

Topics and Phenomena - NGSS/WSS-based Science & Engineering Projects

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Life Science

- Animal observations - LS1 - What animals do you see in different seasons? How do animals look different in the summer vs winter, why?
- Pets at home or classroom - LS1 - split up same amount of food into many small or a few large meals per day and observe energy and begging behaviors of animals.
- Nutrition - What are healthy and unhealthy foods? Why?
- Environmental impacts - ESS3 - What can you do to help the local environment? [students at this age might have unusual ideas, but can articulate in a reasonable way how it would help the environment]
 - Students come up with a waste reduction system at school or home
 - Students come up with ways to encourage recycling and measure results

Physical Science

- Playground investigations - PS2 - investigation - What is effect of more height?
- Farm pushes and pulls - PS2 - Why use a wheelbarrow?

Earth and Space Science

- Weather patterns - ESS2 - When do we see the most sunshine? What do we predict the weather will be like this next week based on ...? Collect data over time - create a month by month guide to activities based on the weather or clothing they should have.
- Plants, Animals, Humans and the Environment - ESS2 - How do plants and animals change their environment? How do people change the world around them to live comfortably? Students could study housing amenities (running water, heat, space, housing options) and research ways they affect the environment. This could extend to global connections - how do other communities or countries live?

1st Grade

Life Science

- From Molecules to Organisms: Structures and Processes - LS1 - Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. Examples: designing clothing for bicyclists or other athletes that mimics a turtle shell for protection; stabilizing structures by mimicking roots of plants or tails of animals; detecting intruders by mimicking eyes and ears.

Physical Science

- Sound Waves and Applications - PS4 - Instrument Study - How does sound make matter vibrate? How do tuning forks and/or various instruments work? How do cup phones work and how could I make them better to transmit sound?
 - Light Waves and Applications - PS4 - Objects can be seen if light is available to illuminate them or if they give off their own light. Students could safely study various sources of light, comparing brightness and where they light comes from.
 - Light Waves and Applications - PS4 - How do objects made from different materials affect the path of a light beam? (transparent, translucent, opaque, reflective)
 - Waves and Their Applications in Technologies for Information Transfer - PS4 - Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. Examples: Light or Sound signals, Paper Cup and String “telephones.”
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Life Science

- Seed dispersal - LS2 and ETS1 - Walk through a school forest or prairie, or one that is nearby in the fall. What seeds can you find? What do they look like? How does what they look like (structures) help them move from one place to another?
 - Develop a device for sending a message that would use similar a method as a certain seed (structure/method).
 - Determine if there are certain materials that burrs stick to better and less than others. Use that information to design/plan forest clothing/gear that doesn't get covered in burrs. Use that information to design a method to better spread seeds.
 - Observe a blooming fruit tree or vegetable plant in the late spring. What insects fly around them or crawl on them? Using the structures of those insects, design and test an artificial pollinator for those plants. Compare the production rate of plants where you use the artificial pollinator to those only naturally pollinated.
- Plant growth - LS2 - Design and conduct an experiment to test whether plants need soil, water, or light to grow (one at a time). Design and conduct an experiment to test whether plants in artificial light or sunlight grow more (try setting the artificial lights up on a timer to mimic outdoor light). Gather and analyze data from an experiment on whether plants need water or light; use evidence to write an explanation of what plants need to grow. Design and conduct an experiment to see which types of plants need water the most to grow (for example, comparing native and non-native plants, or desert and humid-climate plants).
- LS4 - Make predictions about and gather evidence about where in the school grounds you'll find the most variety of plants and animals. Use a form w/ pictures provided or drawn in to count organisms; use that data as evidence in building explanations. Plant a school butterfly garden or prairie as part of the project--use them for the investigation, comparing those areas of the school grounds to other areas (like just grass or the blacktop).

Physical Science

- PS1 - Students study and describe the properties of each of the ingredients for cookies. They then mix them up and bake the cookies. Afterward they “dissect” the cookies and talk about what changed. What ingredients are still there in the same form? What changes happened?
 - PS1 - Design a device to keep a popsicle (or ice cube) from melting out in the sun. Design a method to keep that pile of snow in the yard from melting so you can keep having snowball fights. Design a device to keep your teacher’s coffee, tea or hot chocolate warm until the end of class (when he/she remembers it’s not finished).
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Life Science

- Life Cycles - LS1 - Hatch and collect data on baby chicks. Compare the life cycles of chickens to other organisms.
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Life Science

- LS2-1, PS3-1 - investigate and evaluate different composting strategies, and use of compost as a fertilizer
- LS2-1, PS3-1 - Aquaponics investigations and practices - lots of [online resources for DIY](#).

Physical Science -

- PS1-4 - Soil needs. Have a local co-op test your soil and determines what it needs in relation to a mixing of herbicide, fertilizers, etc. Determine what those things mean and experiment based on those suggested needs.
 - Investigations - garden plot testing of potash vs. banana peels
 - PS1-4 - Investigate moisture levels in silage/haylage and evaluate why certain levels are ideal. Connect silage work to what animals need in terms of nutrition.
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Grades 6-8 (many also apply at grades 9-12)

Life Science

- Ecosystems LS2-1
 - Plastics and biodegradation - impact on other organisms and ecosystems (also PS1 and ESS3)

