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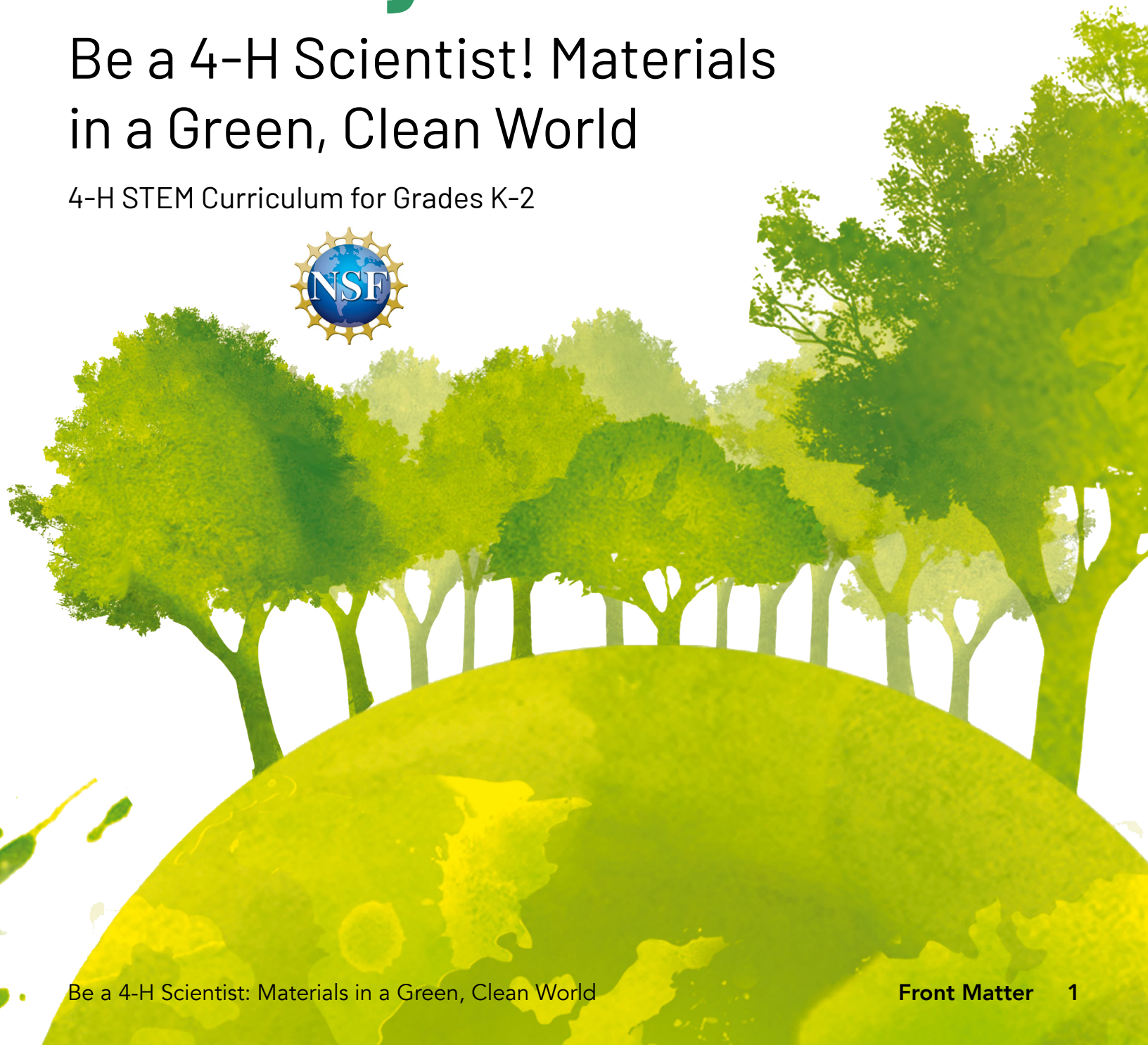
Sustainable Polymers

4-H Polymers

Be a 4-H Scientist! Materials in a Green, Clean World

4-H STEM Curriculum for Grades K-2



Front Matter

BY STEVEN WORKER AND JENNIFER HENDERSON

Be a 4-H Scientist! Materials in a Green, Clean World is an inquiry-based science curriculum focusing on the following concepts: materials; plastics; the three R's: Reduce, Re-use, Recycle; the work of scientists and engineers. The curriculum is designed to build foundational skills of science and engineering: observation, asking questions, sorting and classifying, 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 a "Science At Home" activity to be completed by parents/other adults and children at home.

CURRICULUM TARGETED AUDIENCE

Youth in grades K–2 (5 to 8 years of age)

DEVELOPMENT TEAM

A partnership between the University of Minnesota Center for Sustainable Polymers, University of Minnesota Extension, University of California Agriculture and Natural Resources, Cornell University Cooperative Extension, and edited by SciGirls. This work is supported by the National Science Foundation (NSF) under the Center for Sustainable Polymers CHE-1413862.

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LEARNING OBJECTIVES SUMMARY

In this set of six modules, children are introduced to the world of scientists and engineers. Using their senses, children become scientists themselves by making observations and asking questions about the world around them. As they work through the modules, children explore different materials and their properties. Experimentation illustrates how different materials may perform better in some

situations, depending on that material's properties. Special attention is paid to plastic, a material that is prevalent in our world. Children will learn 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 the environment. To help protect the environment and its resources, children learn about strategies to lessen waste and pollution (reduce, re-use, recycle) and the difference between renewable and non-renewable resources.

MODULE SUMMARIES

Module 1 What is a Scientist? Engaging Youth as Scientists and Engineers

Children are encouraged to use their senses and wonder about the world around them using mystery boxes and hydrogels. They learn that they are using the same skills scientists and engineers use everyday!

Module 2 The Many Properties of Materials

Every item and object we encounter is made of a material, and each material has a different set of properties. Using commonly found items, children categorize materials based on properties and then complete a series of challenges to select the appropriate materials to solve a problem.

Module 3 Plastics in Your World

Plastic and plastic products are abundant in our world. In this module, children learn about the different types of plastic and their uses. After familiarizing themselves with the many types of plastic items, children explore different methods of plastic disposal.

Module 4 Reduce, Re-use, Recycle

Using the techniques of real-life recycling facilities, children sort and separate different materials. They will review the different properties learned in Module 2 to sort these materials.

Module 5 Renewable vs. Non-renewable

The first part of this module reviews the different material properties discovered in Module 2. After learning about the difference between "renewable" and "non-renewable", children play a game in which they mine for resources. They will discover the difference when some materials replenish while others do not.

Module 6 Scientists and Engineers

Children learn about scientists and engineers through reading selected books aloud. Then they make their own stories featuring a scientist or engineer — and in one option, the children are the scientists in their story!

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 the 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. Plastics have many advantages as they can be lightweight alternatives that can save on fuel and energy.

Along with the many advantages of using plastics, plastics have disadvantages. Plastics that end up littered in the environment can take hundreds or thousands of years to degrade. It is estimated that 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.■

■ *"World's Oceans Clogged by Millions of Tons of Plastic Trash." Scientific American. February 2015*

■ *"A Whopping 91% of Plastic Isn't Recycled." National Geographic. July 19, 2017*

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.

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 doesn't only provide valuable benefits in knowledge, skills, and interests, but also in the form of 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 contribution to 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 PROMOTING 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 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 sharing phase, it is important to ensure that the primary learning objectives and concepts have been introduced or discovered by the youth. The goal is to have the youth discover terms and concepts on their own.
- **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 expected to be a facilitator of learning with the primary role being to help 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 close-ended questions tend to be fact-based or yes/no answers and do not promote discussion. Furthermore, 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

RECOMMENDATIONS FOR EVALUATION OF LEARNING

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 targeted or 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 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 "SciGirls *SEVEN*"

These modules were designed to incorporate many of the practices and strategies used to engage girls in science education. *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 seven best practices in their "*SciGirls Seven*". 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 Seven*" will be identified.

The "*SciGirls Seven*" proven strategies for engaging girls in STEM are:

1. Girls benefit from collaboration, especially when they can participate and communicate fairly.
2. Girls are motivated by projects they find personally relevant and meaningful.
3. Girls enjoy hands-on, open-ended projects and investigations.
4. Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.
5. Girls' confidence and performance improves in response to specific positive feedback on things they can control — such as effort, strategies, and behaviors.
6. Girls gain confidence and trust their own reasoning when encouraged to think critically.
7. Girls benefit from relationships with role models and mentors.

CONNECTIONS TO NEXT GENERATION SCIENCE STANDARDS (NGSS)

This collection of activity modules incorporates many of the science and engineering practices identified in the Next Generation Science Standards (NGSS). Children in kindergarten–2nd grades will work on their skills in seven practices (in this collection, less focus is placed on using mathematical and computational thinking).

Science and Engineering Practices:

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematical and computational thinking
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Children explore many of 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:

- Structure and Properties of Matter (PS1.A)
  - Matter can be described and classified by its observable properties
  - Different properties are suited to different purposes
- Human Impacts on Earth Systems (ESS3.C)
  - Humans affect the world around them, but can make choices to reduce their impacts on the land, water, air, and other living things
- Defining and Delimiting Engineering Problems (ETS1.A)
  - A situation that people want to change or create can be approached as a problem to be solved through engineering
  - Asking questions, making observations, and gathering information are helpful in thinking about problems
- Optimizing the Design Solution (ETS1.C)
  - There is always more than one possible solution to a problem, it is useful to compare and test designs

CONNECTIONS TO NEXT GENERATION SCIENCE STANDARDS (NGSS) *(CONTINUED)*

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

Crosscutting Concepts:

- Patterns
  - Patterns in the natural and human designed world can be observed
  - Events have causes that generate observable patterns
- Cause and Effect
  - Events have causes that generate observable patterns
- Structure and Function
  - The shape and stability of structures of natural or designed objects are related to their function(s)
- Interdependence of Science, Engineering, and Technology
  - People encounter questions about the natural world every day
- Influence of Engineering, Technology, and Science, on Society and the Natural World
  - Human-made products are designed by applying some knowledge of the natural world and built using materials derived from the natural world
  - Developing and using technology has impacts on the natural world

Together, the practices, core ideas, and crosscutting concepts covered through these modules mirror a number of performance expectations for children in grades K–2, such as:

- Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. (K-ESS3-3)
- Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. (2-PS1-1)
- Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. (2-PS1-2)
- Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through development of a new or improved object or tool. (K-2-ETS1-1)
- Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. (K-2-ETS1-3)

The types of things scientists and engineers do:

Abilities

Build/Construct

Categorize/Order/Classify

Collaborate

Collect Data

Communicate/Demonstrate

Compare/Contrast

Design Solutions

Develop Solutions

Draw/Design

Evaluate

Hypothesize

Invent/Implement Solutions

Infer

Interpret/Analyze/Reason

Measure

Model/Graph/Use Numbers

Observe

Optimize

Organize/Order/Classify

Plan Investigations

Predict

Problem Solve

Question

Redesign

Research a Problem

State a Problem

Summarize

Test

Troubleshoot

Use Tools

Practices (NGSS)

Asking questions (science) and defining problems (engineering)

