies. The number of Calories a person requires varies from person to person. **GLS SE:** 512, 513, 521 **TWE:** 514, 515
- 5.2e In order to maintain a balanced state, all organisms have a minimum daily intake of each type of nutrient based on species, size, age, sex, activity, etc. An imbalance in any of the nutrients might result in weight gain, weight loss, or a diseased state. **GLS SE:** 513, 520, 521, 532, 525, 548
- 5.2f Contraction of infectious disease, and personal behaviors such as use of toxic substances and some dietary habits, may interfere with one's dynamic equilibrium. During pregnancy these conditions may also affect the development of the child. Some effects of these conditions are immediate; others may not appear for many years. **GLS SE:** 657, 658, 659, 660, 661, 662, 663, 664

Key Idea 6: Plants and animals depend on each other and their physical environment.

Introduction: An environmentally aware citizen should have an understanding of the natural world. All organisms interact with one another and are dependent upon their physical environment. Energy and matter flow from one organism to another. Matter is recycled in ecosystems. Energy enters ecosystems as sunlight, and is eventually lost from the community to the environment, mostly as heat.

PERFORMANCE INDICATOR 6.1 *Describe the flow of energy and matter through food chains and food webs.*

Major Understandings:

- 6.1a Energy flows through ecosystems in one direction, usually from the Sun, through producers to consumers and then to decomposers. This process may be visualized with food chains or energy pyramids. **GLS SE:** 685, 697, 714, 727, 728, 729
- 6.1b Food webs identify feeding relationships among producers, consumers, and decomposers in an ecosystem. **GLS SE:** 696, 697, 726, 727
- 6.1c Matter is transferred from one organism to another and between organisms and their physical environment. Water, nitrogen, carbon dioxide, and oxygen are examples of substances cycled between the living and nonliving environment. **GLS SE:** 18, 190, 191, 308, 720, 721, 722, 723, 724

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PERFORMANCE INDICATOR 6.2 *Provide evidence that green plants make food and explain the significance of this process to other organisms.*

Major Understandings:

6.2a Photosynthesis is carried on by green plants and other organisms containing chlorophyll. In this process, the Sun’s energy is converted into and stored as chemical energy in the form of a sugar. The quantity of sugar molecules increases in green plants during photosynthesis in the presence of sunlight. **GLS SE:** 82, 86-87, 302, 305, 306, 307, 308, 309, 726 **GES SE:** 549

6.2b The major source of atmospheric oxygen is photosynthesis. Carbon dioxide is removed from the atmosphere and oxygen is released during photosynthesis. **GLS SE:** 214, 302, 305, 306, 307, 308, 309 **GES SE:** 549

6.2c Green plants are the producers of food which is used directly or indirectly by consumers. **GLS SE:** 257, 258, 302, 303, 305, 306, 307, 308, 726 **GES SE:** 549

Key Idea 7: Human decisions and activities have had a profound impact on the physical and living environment.

Introduction: The number of organisms an ecosystem can support depends on the resources available and physical factors: quantity of light, air, and water; range of temperatures; soil composition. To ensure the survival of our planet, people have a responsibility to consider the impact of their actions on the environment.

PERFORMANCE INDICATOR 7.1 *Describe how living things, including humans, depend upon the living and nonliving environment for their survival.*

Major Understandings:

7.1a A population consists of all individuals of a species that are found together at a given place and time. Populations living in one place form a community. The community and the physical factors with which it interacts compose an ecosystem. **GLS SE:** 686, 688, 689, 696, 697, 740, 741, 743, 745 **GES SE:** 550, 557

7.1b Given adequate resources and no disease or predators, populations (including humans) increase. Lack of resources, habitat destruction, and other factors such as predation and climate limit the growth of certain populations in the ecosystem. **GLS SE:** 688, 689, 690, 691, 692 **GES SE:** 574, 575

7.1c In all environments, organisms interact with one another in many ways. Relationships among organisms may be competitive, harmful, or beneficial. Some species have adapted to be dependent upon each other with the result that neither could survive without the other. **GLS SE:** 462, 463, 464, 465, 698, 699, 700

