STEAM Integration Suggestions for K-3

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Overview and Summary:
The objective of this document is to offer opportunities for interdisciplinary learning across the STEAM content areas based on the science curriculum for grades K-3 at Park View Elementary in Milltown Public Schools.

After reviewing the units for each grade, I have looked to find age-appropriate projects that foster open-ended problem solving, critical thinking, and opportunities for an interdisciplinary approach based on the activities and topics already planned within each science unit. Throughout all of these suggestions, working to promote design thinking through the utilization of a design process, brainstorming, reflection, and empathy are key components of a successfully integrated STEAM program. Likewise, creating connections to possible careers can also foster greater student engagement, and connect learning to the real-world. For additional instructional strategies and definitions, see this slideshow.

When teaching with an engineering design process, or EDP, choosing a process that supports student comprehension and understanding is key. For grades K-3, I suggest a simple 4-step loop, or a loop that uses terms and processes that are viable for the day to day classroom activities within this age group.

There are also opportunities to incorporate the NJ Student Learning standards for Computer Science (8.1) and Design Thinking (8.2), as well as ISTE Standards for Students, both of which have been annotated in the outline below.

K -

General STEAM Skills for K -

From a Design Thinking perspective for Kindergarten, promoting brainstorming strategies and experimentation is key. At this age, building a foundational understanding that there may not be one right way to do something, or even one correct way, and that making mistakes is OK is the main idea. To do this, allow for students to sketch their ideas, and allow for opportunities for them to sketch different ideas and compare the two. Challenge students to explain their sketches, why they made the decisions they did, and how something in their sketch might work

(verbally). When possible, allow for students to repeat a project and make revisions to something they created for the intention of making it perform better. Consider offering new materials, (like paper, tape, straws, etc), and giving opportunities for experimentation with how these materials might perform in different settings based on their own ideas.

From a Computer Science perspective for Kindergarten, students can begin to learn through unplugged algorithmic thinking activities, as well as technological literacy. Students can learn to code using flashcards and picture based coding activities, where they themselves need to follow the instructions to navigate through a maze as if they are a robot. Getting students to learn how to log into a device using a username, as well as how to use a mouse and keyboard may also be suitable for this age group.

Unit 1: Energy (Sunlight)

The STEAM activity that is already listed in this unit is great, challenging students to design a structure that provides shade. To expand on this, place students in a simulated real-world scenario like, “you’re on a beach, or a sunny island, or you're an animal looking for shelter in the wild.” This may increase engagement and also foster critical thinking across an integrated approach.

Materials may be paper, straws, tape, etc. Consider cutting paper leaves out and challenging students to find a way to make some type of shaded canopy from them to correspond with the real-world scenario provided. And by using something like a micro:bit, you can even measure how much light is being blocked by the student’s shady prototypes!

Possible Standards:

- NJSLS 8.2.2.ED.2: Collaborate to solve a simple problem, or to illustrate how to build a product using the design process.
- NJSLS 8.2.2.ITH.1: Identify products that are designed to meet human wants or needs.
- ISTE 1.4.a Design Process
- ISTE 1.4.b Design Constraints

Unit 2: Weather Forecasting

In addition to or as an alternative to the building a bird nest STEAM activity mentioned in this unit, consider challenging students to create models to demonstrate what type of weather may be experienced. For example, students could make clearly illustrated signs that show the weather, or what weather they are predicting (similar to what we might see in the weather app on our phone). Students can display these signs at their desk throughout the unit and use them as if they were meteorologists.

We can also challenge students to consider the impact weather has on our homes, towns, and structures, and challenge students to make a structure that can withstand extreme weather conditions. This might allow for students to learn about different material properties, like what is and isn’t water resistant, as they build a roof or walls that are put to the test in a sink, or blown

by a fan!

Possible Standards:

- NJSLS 8.2.2.ED.3: Select and use appropriate tools and materials to build a product using the design process.
- NJSLS 8.2.2.ITH.5: Design a solution to a problem affecting the community in a collaborative team and explain the intended impact of the solution.
- ISTE 1.6.c Communicate Complex Ideas
- ISTE 1.7.d Local and Global Issues

Unit 3: Forces and Motion

There are many different challenges suitable for this topic, but consider structural challenges, like building a tower, a paper chain, a bridge, etc. Students can be placed in a simulated real-world environment, like building new desks for our school, and small-scale objects can be placed on their structures to test how they might perform. Challenges like these are quick, which allow for great reflection opportunities as students can learn from their mistakes and make improvements to their designs.

