Green Infrastructure Toolkit For Schools

Engagement and Resources for Integrating Green Infrastructure into the Classroom

Nebraska Science and Mathematics
Curriculum Standard Overview

The Nebraska science and mathematics curriculum standards are designed to test student performance on a variety of topics. Each school district in Nebraska is responsible for students to become science and math literate by creating a K-12 science curriculum that meets the state standards. The standards are laid out by grade level, Kindergarten through Grade 12. Both Science and Mathematics standards are categorized into four science inquiries. There is the Nature of Science and Technology, Physical Science, Life Science, and Earth and Space Science for the Science standards, and Number, Algebra, Geometry, and Data for the Mathematics standards.

The Nebraska State Board of Education adopted the current version of the Nebraska Science Standards on October 6th, 2010. The standards are to be reviewed and updated every seven years and are currently going through the revision process. These standards set the stage for what is taught in classrooms across the state.

Green infrastructure is an excellent way to teach many specific science and math topics inside and outside of the classroom. In addition to science, green infrastructure applies to other subject areas including technology, engineering, arts, and math. These subjects together are often known as STEM or STEAM. This packet of information is the start of creating a better awareness with those in the education system of what is possible with green infrastructure and using it as a means to become more aware of our community's environment.

The standards that have been selected and listed in this package are taken from the 2011 Nebraska Science Standards and 2015 Nebraska Mathematics Standards from the Nebraska Department of Education and can be met through the use of green infrastructure principles and practices. Green infrastructure can be used to explore many areas of science including the water cycle, botany, horticulture, insects and animals, soil science, weather, climate change, environmental pollution, chemistry, and more. It can also involve many areas of math such as calculation, measuring, and chart reading. Utilization of green infrastructure principles and practices provides a dynamic opportunity for students to meet and exceed these science standards. For example, the Science standard 2.4.2.b for K2 states, "Recognize ways in which individuals and families can conserve Earth's resources by reducing, reusing, and recycling." Runoff from a school roof can be directed into a rain garden where plants will use the water rather than letting it go down the storm drain, carrying pollution with it. The Math standard MA 2.3.3.d for second graders states, "Measure the length of an object using two different length units and describe how the measurements relate to the size of the specific unit." A rain garden can provide students a hands-on opportunity to measure its length and width, while also learning about unit conversion.

Standards selected and listed here can be taught using green infrastructure principles and practices. Depending on a teacher's lesson plan, there may be other standards that could be applied to incorporate green infrastructure; so view this document not as a definitive list but as a resource to build upon. One final note: this package is only good if it is used, so we want feedback on how to improve it into the future. Please send questions, comments, or inquiries to omahastormwater@ci.omaha.ne.us, thank you!

Nebraska 6-8 Science Curriculum 2011 - Summary for Green Infrastructure

Inquiry - the Nature of Science, and Technology

Inquiry – Students will design and conduct investigation that will lead to descriptions of relationships between evidence and explanations. 8.1.1

1. Scientific Questioning: Formulate testable questions that lead to predictions and scientific investigations 8.1.1.a

2. Scientific Investigations: Design and conduct logical and sequential investigations including repeated trials 8.1.1.b

3. Scientific Controls and Variables: Determine controls and use dependent (responding) and independent (manipulated) variables 8.1.1.c

4. Scientific Tools: Select and use equipment appropriate to the investigation, demonstrate correct techniques 8.1.1.d

5. Scientific Observations: Make qualitative and quantitative observations 8.1.1.e

6. Scientific Data Collection: Record and represent data appropriately and review for quality, accuracy, and relevancy 8.1.1.f

7. Scientific Interpretations, Reflections, and Applications: Evaluate predictions, draw logical inferences based on observed patterns/relationships, and account for non-relevant information 8.1.1.g

8. Scientific Communication: Share information, procedures, results, and conclusions with appropriate audiences 8.1.1.h

9. Scientific Communication: Analyze and provide appropriate critique of scientific investigations 8.1.1.i

10. Mathematics: Use appropriate mathematics in all aspects of scientific inquiry 8.1.1.j

Nature of Science – Students will apply the nature of science to their own investigations. 8.1.2

1. Scientific Knowledge: Recognize science is an ongoing process and the scientific community accepts and uses explanations until they encounter new experimental evidence not matching existing explanations 8.1.2.a

2. Science and Society: Describe how scientific discoveries influence and change society 8.1.2.b

Technology – Students will solve a design problem that involves one or two science concepts. 8.1.3

