NATIONAL PEER REVIEWED

GRADES 3-5

Sustainable Polymers

Plastics of the Future for a Green, Clean World

A 4-H STEM Curriculum for Grades 3-5 | 4hpolymers.org

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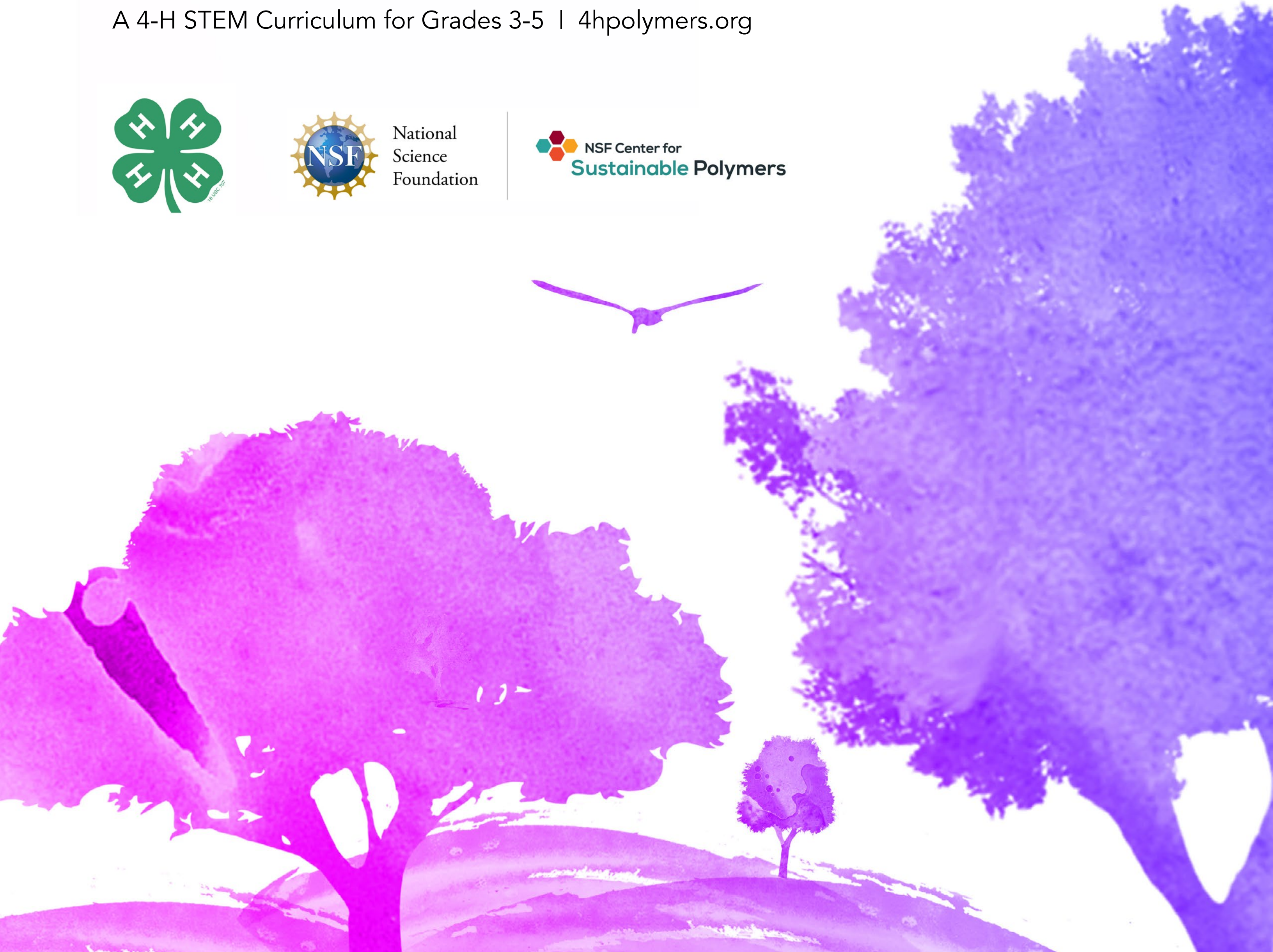

