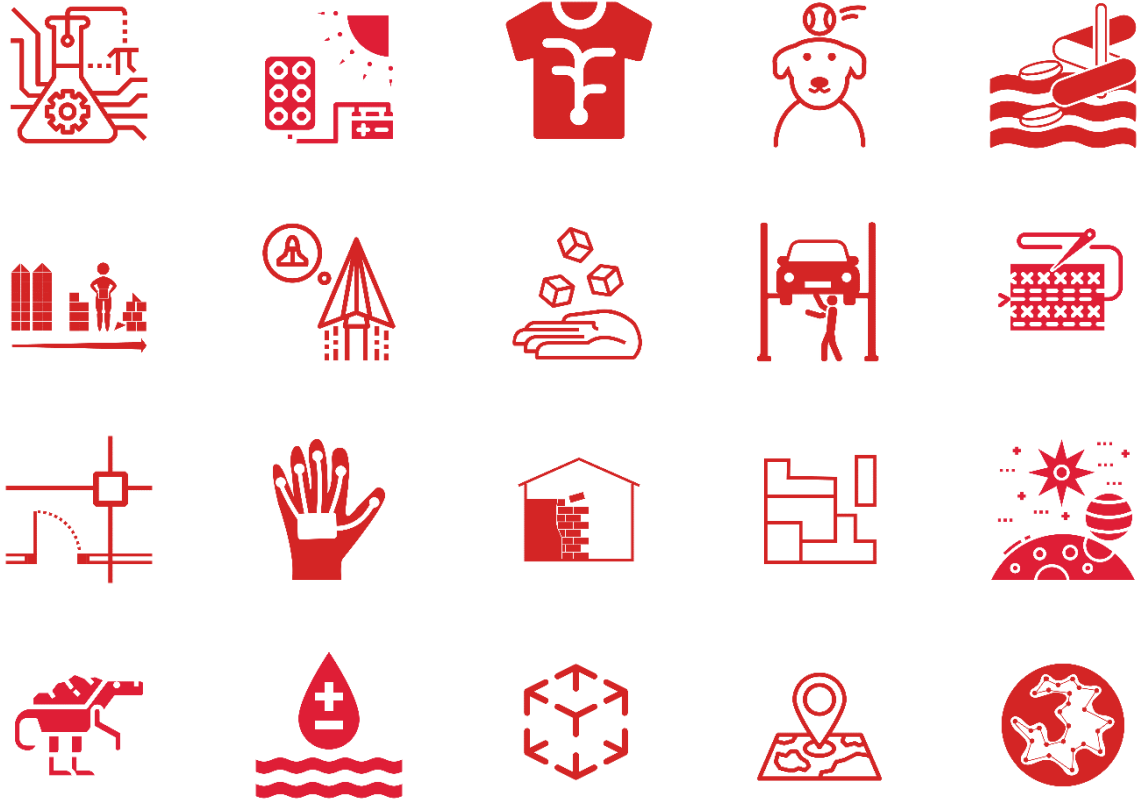


White Space Opportunities for STEM & STEAM Toys



CONTENTS

EXECUTIVE SUMMARY

STEM AND STEAM TOY PLATFORMS AND CONCEPTS:

STEM Principles

- Smart Toys Connect with Weather & Climate
- VR Chemistry World

Wearables and Smart Textiles

- STEM Sleeve

Discovery and Imagination

- Biomimetic Solutions
- For the Greater Good

EXECUTIVE SUMMARY

ProdigyWorks, an innovation firm working with diverse multidiscipline teams of high-IQ and creative innovators and problem solvers, has recently taken a long-term view of *The Future Toy Consumer and Ecosystem* and a closer-in look at *Toy Retail and Manufacturing*.

Now with the Toy Association's in-depth explorations of toys for STEM and STEAM — *Decoding STEM/STEAM* and *STEM/STEAM Formula for Success* as reference points, a completely new Prodigies team of STEM educators, creative parents, innovators, entrepreneurs, artists, engineers, scientists, and toy enthusiasts collaborated to explore potential gaps and uncover new opportunities to bring STEM and STEAM to toys and play in new ways.

The focus is on what can be devised, designed, manufactured, and played within the next one to two years, but adaptability for the future is also an element of many of the ideas.

The Toy Association selected eight platforms, some of which include *Discovery and Imagination*, *Design and Build*, *Toys in Context in New Spaces*, and *Wearables*. The platforms also encompass ideas related to STEM principles, skills for job and career, integration with the Internet of Things/Toys, getting outdoors, and alternatives to passive "screen time."