Developing and using models

Planning and carrying out investigations

Analyzing and interpreting data

Using math and computers

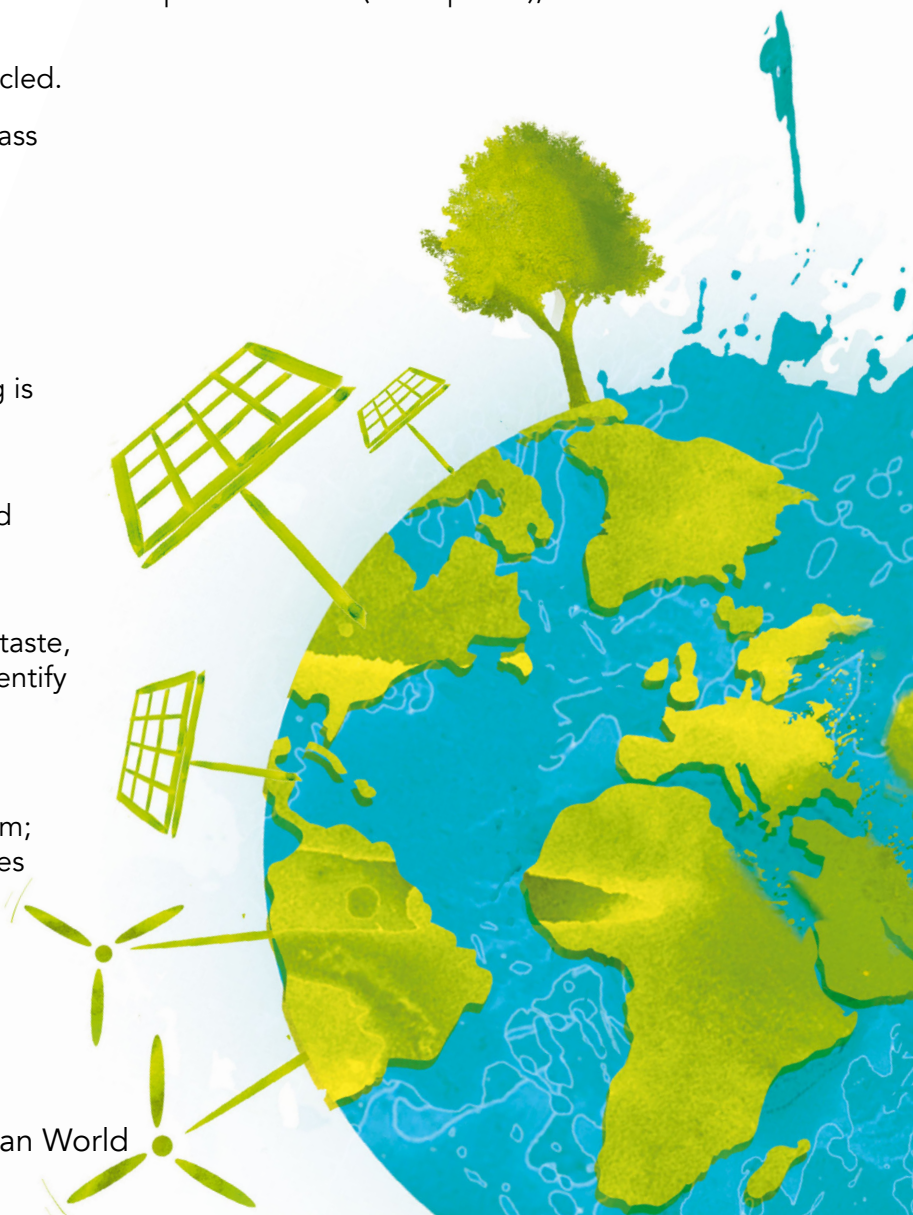
Constructing explanations (science) and designing solutions (engineering)

Engaging in argumentation

Obtaining, evaluating and communicating information

Glossary

- **5 Basic Senses:** Our senses include sense of touch, taste, hearing, smell, and sight.
- **Engineering:** using knowledge to invent, design, or improve a solution to a specific problem.
- **Engineers:** people who use knowledge to invent, design, or improve a solution to a specific problem. Engineers use science knowledge, math, creativity and their experience to design or re-design useful objects or useful ways of doing things (processes). Engineers must weigh design choices based on merits, constraints, and aesthetics to meet design specifications (considering both form and function) and be able to justify those choices.
- **Floatation:** rises to the surface of a liquid (or water).
- **Landfill:** a place used where garbage is disposed of; material put here is not recycled.
- **Litter:** any trash (e.g., paper, plastic or glass bottles, cans) that is left or disposed of in open (e.g., on land or in water) or public places.
- **Magnetic:** attracted to or repelled by a magnet
- **Material:** the substance which something is made from.
- **Non-renewable:** 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)
- **Observation:** what you see, hear, touch, taste, or smell. Students use observations to identify properties of different objects.
- **Plastic:** a type of man-made material.
- **Property:** an attribute or quality of an item; how it looks, tastes, feels, sounds; qualities that can be observed or measured.
- **Recycle:** collecting old material and processing them to make a new material or object
- **Renewable:** a material made from naturally occurring resources that can be replenished, often within one person's lifetime
- **Re-use:** finding a way to use materials again (For simplicity in this curriculum, we also include the idea of "re-purpose" (use an item for a new purpose) under the term Re-use.)
- **Scientists:** people who asks questions about the world around them. Scientists explore the world through the process of inquiry where they describe, explain, and predict through observation, experimentation, modeling, and other scientific techniques. Science methods may rely on quantitative data (numbers), qualitative data (descriptions), or both.



The SciGirls Seven

Proven Strategies for Engaging Girls in STEM

The **SciGirls** approach—for the TV show, website, and educational materials—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 these have become **SciGirls**' foundation. We call these strategies the **SciGirls Seven.**

1. Girls benefit from collaboration, especially when they can participate and communicate fairly. *(Parker & Rennie, 2002; Scantlebury & Baker, 2007; Werner & Denner, 2009)*

Girls are energized by the social part of science—working and learning together. Provide opportunities for small group work, and encourage girls to talk about their ideas and consider all possibilities before digging in. Make sure discussions remain respectful and inclusive, and that each girl's contributions are valued. Girls are likely to remember not only what they learned, but also how they felt when they learned it.

> "Whenever you come together with a team, you can find the answer to any question."
>
> Josie, age 12

2. Girls are motivated by projects they find personally relevant and meaningful. *(Liston, Peterson & Ragan, 2008, Lyon & Jafri, 2010; Mosatche, Matloff-Nieves, Kekelis, & Lawner, 2013; Patrick, Mantzicopoulos, & Samarapungavan, 2009; Thompson & Windschitl, 2005)*

Girls become motivated when they feel their project or task is important and can make a difference. Support them using STEM as a tool to explore issues or topics they care about. If they see how STEM is relevant to their own lives and interests, their attraction to these subjects is likely to increase.

3. Girls enjoy hands-on, open-ended projects and investigations. *(Chatman, Nielsen, Strauss & Tanner, 2008; Denner & Werner, 2007)*

SciGirls promotes exploration, imagination, and invention. Encourage your girls to ask questions and find their own paths for investigation.

For more information, go to scigirlsconnect.org

SciGirls PBS KIDS

4. Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles. *(Calabrese Barton et al., 2013; Calabrese Barton, Tan, & Rivet, 2008; Eisenhart & Finkel, 1998; Lyon & Jafri, 2010)*

Encourage girls to develop their own ways of exploring and sharing knowledge, paying attention to the unique learning styles that motivate your group. You may be surprised by what creative, exciting approaches girls come up with when designing investigations, collecting data, and communicating results.

5. Girls' confidence and performance improves in response to specific, positive feedback on things they can control—such as effort, strategies, and behaviors. *(Blackwell, Trzesniewski, & Dweck, 2007; Dweck, 2000; Halpern et al., 2007; Kim et al., 2007; Mueller & Dweck, 1998)*

Self-confidence can make or break girls' interest in STEM. Foster their efforts, compliment their strategies for problem solving, and let them know their skills can be improved through practice. Celebrate the struggle. Wrestling with problems and having experiments fail is a normal part of the scientific process!

6. Girls gain confidence and trust in their own reasoning when encouraged to think critically. *(Chatman, Nielsen, Strauss & Tanner, 2008; Eisenhart & Finkel, 1998; Kim et al., 2007)*

Cultivate an environment in which asking questions and creative thinking are a must. Throughout the centuries, this same trust in logic and re-examination of ideas made advances in science, technology, and engineering possible.

7. Girls benefit from relationships with role models and mentors. *(Holmes, Redmond, Thomas, & High, 2012; Liston, Peterson & Ragan, 2008; Lyon & Jafri, 2010; Mosatche et al., 2013; Weber, 2011)*

Seeing women who have succeeded in STEM helps inspire and motivate girls, especially when they can relate to these role models as people with lives outside of the lab. Role models and mentors not only broaden girls' views of who does science, but expand girls' vision of what's possible in their own lives.

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

"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 Journals

Journals help youth keep track of what they've noticed and learned during the activities. Journals promote a science identity and allow youth to reflect on their thoughts and feelings. For children who are unable to write, drawing pictures is a good substitute.

Using Math

Providing youth opportunities to use math and numbers are important for developing their math skills at a young age. Math is important to science because it allows definitive answers to be found and can help youth find out if something has changed.

SciGirls Seven

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

Module 1

What is a Scientist? Engaging youth as scientists and engineers

BY ANNE STEVENSON

Module Introduction

MODULE SUMMARY

In this module, children are introduced to the role of scientists through children's literature and several experiments. In **Activity A**, the children consider the question: "What is a scientist?" In **Activity B**, children are encouraged to use their senses and wonder about the world around them using mystery boxes and hydrogels. In **Activity C**, children explore the roles of engineers and reflect on how they may act like scientists and engineers in their everyday lives.

Total lesson time needed for Module 1: **60–80 minutes**

MODULE FOCUS

Learning Objectives	• Youth will use their senses to make observations. • Youth will recognize that (or confirm how) they often act as scientists and engineers in their daily lives, using descriptors from the two books they read in this module.
Science & Engineering Practices	• Youth will engage in the following NGSS Practices: asking questions and defining problems; analyzing and interpreting data; constructing explanations.
Concepts & Vocabulary *Incorporate and define vocabulary & concepts organically throughout the lesson. Check for understanding periodically to reinforce concepts. Encourage youth to use new terms.*	• **Scientists:** people who ask questions to learn about the world around them • **Engineers:** people who use knowledge to invent, design, or improve a solution to a problem • **5 senses:** smell, touch, sight, taste, hear

Facilitator Preparation

BACKGROUND INFORMATION FOR THE FACILITATOR

Most children do not realize the things they do in their daily lives that are comparable to the work of scientists and engineers. More commonly children will visualize adults wearing lab coats, building bridges, and using specialized tools. Children are natural scientists and engineers, exploring and changing the world through design, making, and playing. The goal of this module is to help children become aware of the science and engineering they do and begin to identify themselves as scientists and engineers. This module assists us in understanding children's preconceptions about scientists and engineers, guiding them to a fuller understanding of what scientists and engineers do, and reinforcing the idea that all of us can act as scientists and engineers do.

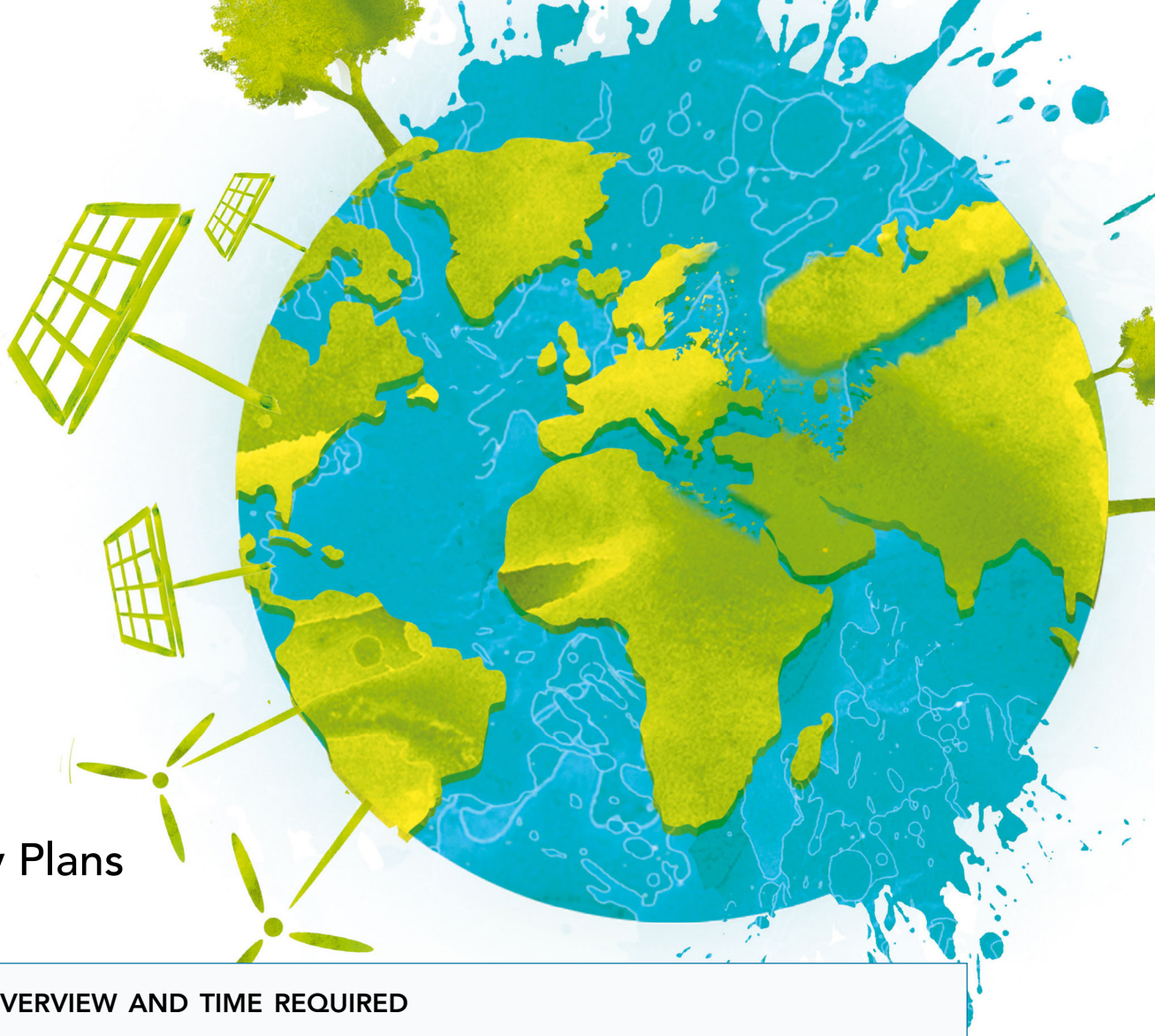
While the professional communities of science and engineering often require specialized training and tools, anyone can learn to engage in the processes and practices of science and engineering! This module introduces the concept of "wondering," how important it is for adults to model and encourage this sense of wonder in children, and how these "wonders" are often turned into questions that can be investigated or studied.