7.1d Some microorganisms are essential to the survival of other living things. **GLS SE:** 190, 191, 194, 196, 698

7.1e The environment may contain dangerous levels of substances (pollutants) that are harmful to organisms. Therefore, the good health of environments and individuals requires the monitoring of soil, air, and water, and taking steps to keep them safe. **GLS SE:** 197, 198, 199, 712, 713, 714, 715, 749, 754, 755, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787 **GES SE:** 427, 557, 558, 559, 560, 561, 572, 576, 582-583, 600-604

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PERFORMANCE INDICATOR 7.2 *Describe the effects of environmental changes on humans and other populations.*

Major Understandings:

7.2a In ecosystems, balance is the result of interactions between community members and their environment. **GLS SE:** 685, 686, 690, 741, 745, 746, 747, 748, 750, 751 **GES SE:** 550, 556, 558

7.2b The environment may be altered through the activities of organisms. Alterations are sometimes abrupt. Some species may replace others over time, resulting in long-term gradual changes (ecological succession). **GLS SE:** 740, 741, 742, 743, 749 **GES SE:** 392, 393

7.2c Overpopulation by any species impacts the environment due to the increased use of resources. Human activities can bring about environmental degradation through resource acquisition, urban growth, land-use decisions, waste disposal, etc. **GLS SE:** 688, 690, 691, 695 **GES SE:** 574, 575, 576, 578, 579, 580, 582

7.2d Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth's resources. **GLS SE:** 754, 755, 757, 758, 759, 771, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787 **GES SE:** 127, 427, 586, 587, 588, 589 **GPS SE:** 111, 263, 271, 652-653, 718

Key Idea 1: The Earth and celestial phenomena can be described by principles of relative motion and perspective.

The universe is comprised of a wide array of objects, a few of which can be seen by the unaided eye. Others can only be observed with scientific instruments. These celestial objects, distinct from Earth, are in motion relative to Earth and each other. Measurements of these motions vary with the perspective of the observer. Cyclical changes on Earth are caused by interactions among objects in the universe.

PERFORMANCE INDICATOR 1.1 *Explain daily, monthly, and seasonal changes on Earth.*

Major Understandings:

1.1a Earth's Sun is an average-sized star. The Sun is more than a million times greater in volume than Earth. **GES SE:** 729-733, 739, 748, 661

1.1b Other stars are like the Sun but are so far away that they look like points of light. Distances between stars are vast compared to distances within our solar system. **GES SE:** 724, 726, 727

1.1c The Sun and the planets that revolve around it are the major bodies in the solar system. Other members include comets, moons, and asteroids. Earth's orbit is nearly circular. **GES SE:** 688-695, 696-701, 702-709, 710-716

1.1d Gravity is the force that keeps planets in orbit around the Sun and the Moon in orbit around the Earth. **GES SE:** 690, 691, 692, 693, 694

1.1e Most objects in the solar system have a regular and predictable motion. These motions explain such phenomena as a day, a year, phases of the Moon, eclipses, tides, meteor showers, and comets. **GES SE:** 527, 694, 695, 710, 711

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1.1f The latitude/longitude coordinate system and our system of time are based on celestial observations.

GES SE: 160, 161, 162, 163, 484

1.1g Moons are seen by reflected light. Our Moon orbits Earth, while Earth orbits the Sun. The Moon's phases as observed from Earth are the result of seeing different portions of the lighted area of the Moon's surface. The phases repeat in a cyclic pattern in about one month.

GES SE: 658, 659, 663, 666, 667-668, 670-675

1.1h The apparent motions of the Sun, Moon, planets, and stars across the sky can be explained by Earth's rotation and revolution. Earth's rotation causes the length of one day to be approximately 24 hours. This rotation also causes the Sun and Moon to appear to rise along the eastern horizon and to set along the western horizon. Earth's revolution around the Sun defines the length of the year as 365 1/4 days.

GES SE: 659, 661, 663, 664, 665

1.1i The tilt of Earth's axis of rotation and the revolution of Earth around the Sun cause seasons on Earth. The length of daylight varies depending on latitude and season.