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FRONT MATTER

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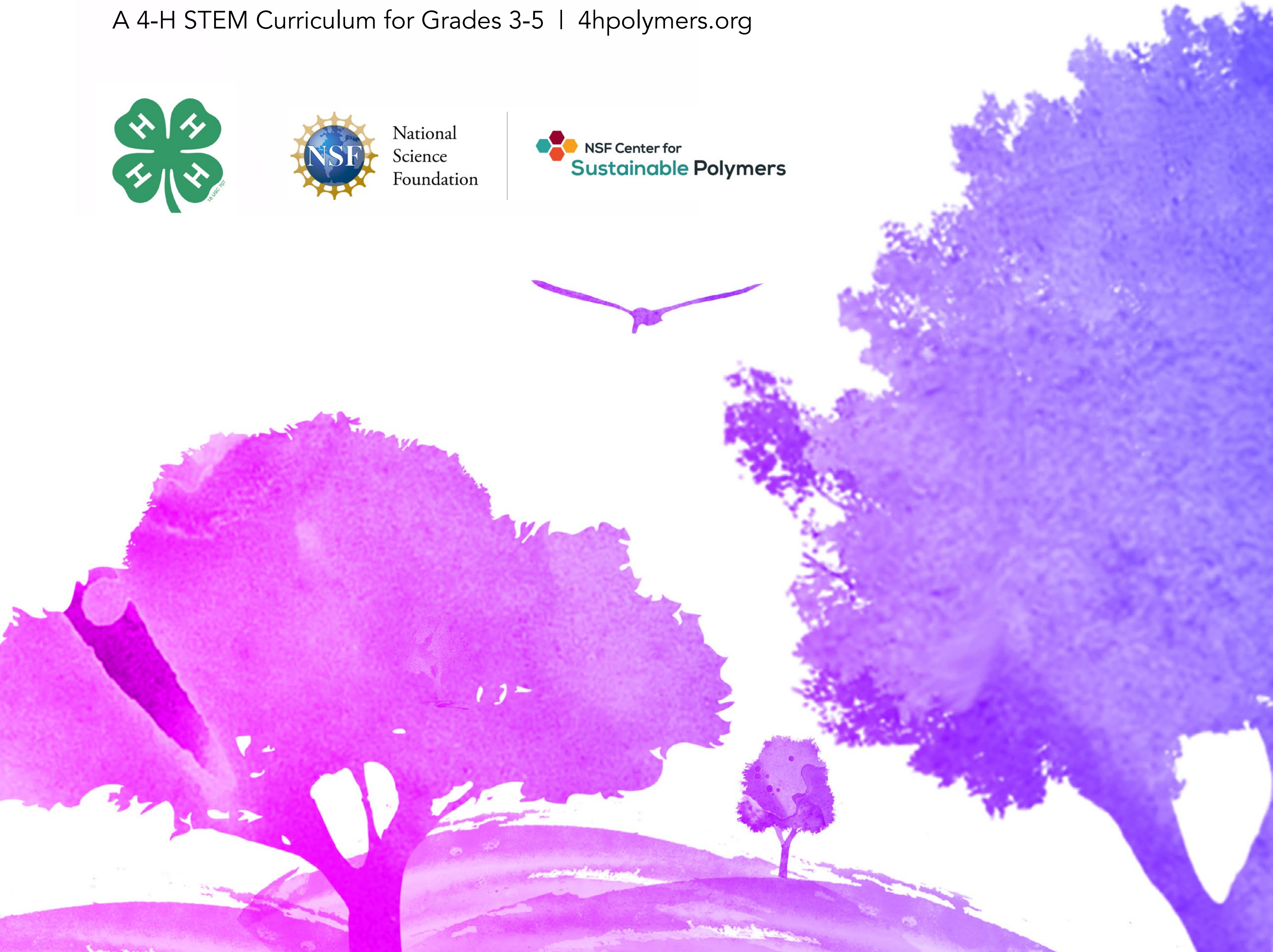

4-H Polymer Science Curriculum for

Grades 3-5

4hpolymers.org

The themes of these modules touch on the prevalence and impact of plastics in everyday life. Plastics are versatile materials that come in different shapes, sizes, and exhibit different material properties. Scientists and engineers are working on new ways to create, use, and recycle plastics, so we can use plastics for their many advantages and lessen their effects on our environment.

Each module will include "Tips for Facilitators" and the Science and Engineering Practices, as well as opportunities to use "I Wonder" Boards. In addition, these modules incorporate the SciGirls Strategies for gender equitable STEM learning. We encourage instructors to collect feedback throughout this module and submit via this evaluation form: **4hpolymers.org/evaluation**.

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Tips and Callouts

Facilitator Tips

These tips provide strategies and helpful suggestions for facilitators.

"I Wonder" Boards

These boards should be used to track children's questions and ideas during the lesson for further investigation. This tool promotes experiential learning by youth while encouraging curiosity and discovery. Basic "I Wonder" Boards have "I Wonder..." written at the top of a large sheet or white board.

Science and Engineering Practices

The Next Generation Science Standards (NGSS) identifies eight practices of science and engineering that are essential for all students to learn. Using these practices, youth make sense of phenomena and use these skills to investigate the world and design and build systems.

SciGirls Strategies

SciGirls

Based on educational research, the SciGirls Strategies are used to target and engage girls in STEM learning, but have also been proven to work with all learners, including underrepresented youth. See the SciGirls Strategies handout at the back of the module for a more detailed explanation.

Front Matter

Front Matter
Primary Authors: Jennifer McCambridge and Steven Worker

Introduction

Sustainable Polymers: Plastics of the Future for a Green, Clean World is an inquiry-based science curriculum in which youth discover and practice the skills used by scientists and engineers to learn about materials and their properties. Special attention is paid to plastic, a material that is prevalent in our world, and the concepts of sustainability; reduce, reuse, refuse and recycle; and the work of scientists and engineers around sustainable polymers. The curriculum is designed to build foundational skills of science and engineering: observation, asking questions and defining problems, planning and carrying out investigations, and communicating. The curriculum contains six learning modules intended for delivery in out-of-school time facilitated by an educator (trained volunteers or program staff). Modules also include "Science At Home" activities that may be completed by parents/other adults and children at home.