PREPARING TO TEACH THIS MODULE

Estimated prep. time:	**1–2 hours** if preparing Mystery Boxes; **15–20 minutes** if Boxes have been prepared (plus **3–4 hours** for soaking hydrogels).
What to prepare:	• Gather all supplies listed under **Materials List**. • Consider how you will divide youth into smaller groups for the various activities. • For **Activity B**: Create the 3 **Mystery Boxes** using non-transparent shoe boxes, photo boxes, plastic tubs, or similar box. Each must have a removable lid (*see materials list*). • Hydrate the hydrogel crystals in a bowl or ziplock bag for 3–4 hours (*see directions on package*). After hydrated, divide into small cups or plates: 1 cup or plate for every 2 children.

MATERIALS LIST FOR MODULE 1

Books:	☐ *What is a Scientist?* (Barbara Lehn, 1998) ☐ *Design. Invent. Create.* (Engineering for Everyone, 2014)
Items for Mystery Boxes (MB):	☐ 3 non-transparent shoe boxes, plastic tubs, or similar boxes with removable lids for the MB's: ☐ **MB #1**: 2 small balls and 3–4 small plastic animal figures, or plastic toy cars ☐ **MB #2**: various interesting looking shells or rocks ☐ **MB #3**: 2–3 types of dried beans or seeds, (e.g. lima beans, sunflower seeds, split peas)
Other materials:	☐ Hydrogel Crystals (super absorbent polymer crystals). *Ordered from science supply stores such as: stevespanglerscience.com* ☐ Flip chart paper and markers ☐ Paper towels ☐ Large bowl, and 10–12 oz. clear plastic cups or small bowls for crystals (1 cup for every 2 children)



Activity Plans

ACTIVITY OVERVIEW AND TIME REQUIRED

As a facilitator, plan to **arrive 15–20 minutes early to set up the lesson materials**. Additionally, allow **3–4 hours** prior to the lesson to soak hydrogels. If you have not yet prepared the Mystery Boxes for Activity B, you will need an additional **1–2 hours** of preparation time for creating Mystery Boxes.

Activity A: What is Scientist?:	15–20 minutes
Activity B: "I Wonder..." Hydrogel Cyrstals and Scientist Mystery Boxes:	30–40 minutes
Activity C: What is an Engineer?:	8–10 minutes
Reflection on Module 1:	5–10 minutes
Total Lesson Time:	60–80 minutes

Activity A: What is a Scientist?

MATERIALS FOR ACTIVITY A

- ☐ Book: *What is a Scientist?* (Barbara Lehn, 1998)
- ☐ Flip chart paper and markers

OPENING QUESTIONS AND PROMPTS

- Lead a discussion with the children using the questions below. Use flip chart paper to draw or write the children's ideas.

2 SciGirls
Girls are motivated by projects they find personally relevant and meaningful.

- Have each child draw a scientist. After drawing, they can share pictures with each other. 2

Facilitator Tip
Save these drawings for a later activity and for outcome assessment.

Science Journals
Drawings can be included in children's Science Journal

6 SciGirls
Girls gain confidence and trust their own reasoning when encouraged to think critically.

- Prompt the youth to think about what scientists are. 6
  Some example questions might include:
  - What do we know, or think we know, about scientists?
  - What are things that scientists do?
  - Where do they do their work?

PROCEDURE (EXPERIENCING)

- Read the book, *What is a Scientist?*

SHARE/PROCESS/GENERALIZE: ACTIVITY A

2 SciGirls
Girls are motivated by projects they find personally relevant and meaningful.

- After reading the book, lead youth in a discussion about how they can and do act like scientists. Examples of prompts are: 2
  - **Which activities in the book looked interesting to you?** Try to encourage youth to identify what ideas interest them and why.
  - **Have you ever done something like these children are doing?** This is important to help children identify how they have acted like scientists in their own lives.
  - **What could we add to our charts from earlier about what we know about scientists?** Add any items that children mention, especially as related to something they heard from the book or other ideas the book may have sparked.

Using Math
Note the "Use math to count or graph" item if the children do not mention this one.

  - **Can children be scientists? Tell about a time when you were a scientist.** The goal here is to have youth identify themselves as "scientists" or capable of being scientists. Some youth may not realize that things they do everyday are the same things scientists do on a daily basis.

Activity B: "I Wonder..." Hyrdogel Cyrstals and Scientist Mystery Boxes

PART ONE — "I WONDER" BOARDS AND HYDROGELS *(see page 9 for alternate activity)*

This activity introduces the children to the **"I Wonder" Board** and the idea of wondering out loud about our curiosities. It uses colorful "hydrogel crystals" to help children practice observing and asking questions. Children explore Mystery Boxes to practice these important skills of scientists.

MATERIALS FOR ACTIVITY B: PART ONE

- ☐ Hydrated hydrogel crystals
- ☐ Small cups or bowls, 1 for each pair
- ☐ Paper towels
- ☐ Flip chart paper (for the "I Wonder" Board)
- ☐ Markers

GETTING READY

- Divide the students into pairs.
- Put a small amount of hydrated crystals on each plate/in each cup (1 cup per pair).

OPENING QUESTIONS AND PROMPTS

- Lead a discussion with the children using the questions below. Use flip chart paper to draw or write words that answer the questions:
    - What is a "sense"?
    - Can we name some senses?
    - What senses did the children in the book use to learn about things?
    - How else can we use our senses to learn about something? 6

6 SciGirls
Girls gain confidence and trust their own reasoning when encouraged to think critically.

PROCEDURE (EXPERIENCING)

- Lead the children through identifying the senses: sight, smell, touch, taste, and hear. Explain that in this activity **we will not use the sense of taste.**
- Ask youth to remember the book we just read and how scientists use their senses to observe. Challenge children to act like scientists in this activity and explore using their senses.
- Share a small container of hydrogels with each group. Remind children to not use the sense of taste for this activity. Have youth take a few minutes to explore and observe using their other senses. In this free exploration try not to respond to any questions yet, instead wonder out loud with the children. 3

3 SciGirls
Girls enjoy hands-on, open-ended projects and investigations.

Science Journals
Have children take a few minutes to write or draw what they see, hear, touch, or smell in their Science Journal.

SHARE/PROCESS/GENERALIZE: ACTIVITY B PART ONE

- After free exploration, bring youth together and explain how to capture their wonderings onto a tool called an "I Wonder" Board.

"I Wonder" Board
On the board, collect the children's thoughts using words or drawings. Children can print their own thoughts on sticky notes to put on a larger board, write directly on the board, or have an adult write for them.

- Examples of prompts adults can use are:
  - **What did you see?** This includes colors, shapes, sizes.
  - **Did anyone touch the crystals?** Observations can include that the crystals were squishy, soft, cold, or bouncy.
  - **Did you notice a smell?** Children may have noticed a smell or noticed there was no smell.
  - **Did you hear anything?** Youth may describe the sound the crystals made when bounced or report that the crystals did not make a sound in the container.

Using Math
You can have children raise their hands if they agree with someone else's statement to make a count of the observations.

ALTERNATE ACTIVITY IF HYDROGELS CANNOT BE OBTAINED

Go outside and take an "I Wonder" walk. In pairs, explore the yard and use your skills of observation to notice things, and share what you wonder about with your partner. Lead the group outside and model your own wonder about something you see. Then follow the "Share, Generalize, Process" procedure on page 8.

PART TWO — SCIENTIST MYSTERY BOXES

MATERIALS FOR ACTIVITY B: PART TWO

- ☐ Flip chart paper
- ☐ Markers
- ☐ Mystery Boxes *(see page 3 for details on MB preparation)*

GETTING READY

- Depending on the size of group, the leader may choose to engage with the boxes as a full group (e.g. 6 or fewer children in your group) or divide into 3 groups of no more than 3 children and have each small group investigate one box then share what they discover. You might also have the groups "rotate" around to experience each box. With a larger group, you may want to prepare more than 3 Mystery Boxes.

OPENING QUESTIONS AND PROMPTS

- Lead a discussion with the children to introduce the Mystery Boxes. Remind students that scientists use their senses to observe, and the students will be acting like scientists.
- Have youth think of how they can use their senses to explore the Mystery Boxes. You might need to revisit the 5 senses with the children (sight, smell, touch, taste, and hear). Remind students that we will not be using the sense of taste in this activity.

PROCEDURE (EXPERIENCING)

- Have youth start with an **unopened box** and guide youth through their observations. Ask what they hear, see, smell, or feel.

"I Wonder" Board
You may record their observations or other "wonders" about the boxes.

Facilitator Tip
You may need to probe further if any of their observations are not truly things they observed with their senses. Children might make assumptions or guesses based on evidence and their own reasoning.

- If time allows, you might have children close their eyes and use their sense of touch to feel the objects inside the Mystery Box. Ask again what observations they made with the sense of touch.

SHARE/PROCESS/GENERALIZE: ACTIVITY B PART TWO

- Talk about the difference between things **we can know for sure** compared to things **we might believe or guess**.
- Unwrap and unveil the objects and note any new observations the children make.
- Have children reflect on what scientist skills they used. Examples of prompts include:
    - **What senses did you use?** This might include touch, sight, or hear.
    - **What questions did you have when you were exploring? What did you wonder about?** Children may have heard something rolling around and wonder if that was a ball or other similar object. They may have wondered how many items were in the boxes.
    - **What guesses did you make? Were they correct?** Youth may have thought objects were a specific item and could have been correct/not so correct.

Facilitator Tip
Give an example if needed: Have you ever smelled something you thought would taste bad, but when you tasted it, you found it was really good? Or maybe the opposite, smelled good but tasted bad?

Activity C: What is an Engineer?

MATERIALS FOR ACTIVITY C

- ☐ Book: *Design. Invent. Create.* (Engineering for Everyone, 2014)
- ☐ Flip chart paper and markers

OPENING QUESTIONS AND PROMPTS

- Lead a discussion with the children using the questions below. Use flip chart paper to draw or write words that answer the questions below.
    - Have you ever solved a problem by fixing something or making something? Tell me about that.
    - Hold up an example of something that was designed/engineered (e.g. crayons, legos, a toy, a chair). Describe how you wonder about how the person who helps create this item figures out how to make it, how they test it to see if its strong enough, etc. Ask the youth if there is something that they've always wondered, "Who makes this thing?"
    - Explain that through this book, we're going to find out about people who help make things to solve problems or to create something (a product) that is needed.

PROCEDURE (EXPERIENCING)

- Introduce the book, *Design. Invent. Create.*, and read it out loud. Children might know someone who has an engineer job similar to one described in the book, so allow time to share.

Facilitator Tip
With a young audience, you may want to choose just a few of the different engineer jobs described in this book, rather than reading the entire book.

SHARE/PROCESS/GENERALIZE: ACTIVITY C

- Lead the children in a discussion about the skills they use that scientists/engineers also use. Examples of questions you can use include:

  - **Do you think engineers and scientists use the same skills? Which ones?** Engineers and scientists both make observations about the world. 6
  - **What seems different about what a scientist does and what an engineer does?** Many scientists learn more about a process in the world. Engineers often design solutions to problems.
  - **How have you acted like an engineer? What did you build or do?**
  - **Did you ever try to engineer something and it didn't work as planned?** It is important for children to know that it's okay to fail at first and this is part of the process of science and engineering!

6 SciGirls
Girls gain confidence and trust their own reasoning when encouraged to think critically.

Facilitator Tip
Adults might tell a short story of their own experience where they tried to create/solve a problem but it did not work the first time.