GES SE: 661, 663, 664, 665, 680-681

1.1j The shape of Earth, the other planets, and stars is nearly spherical.

GES SE: 650-651, 660, 661, 663

Key Idea 2: Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

Students should develop an understanding of Earth as a set of closely coupled systems. The concept of systems provides a framework in which students can investigate three major interacting components: lithosphere, hydrosphere, and atmosphere. Processes act within and among the three components on a wide range of time scales to bring about continuous change in Earth's crust, oceans, and atmosphere.

PERFORMANCE INDICATOR 2.1 *Explain how the atmosphere (air), hydrosphere (water), and lithosphere (land) interact, evolve, and change.*

Major Understandings:

2.1a Nearly all the atmosphere is confined to a thin shell surrounding Earth. The atmosphere is a mixture of gases, including nitrogen and oxygen with small amounts of water vapor, carbon dioxide, and other trace gases. The atmosphere is stratified into layers, each having distinct properties. Nearly all weather occurs in the lowest layer of the atmosphere.

GES SE: 424, 426-427, 428-429, 430, 431, 432-433, 438

2.1b As altitude increases, air pressure decreases.

GES SE: 430, 431, 433

2.1c The rock at Earth's surface forms a nearly continuous shell around Earth called the lithosphere.

GES SE: 280, 281, 309, 310, 311

2.1d The majority of the lithosphere is covered by a relatively thin layer of water called the hydrosphere.

GES SE: 437

2.1e Rocks are composed of minerals. Only a few rock-forming minerals make up most of the rocks of Earth. Minerals are identified on the basis of physical properties such as streak, hardness, and reaction to acid.

GES SE: 60-66, 68-72, 73, 79, 80-81

2.1f Fossils are usually found in sedimentary rocks. Fossils can be used to study past climates and environments.

GLS SE: 164 **GES SE:** 103, 400-404, 406

2.1g The dynamic processes that wear away Earth's surface include weathering and erosion.

GES SE: 182, 183-184, 185, 186-

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2.1h The process of weathering breaks down rocks to form sediment. Soil consists of sediment, organic material, water, and air.

2.1i Erosion is the transport of sediment. Gravity is the driving force behind erosion. Gravity can act directly or through agents such as moving water, wind, and glaciers.

2.1j Water circulates through the atmosphere, lithosphere, and hydrosphere in what is known as the water cycle.

187, 196-197, 198-199, 210-214,
215-220, 221, 222-227, 228-229,
230, 237, 240-241

GES SE: 182, 188, 189, 190, 191

GLS SE: 785 **GES SE:** 210-214,
215-220, 221, 222-227, 228-229, 230

GES SE: 437

PERFORMANCE INDICATOR 2.2. *Describe volcano and earthquake patterns, the rock cycle, and weather and climate changes*

Major Understandings:

2.2a The interior of Earth is hot. Heat flow and movement of material within Earth cause sections of Earth’s crust to move. This may result in earthquakes, volcanic eruption, and the creation of mountains and ocean basins.

2.2b Analysis of earthquake wave data (vibrational disturbances) leads to the conclusion that there are layers within Earth. These layers—the crust, mantle, outer core, and inner core—have distinct properties.

2.2c Folded, tilted, faulted, and displaced rock layers suggest past crustal movement.

GES SE: 282, 284, 287, 290-291,
299, 300-301, 304-305, 306, 309,
405, 406, 412, 498

GES SE: 280, 285, 309, 310, 311

2.2d Continents fitting together like puzzle parts and fossil correlations provided initial evidence that continents were once together.

2.2e The Theory of Plate Tectonics explains how the ‘solid’ lithosphere consists of a series of plates that ‘float’ on the partially molten section of the mantle. Convection cells within the mantle may be the driving force for the movement of the plates.

2.2f Plates may collide, move apart, or slide past one another. Most volcanic activity and mountain building occur at the boundaries of these plates, often resulting in earthquakes.

2.2g Rocks are classified according to their method of formation. The three classes of rocks are sedimentary, metamorphic, and igneous. Most rocks show characteristics that give clues to their formation conditions.

2.2h The rock cycle model shows how types of rock or rock material may be transformed from one type of rock to another.