Curriculum Target Audience

Youth in grades 3-5 (8 to 12 year olds)

Developed by

A partnership between the NSF Center for Sustainable Polymers, University of Minnesota Extension, University of California Agriculture and Natural Resources, Cornell University Cooperative Extension, and *SciGirls*. This work is supported by the National Science Foundation (NSF) under the NSF Center for Sustainable Polymers CHE-1901635.

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RECOMMENDED CITATION

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INDIVIDUAL MODULE CITATIONS

McCambridge, J., & Worker, S. (2020). Front Matter. In A. Stevenson, J. McCambridge, & A. Mondl (Eds.). *Sustainable polymers: Plastics of the future for a green, clean world. A 4-H STEM curriculum for Grades 3-5.* NSF Center for Sustainable Polymers. University of Minnesota. https://www.4hpolymers.org/

Stevenson, A. (2020). Be a Scientist. In A. Stevenson, J. McCambridge, & A. Mondl (Eds.). *Sustainable polymers: Plastics of the future for a green, clean world. A 4-H STEM curriculum for Grades 3-5.* NSF Center for Sustainable Polymers. University of Minnesota. https://www.4hpolymers.org/

Stevenson, A., Mondl, A., & Strei, K. (2020). Materials Matter. In A. Stevenson, J. McCambridge, & A. Mondl (Eds.). *Sustainable polymers: Plastics of the future for a green, clean world. A 4-H STEM curriculum for Grades 3-5.* NSF Center for Sustainable Polymers. University of Minnesota. https://www.4hpolymers.org/

INDIVIDUAL MODULE CITATIONS (CONTINUED)

Bautista, J., Worker, S., Simpson, E., Panero, A., Breneisen, A., Bain, V., & Smith, M. (2020). Plastics in Your World. In A. Stevenson, J. McCambridge, & A. Mondl (Eds.). *Sustainable polymers: Plastics of the future for a green, clean world. A 4-H STEM curriculum for Grades 3-5.* NSF Center for Sustainable Polymers. University of Minnesota. https://www.4hpolymers.org/

Gullikson, T., Simpson, E., Panero, A., Bautista, J., Worker, S., & Smith, M. (2020). Plastics in Our World. In A. Stevenson, J. McCambridge, & A. Mondl (Eds.). *Sustainable polymers: Plastics of the future for a green, clean world. A 4-H STEM curriculum for Grades 3-5.* NSF Center for Sustainable Polymers. University of Minnesota. https://www.4hpolymers.org/

McCambridge, J. (2020). Buy, Sell, Create. In A. Stevenson, J. McCambridge, & A. Mondl (Eds.). *Sustainable polymers: Plastics of the future for a green, clean world. A 4-H STEM curriculum for Grades 3-5.* NSF Center for Sustainable Polymers. University of Minnesota. https://www.4hpolymers.org/

Keaney, A., & Worker, S. (2020). Service Learning. In A. Stevenson, J. McCambridge, & A. Mondl (Eds.). *Sustainable polymers: Plastics of the future for a green, clean world. A 4-H STEM curriculum for Grades 3-5.* NSF Center for Sustainable Polymers. University of Minnesota. https://www.4hpolymers.org/

LEARNING OBJECTIVES SUMMARY

In this set of six modules, youth explore the role of scientists and engineers in everyday life. As they work through the modules, youth discover and practice the skills used by scientists and engineers to learn about materials and their properties. Special attention is paid to plastic, a material that is prevalent in our world. Youth learn about the different types of plastics and their uses, as well as the positive and negative effects plastic (and its pollution) can have on humans, animals, and environment. To help protect the environment, youth explore issues of sustainability, such as renewable and non-renewable resources, strategies to reduce waste, and how to positively impact their communities through a service learning project.

MODULE SUMMARIES

1. **Be a Scientist**
   Youth explore materials and their properties and discover the skills used by scientists and engineers. Youth become slime scientists and toy engineers as they create and test slime materials. By using what they discover, youth create their own improved slime to meet their specifications.

2. **Materials Matter**
   Youth explore different types of materials, and are introduced to the terms monomer, polymer and molecule. They explore how the long chains of molecules that make up polymers and plastics affect the function of an object. Youth conduct a test to see how heat affects different types of plastics. They engage in a brief challenge and determine the advantages and disadvantages of various types of materials for a given task.

3. **Plastics in Your World**
   Plastic and plastic products are abundant in our world. In this module, youth learn about the different types of plastic and their uses. Using their senses, youth categorize plastics based on the U.S. 1-7 numbering system.

4. **Plastics in Our World**
   After learning about the uses of plastics in our everyday lives, youth work in teams to discover and evaluate disposal options for plastics such as recycling, landfill, reuse, refuse, repurpose, and industrial composting. Youth design solutions to lessen the controversial impacts plastic use has on the environment.

