NGSS Fourth Grade Science Curriculum

EWING PUBLIC SCHOOLS
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Board Approval Date: June 26, 2017 Michael Nitti
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In accordance with The Ewing Public Schools' Policy 2230, Course Guides, this curriculum has been reviewed and found to be in compliance with all policies and all affirmative action criteria.

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Fourth Grade Science

Course Description and Rationale

Students in this course will learn to explain scientific phenomena. The Next Generation Science Standards (NGSS) performance expectations rely on three dimensions of learning to develop student understanding of scientific concepts. Core conceptual ideas are learned by engaging in scientific and engineering practices and considering crosscutting concepts. These three dimensions support students in developing useable knowledge to explain real world phenomena in the sciences.

In science, performance expectations at the elementary school level use three dimensional learning to foster student understanding of science concepts.

Students will use the following eight NGSS Science and Engineering Practices to demonstrate understanding of the disciplinary core ideas and develop critical thinking skills:

1. Asking questions (science) and defining problems (engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using math and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

The following seven crosscutting concepts support the development of a deeper understanding of the disciplinary core ideas:

1. Patterns
2. Cause and effect: mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: flows, cycles and conservation
6. Structure and function

21st Century Skills - During this course, students will work on developing, to an age appropriate level, the following 21st century skills:

Career Readiness Pathways:

- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

21st Century Themes:

Global Awareness:

- Using 21st century skills to understand and address global issues

Environmental Literacy:

- Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water and ecosystems

- Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)
- Investigate and analyze environmental issues, and make accurate conclusions about effective solutions
- Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues)

Learning and Innovation Skills

Creativity and Innovation

Think Creatively

- Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Work Creatively with Others

- View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes

CRITICAL THINKING AND PROBLEM SOLVING

Reason Effectively

- Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation

Use Systems Thinking

- Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Make Judgments and Decisions

- Effectively analyze and evaluate evidence, arguments, claims and beliefs
- Synthesize and make connections between information and arguments
- Interpret information and draw conclusions based on the best analysis

Solve Problems

- Identify and ask significant questions that clarify various points of view and lead to better solutions

COMMUNICATION AND COLLABORATION

Communicate Clearly

- Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- Listen effectively to decipher meaning, including knowledge, values, attitudes and intentions
- Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)

- Utilize multiple media and technologies, and know how to judge their effectiveness a priori as well as assess their impact
- Communicate effectively in diverse environments (including multi-lingual)

Collaborate with Others
- Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

Information, Media, and Technology Skills

Informational Literacy

Access and Evaluate Information
- Evaluate information critically and competently

Use and Manage Information
- Use information accurately and creatively for the issue or problem at hand

Life and Career Skills

Social and Cross-Cultural Skills

Interact Effectively with Others
- Know when it is appropriate to listen and when to speak

Work Effectively in Diverse Teams
- Respond open-mindedly to different ideas and values

Be Responsible to Others
- Act responsibly with the interests of the larger community in mind

The course is a year-long course that meets for 45 minutes per day, on average for half the days of each marking period. The course uses a project-based approach to exploring many concepts. Many of the core ideas will be applied to engineering problems, allowing students to also develop an understanding of the engineering design process. This will further develop problem-solving and critical thinking skills as students work to design, test, solve, and revise solutions to problems. The crosscutting concepts of patterns through structure and function are used as organizing concepts for these disciplinary core ideas. These performance expectations focus on students demonstrating proficiency in developing and using models, using mathematical thinking, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

The course content is arranged into four units of study:

- Energy
- Waves: Waves and Information
- Structure, Function, and Information Processing
- Earth's Systems: Processes that Shape the Earth

Unit 1: Energy

Recommended Pacing - 22 days

Why Is This Unit Important?

This unit targets three major areas of Energy:

1. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object.
2. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions.
3. Students apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.

Enduring Understandings:

1. The faster a given object is moving, the more energy it possesses.
2. Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
3. Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
4. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.
5. When objects collide, the contact forces transfer energy so as to change the objects' motions.
6. The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.
7. Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.
8. Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.
9. Cause and effect relationships are routinely identified and used to explain change.
10. Energy can be transferred in various ways and between objects.
11. Knowledge of relevant scientific concepts and research findings is important in engineering.
12. Over time, people's needs and wants change, as do their demands for new and improved technologies.
13. Engineers improve existing technologies or develop new ones.
14. Most scientists and engineers work in teams.
15. Science affects everyday life.

Essential Questions:

1. What is energy and how is it related to motion?
2. How is energy transferred?
3. How can energy be used to solve a problem?

Acquired Knowledge:

1. Definition of energy
2. Types of energy
3. Energy transformation
4. Conservation of energy
5. Energy sources – stored energy
6. Renewable energy

Acquired Skills:

1. Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
2. Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
3. Use evidence (e.g., measurements, observations, patterns) to construct an explanation.
4. Apply scientific ideas to solve design problems.
5. Obtain and combine information from books and other reliable media to explain phenomena.