2.2i Weather describes the conditions of the atmosphere at a given location for a short period of time.

2.2j Climate is the characteristic weather that prevails from season to season and year to year.

2.2k The uneven heating of Earth’s surface is the cause of weather.

GES SE: 370-372, 373, 374-375,
376

GES SE: 272-275, 399, 408

GES SE: 280-282, 283, 284, 285

GES SE: 280, 281-282, 283, 284,
285, 286-287, 289

GES SE: 94-97, 98, 99-102, 103-
108, 109, 110-111

GES SE: 91, 92, 93, 109

GES SE: 454-456, 457, 458, 459,
460

GES SE: 484, 485-487, 488-491

GES SE: 441, 454, 458

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2.2l Air masses form when air remains nearly stationary over a large section of Earth’s surface and takes on the conditions of temperature and humidity from that location. Weather conditions at a location are determined primarily by temperature, humidity, and pressure of air masses over that location.

GES SE: 462, 463, 464

2.2m Most local weather condition changes are caused by movement of air masses.

GES SE: 463, 464, 465, 466, 467, 468

2.2n The movement of air masses is determined by prevailing winds and upper air currents.

GES SE: 440, 441, 442, 443, 462, 463, 464

2.2o Fronts are boundaries between air masses. Precipitation is likely to occur at these boundaries.

GES SE: 463, 464, 465, 469, 472

2.2p High-pressure systems generally bring fair weather. Low-pressure systems usually bring cloudy, unstable conditions. The general movement of highs and lows is from west to east across the United States.

GES SE: 463-464, 469, 472

2.2q Hazardous weather conditions include thunderstorms, tornadoes, hurricanes, ice storms, and blizzards. Humans can prepare for and respond to these conditions if given sufficient warning.

GES SE: 465, 466, 467, 468, 469

2.2r Substances enter the atmosphere naturally and from human activity. Some of these substances include dust from volcanic eruptions and greenhouse gases such as carbon dioxide, methane, and water vapor. These substances can affect weather, climate, and living things.

GLS SE: 778, 779, 780, 781, 782
GES SE: 427, 432, 433, 437, 609, 616-617

Key Idea 3: Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

Objects in the universe are composed of matter. Matter is anything that takes up space and has mass. Matter is classified as a substance or a mixture of substances. Knowledge of the structure of matter is essential to students’ understanding of the living and physical environments. Matter is composed of elements which are made of small particles called atoms. All living and nonliving material is composed of these elements or combinations of these elements.

PERFORMANCE INDICATOR 3.1 *Observe and describe properties of materials, such as density, conductivity, and solubility.*

Major Understandings:

3.1a Substances have characteristic properties. Some of these properties include color, odor, phase at room temperature, density, solubility, heat and electrical conductivity, hardness, and boiling and freezing points.

GES SE: 33, 43, 46, 47-48, 49, 50, 436, 522 **GPS SE:** 458, 459, 460, 461, 462, 603, 606, 696, 697, 698-699, 759, 763, 765, 770, 777

3.1b Solubility can be affected by the nature of the solute and solvent, temperature, and pressure. The rate of solution can be affected by the size of the particles, stirring, temperature, and the amount of solute already dissolved.

GPS SE: 671, 672, 673-674, 675, 686-687

3.1c The motion of particles helps to explain the phases (states) of matter as well as changes from one phase to another. The phase in which matter exists depends on the attractive forces

GES SE: 50 **GPS SE:** 476, 477, 478, 479, 480

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among its particles.

3.1d Gases have neither a determined shape nor a definite volume. Gases assume the shape and volume of a closed container.

GES SE: 48 **GPS SE:** 479, 483

3.1e A liquid has definite volume, but takes the shape of a container.

GES SE: 48 **GPS SE:** 478, 483

3.1f A solid has definite shape and volume. Particles resist a change in position.

GES SE: 47 **GPS SE:** 477, 483

3.1g Characteristic properties can be used to identify different materials, and separate a mixture of substances into its components. For example, iron can be removed from a mixture by means of a magnet. An insoluble substance can be separated from a soluble substance by such processes as filtration, settling, and evaporation.