5. **Buy, Sell, Build**
   Youth discover more about renewable and nonrenewable resources through a game, in which they exchange resource cards at the marketplace in order to create plastic items. As resources are depleted or replenished, youth discover strategies to sustain building when supplies are limited.

6. **Service Learning**
   Participating in a service learning project is an opportunity for youth to apply science knowledge and/or skills to a real-world situation. Youth identify a need or problem in relation to polymers and plastics and create a plan to address that need or problem to complete the service activity.

CONTENT SUMMARY — THE IMPACTS OF PLASTIC

The theme of these modules touches on the prevalence and impact of plastics in everyday life. Plastics are versatile materials that come in different shapes, sizes, and exhibit different material properties. Plastics can be strong and rigid (such as safety helmets and the exterior of automobiles) or soft and flexible (such as those used in shoe cushioning or plastics bags). It's easy to find examples of plastics in everyday life and we all encounter plastic items at multiple points each day. There are many advantages to using plastic as they can be lightweight alternatives that can save on fuel and energy.

Along with the many advantages of using plastics, there are disadvantages to their use. Plastics that end up littered in the environment can take hundreds or thousands of years to degrade. It is estimated that 4.8 million metric tons of plastics end up in our oceans each year. One of the best ways to dispose of plastics is through a recycling program. Plastics that are recycled can be reprocessed into the same item or converted into a different item. However, not all plastic makes its way to the recycling bin. Only about 10% of all plastic is recycled - the rest is either incinerated, put into a landfill, or ends up as pollution in the environment.

Scientists and engineers are working on new ways to create, use, and recycle plastics so we can use plastics for their many advantages and lessen their effects on our environment. Some plastics are now designed to biodegrade without polluting the environment and others are created using renewable resources to lessen the dependence on traditional, oil-based plastics. The video, Plastic 101, by National Geographic provides a short background on how plastics and bioplastics are designed and manufactured: https://youtu.be/ggh0Ptk3VGE

LIFE SKILLS AND POSITIVE YOUTH DEVELOPMENT

Positive youth development builds on young people's strengths and assets. Youth development involves an intentional process that promotes positive outcomes for young people by providing opportunities, choices, caring relationships, and the support necessary for youth to fully participate in families and communities. High quality programming not only provides valuable benefits in knowledge, skills, and interests, but encourages leadership development, life skills development, and civic development. Through participation in science and engineering education, youth should have opportunities to strengthen their competence, confidence, connection, character, caring/empathy, and contribute to their community.

Practices to support positive youth development:

- Establishing a safe environment and building relationships. All youth need a caring, supportive relationship in their lives. Educators provide this by showing interest in, actively listening to, and fostering the assets of youth.
- Provide youth leadership opportunities. Creating opportunities for youth to develop skills and confidence for leadership and self-discipline is important for youth development.
- Provide community involvement experiences. Service forges bonds between youth and the community, and doing something valued by others raises feelings of self-worth and competence.

EXPERIENTIAL LEARNING CYCLE AND GUIDED INQUIRY

The curriculum is designed around the teaching methods of inquiry and experiential learning. Experiential learning is a cyclical process where learners have opportunities to construct meaning through engaging experiences. The cycle includes multiple phases including a concrete hands-on experience; a reflection phase where youth share, process, and generalize from the experience; and application of learning in new and authentic situations to deepen their understanding.

In a learning environment that promotes inquiry-based learning, youth build understanding through active exploration and questioning. The key to inquiry is that youth seek answers to questions rather than being given answers. This requires those who lead activities to facilitate the learning process and not simply disseminate knowledge. When activities are being led in an inquiry manner, youth actively question, observe and manipulate objects in the environment.

EXPERIENTIAL LEARNING MODEL

Source: Cooperative State Research, Education, and Extension Service (1996). Curriculum Development for Issues Programming - A Handbook for Extension Youth Development Professionals. Based on the work of Kolb, D. (1984). Experiential learning: Experience as the source of learning and development. New Jersey: Prentice-Hall.

EXPERIENTIAL LEARNING IN THE CURRICULUM

The curriculum outlines each activity around the experiential learning cycle:

- **Opening questions and prompts**: Before providing the materials for the experience, you should facilitate a group discussion to get youth thinking about what they know about the main learning objectives of the module.
- **Experiencing**: Procedures and instructions for a hands-on activity.
- **Sharing, Processing, Generalizing**: Help guide youth as they question, share, and compare their observations. Sample broad and open questions are included. Often, some of the sharing and processing takes place during "experiencing", however, it is vitally important to schedule time for group reflection after the activity. If necessary, use more targeted questions as prompts to get to particular points.
- **Concept and Term Discovery**: During this phase, it is important you ensure the primary learning objectives and concepts have been introduced or discovered by the youth.

Important factors to include in term discovery are: (a) concepts must be stated in the young people's own words; (b) you may then introduce the terminology used by scientists to refer to the concepts; and (c) you should lead a brief conversation on the importance of the concepts.