Another fun experiment to test force upon impact is by dropping objects on play doh. The imprint left will be an easy visual towards force applied. You can also use a micro:bit to make a force impact meter too. Alternative to dropping objects, you can drag them. If you place text books on a single piece of toilet paper or newspaper, it will rip when you attempt to tug the books along. But if we stack and add paper, we will eventually be able to drag the objects. Students can work through a design process during these experiments, and are challenged to predict what might happen, then reflect on their thoughts.

Possible Standards:

- NJSLS 8.2.2.ED.3: Select and use appropriate tools and materials to build a product using the design process.
- NJSLS 8.2.2.NT.2: Brainstorm how to build a product, improve a designed product, fix a product that has stopped working, or solve a simple problem.
- ISTE 1.4.d Open-Ended Problems
- ISTE 1.6.a Choose Platforms or Tools

Unit 4: Ecosystems

For this unit, students can be challenged to design an optimal ecosystem based on the observations made, and what they learn about plant and animal needs. This ecosystem can be a sketch or model, perhaps made from paper or play doh.

A key aspect towards this activity would be challenging students to brainstorm, and challenging students to explain their decisions. Helping students label the different parts of their ecosystems with signs may work well to achieve this. You could also challenge students to design their own plant or animal, one that shows suitable traits for different circumstances. In this, they can name

the animal and create different facts about it.

There are also many fictional books which may also tie in with this, perhaps students make an animal or an ecosystem based on a book while using the real-world knowledge gained throughout.

Possible Standards:

- NJSLS 8.2.2.ED.1: Communicate the function of a product or device.
- NJSLS 8.2.2.ITH.2: Explain the purpose of a product and its value.
- ISTE 1.4.a Design Process
- ISTE 1.7.d Local and Global Issues

1 -

General STEAM Skills for 1 -

From a Design Thinking perspective for 1st Grade, we can promote deeper thinking when it comes to brainstorming and explaining how something works, as well as following visual instructions. Promote writing skills by challenging students to label their drawings, and instead of having students add to a single drawing, challenge them to make several different drawings to narrow down their different ideas (thumbnail sketching, morphological charts, etc). Additionally, offer picture instructions to students on how something should be built or used, and challenge students to follow them. You can then challenge students to make their own instructions using a combination of steps, pictures, and words, to build stronger spatial reasoning and technical skills.

From a Computer Science perspective for 1st Grade, the type of unplugged programming students engage with can increase. In addition to picture-based coding using unplugged activities, students can also engage with color-based coding languages too. We can also challenge students to build robots or technology using simple block systems, as well as challenge them to identify how these items work by sketching the parts of a robot and learning the basics of motors, sensors, etc. Building stronger keyboarding and mouse control would also be appropriate.

Unit 1: Waves (Light)

One fun activity is to challenge students to get light to appear in a specific location using mirrors. This is a great team activity, where a flashlight might be set up in one corner of the room, and a target somewhere else. Students then need to troubleshoot as to where mirrors need to be placed in order for the light to hit the target. A real-world connection for this could be that students must create a network of mirrors that allows for light to travel through the town, which is relatable to how fiber optic cables work, or some fictional books and movies. See this project for an example.

Creating shadow puppets is another fun challenge, and one that can be implemented through a design process with strong ELA connections. Students could be challenged to share a message with their shadow puppets, or tell a story as a team.

And making mini flashlights or mini lightsabers is a fun, cheap, and engaging project too! These mini lights can then be used to cast light and shadows onto objects, or used to tell a message using morse code. Challenges like this also allow for students to work with more materials, and expand upon their understanding for material properties.

Possible Standards:

- NJSLS 8.2.2.ITH.3: Identify how technology impacts or improves life.
- NJSLS 8.2.2.NT.2: Brainstorm how to build a product, improve a designed product, fix a product that has stopped working, or solve a simple problem.
- ISTE 1.1d Technology Fundamentals
- ISTE 1.7.c Project Teams

Unit 2: Waves (Sound)

As students learn how vibrations make sound, they can also be challenged to learn what materials vibrate in ways that are more suitable for creating sounds, like tight strings or pieces of foil. From this, students can be challenged to design their own instruments using different materials, then challenged to work collaboratively as a band with their unique sound machines! In this, students can learn about how different instruments work, or about different instruments from across the globe!