GES SE: 43 **TWE:** 32E **GPS SE:** 449, 459, 461, 709

3.1h Density can be described as the amount of matter that is in a given amount of space. If two objects have equal volume, but one has more mass, the one with more mass is denser.

GES SE: 46, 47, 52-53 **GPS SE:** 19, 21, 486, 489

3.1i Buoyancy is determined by comparative densities.

GES SE: 52-53 **GPS SE:** 485, 486, 489

PERFORMANCE INDICATOR 3.2 *Distinguish between chemical and physical changes.*

Major Understandings:

3.2a During a physical change a substance keeps its chemical composition and properties.

Examples of physical changes include freezing, melting, condensation, boiling, evaporation, tearing, and crushing.

GES SE: 50 **GPS SE:** 460, 461, 464

3.2b Mixtures are physical combinations of materials and can be separated by physical means.

GES SE: 43 **GPS SE:** 448, 449, 452, 453, 454, 455, 456, 457, 459, 460

3.2c During a chemical change, substances react in characteristic ways to form new substances with different physical and chemical properties. Examples of chemical changes include burning of wood, cooking of an egg, rusting of iron, and souring of milk.

GES SE: 40 **GPS SE:** 461, 462, 463, 464, 465, 466-467

3.2d Substances are often placed in categories if they react in similar ways. Examples include metals, nonmetals, and noble gases.

GPS SE: 522, 523, 525, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 582, 583

3.2e The Law of Conservation of Mass states that during an ordinary chemical reaction matter cannot be created or destroyed. In chemical reactions, the total mass of the reactants equals the total mass of the products.

GPS SE: 465, 632, 633, 638

PERFORMANCE INDICATOR 3.3 *Develop mental models to explain common chemical reactions and changes in states of matter.*

Major Understandings:

3.3a All matter is made up of atoms. Atoms are far too small to see with a light microscope.

GLS SE: 66 **GES SE:** 34, 36, 37, 38
GPS SE: 505, 507, 509, 510, 511, 520, 536, 539

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3.3b Atoms and molecules are perpetually in motion. The greater the temperature, the greater the motion.

GPS SE: 158, 159, 160, 163, 164, 165, 476, 477, 483, 511, 536

3.3c Atoms may join together in well-defined molecules or may be arranged in regular geometric patterns.

GLS SE: 68, 69 **GES SE:** 34, 35, 39, 40 **GPS SE:** 608, 609, 610, 611, 612, 613, 614

3.3d Interactions among atoms and/or molecules result in chemical reactions.

GLS SE: 68, 69 **GPS SE:** 632, 635, 637

3.3e The atoms of any one element are different from the atoms of other elements.

GLS SE: 67, 70 **GES SE:** 36 **GPS SE:** 509, 513, 520, 522, 582

3.3f There are more than 100 elements. Elements combine in a multitude of ways to produce compounds that account for all living and nonliving substances. Few elements are found in their pure form.

GLS SE: 70, 71 **GES SE:** 35, 38, 54 **GPS SE:** 450, 452, 457, 468

3.3g The periodic table is one useful model for classifying elements. The periodic table can be used to predict properties of elements (metals, nonmetals, noble gases).

GLS SE: 67, 852-853 **GES SE:** 37, 804-805 **GPS SE:** 516, 517, 518-519, 520, 523, 524, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 582

Key Idea 4: Energy exists in many forms, and when these forms change energy is conserved.

Introduction: An underlying principle of all energy use is the Law of Conservation of Energy. Simply stated, energy cannot be created or destroyed. Energy can be transformed, one form to another. These transformations produce heat energy. Heat is a calculated value which includes the temperature of the material, the mass of the material, and the type of the material. Temperature is a direct measurement of the average kinetic energy of the particles in a sample of material. It should be noted that temperature is not a measurement of heat.

PERFORMANCE INDICATOR 4.1 *Describe the sources and identify the transformations of energy observed in everyday life.*

Major Understandings:

4.1a The Sun is a major source of energy for Earth. Other sources of energy include nuclear and geothermal energy.