- **Application**: The true test of learners' understanding is when they can apply new knowledge and skills to authentic situations. When engaging youth in inquiry-based learning, hands-on activities serve as vehicles for learning new concept knowledge and skills; however, it is the application of new knowledge or skills to independent, real-world situations that is the critical factor in the learning process. Thus, to complete the cycle of experiential learning it is important to intentionally provide youth specific opportunities for authentic applications. Each module includes examples for real-world application.

RECOMMENDED EDUCATOR PRACTICES

The educator is a facilitator of learning, responsible for helping youth make meaning of their experiences. Educators are not expected to be the "sage on the stage" but rather the "guide on the side." Facilitating an open discussion is crucial in helping learners make meaning of their experience. Questions allow us to access information, analyze data, and draw sound conclusions. Good questions help stimulate thinking and creativity. To this end, broad and open questions are ideal in promoting discussion and interaction. They do not have a single right answer. In contrast, focused, narrow, and closed-ended questions tend to be fact-based or solicit yes or no answers and do not promote discussion. Encouraging science talk has four purposes (elicitation, consolidation, data, and explanation) and may involve full group, small group, or partner discussions. For more about encouraging productive science talk, see Sarah Michael and Cathy O'Connor's Talk Science Primer at: https://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf

The curriculum emphasizes the use of embedded evaluation and formative strategies to assess learning which may occur in multiple places during the implementation of an activity. First, educators may assess youth understanding of the main concepts and their engagement with Next Generation Science Standards (NGSS) practices and concepts through the types of questions youth ask, moments of wonder or puzzlement, and being able to successfully complete the task. Second, when youth share their ideas and experiences, the educators can assess how well youth understood the primary learning objective through the activity. Additionally, during the sharing, processing, and generalizing phase, educators can ask more focused questions to assess youth understanding, particularly with regard to the concept and term discovery. Finally, the application phase provides another opportunity to assess youth learning. Educators may have youth share their application activity at subsequent sessions.

To conduct outcome assessment of the curriculum, educators may want to administer the Draw-a-Scientist Test (DAST) to assess youth perceptions of scientists before and then again after the curriculum. Research has shown that children develop a stereotypic image of a scientist at an early age. Exciting, hands-on, and educational programs — such as this curriculum — should help youth deconstruct these images and help them start to see themselves as someone who can do, uses, and may contribute to science.

CONNECTION TO THE "*SCIGIRLS* STRATEGIES"

These modules were designed to incorporate the SciGirls strategies for gender-equitable STEM learning. *SciGirls* is an Emmy award-winning PBS Kids television show, website, and educational outreach program that engages girls in science, technology, engineering, and math (STEM) learning. Using research, *SciGirls* outlines best practices in their "*SciGirls* Strategies." These strategies are used to target and engage girls in STEM learning but have also been proven to work with all learners, including underrepresented youth. In the individual modules, practices that correspond to one of the "*SciGirls* Strategies" will be identified.

The *SciGirls* strategies for gender-equitable STEM learning are:

1 Connect STEM experiences to lives of young people

2 Support youth as they investigate using STEM practices

3 Embrace struggle, overcome challenges, and increase self-confidence in STEM

4 Identify and challenge STEM stereotypes

5 Emphasize that STEM is collaborative, social, and community-oriented

6 Interact with and learn from diverse STEM role models

CONNECTIONS TO NEXT GENERATION SCIENCE STANDARDS (NGSS)

This collection of activity modules builds many of the science and engineering practices identified in the Next Generation Science Standards. Youth in grades 3-5 will work on their skills in the eight practices (in this collection, however, less focus is on using mathematical and computational thinking).

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices:

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

Youth explore many different disciplinary core ideas defined by NGSS through these six modules. These core ideas span the physical sciences (PS), earth and space sciences (ESS), and engineering, technology, and the applications of science (ETS).

Disciplinary Core Ideas:

1. Natural Resources (ESS3.A)
    - 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.
2. Human Impacts on Earth Systems (ESS3.C)
    - Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.
3. Defining and Delimiting Engineering Problems (ETS1.A)
    - 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.
4. Developing Possible Solutions (ETS1.B)
    - Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.
    - At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
    - Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
5. Optimizing the Design Solution (ETS1.C)
    - Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

These modules also feature a number of crosscutting concepts. These concepts connect different areas of content by providing related connections and tools.

Crosscutting Concepts:

1. Cause and Effect
    - Cause and effect relationships are routinely identified and used to explain change.
2. Interdependence of Science, Engineering, and Technology
    - Knowledge of relevant scientific concepts and research findings is important in engineering.
    - People encounter questions about the natural world every day
3. Influence of Engineering, Technology, and Science on Society and the Natural World
    - People's needs and wants change over time, as do their demands for new and improved technologies.
    - Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

Together, the practices, core ideas, and crosscutting concepts covered through these modules mirror a number of performance expectations for children in grades 3-5, such as:

- Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment (4-ESS3-1).
- Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans (4-ESS3-2).
- Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment (5-ESS3-1).
- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost (3-5-ETS1-1).
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem (3-5-ETS1-2).
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved (3-5-ETS1-3).