Wrap Up

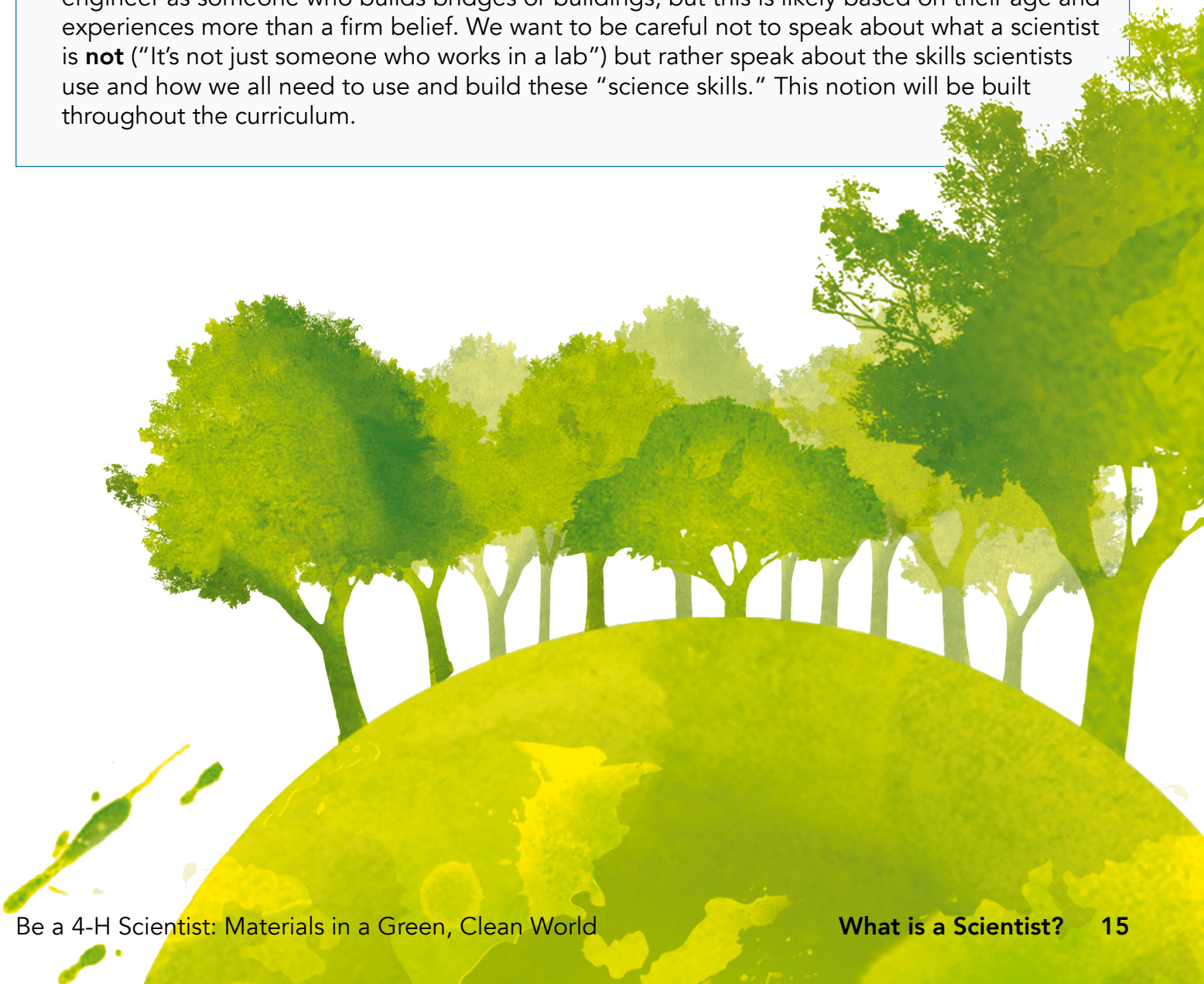
ENSURE CONCEPT UNDERSTANDING

Concept and Term Discovery

Help ensure that children understand scientists and engineers are people who use curiosity and questioning to explore the natural or "designed" world and to solve problems. There are many skills and processes that scientists and engineers use, such as asking questions, observing, collecting data, sharing what they discover, etc. We all use many of these skills every day! There are many careers and jobs that involve science and engineering design.

Common misconceptions often occur around:

Children may have a limited concept of a scientist as someone who works in a lab, or an engineer as someone who builds bridges or buildings, but this is likely based on their age and experiences more than a firm belief. We want to be careful not to speak about what a scientist is **not** ("It's not just someone who works in a lab") but rather speak about the skills scientists use and how we all need to use and build these "science skills." This notion will be built throughout the curriculum.



REFLECTION

Reflecting on experience is an essential part of learning and "making meaning of" an experience. Now is an opportunity to bring the children together and discuss the things they experienced throughout the module.

Facilitator Tip: *Circle Share*
You may want to use a "circle share" process to facilitate this discussion. Have children sit in a circle with you. Use a soft tossable object, such as a small toy as a "talking stick" object. Model to the children that you will ask a question, give them time to think quietly, then give your response while holding the "talking stick." You then gently toss the object to the next person for their turn to share. If you prefer, simply pass the object around the circle in order, eliminating the "toss" aspect.

- To quickly review some of the key points from the module, begin by holding up the books or boxes or point to the "I Wonder" Board to trigger memories. Examples of key points from the module include:
    - In the book *What is a Scientist?*, we saw children being scientists and heard about skills scientists use. We also read about different kinds of engineers in *Design. Invent. Create.* and how they are creative, clever problem solvers.
    - We used our senses to explore hydrogel crystals.
    - We got to explore Mystery Boxes with our senses.
    - We created our "I Wonder" Board:

"I Wonder" Board
Refer to your wonder board for this module — what questions did you explore the answers to? What questions do you still have?

    - Discuss other things you did with the group if desired.
    - Let the children know that they each did some of the things that scientists do!
- Some general reflection questions you can ask the children include:
    - What is something new you learned in this module?
    - Did you try something that you've never done before?
    - How were you a scientist or engineer today?
    - What questions did we explore the answers to? What questions do we still have?

SCIENCE NOTEBOOKS

Science Journals
You may want to have children redraw a scientist based on what they now know after completing the activities. Additionally, children can add additional observations or thoughts. You might also ask them to draw a picture of something they wondered about.

SCIENCE & ENGINEERING IN EVERYDAY LIFE — CONCEPT APPLICATION

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.

The **Science At Home** activities are possible extension activities that can be used with your group as time/interest allows. You might also look to your "I Wonder" Board for questions you'd like to explore further. If you meet multiple times, you might invite children to do a take home activity or investigate an "I Wonder," and have them report back or bring in an item as described. This helps support application of the concepts you've explored in this module.

SCIENCE AT HOME ACTIVITY

Science At Home is a handout for you to copy and send home with the children. The handout gives a brief summary of the module and provides several activity ideas. It encourages families to engage in science learning together, supporting application of the concepts. Make one copy per child, or you may email the activity if you prefer.

FEEDBACK

We encourage instructors to collect feedback throughout this module and submit via this evaluation form: 4hpolymers.org/evaluation

science at home

Be a 4-H Scientist!

Hello Families,

Your child is exploring science and engineering in the Be a 4-H Scientist! program. This week we discovered things that scientists and engineers do and we did some of those things too! We hope you will try one or more of these "Science at Home" activities with your child. This supports your child in practicing the skills and engaging in discovery! We hope your child will tell us what you did at our next session! Thank you!

Try these "Science at Home" Activities:

- Ask your child about creating an "I Wonder" Board. We use this to capture the things we are curious about. Families can create an "I Wonder" Board using a large sheet of paper or tag board—write "I wonder…" at the top, then all family members are encouraged to write their "I wonders…" on it. Your child and an adult or older teen can decide to explore or investigate one or more of their wonders.
- **Use Your Senses!** Child or family members close their eyes and take 3 minutes to use their senses to identify things they can smell, hear, or feel.
- **Guess the Smell:** Find a few different items in your home that have a scent or a smell. Examples could include: bar of soap, shampoo, vanilla extract, a pickle, a lemon or lime, other foods, freshly washed towel, dirty sock, etc. Have your child close their eyes (or use a hat pulled over their eyes as a blindfold) and have them smell the item. See how many they can identify! Switch roles using other objects and see how many the adult can identify!
- **Build a notecard bridge:** using two stacks of books to create a "valley", children and families can try to build a bridge using seven index cards (you can use scissors to alter the shape of the index cards, but no glue or tape!). See how many pennies your bridge can hold up before breaking!

Center for Sustainable Polymers

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Module 2

The many properties of materials

BY JENNIFER HENDERSON AND STEVEN WORKER

Module Introduction

MODULE SUMMARY

Every item and object we encounter is made of a material and each material has a different set of properties. Using commonly found items, children will categorize materials based on properties (**Activity A**). After learning about different material properties, children will complete a series of engineering challenges to select the appropriate materials to solve a given problem (**Activity B**).

Total lesson time needed for Module 2: **95–145 minutes**

MODULE FOCUS

Learning Objectives	• Youth will be able to recognize that different materials have different properties. • Youth will make the connection that the material an object is made from affects its properties. • Youth will understand that different materials are suited for different uses. • Youth will be able to name different types of materials, including plastic. • Youth will identify that some materials are better than others for making a particular object that meets a need or solves a problem.
Science & Engineering Practices	• Youth will engage in the following NGSS Practices: making observations; asking questions and defining problems; planning and carrying out investigations.

MODULE FOCUS *(CONTINUED)*

Concepts & Vocabulary

Incorporate and define vocabulary & concepts organically throughout the lesson. Check for understanding periodically to reinforce concepts. Encourage youth to use new terms.

- **Material:** the substance which something is made from.
- **Properties:** attributes or qualities of items that can be observed or measured (how an item looks, tastes, feels, sounds).
- **Observation:** what you see, hear, touch, taste, or smell.
- **Engineering:** using knowledge to invent, design, or improve a solution to a specific problem.

Facilitator Preparation

BACKGROUND INFORMATION FOR THE FACILITATOR

Every item and object we encounter and interact with on a daily basis is composed of one or more materials. Materials are the substance of which a thing is made. Various materials surround us, both human-made and natural, including metals, plastics, glass, wood, fabrics, and rocks. We experience hundreds of different types of materials every day, upon waking until we sleep – and even while we sleep! What type of materials is your bed made from?

Depending on the purpose, objects can be made from one or more materials. We can group materials based on how they look or behave - these qualities are called properties. The properties of a specific material, whether natural or human-made, influences how it reacts in the world. Properties of materials are sometimes easily observable (such as transparency or opaqueness); other times tests may need to be carried out to determine a material's properties (such as hardness or softness). By exploring different materials and conducting tests, children can understand how some materials are better suited for a particular purpose.

Each material can be described as having one or more of the following properties:

- **Transparent** (see-through) or **opaque** (not see-through): an object is transparent when light passes through it (for younger kids, you can use "see-through" and "not see-through" to describe this property)
- **Waterproof** or **absorbent**: a waterproof object repels water/liquids (for younger kids, this can be described as soaking up water or staying dry)
- **Hard** or **soft**: an object is hard if it is resistant to scratching and pressure
- **Strong** or **brittle**: an object is strong if it is resistant to breaking by cracking. A brittle object will easily snap in half.

For example, metals are strong and opaque. Glass is transparent; thick glass may be strong but a thin glass will be brittle. Some materials can have different properties based on how they are constructed. For example, plastics can be transparent or opaque, made into different shapes, and can be strong or brittle.

PREPARING TO TEACH THIS MODULE

Estimated prep. time:	**15 minutes** for activity set-up

What to prepare:

Activity A

- Gather items representing the various types of materials (as described in the **Materials** section) for each group.
- Note any safety hazards of items, such as fragile items or choking hazards.
- Consider how you will divide youth into pairs or small groups. 1
- For each youth or group, provide an assortment of items in a bag or on a table.