GLS SE: 774, 775, 777 **GES SE:** 127-128, 129, 130, 131, 132, 133, 134, 135, 435, 454 **GPS SE:** 167, 173-174, 182, 255, 264-265, 271, 275, 280

4.1b Fossil fuels contain stored solar energy and are considered nonrenewable resources. They are a major source of energy in the United States. Solar energy, wind, moving water, and biomass are some examples of renewable energy resources.

GLS SE: 770, 771, 772, 773, 774, 775, 776 **GES SE:** 120-125, 127, 130-135 **GPS SE:** 256, 257, 258, 259, 260, 261, 263, 271, 272, 273, 274, 275, 276

4.1c Most activities in everyday life involve one form of energy being transformed into another.

GLS SE: 773, 774, 776 **GPS SE:**

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For example, the chemical energy in gasoline is transformed into mechanical energy in an automobile engine. Energy, in the form of heat, is almost always one of the products of energy transformations.

4.1d Different forms of energy include heat, light, electrical, mechanical, sound, nuclear, and chemical. Energy is transformed in many ways.

4.1e Energy can be considered to be either kinetic energy, which is the energy of motion, or potential energy, which depends on relative position.

PERFORMANCE INDICATOR 4.2 *Observe and describe heating and cooling events.*

Major Understandings:

4.2a Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.

4.2b Heat can be transferred through matter by the collisions of atoms and/or molecules (conduction) or through space (radiation). In a liquid or gas, currents will facilitate the transfer of heat (convection).

4.2c During a phase change, heat energy is absorbed or released. Energy is absorbed when a solid changes to a liquid and when a liquid changes to a gas. Energy is released when a gas changes to a liquid and when a liquid changes to a solid.

4.2d Most substances expand when heated and contract when cooled. Water is an exception, expanding when changing to ice.

4.2e Temperature affects the solubility of some substances in water.

PERFORMANCE INDICATOR 4.3 *Observe and describe energy changes as related to chemical reactions.*

Major Understandings:

4.3a In chemical reactions, energy is transferred into or out of a system. Light, electricity, or mechanical motion may be involved in such transfers in addition to heat. Observe and describe the properties of sound, light, magnetism, and electricity.

PERFORMANCE INDICATOR 4.4 *Observe and describe the properties of sound, light, magnetism, and electricity.*

Major Understandings:

4.4a Different forms of electromagnetic energy have different wavelengths. Some examples of electromagnetic energy are microwaves, infrared light, visible light, ultraviolet light, X-rays,

100-101, 107, 108, 115, 176, 177, 179, 256

GLS SE: 774, 775, 776, 777 **GPS SE:** 98, 99, 100, 101, 107, 108, 109, 110, 111, 114, 115, 158, 159, 160, 161, 162, 164, 165, 166, 167, 171, 264, 265, 266, 267, 268, 269, 270, 646, 647
GPS SE: 102, 103, 104, 105, 108, 109, 110, 111

GLS SE: 498 **GES SE:** 435, 436, 438 **GPS SE:** 160, 161, 163, 164, 165, 166, 167, 168, 169, 170, 171, 175, 177
GES SE: 435, 436-437, 438, 448
GPS SE: 164, 165, 166, 167, 171, 180-181
GPS SE: 478, 479

GES SE: 184 **GPS SE:** 481, 482, 483, 494, 495
GPS SE: 674, 675, 686-687

GPS SE: 646, 647, 648, 649, 650

GES SE: 628, 629, 633 **GPS SE:** 360, 361, 362, 363, 364, 365

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and gamma rays.

4.4b Light passes through some materials, sometimes refracting in the process. Materials absorb and reflect light, and may transmit light. To see an object, light from that object, emitted by or reflected from it, must enter the eye.

[GPS SE:](#) 303, 304, 305, 384, 385, 386, 387, 388, 405, 416, 417, 418, 419, 420, 421, 422, 423, 455

4.4c Vibrations in materials set up wave-like disturbances that spread away from the source. Sound waves are an example. Vibrational waves move at different speeds in different materials. Sound cannot travel in a vacuum.