NASA also has a fun project where students learn about vibrations by placing different objects in balloons. Though this may be difficult for each student to do on their own at this age, consider it as a demonstration tool to lead into this instrument activity.

Another fun activity is to make our own stethoscopes. In this, we can create connections to the medicine field and go to the dr's office, in a fun and positive way. If this activity is completed earlier in the unit, students can even use their stethoscopes to test and hear sounds generated by materials and vibrations later on!

Possible Standards:

- NJSLS 8.2.2.NT.1: Model and explain how a product works after taking it apart, identifying the relationship of each part, and putting it back together.
- NJSLS 8.2.2.EC.1: Identify and compare technology used in different schools, communities, regions, and parts of the world.
- ISTE 1.4.d Open-Ended Problems
- ISTE 1.6.a Choose Platforms or Tools

Unit 3: Space

NASA has a lot of great design challenges and learning resources for this age group. One great

one is creating a mars helicopter. In this, students can learn about Mars and how other planet surfaces differ from our own, as well as design and test a fun prototype!

Another fun NASA project is creating straw rockets. This one connects less to conditions in space or planets, but more to traveling to space, history of space travel, and flight.

And while working with TInkercad may be a bit too complex for this age group, it may be a great demonstration tool to promote inquiry. Tinkercad Sim Lab recently added the ability to change the gravity being used in the simulated model. You can use this to test how objects may fall or move on Earth, the moon, etc, and play it back for students to see and engage with.

Lastly, as students learn about space, conditions in space, stars, etc, we may challenge students to consider how we can survive in space. In this, students can be placed in a real-world setting where they are designing the next space capsule, or space station, or an elementary school to be placed on the moon! How would we be able to eat lunch if we were on the moon? Or what kind of games would we play in the gym? Students can work in groups to design their own lunar location, and present their ideas to the class through the steps of a design process.

Possible Standards:

- NJSLS 8.2.2.ETW.2: Identify the natural resources needed to create a product.
- NJSLS 8.2.2.ETW.4: Explain how the disposal of or reusing a product affects the local and global environment.
- ISTE 1.4.b Design Constraints
- ISTE 1.4.c Prototypes

Unit 4: Traits

As students learn about different plant and animal traits, they can be challenged to create paper or cardboard models that show these traits effectively. Students may be challenged to make a model of a plant, or a model of an animal that highlights their physical traits, while also offering an opportunity to work with materials and get hands-on with their learning.

Students could also be challenged to think about how an animal might live or survive if it didn't have a certain trait. For example, students may learn why birds have beaks, and compare different types of beaks, or why plants have different types of leaves. What would happen to these animals or plants if they had a different trait? How might this look? In creating models as discussed earlier, students could be challenged to mix and match traits across models to make hybrids, while being challenged to describe how that species would need to live based on their selected traits.

Possible Standards:

- NJSLS 8.2.2.ED.1: Communicate the function of a product or device.
- NJSLS 8.2.2.ITH.5: Design a solution to a problem affecting the community in a collaborative team and explain the intended impact of the solution.
- ISTE 1.4.a Design Process
- ISTE 1.4.d Open-Ended Problems

2 -

General STEAM Skills for 2 -

From a Design Thinking perspective for 2nd grade, the types of materials and tools we use can increase. Student dexterity can be challenged as they learn to cut materials and adhere them using cold gluing methods and tape. Bigger, multi-day projects are also more feasible, allowing for more materials to be used for more complex projects. We also want to begin to emphasize independent research, where students may begin to learn how to search for existing ideas using a computer and incorporate what they find in their designs.

From a Computer Science perspective for 2nd grade, students may begin to transition from unplugged coding activities to onscreen block-based coding activities. Programming using picture-based or color-based code is still appropriate, but linear block-based languages are also suitable for students to begin to engage with. Students should also brainstorm their code off screen, using sketches or written lists, and engage with documentation where they plan their programs more effectively.

Unit 1: Earth (Land Erosion)

Real-world connections can be made by sharing locations which are experiencing land erosion, local connections may include the Jersey shore. From these connections, students can be placed into a real-world scenario where they have been asked to help the town by designing a solution to reduce / prevent land erosion. Based on what students have learned, they can create sketches or models of their prototypes, then be challenged to present their ideas to the class.

Scale models can also be created with sand and water, students can be challenged to design solutions which are tested in a scale setting. Encourage brainstorming and reflection as students try different ideas and compare their solutions to that of their peers'.