Major Assessments:

1. Design, Test, and Refine a Device

Suggested Learning Experiences and Instructional Activities:

Anticipatory Sets:

- Batter Up!

In-Class Activities and Laboratory Experiences:

- Speed
- Motion
- Sound
- Light
- Heat
- Electric Circuits

Closure and Reflection Activities:

- Obtain and Combine Information

Instructional Materials:

Exploring Science Cengage & National Geographic Learning; 2016

Interdisciplinary Connections:

Common Core Standards

ELA/Literacy -

- **RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)
- **RI.4.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1)

- **RI.4.9** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1)
- **W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)
- **W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-PS3-3),(4-PS3-4),(4-ESS3-1)
- **W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4),(4-ESS3-1)
- **W.4.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1),(4-ESS3-1)

Mathematics -

- **MP.2** Reason abstractly and quantitatively. (4-ESS3-1)
- **MP.4** Model with mathematics. (4-ESS3-1)
- **4.OA.A.1** Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1)
- **4.OA.A.3** Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4)

Technology Connections:

- http://www.bbc.co.uk/schools/scienceclips/ages/9_10/changing_sounds.shtml
- http://ngss-k-5-ausd.weebly.com/4energy-part-1.html
- http://ngss-k-5-ausd.weebly.com/4energy-part-2.html

Accommodations or Modifications for Special Education, ESL or Gifted Learners:
Multisensory instruction, visual displays, adapted readings, adapted tests, hands-on activities, flexible grouping/cooperative learning, scaffolded organizers/lessons, and modeling procedures/expectations

List of Applicable Performance Expectations (PE) Covered in This Unit:

4-PS3-1: Use evidence to construct an explanation relating the speed of an object to the energy of that object. [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]
4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
4-PS3-3: Ask questions and predict outcomes about the changes in energy that occur when objects collide. [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]
4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]

4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

Unit 2: Waves: Waves and Information

Recommended Pacing - 22 days

Why Is This Unit Important?

This unit targets a major area of Waves: Waves and Information:

1. Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move.

Enduring Understandings:

1. Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.
2. Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).
3. Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.
4. Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.
5. Similarities and differences in patterns can be used to sort and classify natural phenomena.
6. Similarities and differences in patterns can be used to sort and classify designed products.
7. Knowledge of relevant scientific concepts and research findings is important in engineering
8. Science findings are based on recognizing patterns.

Essential Questions:

1. What are waves and what are some things they can do?
2. What starts a wave?
3. How do waves travel?
4. What are the properties of waves?
5. What can waves transmit?

Acquired Knowledge:

1. Definition of waves
2. Wavelength
3. Amplitude
4. How waves move; what they really move.

Acquired Skills:

1. Develop a model using an analogy, example, or abstract representation to describe a scientific principle.
2. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

Major Assessments:

- Compare Multiple Solutions

Suggested Learning Experiences and Instructional Activities:

Anticipatory Sets:

- Waves

In-Class Activities and Laboratory Experiences:

- Wavelength and Amplitude
- How waves Move Objects
- Use a Code

Closure and Reflection Activities:

- Animal Tracker

Instructional Materials:

Exploring Science Cengage & National Geographic Learning; 2016

Interdisciplinary Connections:

Common Core Standards

ELA/Literacy -

- **RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS4-3)
- **RI.4.9** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)
- **SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1)

Mathematics -

- **MP.4** Model with mathematics. (4-PS4-1)
- **4.G.A.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-1)

Technology Connections:

- http://ngss-k-5-ausd.weebly.com/4waves-waves-and-information.html
- https://sqworl.com/oaj1b4
- https://betterlesson.com/lesson/628342/what-are-waves

Accommodations or Modifications for Special Education, ESL or Gifted Learners:
Multisensory instruction, visual displays, adapted readings, adapted tests, hands-on activities, flexible grouping/cooperative learning, scaffolded organizers/lessons, and modeling procedures/expectations

List of Applicable Performance Expectations (PE) Covered in This Unit:

4-PS4-1: Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]

4-PS4-3: Generate and compare multiple solutions that use patterns to transfer information. [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

Unit 3: Structure, Function, and Information Processing

Recommended Pacing - 22 days

Why Is This Unit Important?

This unit targets two major areas of Structure, Function, and Information Processing:

1. Students are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
2. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye.

Enduring Understandings:

1. An object can be seen when light reflected from its surface enters the eyes.
2. Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
3. Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.
4. Cause and effect relationships are routinely identified.
5. A system can be described in terms of its components and their interactions.