Activity B

- Note any safety hazards of items, such as fragile items or choking hazards.
- For Test One, prepare the cardboard by cutting holes in the middle of each.
- For Test Two, fill a bucket with water (enough so they can submerge their packaged animal or towel).
- Consider how you will divide youth into pairs or small groups. 1

1 SciGirls
Girls benefit from collaboration, especially when they can participate and communicate fairly.

MATERIALS LIST FOR MODULE 2: ACTIVITY A

Activity A: Provide each group a bag of 15–20 items, with 2–3 from each category. Examples include, but are not limited to:

☐ **Metal** objects such as:

- aluminum foil
- paper clips
- keys
- coins

☐ **Plastic** objects such as:

- empty drink bottles
- plastic utensils
- plastic wrap
- toys
- plastic straws

☐ **Wood** objects such as:

- craft sticks
- pencils
- clothespins
- toothpicks
- dowels or other wood pieces

☐ **Glass** objects such as:

- marbles
- empty glass cups

☐ **Fabric** objects such as:

- clothing
- towel
- handkerchief
- cloth hair ties

☐ **Other** objects such as:

- rubber eraser
- rubber bands

MATERIALS LIST FOR MODULE 2: ACTIVITY B

Activity B:

☐ For **each test in Activity B** provide a variety of materials youth can select from, such as:

- plastic zipper-seal bags
- plastic grocery bags
- plastic wrap
- paper bags
- paper towels
- aluminum foil

For **Test One**
"Water Proofing"

☐ Bucket to hold water (2–5 gallons)

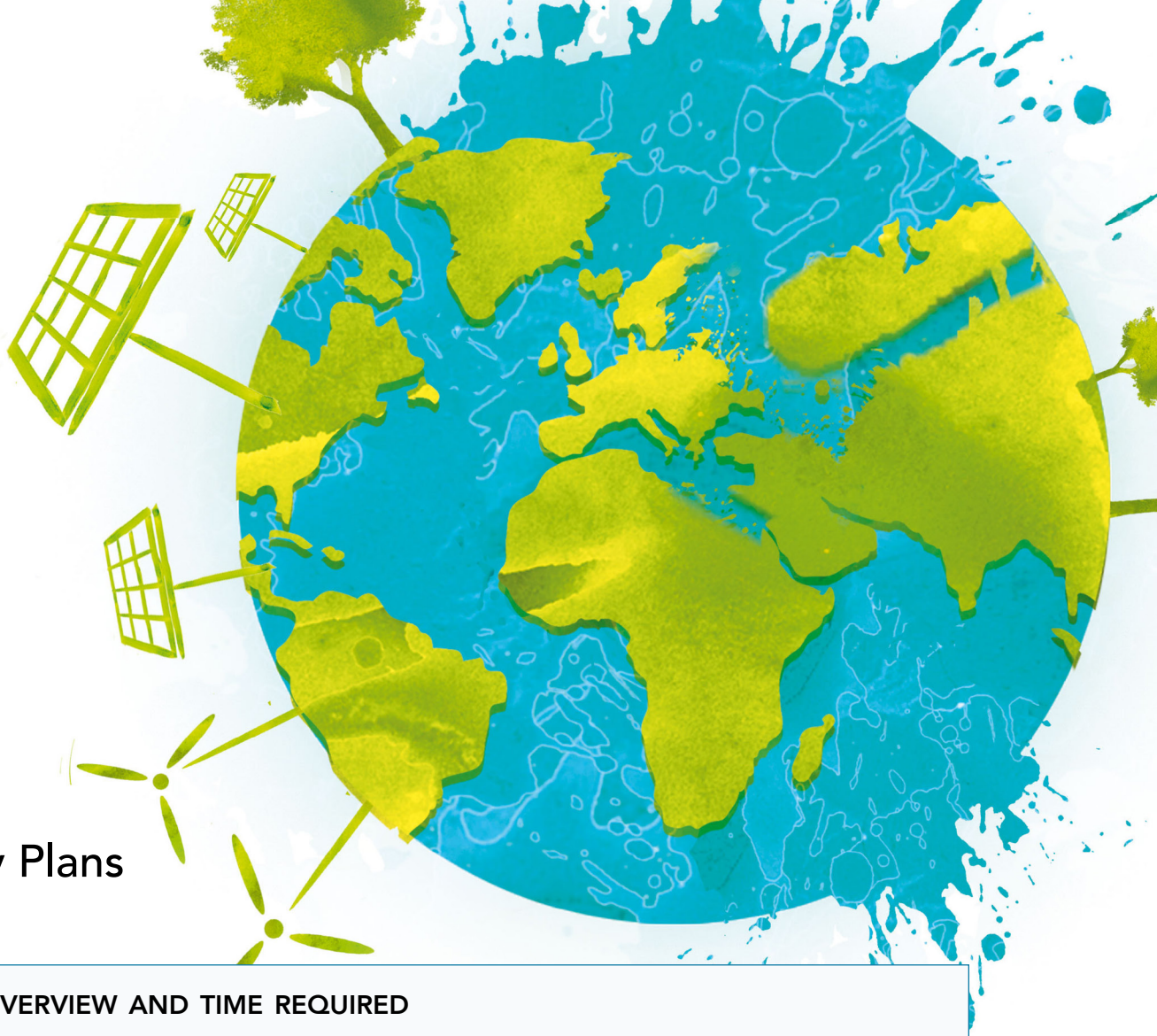
☐ A small stuffed animal (such as a Beanie Baby®), or a cloth towel or washcloth (1 for each group)

For **Test Two**
"A Window to the World"

☐ Flashlight to simulate the "sun"

☐ Pieces of flat cardboard (approximately 12" x 12") with a hole cut out of the middle for each group to represent the wall of their room (1 for each group)

☐ Tape (masking or scotch) to adhere the "window" material to the cardboard



Activity Plans

ACTIVITY OVERVIEW AND TIME REQUIRED

As a facilitator, plan to **arrive 15–20 minutes early to set up the lesson materials**.

Activity A: Exploring Materials:	30–45 minutes
Activity B: Materials Engineering:	60–90 minutes
Reflection on Module 2:	5–10 minutes
Total Lesson Time:	95–145 minutes

Activity A: Exploring Materials

OVERVIEW

Youth will explore materials of objects commonly found in their lives (or classrooms). Using properties of their choosing, as well as assigned criteria, youth will group objects based on properties they observe. Youth will reflect on their exploration of properties and start to understand that some objects made from the same material (such as plastic) can look and behave differently.

MATERIALS FOR ACTIVITY A

See page 6 for list of materials for Activity A.

GETTING READY

- Divide youth into small groups.
- Note any safety hazards of items, such as fragile items or choking hazards, and warn children appropriately.
- For each group, provide a random selection of items (see **Materials List** on page 6) in a bag or on a table/workspace.

OPENING QUESTIONS AND PROMPTS

- Play a game of: "I Spy": What are some objects that you see that are [color - e.g. blue]? What are some objects that you see that are made of [material –e.g. wood]?
- Before providing the materials, facilitate a group discussion to get youth thinking about what they know about materials and their properties. Some example questions might include:
  - What is something you use every day?
  - Do we know what it is made of?
  - What does it feel like? Look like?

PROCEDURE (EXPERIENCING)

- Allow youth time to explore the objects. Invite them to touch, listen, smell, and look at the objects. As youth explore, you may prompt them:
  - Are any of these objects new to you? 2
  - What do you think they were made for?
  - What happens with them when they are no longer needed?

2 SciGirls
Girls are motivated by projects they find personally relevant and meaningful.

"I Wonder" Board
Use the "I Wonder" Board to capture things the children wonder about as they experience the objects. Also capture grouping categories and wonders youth generate during the *free sorting* and *criteria sorting* acvities below.

Free Sorting:

3 SciGirls
Girls enjoy hands-on, open-ended projects and investigations.

- Ask youth to sort the objects into groups (any way they choose). Encourage youth to be creative. Groupings might be based on color, size, what the items are made of, or something completely different. 3
  - Ask groups to explain why they sorted items the way they did.
  - Ask if there is another way they could group these. 6

6 SciGirls
Girls gain confidence and trust their own reasoning when encouraged to think critically.

Facilitator Tip
Observe if youth are sorting objects based on material type. If they have not, gently guide youth to keep sorting in new ways until they get to these categories.

- Have youth re-sort the objects using a new criterion.
- Have one youth sort items without telling the other group members how they are sorted. Then group members can guess how the items are sorted.

PROCEDURE (EXPERIENCING) *(CONTINUED)*

Criteria Sorting:

- As a final sort, youth should sort objects into material groups: metal, plastic, wood, glass, and any other types of materials you've provided.
- Sample questions to use to prompt discussion include:
  - How are the groups different?
  - How are the groups similar?

SHARE/PROCESS/GENERALIZE: ACTIVITY A

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
  - **What groupings did you use to sort the objects?** Children may have sorted based on size, shape, color, material, etc.
  - **What did you do with objects that did not fit exactly into one group?** Youth may have placed these objects in their own group or developed their own reasoning why an object was placed in a particular group.
  - **Are there any objects you could not sort into a group?** Facilitators can discuss why it was difficult to sort these objects and help children identify a property that they can use to place the object in a particular group.
  - **What do you notice about the plastic?** Guide students to observe that plastic objects have different properties (color, transparency, flexibility, strength, etc.) while all being made from the same type of material.
  - **If you were going to build a bridge (or car, sofa, etc.), which would you use? Why?** Youth may think that strong materials are important for a bridge, but encourage alternative explanations. For example, youth may think that really long materials are needed to span a distance rather than short ones. For a car, strong materials might be important but soft materials may prevent injuries (like bumper cars).

Activity B: Materials Engineering

OVERVIEW

Youth will further explore material properties and come to understand that some materials are better than others to accomplish certain tasks based on their properties. Youth will discuss which materials are useful and what properties are important through a series of two challenges.

MATERIALS FOR ACTIVITY B

See page 6 for list of materials for Activity B.

GETTING READY

- Divide the students into small groups. Note: If there is more than one adult staff/volunteer, youth can be split into multiple groups where one group completes test one and one group completes test two simultatneously, and then have the groups switch tests when they are done to complete the other test. All students should complete both tests.
- Note any safety hazards of items, such as fragile items or choking hazards, and warn children appropriately.
- For **Test One**, fill a bucket with water (enough so they can submerge their packaged toy/towel).
- For **Test Two**, make sure you have a piece of cardboard with a "window" cut for each group (see page 7 for cardboard preparation details).

OPENING QUESTIONS AND PROMPTS

3 SciGirls
Girls enjoy hands-on, open-ended projects and investigations.

- Provide youth time to explore the material samples gathered. Have them touch, listen, and look at the objects. Some items may be reused from Activity A and students will not require much time to explore materials. 3
- Ask youth to describe the different materials. What properties do they have? (Adult leaders can remind youth of properties they identified earlier — e.g. hard/soft, transparent/opaque, strong/brittle, etc.)

PROCEDURE (EXPERIENCING): ACTIVITY B TEST ONE

- In this challenge, youth need to protect a toy/ towel from getting wet. Youth will select a material to wrap around their toy/towel to protect it. In this challenge, it is important that the material selected is waterproof rather than absorbent.
- Allow youth to look at the various items available for waterproofing (plastic zipper-seal bags, plastic grocery bags, plastic wrap, paper bags, additional paper towels, aluminum foil).
- Ask youth to select one of the materials to use to waterproof their toy/towel. (Encourage youth to try different items — e.g. one youth uses zipper seal bags, another uses a paper bag).
- Before submerging, have youth predict and explain their reasoning for the material they've selected. Why do they think it will provide the best waterproofing? 6

6 SciGirls
Girls gain confidence and trust their own reasoning when encouraged to think critically.

Science Journals
Have youth draw their chosen object and the procedure in their science journals with what they expect to happen. (Object + protective material + water = wet or dry object).

- Allow youth (with adult supervision) to submerge their "waterproofed" toy/towel into the bucket of water and keep it under water for 10 seconds.

Using Math
It may help to count to 10 aloud.

- Have youth remove their object and observe whether the toy/ towel is wet or dry (or both). Prompt observations with questions, if needed. Sample questions to use to prompt discussion include:
  - How are the materials different?
  - Is your toy/towel wet or dry?
  - How do you know?
  - Do you think your material was good at waterproofing? Why?
- Repeat the test with the other materials.
- Lead a discussion guided by the questions in the **Share, Process, and Generalize** section before beginning test two. If you have multiple groups of students (see **Getting Ready** on page 12) complete the **Share, Process, and Generalize** section before switching tests.

SHARE/PROCESS/GENERALIZE: ACTIVITY B TEST ONE

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **How well did the plastic protect the toy/towel from the water?** Be sure to probe how the children determined whether or not the toy/towel was protected by asking them to explain how they knew.
    - **How well did the paper protect the toy/towel from the water?** In addition to explaining how they knew whether or not the toy/towel was protected, probe to determine what specific criteria they used. For example, how would they determine the status if the object was a little wet?
    - **If we needed to protect something from getting wet, what material would we use?** Ask youth how they would keep some items dry, such as their head when they are outside, a book being carried to school, or an apple/orange when outside at a picnic.

PROCEDURE (EXPERIENCING): ACTIVITY B TEST TWO

- In this test, youth will need to select a material to use for building a window in a house. Youth will learn that the selection of materials is often based on human wants; e.g., people like to see outside and allow the sunlight in, so the material for a window will need to be transparent/see-through. You will simulate the "sun" using a flashlight.
- Prompt youth to think about the types of properties a window might need; for example:
    - What do you observe about the windows in our room right now?
    - What else do you know about windows?
- Provide each group a cardboard piece with a square hole (the "window") cut out of the middle. Explain that this is a wall of the house and they will need to select a material to cover the window. Show youth the flashlight and tell them that this is the sun and that youth want to allow sunlight into their house.

3 SciGirls
Girls enjoy hands-on, open-ended projects and investigations.

- Allow youth to look at the various items available to use as their window (paper bags, plastic bags, towels, and any other items available). Ask youth to select one of the materials. 3
- Have youth predict and explain their reasoning for the material they've selected. Why do they think it will provide the best window material?
- Allow youth time to attach their window to the cardboard with tape.
- Gather everyone and shine the flashlight through the window. Ask groups to observe and share what's happening. Does the "sun" shine through the window?
- Repeat the test with the other window materials.
- Lead a discussion guided by the questions in the **Share, Process, and Generalize** section before beginning test two. If you have multiple groups of students (see **Getting Ready** on page 12) complete the **Share, Process, and Generalize** section before switching tests.