- Local water study - what macroinvertebrates can you find? What do trends in data look like over time? How does class generated data compare to DNR data?
- Impact of invasives, such as earthworms, jumping worms, purple loosestrife, Asian carp, garlic mustard, honey bees, pets (boa constrictors), buckthorn
 - Pros and cons of introducing other species, herbicides to combat invasives
- Local waterways for hydroponics or fish farming, or aquaponics - grow and support use of edible native species (alternative agriculture).
- Heredity - LS3
 - LS3.A Inheritance - conduct or review selective breeding programs (animal sciences)
 - LS3.B Conduct studies in variation of home, community, or local animals; evaluate use of genetically-modified organisms
- Biological Evolution: Unity and Diversity LS4
 - Students create a simulation showing how natural selection would favor certain organisms, or organisms of a particular species with a particular trait.
 - Students conduct cross-pollination studies as an example of artificial selection.
 - Students conduct common ancestry studies.
 - Students research biodiversity (or lack thereof) within local ecosystems (large and small scale - ditches, parks, wetlands, prairie restoration, tree farms, paper company lands). They connect that to sustainable practices.
- Cheese making - LS1.B, PS1
 - Students experiment with different means of making cheese themselves (outside help may be needed for safety considerations if cheese it to be eaten).

Physical Science -

- PS2 - Pulley systems - engineering studies in the home, farm, or school to lift heavy objects, with students identifying a particular problem to begin
- PS2, ETS1, LS1 - Designing/engineering tools for people or animals with disabilities to solve a problem
- PS1 - Structures and Properties of Matter
 - How do we store chemicals, such as for industry or farms? When are solids best and how does that use crystal forms?
 - How do we create the largest possible crystals? What uses do those crystals have and when does size matter for them?
 - Coral bleaching - PS1, LS2, ESS3
 - How can we model that within the classroom? (non-coral model)
 - Uses and Safety of Nanotechnology
 - What are the differences across different restaurant soda? (some claim that soda tastes different in some places, and that it tastes different in cans or bottles)
 - What's in water? What gives water different tastes? What's in our pipes? What in our soil or aquifers ground ends up in water? Students could conduct local sampling and comparisons.

- UW-Extension can provide free well-water testing kits in relation to the WIC program for pregnant women - a prenatal program.
 - City water utilities are required to provide water testing results and what's in the water. Students could compare such results across different parts of the state. ESS2 - Students could relate that to the minerals in different parts of the state.
- Waves and their Applications - PS4
 - How does the design of a building (house, school, etc.) influence how sound travels? What are good ways to soundproof a room for a parent working 3rd shift (graveyard shift) and needing to sleep?
 - What's up with those funny shapes on walls in sound testing rooms (anechoic chamber)? What happens to sounds waves? How could students model that and what could it be used for?

Earth and Space Science -

- Earth and Human Impacts - ESS3
 - How have humans impacted their community, state, world?
 - ETS-1 - What is the evolution of product packaging and how does that impact the world? How could we change product packaging to be more environmentally friendly?
 - What are the pros and cons of manure digesters? What design changes are possible?
 - <http://www.wisfarmer.com/story/news/2016/12/01/what-manure-digesters-can-and-cannot-do/94739414/>
- Earth's Place in the Universe - ESS1
 - What can we learn from the Farmer's Almanac? How accurate is it ? How do they come up with the dates and predictions? ESS1, ESS2 (climate)
 - How do farmers decide when to plant or when to wait? Could connect to students planting at their school - they could use dates from various sources such as the seed package, the Farmer's Almanac, their grandma's knee, potatoes on Good Friday, etc. and compare results.
 - Space Junk
 - Design a system to clean it up (if a ground-based model is created, students might deploy it in a pool to test it).
- ESS2 - Earth's Systems
 - Erosion - Wisconsin flooding and roads washing out. Example from the news: <https://www.youtube.com/watch?v=tqU30nF7WZQ>
 - How do we prevent roads washing out and other flood damage?
 - How does flooding relate to types of soils - clay, sandy, etc.?
 - Investigate crop damage due to lack of drainage, and create designs to improve drainage.
 - What are best soil management procedures on a farm, in a region, across the state and how could we test those at the classroom level?

- Mining - ESS2, ESS2.A, ESS3, LS2 - evaluate locations in relation to potential effects on environment.

Grades 9-12 (many also apply at grades 6-8)

Life Science

- LS2 - Investigate biodiversity and humans, such as the several varieties of bees in Wisconsin, how those have changed over time, and their importance in pollination.
- LS4-1 - Investigate common ancestry, artificial selection, and biological evolution in relation to livestock, and note current technologies in livestock breeding programs.

Physical Science

- PS1.C - Nuclear Processes
 - Analyze the pros and cons of nuclear energy.
 - Create a model of a nuclear reactor to explain how it works with a variable heat source, using it to create some sort of back-up safety measures in case of overheating.
 - Research Wisconsin reactors and evaluate/design processes in relation to decommissioning reactors - https://en.wikipedia.org/wiki/List_of_power_stations_in_Wisconsin
 - How we prevent and/or detect “dirty” nuclear bombs? (possibly geiger counter work).
- PS2 - Force and Motion
 - Research work done at the Badger Ammunition Plant - science and engineering behind those weapons and clean-up programs after
 - Chemistry and force/motion within weapons, history of weapons
 - How do we brace against kickback? Can we increase accuracy by having more stable set-ups for firing? (data could be from local 4H club)
 - Canoe and kayak aerodynamics? How do you row and why?
 - Designing a safer kayak or canoe to prevent tipping over.
 - Why can't water fountains give you a consistent, predetermined pressure? Why do they sometimes shoot 4 feet away and then go back to a more consistent, lower level?