Grade 3-5 Glossary

This glossary is intended as content/background information for the facilitator.

- **Atom**: The basic unit of a chemical element; the smallest component of an element
- **Bacteria**: Microscopic living organisms that help with decomposition
- **Biodegradable**: A substance or object that can be decomposed by bacteria or other living organisms
- **Bioplastic**: Polymers often made from starch-containing plants, such as corn and potatoes. Many of these bioplastics are compostable
- **Criteria**: A standard by which something can be judged or decided
- **Degrade**: Matter breaks down into smaller parts by a chemical process
- **Engineer**: A person who uses creativity and a systematic approach to solving problems in ways that make peoples' lives easier and better
- **Function**: The purpose of an object or what it is used for
- **Indirect service**: Service that benefits the community or environment as a whole
- **Industrial Compost**: A site where organic waste products go through a multi-step process converting items into usable soil
- **Landfill**: A site where waste from the community is taken. Clay or soil is used to cover the waste to isolate it from reaching water systems.
- **Litter**: Waste items not properly disposed of in recycling, compost or trash receptacles; are instead left on the ground or in lakes/rivers/ponds
- **Matter**: Anything that takes up space is called matter (air, water, rocks, and even people are examples of matter). Matter can exist in one of three main states:solid, liquid, or gas.
- **Molecule**: The smallest unit of a substance that has all the properties of that substance; made up of two or more atoms
- **Monomer**: A part or single unit ('mono' means one and 'mer' means unit)
- **Natural polymers**: A type of polymer that comes from nature
- **Non-renewable resource**: A material made from resources that are only available in limited quantities and take a long time to be replenished (i.e. millions of years)
- **Petroleum**: Oil extracted from the earth that can be used for fuel or made into plastic

- **Plastic**: A human-made material made from polymers that can be molded into different shapes while soft, and eventually made firm or slightly flexible, usually made from petroleum or oil (traditional) but new plastics can be made from renewable resources like plants, such as corn, or algae (bio-based plastic)
- **Pollution**: Contamination by waste, chemicals, or other harmful substances to an environment
- **Polymer**: Large molecules made of long, repeating chains of smaller molecules called monomers. Each repeating unit is the "monomer," so polymer=many repeating units
- **Properties**: Characteristics that can be observed or measured; properties include size, shape, density, texture, hardness, color, odor, and other ways something looks or feels
- **Recycle**: To collect and process materials that would otherwise be thrown away as trash and turn them into new products
- **Refuse**: To say no to purchasing or using specific products with plastics, often single use plastics
- **Renewable resource**: A material made from naturally occurring resources that can be replenished, often within one person's lifetime
- **Reduce**: To limit the amount of plastic used in daily life
- **Repurpose**: To use an object for a new purpose other than it was originally intended
- **Reuse**: To use an object again for the same purpose it was originally intended
- **RIC-resin identification code**: A number used to identify plastic based on its composition. In the US, there are 7 resin identification codes which are usually placed within the "recycling symbol" of arrows forming a triangle.
- **Scientist**: A person who studies, specializes in, or investigates a field of science and does scientific work
- **Service Learning**: Connecting concept learning with needs of the community and responding with action
- **Single use**: To use a plastic item once and dispose after intended use
- **Starch**: An odorless and tasteless white substance made from plants
- **Sustainable**: Able to be maintained or run continuously
- **Synthetic Polymer**: A type of polymer made up of chemical compounds discovered by scientists; "human-made" rather than occurring in nature
- **Synthetic**: A material made by chemical means, especially to imitate a natural product.

The SciGirls Strategies

Proven Strategies for Engaging Girls in STEM

The **SciGirls** approach is rooted in research about how to engage girls in STEM. A quarter of a century of studies have converged on a set of common strategies that work, and they have become the framework for **SciGirls**. The original set of strategies, created in 2010, were updated in 2019 to reflect current research.

1. **Connect STEM experiences to girls' lives.**

(Boucheretal.,2017;Sammetetal.,2016;Bonner&Dornerich,2016;Ereteetal.,2016;Stewart-Gardineretal.,2013;Civil,2016;Verdinetal.,2016;Cervantes-Soon,2016).

Make STEM real and meaningful by engaging girls in activities that draw on their interests, knowledge, skills, culture, and lived experiences. This helps girls develop a STEM identity and increases their sense of belonging in STEM.

2. **Support girls as they investigate questions and solve problems using STEM practices.**

(Buckholz et al., 2014; Kim, 2016; Scott & White, 2013; Farland-Smith, 2016; Munley & Rossiter, 2013; Civil, 2016; Riedinger et al., 2016)

Engage girls in hands-on, inquiry-based STEM experiences that incorporate practices used by STEM professionals. Let girls take ownership of their own STEM learning and engage in meaningful STEM work to positively impact their identities and re-define how they see STEM.