SHARE/PROCESS/GENERALIZE: ACTIVITY B TEST TWO

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **Which materials did the light pass through?**
    - **Which materials blocked the light?**
    - **If we were making a window, which material would you want to use?** Encourage alternative explanations. For some children, a window that is see-through is important, but you may want a material that is not see-through if they wanted to block the sun (like sunglasses) or for privacy.
    - **Why would you choose that type of material?** Students may also use other properties in their reasoning – e.g. using plastic because it is transparent like glass but less likely to break.

- To further probe youth understanding, have children extend their learning to a new situation. Example prompts include:
    - **There were many materials you could choose for each test. What properties do you think were important for each of the tests?** Adult leaders can remind youth of properties they identified earlier — e.g. hard/soft, see-through/not see-through, strong/brittle, etc.

2 SciGirls
Girls are motivated by projects they find personally relevant and meaningful.

    - **If you had to select materials for another purpose — like to build a bridge across a river — which materials would you use and how will you make those decisions?** 2

Wrap Up

ENSURE CONCEPT UNDERSTANDING

Concept and Term Discovery

At this point, it is important to ensure that the terms **material** and **property** have been discovered by or introduced to the youth. The goal is to have the youth discover terms and concepts on their own, defining them with their own words. It may be helpful to have youth identify which materials they worked with or name some properties that were important in the engineering tests.

Common misconceptions often occur around:

- The same material can have different properties (e.g. plastic can be hard, like a block, or plastic can be flexible, like a bendable toy or a disposable water bottle, depending on how that plastic is made or manufactured.
- An object can be made of one or more materials (e.g. a table or chair can be made of wood, but may also have parts that are metal).

REFLECTION

Reflecting on experience is an essential part of learning and "making meaning of" an experience. Now is an opportunity to bring the children together and discuss the things they experienced throughout the module.

Facilitator Tip: *Circle Share*
You may want to use a "circle share" process to facilitate this discussion. Have children sit in a circle with you. Use a soft tossable object, such as a small toy as a "talking stick" object. Model to the children that you will ask a question, give them time to think quietly, then give your response while holding the "talking stick." You then gently toss the object to the next person for their turn to share. If you prefer, simply pass the object around the circle in order, eliminating the "toss" aspect.

- Some general reflection questions you can ask the children include:
    - What is something new you learned in this module?
    - Did you try something that you've never done before?
    - How were you a scientist or engineer today?
    - What questions did we explore the answers to? What questions do we still have?

"I Wonder" Board
If used, refer to your wonder board for this module — what questions did you explore the answers to? What questions do you still have?

SCIENCE & ENGINEERING IN EVERYDAY LIFE — CONCEPT APPLICATION

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.

The **Science At Home** activities are possible extension activities that can be used with your group as time/interest allows. You might also look to your "I Wonder" Board for questions you'd like to explore further. If you meet multiple times, you might invite children to do a take home activity or investigate an "I Wonder," and have them report back or bring in an item as described. This helps support application of the concepts you've explored in this module.

SCIENCE AT HOME ACTIVITY

Science At Home is a handout for you to copy and send home with the children. The handout gives a brief summary of the module and provides several activity ideas. It encourages families to engage in science learning together, supporting application of the concepts. Make one copy per child, or you may email the activity if you prefer.

FEEDBACK

We encourage instructors to collect feedback throughout this module and submit via this evaluation form: **4hpolymers.org/evaluation**

science at home

Be a 4-H Scientist!

Hello Families,

Your child is learning about materials and their properties. Materials are the substance of which a thing is made. Various materials surround us, both human-made and natural, including metals, plastics, glass, wood, fabrics and rocks. Properties are characteristics of a material, such as hard/soft, transparent (you can see through this)/ opaque (you can't see through this). We hope you will try one or more of these "Science at Home" activities with your child and continue discovering more about materials and their properties. This supports your child in practicing the skills and engaging in discovery! We hope your child will tell us what you did at our next session! Thank you!

Try these "Science at Home" Activities:

- Do a scavenger hunt of plastic objects in your home. Which objects are made from plastic? Challenge your child to find plastic objects that have different properties (such as the "**softness**" or "**hardness**" of plastics such as a one-time use grocery bag vs. flexible plastic water bottle).
- You and your child can try to find similar objects made from different materials (e.g bags made of paper and plastic or cups made of glass, metal, or plastic). What are the advantages or disadvantages of each item?
- Have your child think about what other materials could be substituted for plastic (for example: glass instead of plastic for a bottle, wood instead of plastic for a chair). What would be an advantage and disadvantage of using the substituted material?
- We learned about the properties of "**absorbent**" and "**waterproof**." Find objects in your home that absorb water and objects that are waterproof. Ask your child about their stuffed animal experiment!
- Prepare hot chocolate or tea with your child and try serving them in cups with different properties: plastic/styrofoam cups, paper, and ceramic mugs. You will notice differences between the cup types. (Is one sturdier? Is one hotter to touch?) Make a list of the differences in the cup properties.

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Module 3

Plastics in your world

BY JOY NG AND MARTIN SMITH

Module Introduction

MODULE SUMMARY

Plastic and plastic products are abundant in our world. In **Activity A**, youth learn about the different types of plastics by observing characteristics and properties of different types of plastics. In **Activity B**, youth will learn about the U.S. #1–7 numbering system for recycling. In **Activity C**, youth will think about different methods of plastic disposal.

Total lesson time needed for Module 3: **55–85 minutes**

MODULE FOCUS

Learning Objectives	• Youth will identify plastics as one type of material. • Youth will discover that plastics are all around us. • Youth will understand that there are different types of plastics with differing properties and uses. • Youth will identify different types of recyclable plastic using the U.S. # 1–7 numbering system for recycling. • Youth will describe environmentally responsible ways to dispose of or re-use plastics.
Science & Engineering Practices	• Youth will engage in the following NGSS Practices: asking questions and defining problems; planning and carrying out investigations; analyzing and interpreting data.

MODULE FOCUS *(CONTINUED)*

Concepts & Vocabulary

Incorporate and define vocabulary & concepts organically throughout the lesson. Check for understanding periodically to reinforce concepts. Encourage youth to use new terms.

- **Landfill:** a place where garbage is disposed of; material put here is not recycled.
- **Litter:** any trash (e.g., paper, plastic or glass bottles, cans) that is left or disposed of in open (e.g., on land or in water) or public places.
- **Plastic:** a type of man-made material.
- **Re-use:** finding a way to use materials again.
- **Recycle:** collecting old material and processing them to make a new material or object.

Facilitator Preparation

BACKGROUND INFORMATION FOR THE FACILITATOR

Plastics represent one type of material that is abundant in our world. Plastics are common in many products we use, enjoy, and depend upon each day. Some commonly used plastic items include: drinking bottles, bags, toys, medicine bottles, and food containers. However, not all plastics are the same; it is important to know what the different types of plastics are, how we use them, and how to dispose of them properly.

In the United States, plastics are classified into seven types depending on their chemical make-up. Different types of plastics are made of different types of materials, each with different characteristics and thus have different uses. For example, a # 3 plastic, vinyl or PVC, is often flexible, yet durable. It is used to make things such as shampoo bottles and medical tubing. Note: The number of a plastic is typically shown on the product (e.g., on the bottom of a bottle).

Once a plastic object has served its purpose, it must be disposed of in a responsible manner. Plastics can be disposed of in different ways. Many plastics can be recycled and remade into other products, while others must be repurposed if they are to be kept from being disposed in a landfill (e.g., a soda bottle can be cut and used as a flower pot). Because there are so many different types of plastics, it is important to know which types of plastics are recyclable and which types are not. The improper disposal of a plastic product (e.g., littering) could potentially harm the environment, humans, or nonhuman animals. Of the seven different types of plastics, # 1–6 are all recyclable; # 7 is not. However, it is important to note that not all recycling facilities accept all types of plastic. Often times, # 3 plastics (PCV or vinyl) must be taken to specialty recycling centers that can handle the complex material. Plastics that fall under # 7 can be either repurposed (e.g., turn a three-gallon water jug made from # 7 plastic into a coin bank for loose change) or placed into the garbage and disposed of in a landfill.

- Mouthwash bottles
- Peanut butter jars
- Plastic water bottles
- Soft drink bottles

- Milk containers
- Some shampoo bottles
- Yogurt containers
- Household cleaner bottles
- Laundry detergent bottles

- Vinyl toys (e.g., dolls or action figures)
- PVC pipe
- Plastic food wrap
- Shrink wrap/packaging materials
- Cooking oil bottles
- Plastic shower curtains
- Medical tubing
- Some shampoo bottles

- Plastic grocery bags
- Sandwich bags
- Squeezable bottles
- Shrink wraps/wrapping films
- Frozen food bags

- Straws
- Syrup bottles
- Plastic lids and caps
- Medicine bottles
- Tupperware-like food containers

- Styrofoam products (e.g., egg cartons, cups, packing peanuts, take-out containers)
- CD cases
- Disposable cups
- Plastic utensils (e.g., fork, knife and spoon)

- Nalgene-type water bottles
- Sippy cups
- DVD (movie) cases
- Sunglasses
- 3 and 5-gallon reusable bottles (gas cans, water cooler refills)
- Lego® bricks

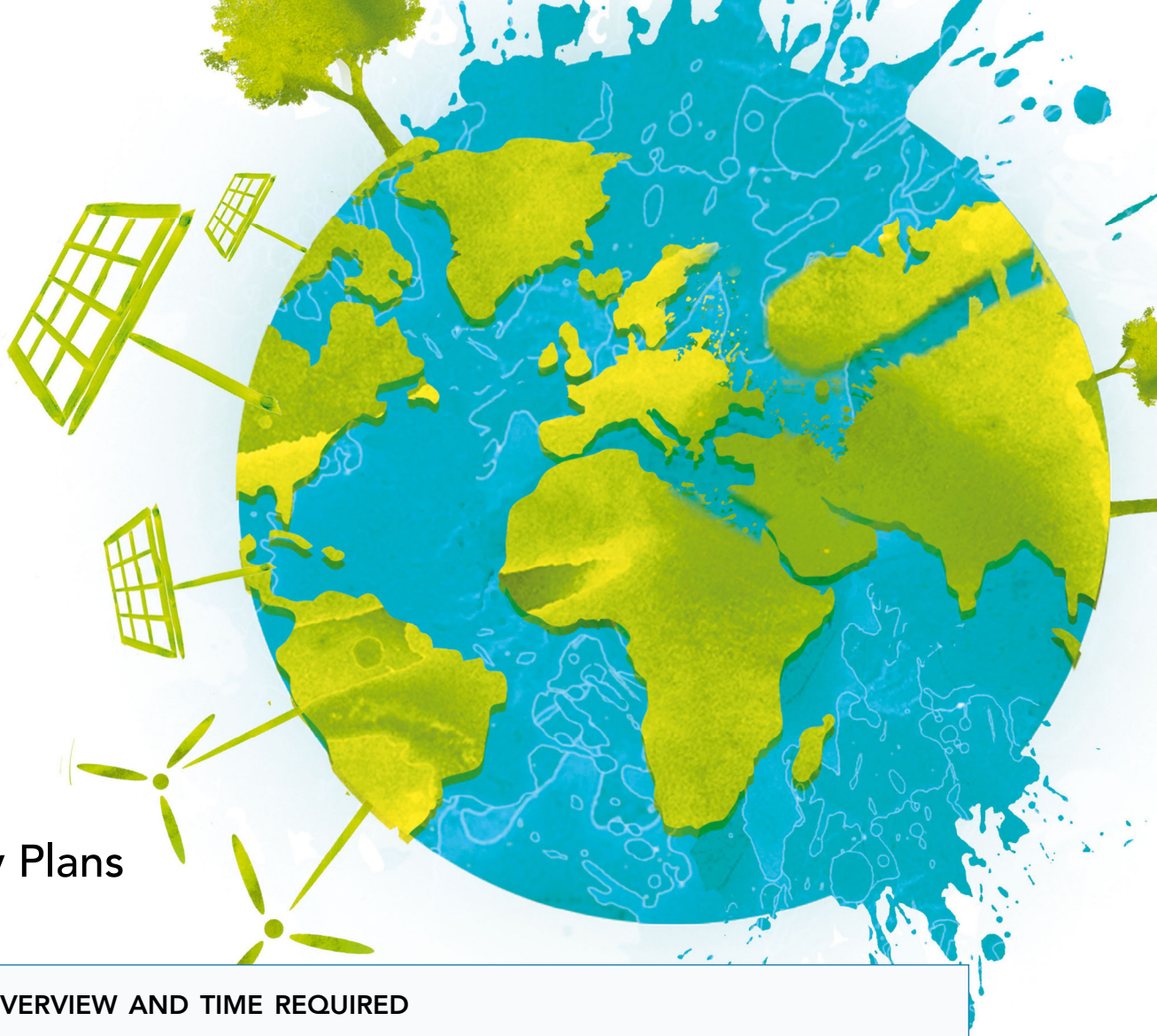
PREPARING TO TEACH THIS MODULE

Estimated prep. time:	**15 minutes** for activity set-up
What to prepare:	• You may want to begin collecting plastic items for a few days before presenting this module to make sure items of each recycling number are available for each group (see **page 5** for examples of plastics for each number). Remember to empty and clean all items. • Gather items for each group of youth. You might wish to fill bags with plastic items, one bag for each group, prior to the activity to make it easier to distribute to the groups. • Each group should have approximately 7–14 plastic items, having at least one from each plastic type (1–7). • Draw data chart on flipchart paper or whiteboard (see **Appendix A**). • Print and cut out cards in **Appendix B** and **Appendix C**. • Note any safety hazards of items, such as fragile materials or choking hazards. • Consider how you will divide youth into pairs or small groups. [1] • Provide each pair/small group with scratch paper and writing utensils.