Possible Standards:

- NJSLS 8.2.2.ITH.3: Identify how technology impacts or improves life.
- NJSLS 8.2.2.ITH.5: Design a solution to a problem affecting the community in a collaborative team and explain the intended impact of the solution.
- ISTE 1.3.a Effective Research Strategies
- ISTE 1.3.d Explore Real-World Issues

Unit 2: Matter

As students learn about the states of matter, they may also learn about different materials and various material properties. In this, they can be challenged to design prototypes based on these properties.

Common projects like making oobleck, slime, or magnetic slime are fun and common projects. A

real-world connection to this could be challenging students to make something that protects something fragile during transport, like a potato chip. Students can be challenged to design a protective box that will prevent the chip from breaking by choosing the right materials. Connections can also be made to packaging design, as well as how mailing objects work, and student prototypes can be tested with drops from a set height, or by placing them under objects of a set weight.

Students can also be challenged to design a fun fidget toy by combining different materials to make a safe and engaging toy to play with. The real-world scenario may be that students are being hired by a toy company to design a new fidget for kids their age. Through the steps of a design process, students can research, plan, develop, and test their toys. Students may be challenged to test each other's toys and provide feedback, which is then used in a reflection activity. This offers strong opportunities for empathy connections as well.

Possible Standards:

- NJSLS 8.2.2.ITH.1: Identify products that are designed to meet human wants or needs.
- NJSLS 8.2.2.NT.2: Brainstorm how to build a product, improve a designed product, fix a product that has stopped working, or solve a simple problem.
- ISTE 1.1c Feedback to Improve Practice
- ISTE 1.4.b Design Constraints

Unit 3: Habitats and Biodiversity

As students learn about different animal habitats and ecosystems, they can be challenged to apply what they are learning to design a successful ecosystem. Consider placing students in a real-world challenge where they have been asked to help an animal that is endangered, or whose habitat is a risk.

From this, students may be challenged to research a new area that is suitable for this animal's needs, or design a solution to revitalize the animals' natural habitat instead. Students can also be challenged to consider how such an animal may need to be transported from their current habitat to the new one, and present their ideas as if they were pitching them to sway others to support this cause.

Students may be challenged to create a map or model of this habitat, or use computers to do this. Using an app like google slides to make a slideshow, poster, or map of the new habitat would also build stronger technological literacy skills while also creating connections to the content.

Possible Standards:

- NJSLS 8.2.2.ED.2: Collaborate to solve a simple problem, or to illustrate how to build a product using the design process
- NJSLS 8.2.2.ITH.2: Explain the purpose of a product and its value.
- ISTE 1.1d Technology Fundamentals
- ISTE 1.3.d Explore Real-World Issues

Unit 4: Plants

As students learn about pollination and the role animals play in this to support plants, they could be challenged to make a model to demonstrate this process. This allows for students to get hands-on with the content, as well as work with different materials and tools to construct a visual to demonstrate how this process is completed, as shown in this example lesson.

Students can also be challenged to consider what might happen if our pollinators continue to decrease due to climate change, then be challenged to design an alternative solution to support through the steps of the engineering design process.

Possible Standards:

- NJSLS 8.2.2.ITH.2: Explain the purpose of a product and its value.
- NJSLS 8.2.2.ETW.1: Classify products as resulting from nature or produced as a result of technology.
- ISTE 1.7.c Project Teams
- ISTE 1.7.d Local and Global Issues

3 -

General STEAM Skills for 3 -

From a Design Thinking perspective for 3rd Grade, we can begin to expect greater independence as students work through stations for their projects. Challenge students to organize their own materials based on their designs and ideas is beneficial, as well as promoting more group work where each student has a specific role to play in the group. We can again increase the complexity of the materials and tools available, and perhaps even utilize digital methods to brainstorm, like basic design software to make models, posters, simulations, etc, as a tool for planning or reflection. Students can also create their own connections with possible careers, as well as engage with more indepth research and planning.

From a Computer Science perspective for 3rd Grade, we can actively engage students through on-screen block-based coding challenges, as well as a range of coding activities from making games, to animations, to programming robots. A greater understanding of how and technology robots work is appropriate, as well as challenging students to design their own robotic or technology solutions to help people or solve problems. These solutions do not need to be functional, but described through sketches or models.