1. Abilities to do Technical Design: Identify problems for technical design 8.1.3.a

2. Abilities to do Technical Design: Design a solution or product 8.1.3.b

3. Abilities to do Technical Design: Implement the proposed design 8.1.3.c

4. Abilities to do Technical Design: Evaluate completed technological designs or products 8.1.3.d

5. Understanding of Technical Design: Recognize that solutions have intended and unintended consequences 8.1.3.h

6. Understanding of Technical Design: Compare and contrast the reporting of scientific knowledge and the reporting of technological knowledge 8.3.3.i

Physical Science

Matter – Students will identify and describe the particulate nature of matter including physical and chemical interactions. 8.2.1

1. Properties and Structures of Matter: Describe physical and chemical properties of matter 8.2.1.b

2. States of Matter: Recognize most substances can exist as a solid, liquid, or gas depending on temperature 8.2.1.c

3. Classification of Matter: Classify substances into similar groups based on physical properties 8.2.1.g

Force and Motion – Students will investigate and describe forces and motion. 8.2.2

1. Motion: Describe motion of an object by its position and velocity 8.2.2.a

Energy – Students will identify and describe how energy systems and matter interact. 8.2.3

1. Sound/Mechanical Waves: Identify that waves move at different speeds in different materials 8.2.3.b

2. Light: Recognize that light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection) 8.2.3.c

3. Light: Recognize that to see an object, light from the surface of the object must enter the eye; the color seen depends on the properties of the surface and the color of the available light sources 8.2.3.d

4. Heat: Recognize that heat moves from warmer objects to cooler objects until both reach the same temperature 8.2.3.e

5. Conservation: Describe transfer of energy from electrical and magnetic sources to different energy forms (heat, light, sound, and chemical) 8.2.3.f

6. Conservation: Recognize all energy is neither created nor destroyed 8.2.3.g

Life Science

Structure and Function of Living Systems – Students will investigate and describe the structure and function of living organisms. 8.3.1

1. Characteristics of Life: Recognize the levels of organization in living organisms (cells, tissues, organs, organ systems, and organisms) 8.3.1.a

2. Cellular Composition of Organisms: Recognize that all organisms are composed of one or many cells; that these cells must grow, divide, and use energy; and that all cells function similarly 8.3.1.b

3. Cellular Composition of Organisms: Recognize specialized cells perform specialized functions in multi-cellular organisms 8.3.1.c

4. Behavior: Describe how plants and animals respond to environmental stimuli 8.3.1.e

Heredity – Students will investigate and describe the relationship between reproduction and heredity. 8.3.2

1. Reproduction: Compare and contrast sexual and asexual reproduction 8.3.2.b

Life Science

Flow of Matter and Energy in Ecosystems – Students will describe populations and ecosystems. 8.3.3

1. Flow of Energy: Diagram and explain the flow of energy through a simple food web 8.3.3.a

2. Flow of Energy: Compare the roles of producers, consumers, and decomposers in an ecosystem 8.3.3.b

3. Ecosystems: Recognize that producers transform sunlight into chemical energy through photosynthesis 8.3.3.c

4. Ecosystems: Determine that biotic and abiotic factors that impact the number of organisms an ecosystem can support 8.3.3.d

5. Ecosystems: Recognize a population is all the individuals of a species at a given place and time 8.3.3.e

6. Ecosystems: Identify symbiotic relationships among organisms 8.3.3.f

7. Impacts on Ecosystems: Identify positive and negative effects of natural and human activity on an ecosystem 8.3.3.f

Earth and Space Science

Earth Structures and Processes – Students will investigate and describe Earth's structure, systems, and processes. 8.4.2

1. Properties of Earth Materials: Describe the layers of Earth (core, mantle, crust, atmosphere) 8.4.2.a

2. Properties of Earth Materials: Describe the physical composition of soil 8.4.2.b

3. Earth's Processes: Compare and contrast constructive and destructive forces (deposition, erosion, weathering, plate motion causing uplift, volcanoes, and earthquakes) that impact Earth's surface 8.4.2.e

4. Earth's Processes: Describe the water cycle (evaporation, condensation, precipitation) 8.4.2.g

5. Use of Earth Materials: Classify Earth materials as renewable and nonrenewable 8.4.2.h

Energy in Earth's Systems – Students will investigate and describe energy in Earth's systems. 8.4.3

1. Energy Sources: Describe how energy from the Sun influences the atmosphere and provides energy for plant growth 8.4.3.a

Reference:
SAMPLE K-12 SCIENCE CURRICULUM 2011 [PDF].(n.d.). Lincoln: Nebraska Department of Education.
NEBRASKA SCIENCE STANDARD GRADE K12 2010 [PDF].(n.d.). Lincoln: Nebraska Department of Education.