[1] SciGirls
Girls benefit from collaboration, especially when they can participate and communicate fairly.

MATERIALS LIST FOR MODULE 3

Plastic objects:	☐ Items to be sorted by youth. Each group should have approximately 7–14 various items, at least one from each type of plastic (# 1–7, see **page 5** for examples) that are empty and clean.
Other items:	☐ A large data sheet (e.g. flipchart paper or whiteboard with data sheet (**Appendix A**) drawn on. ☐ Printed out "cards" with various disposal methods (**Appendix B**). ☐ Printed out large numbers (1–7) to be placed around the room (**Appendix C**).



Activity Plans

ACTIVITY OVERVIEW AND TIME REQUIRED

As a facilitator, plan to **arrive 15–20 minutes early to set up the lesson materials**.

Activity A: What "Sort" of Plastic is This?:	30–45 minutes
Activity B: U.S. Numbering System:	10–15 minutes
Activity C: What Can We Do with Our Plastic?	10–15 minutes
Reflection on Module 3:	5–10 minutes
Total Lesson Time:	55–85 minutes

Activity A: What "Sort" of Plastic is This?

OVERVIEW

Youth will observe a variety of plastic items commonly found in households. They will use their observations to sort the items by any criteria of their choosing. Through several rounds of this procedure, and through guidance from the facilitator, youth will learn the characteristics of the different types of plastic.

MATERIALS FOR ACTIVITY A

See page 7 for list of materials.

GETTING READY

- Divide youth into small groups.
- Note any safety hazards of items, such as fragile items or choking hazards, and warn children appropriately.
- Divide plastic items so that each group will have 7–14 items, with at least 1 from each plastic type (# 1–7).

OPENING QUESTIONS AND PROMPTS

- Before providing the materials, facilitate a group discussion to get youth thinking about what they know about plastics and their disposal. Some example questions might include:
  - What are some objects made of plastic?
  - What are different ways plastic is used? (e.g. chairs to sit on, clear bottles to hold liquids, colorful toys)
  - What happens when someone is done using a plastic item (for example, a plastic cup, a plastic food container, etc.)? What would you do with the item?

Facilitator Tip
Introduce and explore vocabulary (re-use, litter, landfill, recycle, plastic) here as youth are talking about what to do with a used plastic container.

- Use an example set of plastics and brainstorm as a group the different characteristics of the plastic items. List these on large chart paper so youth can refer to them while working in their small groups.

PROCEDURE (EXPERIENCING)

3 SciGirls
Girls enjoy hands-on, open-ended projects and investigations.

- Give each group the plastic items. Allow youth time to explore the items. Encourage them to touch, listen, smell, and look at the objects. **Note: No tasting**. 3
- Have youth to sort the plastic containers based on some of the characteristics they observe (refer to the ones listed during the large group discussion if needed). For example, they might sort by shape, size, color, or other feature.

Science Journals
Have youth to write down, draw, or talk about their ideas in their science journals. If youth struggle with writing skills, adults may record their observations for them or youth may draw pictures.

- Ask the youth to sort the plastic containers another way. Again, ask the youth to record their ideas.
- Continue this process 1–2 additional times.

Facilitator Tip
Allow the learners to make their own decisions in this sorting process; however, at some point you may have to guide them to sort according to the type of plastic (based on characteristics they observe, or based on what the plastic feels like).

SHARE/PROCESS/GENERALIZE: ACTIVITY A

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **How did you sort the plastics and why did you sort them this way?** Have youth also describe if they noticed similarities or differences in the sorting compared to the other pairs/small groups.
    - As youth are explaining, record on existing data chart on whiteboard or flipchart paper for them to see. (This is a model for what they will be doing with the scavenger hunt in the **Science at Home** activity).

Activity B: U.S. Numbering System

OVERVIEW

After observing different characteristics of plastics, youth will learn about the U.S. numbering system for recycling and which items can be recycled, re-used, or repurposed.

MATERIALS FOR ACTIVITY B

See page 7 for list of materials.

GETTING READY

- Youth remain in pairs or small groups.
- Youth keep bags of items.
- Place large printed numbers around the room.

OPENING QUESTIONS AND PROMPTS

6 SciGirls
Girls gain confidence and trust their own reasoning when encouraged to think critically.

- Ask youth to examine some of the plastic items and see if they see a number on it. Have youth explain what they think this number means. Encourage multiple explanations or ideas and explain to youth that in the next activity they will learn what these numbers mean. 6

PROCEDURE (EXPERIENCING): ACTIVITY B

- Help youth find and identify U.S. recycling numbers on items.
- Once numbers on plastic items are identified, have youth move items, one at a time, to the corresponding number placed around the room.
- Record observations about items in each category on data chart.

Facilitator Tip
Review and explore vocabulary again here and introduce which numbers can be recycled and which cannot. Be sure to check with your local recycling facility on which types they collect.

SHARE/PROCESS/GENERALIZE: ACTIVITY B

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **How did the numbering system differ from the groups of items you made in Activity A?** Ask youth to identify objects that remained in similar groups and which objects moved to different groups.
    - As youth are explaining, record on existing data chart on whiteboard or flipchart paper for them to see. (This is a model for what they will be doing with the scavenger hunt in the **Science at Home** activity).

Activity C: What Can We Do with Our Plastic?

OVERVIEW

After sorting and creating a master data table, youth will have the opportunity to learn more about ways to dispose of plastic. Learners will discover which plastics are recyclable and which must be disposed of in a special location. The consequences of each action will also be explored. The ways to dispose of plastics include:

- Recycle
- Re-use
- Litter (land)
- Litter (aquatic)
- Throw away/Landfill

MATERIALS FOR ACTIVITY C

See page 7 for list of materials.

GETTING READY

- Youth remain in pairs or small groups.
- Each pair or small group picks one item from around the room (after sorting into U.S. numbering system).
- Create a stack with the cards of different disposal methods (**Appendix B**).

OPENING QUESTIONS AND PROMPTS

- To help youth think about the consequences of disposing plastic items, lead a discussion on litter seen everyday. Prompt youth to think about if they see litter and where they see it. Sample questions might include:
    - Have you seen trash oustide on the ground? If you have time, you may even have youth go on a short walk and look for trash or litter (advise youth not to pick it up at this time). 2
    - How do you feel when you see trash or litter on the ground? Does it make you feel happy or sad?
    - What do you do when you need to dispose of something? Do you put it in the garbage can? Recycling bin?

2 SciGirls
Girls are motivated by projects they find personally relevant and meaningful.

PROCEDURE (EXPERIENCING)

- Each group/pair will take a plastic item from the previous sorting activity and will use this as their model.
- With their plastic item, youth will pick a card from a stack (**Appendix B**) that has a disposal method (e.g., thrown away, re-used, land litter, etc.). Youth will be asked to explain to the group what they think the consequences (positive or negative) of this disposal method. 4
- Repeat with each pair or small group and with different plastic items.
    - **Examples of landfill consequences:** trash is disposed of safely, not littering (positive); adds to waste, not as good as recycling or re-using (negative)
    - **Examples of recycling consequences:** reduces waste, can be recycled into new material (positive)
    - **Examples of re-use consequences:** reduces waste, does not need to be recyclable to use material (positive)
    - **Examples of litter consequences:** cause harm to plants and animals (negative)

4 SciGirls
Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.

SHARE/PROCESS/GENERALIZE: ACTIVITY C

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **What should we do with unwanted items?**
    - **Is it better to reuse them or recycle them?**
    - **If we can't reuse or recycle, is it better to place them in a landfill or litter? Why?** Youth may have different reasons for preferring one method to another (e.g. why it might be better or reuse versus recycle, or vice versa). Encourage youth to think of alternative reasons or justifications for their preferences.
    - **What can we do to make sure trash gets disposed of correctly in our homes/schools/community?** Encourage youth to think of ways to make sure trash is disposed of correctly. This might include placing informative signs near trash cans/recycling bins, going on trash pick-up walks, or teaching others on how to dispose of trash properly. At this point it is not important for youth to carry out these exercises but rather to think of how they can improve their communities. 2

2 SciGirls
Girls are motivated by projects they find personally relevant and meaningful.

Wrap Up

ENSURE CONCEPT UNDERSTANDING

Concept and Term Discovery

At this point, youth should have a deeper understanding of different types of plastics and methods of disposal. It is also important to ensure that the terms **landfill**, **litter**, **plastic**, **re-use**, and **recycle** have been introduced or discovered by the youth. The goal is to have the youth discover terms and concepts as they engage in learning activities. However, if necessary, go over terms/concepts and vocabulary here and clear up any misconceptions or deepen understanding.

Common misconceptions often occur around:

- Plastics being "bad" or negative. Plastics are all around us and are extremely helpful and useful in many ways, but we all need to dispose of plastics responsibly and keep the consequences of irresponsible disposal in mind.
- Plastics are often believed to be one type of material. When we think about "plastics" we are actually thinking about a class of materials that are made of different types of chemicals with unique properties.

REFLECTION

Reflecting on experience is an essential part of learning and "making meaning of" an experience. Now is an opportunity to bring the children together and discuss the things they experienced throughout the module.

Facilitator Tip: *Circle Share*
You may want to use a "circle share" process to facilitate this discussion. Have children sit in a circle with you. Use a soft tossable object, such as a small toy as a "talking stick" object. Model to the children that you will ask a question, give them time to think quietly, then give your response while holding the "talking stick." You then gently toss the object to the next person for their turn to share. If you prefer, simply pass the object around the circle in order, eliminating the "toss" aspect.

- Some general reflection questions you can ask the children include:
    - What is something new you learned in this module?
    - Did you try something that you've never done before?
    - How were you a scientist or engineer today?
    - What questions did we explore the answers to? What questions do we still have?

"I Wonder" Board
If used, refer to your wonder board for this module — what questions did you explore the answers to? What questions do you still have?

SCIENCE & ENGINEERING IN EVERYDAY LIFE — CONCEPT APPLICATION

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.

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FEEDBACK

We encourage instructors to collect feedback throughout this module and submit via this evaluation form: **4hpolymers.org/evaluation**

science at home

Be a 4-H Scientist!

Hello Families,

We are exploring the many types of plastics! We have sorted plastics by the small number found (usually) on the bottom of plastics which tells us where and if the item can be recycled. We learned that there are many different properties of different plastics, such as hard or flexible, transparent and opaque, and more! We hope you will go on a plastics scavenger hunt in your home or yard this week. Thanks!

Try these "Science at Home" Activities:

- Explore your home, yard, neighborhood, or local stores to search for plastics. On the back side of this paper, you will find a "Data Sheet." A data sheet is where a scientist writes what they find out about! See if you and your child can find the seven different types of plastics and make observations about them.
- Help your child draw or write their answers on the data sheet and send the sheet back to our next session so your child can share it with our group.
- This will help reinforce the idea that plastics are everywhere and can help children understand the uses of plastics and how they are important as a material. It is sometimes hard to believe that a plastic bag, a plastic water bottle, a toy dinosaur, or a plastic chair are all plastics!

- About the numbers on plastics — Plastics are classified into seven types depending on their chemical make-up. The different types of plastics are made of different types of materials, each of which have different characteristics, and therefore have different uses.