Review by STEM Teachers

Two outstanding STEM educators reviewed more than 70 ideas under the selected platforms to narrow the list to 40 concepts.

- *K-12 STEM Outreach Manager* — a microbiologist, mentor to early-career scientific researchers, the recipient of several top national STEM teaching awards, and a classically trained pianist.

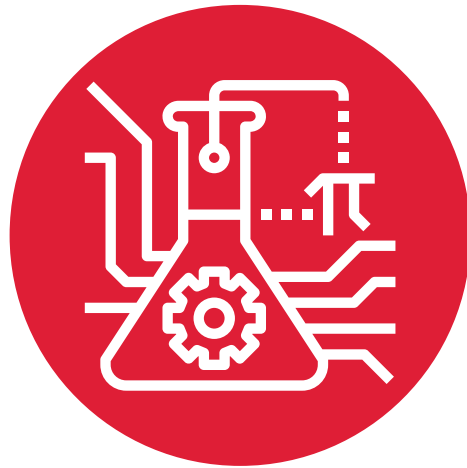
- *STEM and Science Supervisor* for grades 6-12 — creator of new Virtual Reality tools for teaching geology, as well as a maker, builder, brewer, baker, and avid family road tripper.

The experts considered the connections with NGSS (*Next Generation Science Standards*) and added options to selected concepts to improve STEM and STEAM learning, safety, and play value. They made some connections across platforms to describe exciting new opportunities. Their notes and recommendations are included with many of the ideas.

Concepts Can Take Many Paths from the Starting Point

The concepts and ideas for learning and play presented in this document are not detailed plans tied to any particular company or current product line and should be open for a broad range of Toy Association members to explore and interpret for their own distinctive lines of STEM and STEAM toys. We hope that the concepts and resources will lead to some exciting conversations among your stakeholders.

STEM PRINCIPLES



- Smart Toys Connect with Weather & Climate
- VR Chemistry World

The platform of STEM Principles is a group of toys and play experiences to introduce and expand knowledge of principles of Science, Technology, Engineering, and Mathematics.

The example ideas for toys and product lines described in this section and in the Appendix go beyond standard experiment kits and can be interpreted and developed in a variety of physical and virtual formats.

SMART TOYS CONNECT WITH THE WEATHER & CLIMATE



The seasons change in many places, which can lead to the shelving of some favorite toys until the season comes back around again.



What if a line of toys could adapt and even change the play experience, without changing its STEM/STEAM core identity? It needn't be an exclusively outdoor toy or even an outdoor toy at all. It simply recognizes that the seasonal change has arrived, and the fun changes with it. It's easy to think of a toy that thrills on Christmas morning and is forgotten by Spring. However, with this new line of toys, by the first day of spring, something has changed, and the same toy can provide new fun, challenges, discoveries, and capabilities.

This would require at least some level of technology. Toys like this could be associated with weather news or the Weather Channel. STEM/STEAM elements can be easily incorporated and, more importantly, stay fresh and surprising long past the point where other toys have lost kids' interest.

VR CHEMISTRY WORLD



Chemistry starts with the study of things too small to see, and could make an exciting and fun virtual world to walk around in and manipulate!



A line of virtual reality toys and apps takes kids into a chemical world filled with atoms and molecules that are huge and floating around them. Kids could manipulate these items and learn about chemical bonding as they see which things have charges that make them want to pull together and combine into larger molecules or compounds—and learn about their properties too. Kids could grab and combine hydrogen and oxygen atoms to form water right in front of their eyes, and see it pour right out of their hands!

Perhaps instead of a single item, the molecules are physical, but they are programmed with their atomic properties to interact virtually. Alternatively, it could be represented by periodic table pieces instead of the molecules due to limitations of atomic size.

This line would allow for fresh, fun, and amazing experiences, along with lots of learning about chemistry in a safe and engaging setting. It combines open-ended fun with learning opportunities and would be relevant now and into the future.

WEARABLES AND SMART TEXTILES



- STEM Sleeve

It's exciting to explore the potential intersection of wearable clothing and devices with play and toys because it can leverage the developments in smart textiles and wearables and incorporate the element of fun in learning.

Wearables can take STEM and STEAM toys to new retail spaces beyond the toy store or "toy aisle" of a mass merchandiser. We can imagine wearables using smart fabrics, formats, and designs beyond the expected clothing elements of shirts or jackets.

STEM SLEEVE



Seeing things as they exist in their natural habitat is a more effective learning method than just reading or watching a video about plants and insects. It's also fun and great exercise to go for a walk.