Essential Questions:

1. How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals?
2. What external structures do all or most plants have? What do these structures do?
3. What external structures do groups of plants have that others do not? What do these structures do?
4. What internal structures do plants have?
5. What external structures do all or most animals have? What do these structures do?
6. What external structures do groups of animals have that others do not? What do these structures do?
7. What internal structures do animals have?
8. What senses do animals have?
9. How does an eye work?

Acquired Knowledge:

1. Plant external structures and functions
2. Animal external structures and functions
3. Plant internal structures and functions
4. Animal internal structures and functions
5. The senses
6. The structure and function of a human eye

Acquired Skills:

1. Develop a model to describe phenomena.
2. Use a model to test interactions concerning the functioning of a natural system.
3. Construct an argument with evidence, data, and/or a model.

Major Assessments:

- Use a Model

Suggested Learning Experiences and Instructional Activities:

Anticipatory Sets:

- Structure of a Wild Rose

In-Class Activities and Laboratory Experiences:

- Construct an Argument
- How We See

Closure and Reflection Activities:

- Dog Whisperer

Instructional Materials:

Exploring Science Cengage & National Geographic Learning; 2016

Interdisciplinary Connections:

Common Core Standards

ELA/Literacy -

- **W.4.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)
- **SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-2),(4-LS1-2)

Mathematics -

- **MP.4** Model with mathematics. (4-PS4-2)
- **4.G.A.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2)
- **4.G.A.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1)

Technology Connections:

- http://ngss-k-5-ausd.weebly.com/4structure-function-and-information-processing.html
- http://www.bbc.co.uk/schools/scienceclips/ages/10_11/see_things.shtml
- http://ngss.nsta.org/DisplayStandard.aspx?view=topic&id=17

Accommodations or Modifications for Special Education, ESL or Gifted Learners:
Multisensory instruction, visual displays, adapted readings, adapted tests, hands-on activities, flexible grouping/cooperative learning, scaffolded organizers/lessons, and modeling procedures/expectations

List of Applicable Performance Expectations (PE) Covered in This Unit:

4-PS4-2: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]
4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]
4-LS1-2: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

Unit 4: Earth's Systems: Processes that Shape the Earth

Recommended Pacing - 22 days

Why Is This Unit Important?

This unit targets three major areas of Earth's Systems: Processes that Shape the Earth:

1. Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
2. Students apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans.
3. In order to describe patterns of Earth's features, students analyze and interpret data from maps.

Enduring Understandings:

1. Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.
2. An object can be seen when light reflected from its surface enters the eyes.
3. Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
4. Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.
5. Cause and effect relationships are routinely identified.
6. A system can be described in terms of its components and their interactions.

Essential Questions:

1. How can water, ice, wind and vegetation change the land?
2. How are weathering and sediment related?
3. What patterns of Earth's features can be determined with the use of maps?
4. What are natural hazards?
5. How do natural hazards impact land changes?

Acquired Knowledge:

1. Erosion and deposition
2. The role of the following in changing the land:
   - Water
   - Ice
   - Wind
   - Vegetation
3. Types of Earth features and there patterns based on locations
4. How the following natural hazards impact land change:
   - Earthquakes
   - Tsunamis
   - Volcanoes

Acquired Skills:

1. Develop a model to describe phenomena.
2. Use a model to test interactions concerning the functioning of a natural system.
3. Construct an argument with evidence, data, and/or a model.

Major Assessments:

- Identify Evidence

Suggested Learning Experiences and Instructional Activities:

Anticipatory Sets:

- United States: Regions versus Rainfall

In-Class Activities and Laboratory Experiences:

- Weathering and Erosion
- Make Observations
- Earthquakes
- Analyze and Interpret Data
- Building for the Future
- Generate and Compare Solutions

Closure and Reflection Activities:

- Crisis Mapper

Instructional Materials:

Exploring Science Cengage & National Geographic Learning; 2016

Interdisciplinary Connections:

Common Core Standards

ELA/Literacy -

- **W.4.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)
- **SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-2),(4-LS1-2)

Mathematics -

- **MP.4** Model with mathematics. (4-PS4-2)
- **4.G.A.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2)
- **4.G.A.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1)

Technology Connections:

- https://betterlesson.com/lesson/636200/the-marshmallow-challenge
- http://ngss-k-5-ausd.weebly.com/4-earth-systems-processes-that-shape-the-earth-part-1.html
- http://ngss-k-5-ausd.weebly.com/4earth-systems-processes-that-shape-the-earth-part-2.html
- http://ngss.nsta.org/DisplayStandard.aspx?view=topic&id=18

Accommodations or Modifications for Special Education, ESL or Gifted Learners:
Multisensory instruction, visual displays, adapted readings, adapted tests, hands-on activities, flexible grouping/cooperative learning, scaffolded organizers/lessons, and modeling procedures/expectations

List of Applicable Performance Expectations (PE) Covered in This Unit:

4-PS4-2: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]
4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]
4-LS1-2: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]