[GES SE:](#) 304-308, 311, 322 [GPS SE:](#) 292, 293, 295, 298, 299, 301, 302, 304, 312-313, 314, 322, 323, 324, 325, 326, 356

4.4d Electrical energy can be produced from a variety of energy sources and can be transformed into almost any other form of energy.

[GES SE:](#) 120, 121, 127, 128, 130-135 [GPS SE:](#) 107, 190, 210, 213, 235, 310

4.4e Electrical circuits provide a means of transferring electrical energy.

[GPS SE:](#) 191, 201, 204, 205, 207, 208, 209, 210, 213, 214-215

4.4f Without touching them, material that has been electrically charged attracts uncharged material, and may either attract or repel other charged material.

[GPS SE:](#) 193, 194, 195, 199

4.4g Without direct contact, a magnet attracts certain materials and either attracts or repels other magnets. The attractive force of a magnet is greatest at its poles.

[GPS SE:](#) 224, 225, 226, 228, 230, 233, 234, 237, 355, 459

PERFORMANCE INDICATOR 4.5 *Describe situations that support the principle of conservation of energy.*

Major Understandings:

4.5a Energy cannot be created or destroyed, but only changed from one form into another.

[GLS SE:](#) 726 [GPS SE:](#) 106, 111, 112, 115, 116-117, 135, 193, 199

4.5b Energy can change from one form to another, although in the process some energy is always converted to heat. Some systems transform energy with less loss of heat than others.

[GPS SE:](#) 106, 107, 111, 135, 136, 137, 176, 177, 179, 256

Key Idea 5: Energy and matter interact through forces that result in changes in motion.

Introduction: Examples of objects in motion can be seen all around us. These motions result from an interaction of energy and matter. This interaction creates forces (pushes and pulls) that produce predictable patterns of change. Common forces would include gravity, magnetism, and electricity. Friction is a force that should always be considered in a discussion of motion. When the forces acting on an object are unbalanced, changes in that object's motion occur. The changes could include a change in speed or a change in direction. When the forces are balanced, the motion of that object will remain unchanged. Understanding the laws that govern motion allows us to predict these changes in motion.

PERFORMANCE INDICATOR 5.1 *Describe different patterns of motion of objects.*

Major Understandings:

5.1a The motion of an object is always judged with respect to some other object or point. The idea of absolute motion or rest is misleading.

[GPS SE:](#) 38, 39, 46

5.1b The motion of an object can be described by its position, direction of motion, and speed.

[GPS SE:](#) 38, 39, 46

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5.1c An object's motion is the result of the combined effect of all forces acting on the object. A moving object that is not subjected to a force will continue to move at a constant speed in a straight line. An object at rest will remain at rest.

GPS SE: 54, 55, 56, 57, 58-59

5.1d Force is directly related to an object's mass and acceleration. The greater the force, the greater the change in motion.

GPS SE: 54, 55, 56, 57, 58-59, 75, 77, 78, 81

5.1e For every action there is an equal and opposite reaction.

GPS SE: 83, 84, 85, 88

PERFORMANCE INDICATOR 5.2 *Observe, describe, and compare effects of forces (gravity, electric current, and magnetism) on the motion of objects.*

Major Understandings:

5.2a Every object exerts gravitational force on every other object. Gravitational force depends on how much mass the objects have and on how far apart they are. Gravity is one of the forces acting on orbiting objects and projectiles.

GES SE: 691, 692, 693, 694 **GPS SE:** 75, 76, 77, 78, 79, 80, 82, 89, 92, 104, 105, 109

5.2b Electric currents and magnets can exert a force on each other.

GPS SE: 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 243, 244, 246-247

5.2c Machines transfer mechanical energy from one object to another.

GPS SE: 132, 133, 134, 135, 137

5.2d Friction is a force that opposes motion.

GPS SE: 70, 71, 72, 74, 134, 135, 136, 137, 148-149

5.2e A machine can be made more efficient by reducing friction. Some common ways of reducing friction include lubricating or waxing surfaces.

GPS SE: 135, 136, 137, 148-149

5.2f Machines can change the direction or amount of force, or the distance or speed of force required to do work.

GPS SE: 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 148-149