3. **Empower girls to embrace struggle, overcome challenges, and increase self-confidence in STEM.**

(Blackwell et al., 2007; Dweck, 2000; Halpern et al., 2007; Kim et al., 2007; Mueller & Dweck, 1998)

Help girls focus on and value the process of learning by supporting their strategies for problem solving and letting them know their skills can improve through practice. Support girls to develop a growth mindset—the belief that intelligence can develop with effort and learning.

4. **Encourage girls to identify and challenge STEM stereotypes.**

(Allenetal.,2017;Carlietal.,2016;Cheryanetal,2015;Robnett,2016;Allenetal.,2017;Carloneetal.,2015;Sammetetal.,2016,Scottetal.,2014;Tanetal.,2013;Dasguptaetal.,2014;Verdin et al., 2016; Civil, 2016; Boucher et al., 2017)

Support girls in pushing against existing stereotypes and the need to conform to gender roles. Helping girls make connections between their unique cultural and social backgrounds and STEM disciplines will negate potential stereotype barriers.

5. **Emphasize that STEM is collaborative, social, and community-oriented.**

(Capobiancoetal.,2015;Diekmanetal.,2015;Leaper,2015;Riedingeretal.,2016;Robnett,2013;Parker&Rennie,2002;Scantlebury&Baker,2007;Werner&Denner,2009;Cakiretal.,2017; Sammet et al., 2016; Boucher et al., 2017; Clark et al., 2016; Leaper, 2015)

Highlight the social nature of STEM to increase interest and motivation and change the stereotypical perception that STEM jobs require people to work alone. Girls benefit from a supportive environment that offers opportunities to build relationships and form a collective identity.

6. **Provide opportunities for girls to interact with and learn from diverse STEM role models.**

(Kochetal.,2015;Leaper,2015;Adamsetal.,2014;Jethwanietal.,2017;Kessels,2014;O'Brienetal.,2016;Levineetal.,2015;Hughesetal.,2013;Cheryanetal.,2015;Weisgram&Diekman,2017)

Introduce girls to diverse women role models from varied STEM career pathways to help girls see potential futures and develop resilient STEM identities. Positive role models can increase girls' interests in, positive attitudes toward, and identification with STEM.

Supply/Material List Grades 3-5

**Please determine quantities based on the number of students

Supplies	Module 1 Be a Slime Scientist	Module 2 Materials Matter	Module 3 Plastics in Your World	Module 4 Plastics in Our World	Module 5 Buy, Sell, Build	Module 6 Service Learning
Drawing Paper	1 sheet per youth					
Scratch Paper			1 per student			
Writing/ Drawing Supplies (Pencils, pens, markers, crayons)	3-4 items per person	1 per student (pencils & pens)	1 per student	1 per student	1-2 per student	1-2 per student
Flip Chart	2 sheets	1 sheet	2 sheets			1 sheet per group
Masking Tape	1 roll					2 rolls
Scissors			1 pair	5-10 pair		
Random Objects Glass, plastic, wood, fabric (4 -5 bags)	1 assorted bag per group					
Technology equipment	X					X
20 Mule Team Borax	1 box					

Supplies	Module 1 Be a Slime Scientist	Module 2 Materials Matter	Module 3 Plastics in Your World	Module 4 Plastics in Our World	Module 5 Buy, Sell, Build	Module 6 Service Learning
Baking Soda	¼ tsp per person					
Non-Toxic White Glue	¼ cup glue per person					
Glue Variation (clear glue, colored glue, glue with glitter)	¼ cup per person					
Measuring Spoons (1 Tbls. & 1 tsp.)	1 set per group					
Plastic Cups	1 per pair	1 per pair				
Food Coloring	1 box per group				1 box per group	
Stirrers (spoons or craft sticks)	2 per youth					
Small Container with lids	1 per pair					
Small bowls/ plates	2 per youth					
Saline Solution (Contact lens solution)	1 bottle					
Water	¼ cup per recipe					

Supplies	Module 1 Be a Slime Scientist	Module 2 Materials Matter	Module 3 Plastics in Your World	Module 4 Plastics in Our World	Module 5 Buy, Sell, Build	Module 6 Service Learning
Beauty/ Texture options: (Acrylic paint, glitter, tiny beads, white foam shaving cream, scented lotion)	Assortment for your group					
Paper towels	2 rolls					
Sandwich bags	2 per youth				1 per student	
Hairdryer		1 per station (2-3)				
PLA Cups (compostable or GreenWare, #7)		1 per pair				
Polystyrene Cups (PS) (white styrofoam or clear plastic #6)		1 per student pair				
Bandanas		12-15				
Roll of Toliet Paper		1 roll				
Collected Assorted Plastic Objects (#1-7)		5 bags (see Module 2 for examples)	At least one of each plastic type per group		X	
Paper or Science Journal	1 per student	1 per student				