When walking in a park, on a trail, or in the woods, the user could wear a GPS-enhanced STEM Sleeve, which has a screen and a magnifying glass to enlarge the view of tiny insects and leaves, and a database would identify what they are. (The app *Leafsnap*, for example, connects with a database compiled by the Smithsonian and two universities.)

To add a sense of purposeful play or adventure, and based on the geographic location of the player, challenges can be sent out to find specific organisms native/endemic to that area. This could even be linked to citizen science challenges to find and document invasive species.

DISCOVERY AND IMAGINATION



- Biomimetic Solutions
- For the Greater Good

The Discovery and Imagination platform begins with STEM and STEAM principles in astronomy, biomimetics, genetics, and more to spark the user's creative imagination for engaging play and a different experience and outcome each time.

Real-world challenges based on contemporary goals and standards can encourage imagination of new solutions to

BIOMIMETIC SOLUTIONS



Students are always amazed at the new technology developed from a solution already existing in nature. Biomimicry is an up and coming field.



Players create solutions to "problems" with the inspiration of biomimicry — mixing characteristics of the models, systems, and elements found in nature. Challenges can be on game pieces or cards with descriptions of unique traits found in nature and problems found in our lives. Mix and match for unique creations, which can be realistic or fantastical. Solutions

could be submitted and voted on by the "gaming" community. These could lead to student-designed projects to be entered in competitions.

- Sahara desert beetle with superhydrophobic shell = superhydrophobic structures to capture water vapor.
- Kingfisher beak design = noise reduction for Japanese super train.
- Helicopter seeds = seed bombing for deforestation.

This is a crossover of biology, creativity, and play.

<https://biomimicry.org/>

<https://asknature.org/>

<https://biomimicry.net>

<https://youthchallenge.biomimicry.org/en/custom/ydcgallery/directory>

Another option is to use Virtual Reality to help create and visualize entirely new "living" organisms by applying biomimetic characteristics in a virtual world to see them come to life and demonstrate their newly combined capabilities.

FOR THE GREATER GOOD



UN Sustainability Goals and research regarding Gen Z and Millennials connect interest in improving the community. Problem-solving challenges are based on current global issues.



Using the UN Sustainability Goals, design toys and kits that challenge players to come up with unique solutions to the problems.

Because the goals are so diverse, the range of toys/kits could be widely varied. From: decks of card prompts, building sets, soil/water/plant related,

food and food chemistry, math-related population challenges. Problem prompts and kits easily fit into a subscription model.

A key component to this is a component of public sharing amongst the playing community — a platform where pictures/videos of their play/ideas can be shared and commented on.

This concept relates directly to the real world. It is an opportunity to create unique solutions to real problems. There should be a wide variety of toys/items that have endless iterations. It is entirely open-ended. These are problems that currently do NOT have a solution.

<https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

Option: Add toy kits that contain objects that can represent almost anything because they are digitally unique (i.e. a pattern similar to a QR code on the outside, embedded RFID, etc.) that allows the playing board (if that's the implementation) to recognize not only where the player's piece is, but what it represents. So, as an example, the challenge of a particular game could be to solve certain instances of drought (such as the Somalia/East Africa Famine and Drought in which reportedly killed 260,000 people). The players have a certain amount of capital, granted in equal amounts to all players in the game, and choices on how to deploy that capital.

The connected app on a mobile device, which drives the data that the playing board has access to, has several scenarios that guide gameplay and give statistics in realtime on the impact of each player's decisions. The algorithms behind the app could be structured to cover all ages (K-12 and beyond).

In addition to the above topics, you can find more STEM & STEAM toy platforms and concepts in the full report which will be released in February, 2020 on WWW.TOYASSOCIATION.ORG/STEAM.

ADDITIONAL STEM AND STEAM TOY IDEAS:

- Show the Flow of Electricity
- Easy-Bake Chemist
- Water Play
- An Expandable Line of “Watch” Wearables
- Make Large Scale Art Patterns Outdoors
- Solar Building Blocks
- Weak Link
- Force-Measuring Blocks
- Enhanced Construction
- Building Challenges
- Composting Wired Worm Farm
- Disassembly Toolkit
- Make a Galaxy
- DNA Dice
- Evolve the Dinosaur
- Creature Creator
- GIS Surveyor in the Yard
- Survival Shelter Kits
- Limnology Kits
- Sun Play at Parks
- Toys in Context at New Spaces
- STEM Toys at Airports and Train Stations
- STEM-based DIY Pet Toys and Agility Training