Omaha Green Infrastructure Education Network

NUMBER

Numeric Relationships: Students will demonstrate, represent, and show relationships among fractions, decimals, percents, and integers within the base-ten number system. 6.1.1

1. Determine ratios from drawings, words, and manipulatives. 6.1.1.e

Operations: Students will compute with fractions and decimals accurately. 6.1.2

1. Add, subtract, multiply, and divide decimals using the standard algorithms. 6.1.2.d

2. Estimate and check reasonableness of answers using appropriate strategies and tools. 6.1.2.e

ALGEBRA

Algebraic Relationships: Students will demonstrate, represent, and show relationships with expressions, equations, and inequalities. 6.2.1

1. Represent and analyze the relationship between two variables using graphs, tables, and one-step equations. 6.2.1.c

Algebraic Processes: Students will apply the operational properties when evaluating expressions and solving expressions, equations, and inequalities. 6.2.2

1. Solve one-step equations with non-negative rational numbers using addition, subtraction, multiplication and division. 6.2.2.e

Applications: Students will solve real-world problems involving ratios, unit rates, and percents. 6.2.3

1. Write equations (e.g., one operation, one variable) to represent real-world problems involving non-negative rational numbers. 6.2.3.a

2. Solve real-world problems involving non-negative rational numbers. 6.2.3.b

3. Solve real-world problems involving percents of numbers. 6.2.3.c

4. Solve real-world problems using ratios and unit rates. 6.2.3.d

GEOMETRY

Characteristics: Students will identify and describe geometric characteristics and create two- and three-dimensional shapes. 6.3.1

1. Identify and create nets to represent two-dimensional drawings of prisms, pyramids, cylinders, and cones. 6.3.1.a

Coordinate Geometry: Students will determine location, orientation, and relationships on the coordinate plane. 6.3.2

1. Identify the ordered pair of a given point in the coordinate plane. 6.3.2.a

2. Plot the location of an ordered pair in the coordinate plane. 6.3.2.b

3. Identify the quadrant of a given point in the coordinate plane. 6.3.2.c

4. Draw polygons in the coordinate plane given coordinates for the vertices. 6.3.2.d

5. Calculate vertical and horizontal distances in the coordinate plane to find perimeter and area. 6.3.2.e

Measurement: Students will perform and compare measurements and apply formulas. 6.3.3

1. Determine the surface area of rectangular prisms and triangular prisms using nets. 6.3.3.b

2. Apply volume formulas for rectangular prisms. 6.3.3.c

DATA

Representations: Students will create displays that represent data. 6.4.1

1. Represent data using line plots, dot plots, box plots, and histograms. 6.4.1.a

Analysis & Applications: Students will analyze data to address the situation. 6.4.2

1. Solve problems using information presented in line plots, dot plots, box plots, and histograms. 6.4.2.a

2. Compare and interpret data sets based upon their graphical representations (e.g., center, spread, and shape). 6.4.2.b

3. Find and interpret the mean, median, mode, and range for a set of data. 6.4.2.c

4. Compare the mean, median, mode, and range from two sets of data. 6.4.2.d

Reference:
NEBRASKA MATHEMATICS STANDARDS (Rep.). (n.d.). Retrieved
https://www.education.ne.gov/math/Math_Standards/Adopted_2015_Math_Standards/
2015_Nebraska_College_and_Career_Standards_for_Mathematics_Vertical.pdf

NUMBER

Operations: Students will compute with rational numbers accurately. 7.1.2

1. Solve problems using proportions and ratios (e.g., cross products, percents, tables, equations, and graphs). 7.1.2.a

2. Add, subtract, multiply, and divide rational numbers (e.g., positive and negative fractions, decimals, and integers). 7.1.2.b

3. Apply properties of operations as strategies for problem solving with rational numbers. 7.1.2.c

ALGEBRA

Algebraic Relationships: Students will demonstrate, represent, and show relationships with expressions, equations, and inequalities. 7.2.1

1. Represent real-world situations with proportions. 7.2.1.b

Applications: Students will solve real-world problems involving expressions, equations, and inequalities. 7.2.3

1. Write a two-step equation to represent real-world problems involving rational numbers in any form. 7.2.3.b

2. Solve real-world problems with equations that involve rational numbers in any form. 7.2.3.c

3. Use proportional relationships to solve real-world problems, including percent problems, (e.g., % increase, % decrease, mark-up, tip, simple interest). 7.2.3.e