Supplies	Module 1 Be a Slime Scientist	Module 2 Materials Matter	Module 3 Plastics in Your World	Module 4 Plastics in Our World	Module 5 Buy, Sell, Build	Module 6 Service Learning
Small Stickers for Voting		3-4 per student				3-4 per student
Different Beverage Containers (glass, plastic, aluminum, and reusable water bottle)		1 set				
Paper Bags			1 per group	9 bags		
Plastic Bottles with Caps				1 per student		
Potting Soil				1 bag		
Herb or Flower Seedling				1 per student		
Cornstarch					1 Tablespoon per student	
Vegetable Oil					1 small bottle	
Microwave Oven					1	
Service Journal						1 per student
Supplies Specific to Service Plan (tools, equipment, or supplies)						X

Supplies	Module 1 Be a Slime Scientist	Module 2 Materials Matter	Module 3 Plastics in Your World	Module 4 Plastics in Our World	Module 5 Buy, Sell, Build	Module 6 Service Learning
Poster Board						X
Emergency Contact List	X	X	X	X	X	X
Community Partner Contact List						X
First Aid Kit	X	X	X	X	X	X
Camera						X
Snacks Supplies for Celebration						1-2 per student

Appendices To Be Printed

Module 1:

- ☐ Slime Recipe (Appendix B) - 1 per pair
- ☐ Slime Test Observation Sheet (Appendix C) - 1 per pair
- ☐ A Different Slime Recipe (Appendix D) - 1 per pair

Module 2:

- ☐ Cup wars data sheet (Appendix A) - 1 per group
- ☐ Polymer Cards (Appendix B) - 1 copy for the leader
- ☐ Four container description sheets (Appendix C) - 1 copy per group

Module 3:

- ☐ Observation Sheet (Appendix A) - 1 per group
- ☐ Sample Town Guide to Plastic Recycling (Appendix B) - 1 copy per pair
- ☐ Local recycling information

Module 4:

- ☐ Station Names - 1 copy for the leader (Appendix B)
- ☐ Item Cards (Appendix C) - 1 set single-sided, cut
- ☐ Recycling Center Reference Sheet (Appendix D) - 2 copies, cut in half
- ☐ Disposal Options Sheet (Appendix E) - 1 copy at each station A-D.
- ☐ Repurpose Idea Sheet (Appendix F) - print as many as needed

Module 5:

- ☐ Money cards for each group (Appendix A) - at least 2 pages/24 coins per group
- ☐ Supply cards (Appendix A) - at least 2-3 pages of corn/oil and 2 pages of chemical/factory per group
- ☐ Plastic item cards (Appendix A) (if not using real items) - at least 2-3 per group
- ☐ Recipe Cards (Appendix B) - 1 per group

Module 6:

- ☐ Facilitator Tip Sheet (Appendix A) - 1 for the leader
- ☐ Selecting A Project sheet (Appendix B) - 1 per group
- ☐ Project Planning Tool (Appendix C) - 1 per group
- ☐ Project Evaluation Form (Appendix D) - 1 per youth
- ☐ Service-Learning Model (Appendix E) - 1 for the leader

RESIN IDENTIFICATION CODE GUIDE

In the U.S., there are 7 resin identification codes which are usually placed within the "recycling symbol" of arrows forming a triangle. Use the chart below as a guide to know which types of plastics are recyclable and which types are not. Be sure to find out from your local municipality what materials are recyclable in your area.

SYMBOL	POLYMER NAME	PRODUCT EXAMPLES
1 PETE	Polyethylene Terephthalate (PETE or PET)	• Soft drink bottles • Water bottles • Sports drink bottles • Salad dressing bottles • Vegetable oil bottles • Peanut butter jars • Pickle jars • Jelly jars • Prepared food trays • Mouthwash bottles 
2 HDPE	High-density Polyethylene (HDPE)	• Milk jugs • Juice bottles • Yogurt tubs • Butter tubs • Cereal box liners • Shampoo bottles • Motor oil bottles • Bleach/detergent bottles • Household cleaner bottles • Grocery bags 
3 V	Polyvinyl Chloride (PVC or V)	• Clear Food packaging • Wire/cable insulation • Pipes/fittings • Siding • Flooring • Fencing • Window frames • Shower curtains • Lawn chairs • Children's toys 
4 LDPE	Low-density Polyethylene (LDPE)	• Dry cleaning bags • Bread bags • Frozen food bags • Squeezable bottles • Wash bottles • Dispensing bottles • 6 pack rings • Various molded laboratory equipment 
5 PP	Polypropylene (PP)	• Ketchup bottles • Most yogurt tubs • Syrup bottles • Bottle caps • Straws • Dishware • Medicine bottles • Some auto parts • Pails • Packing tape 
6 PS	Polystyrene (PS)	• Disposable plates • Disposable cutlery • Cafeteria trays • Meat trays • Egg cartons • Carry out containers • Aspirin bottles • CD/video cases • Packaging peanuts • Other Styrofoam products 
7 OTHER	Other Plastics (OTHER or O)	• 3/5 gallon water jugs • Citrus juice bottles • Plastic lumber • Headlight lenses • Safety glasses • Gas containers • Bullet proof materials • Acrylic, nylon, polycarbonate • Polylactic acid (a bioplastic) • Combinations of different plastics