Unit 1: Forces and Interactions

As students learn about forces and motion, they could be challenged to create a marble roller coaster. In this project, students will have the opportunity to experiment and experience motion as they need to construct slides and pathways for marbles to move through so they don’t get

stuck or stop, but also don't fly out! This fun project is a classic, with lots of examples across the web. One real-world scenario to place students in could be that they were hired to design an exciting new ride for a local amusement park, but need to showcase their abilities first in a small scale model. Students will also be challenged to come up with a theme and name for their ride, as well as ensure it is safe for all passengers.

Working in teams, students can plan and brainstorm their ideas before moving into a multi-day project to construct and test their prototype solutions. As an added challenge at the end, groups can be challenged to connect their prototypes together for a continuous roller coaster across the classroom! Each roller coaster may be constrained to a poster board as its base, which helps contain the project, as well as makes storage more viable.

Something similar but with a different twist could be challenging students to create rube goldberg machines. For this, I again suggest providing students with a poster board that they can fix their machines to for easier material management and classroom clean up. Like the roller coaster project, students can be challenged to work in groups, but then connect their rube goldberg machines together at the end!

For this age group, students can also learn to use Tinkercad to design 3D models. In Tinkercad, Sim Lab may allow for students to design and test the motion and physics of their models in a fun and easy to use simulator.

Possible Standards:

- NJSLS 8.2.5.ED.1: Explain the functions of a system and its subsystems.
- NJSLS 8.2.5.ITH.3: Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use.
- ISTE 1.6.a Choose Platforms or Tools
- ISTE 1.4.d Open-Ended Problems

Unit 2: Weather and Hazards

As students learn about storms and weather, they may be challenged to design a new type of umbrella or raincoat through a real-world design challenge. How might they design their device to keep them dry in a storm? What makes their design different from an existing solution? Students can work through designing a prototype via a sketch or model, and also be challenged to consider how they may market or sell their invention. Challenge students to come up with a catchy name, logo, or slogan, and even design an advertisement that showcases its unique features!

Making rain sticks is another fun hands-on challenge. This may not connect to the content as directly, but offers a chance to discuss the history of rain sticks and bring in a social studies perspective, or ELA connections with books and short stories. It may also offer a relatable project that breaks up the lessons through a fun and engaging way.

Possible Standards:

- NJSLS 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a

problem, and evaluate all possible solutions to provide the best results with supporting sketches or model
- NJSLS 8.2.5.ED.4: Explain factors that influence the development and function of products and systems
- ISTE 1.4.a Design Process
- ISTE 1.6.d Customize the Message

Unit 3: Variation of Traits

The Recipe for Traits activity allows for students to learn how DNA determines our traits and physical characteristics. In this challenge, students pick different 'strands' of DNA for a dog that are cut from paper strips. From this, they need to determine the traits of their dog based on the DNA they selected by decoding the strips using an answer key.

Students then need to draw their dog based on their DNA sequence, and they can compare and reflect on their dog's traits to that of their peers! While the lesson shared is for a dog, something similar could be done with plants, animals, fictional monsters, even dinosaurs!

You can also challenge students to design their own solutions and trait games by choosing the real traits for an animal, then making their own DNA table to determine the likelihood of getting the traits they determined.

Possible Standards:

- NJSLS 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
- NJSLS 8.2.5.NT.3: Redesign an existing product for a different purpose in a collaborative team.
- ISTE 1.5.b Data Sets
- ISTE 1.5.d Algorithmic Thinking

Unit 4: Ecosystems, Change, and Survival

Students can be placed in a real-world scenario where they work for an animal conservation group, and they have been asked to go to an ecosystem that just experienced a disaster. The disaster can vary (hurricane, tornado, earthquake, wildfire, etc), and perhaps the disaster is different across different groups.

Students will have learned, or be challenged to research, the animals native to this area. From this knowledge, and the knowledge traits and how the environment influences animal survival, students are challenged to determine which animals may have survived this disaster, and then design a solution to support the animals who didn't survive by suggesting changes to their traits, or changes to the ecosystem in the aftermath of the disaster. Students can also be challenged to find animals who may have survived from another ecosystem

Students may present their findings in a number of ways, like creating sketches or models, or creating tables to sort their findings using computers.

Possible Standards:

- NJSLS 8.2.5.ITH.1: Explain how societal needs and wants influence the development and function of a product and a system.
- NJSLS 8.2.5.ETW.5: Identify the impact of a specific technology on the environment and determine what can be done to increase positive effects and to reduce any negative effects, such as climate change.
- ISTE 1.6.c Communicate Complex Ideas
- ISTE 1.7.d Local and Global Issues