4. Solve real-world problems involving scale drawings using a proportional relationship. 7.2.3.f

GEOMETRY

Measurement: Students will perform and compare measurements and apply formulas. 7.3.3

1. Solve real-world problems involving perimeter and area of composite shapes made from triangles, quadrilaterals and polygons. 7.3.3.a

2. Solve real-world problems involving surface area and volume of composite shapes made from rectangular and triangular prisms. 7.3.3.b

3. Determine the area and circumference of circles both on and off the coordinate plane. 7.3.3.c

DATA

Representations: Students will create displays that represent data. 7.4.1

1. Represent data using circle graphs. 7.4.1.a

Analysis & Applications: Students will analyze data to address the situation. 7.4.2

1. Solve problems using information presented in circle graphs. 7.4.2.a

2. Explain the difference between a population and a sample. 7.4.2.b

3. Generate conclusions about a population based upon a random sample. 7.4.2.c

4. Determine and critique biases in different data representations. 7.4.2.d

Probability: Students will interpret and apply concepts of probability. 7.4.3

1. Generate a list of possible outcomes for a simple event. 7.4.3.a

2. Describe the theoretical probability of an event using a fraction, percentage, and decimal. 7.4.3.b

3. Find theoretical probabilities for independent events. 7.4.3.c

4. Perform simple experiments and express the degree of likelihood (possible, impossible, certain, more likely, equally likely, or less likely); write as fractions and percentages. 7.4.3.d

5. Find experimental probability for independent events. 7.4.3.e

6. Compare and contrast theoretical and experimental probabilities. 7.4.3.f

7. Find the probability of dependent compound events. 7.4.3.g

8. Identify complementary events and calculate their probabilities. 7.4.3.h

Reference:
NEBRASKA MATHEMATICS STANDARDS (Rep.). (n.d.). Retrieved
https://www.education.ne.gov/math/Math_Standards/Adopted_2015_Math_Standards/
2015_Nebraska_College_and_Career_Standards_for_Mathematics_Vertical.pdf

NUMBER

Operations: Students will compute with exponents and roots. 8.1.2

1. Multiply and divide numbers using scientific notation. 8.1.2.d

ALGEBRA

Algebraic Relationships: Students will demonstrate, represent, and show relationships with expressions, equations, and inequalities. 8.2.1

1. Determine and describe the rate of change for given situations through the use of tables and graphs. 8.2.1.b

2. Graph proportional relationships and interpret the slope. 8.2.1.d

Applications: Students will solve real-world problems involving multi-step equations and multi-step inequalities. 8.2.3

1. Describe and write equations from words, patterns, and tables. 8.2.3.a

2. Write a multi-step equation to represent real-world problems using rational numbers in any form. 8.2.3.b

3. Solve real-world multi-step problems involving rational numbers in any form. 8.2.3.c

GEOMETRY

Characteristics: Students will identify and describe geometric characteristics of two- dimensional shapes. 8.3.1

1. Identify and apply geometric properties of parallel lines cut by a transversal and the resulting corresponding, alternate interior, and alternate exterior angles to find missing measures. 8.3.1.b

Coordinate Geometry: Students will determine location, orientation, and relationships on the coordinate plane. 8.3.2

1. Perform and describe positions and orientation of shapes under single transformations including rotations (in multiples of 90 degrees about the origin), translations, reflections, and dilations on and off the coordinate plane. 8.3.2.a

2. Find congruent two-dimensional figures and define congruence in terms of a series of transformations. 8.3.2.b

3. Find similar two-dimensional figures and define similarity in terms of a series of transformations. 8.3.2.c

Measurement: Students will perform and compare measurements and apply formulas. 8.3.3

1. Explain a model of the Pythagorean Theorem. 8.3.3.a

2. Apply the Pythagorean Theorem to find side lengths of triangles and to solve real-world problems. 8.3.3.b

3. Find the distance between any two points on the coordinate plane using the Pythagorean Theorem. 8.3.3.c

4. Determine the volume of cones, cylinders, and spheres, and solve real-world problems using 8.3.3.d volumes.

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DATA
Representations: Students will create displays that represent data. 8.4.1
1. Represent bivariate data (i.e. ordered pairs) using scatter plots. 8.4.1.a
Analysis & Applications: Students will analyze data to address the situation. 8.4.2
1. Solve problems and make predictions using an approximate line of best fit. 8.4.2.a

Reference:
NEBRASKA MATHEMATICS STANDARDS (Rep.). (n.d.). Retrieved
https://www.education.ne.gov/math/Math_Standards/Adopted_2015_Math_Standards/
2015_Nebraska_College_and_Career_Standards_for_Mathematics_Vertical.pdf