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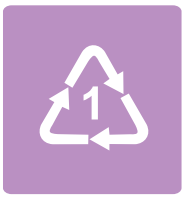
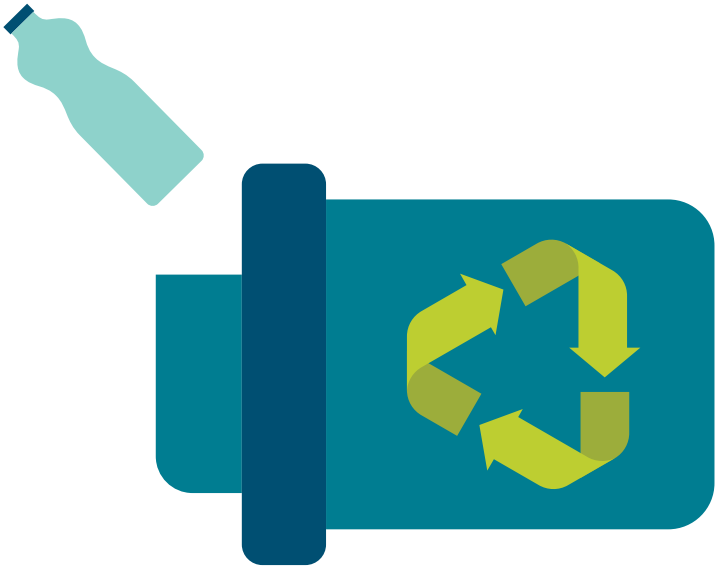
Plastic Number #1 – #7	What is it? (e.g., a food container, a bottle, a toy)	What is it used for?	What are its characteristics? (e.g.,what it feels like, is it hard or soft, transparent?)	Circle if this item can be recycled and/or re-used
				Recycle Re-use
				Recycle Re-use
				Recycle Re-use
				Recycle Re-use
				Recycle Re-use
				Recycle Re-use
				Recycle Re-use

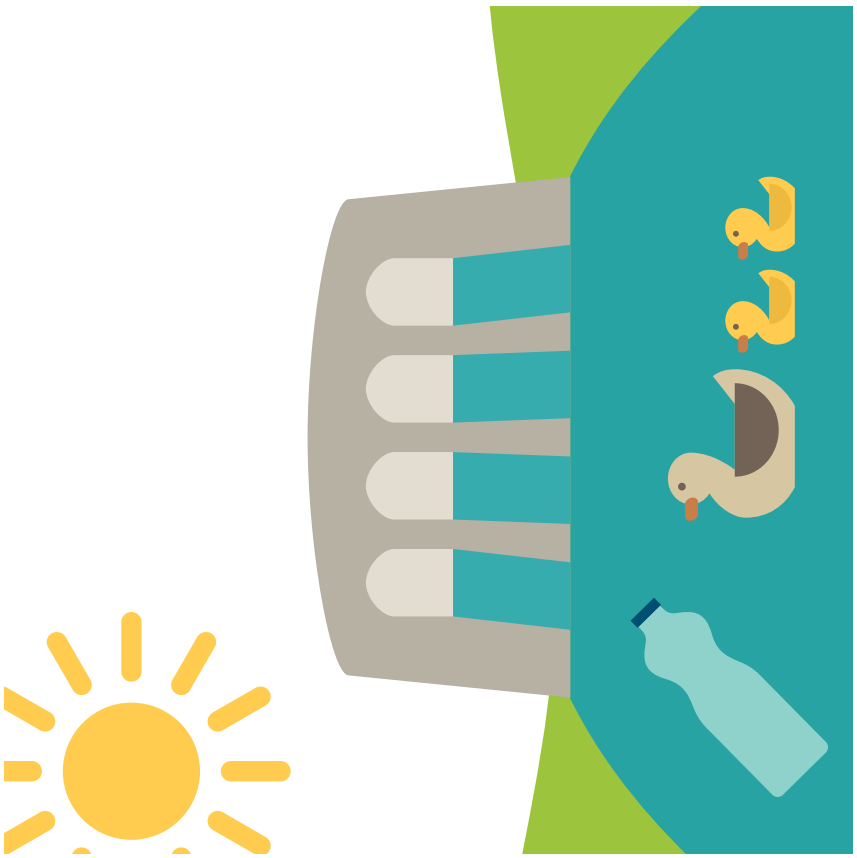
Appendix A — Datasheet

Plastic Number #1 – #7	What is it? (e.g., a food container, a bottle, a toy)	What is it used for?	What are its characteristics? (e.g.,what it feels like, is it hard or soft, transparent?)	Circle if this item can be recycled and/or re-used
#1				Recycle Re-use
#2				Recycle Re-use
#3				Recycle Re-use
#4				Recycle Re-use
#5				Recycle Re-use
#6				Recycle Re-use
#7				Recycle Re-use

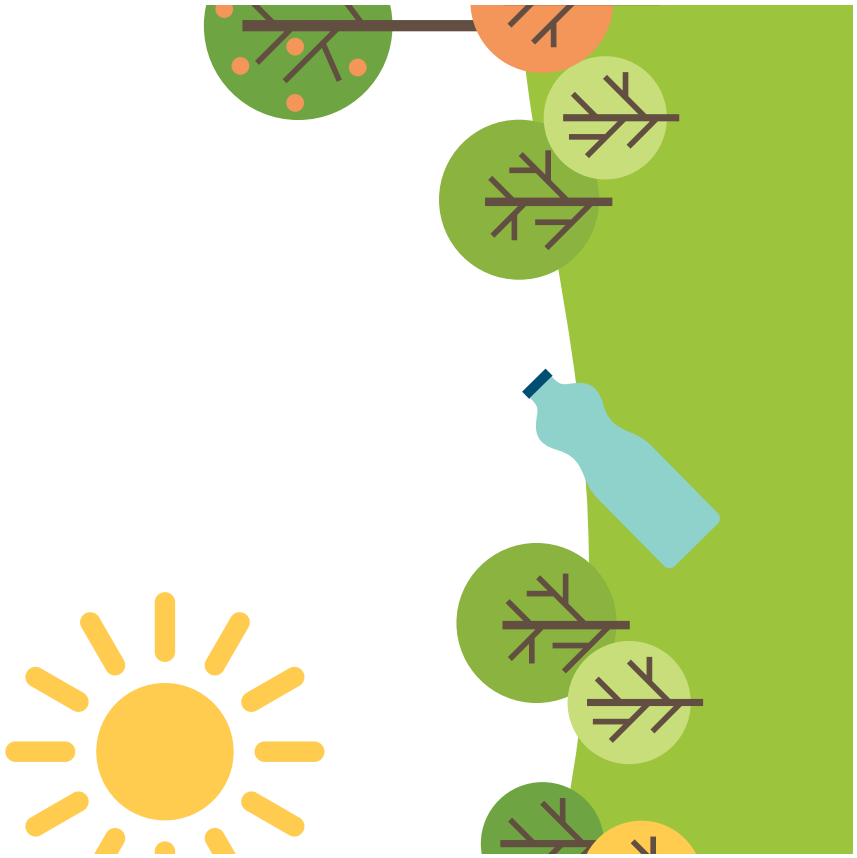
Landfill



Recycle



Water Litter

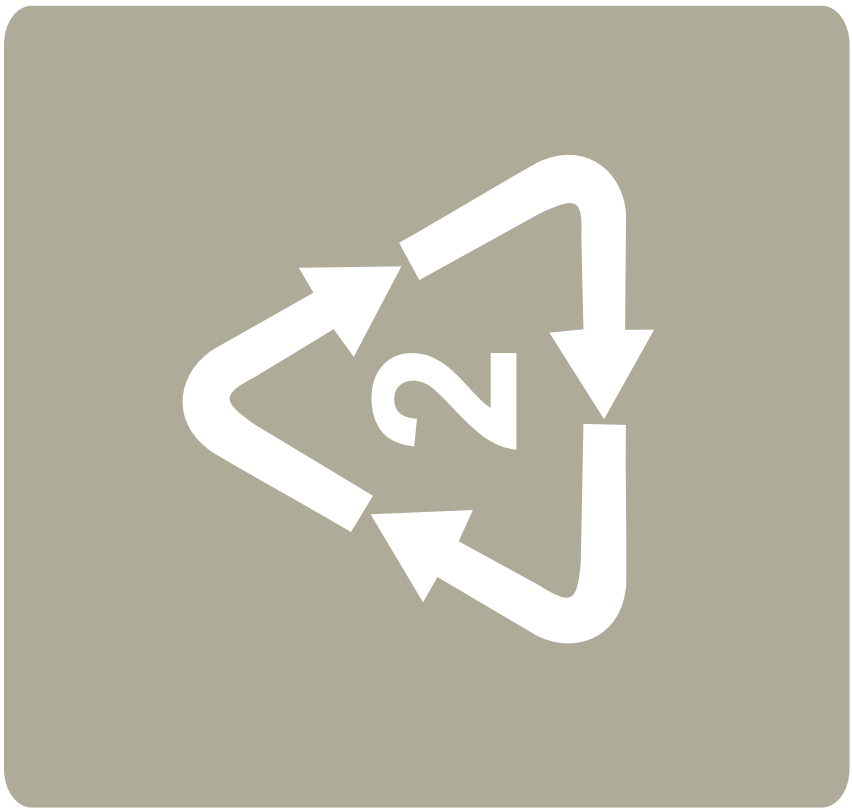


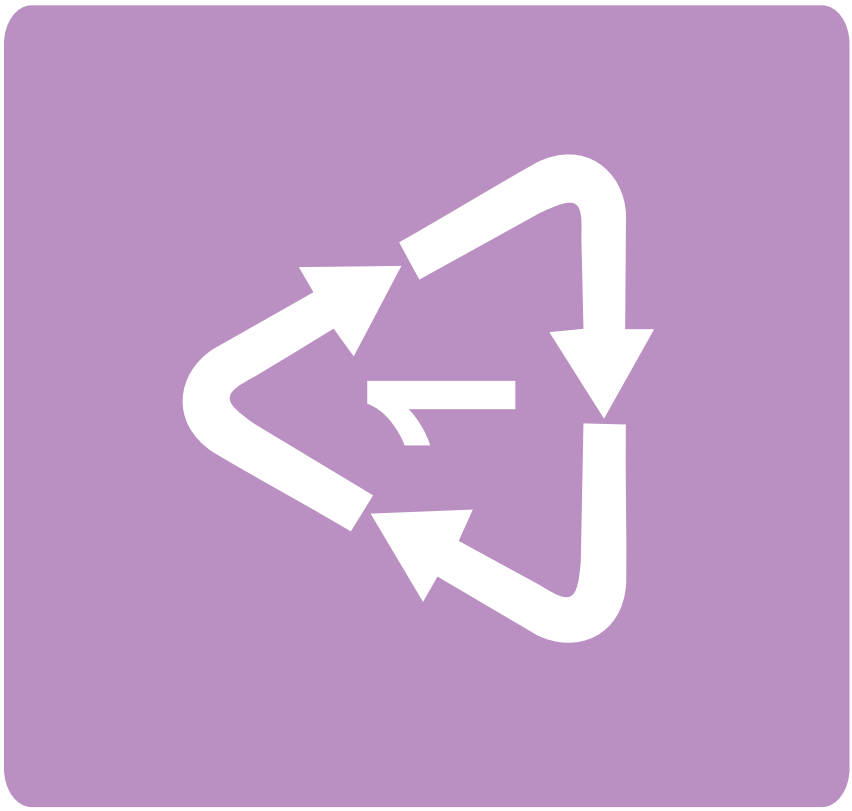
Land Litter

Appendix B

Re-use

Appendix C





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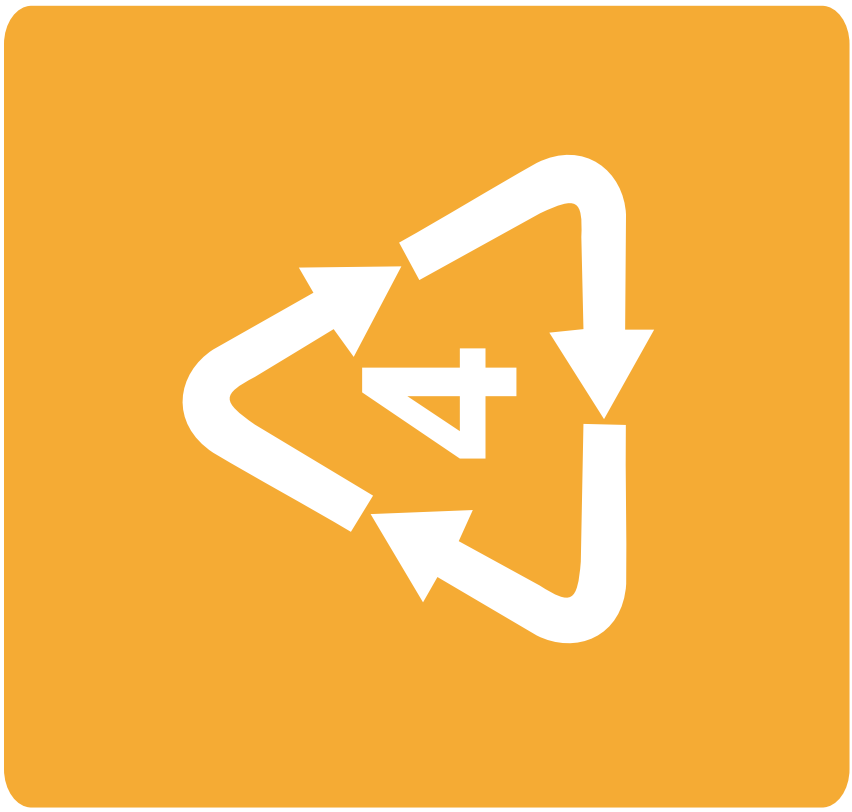

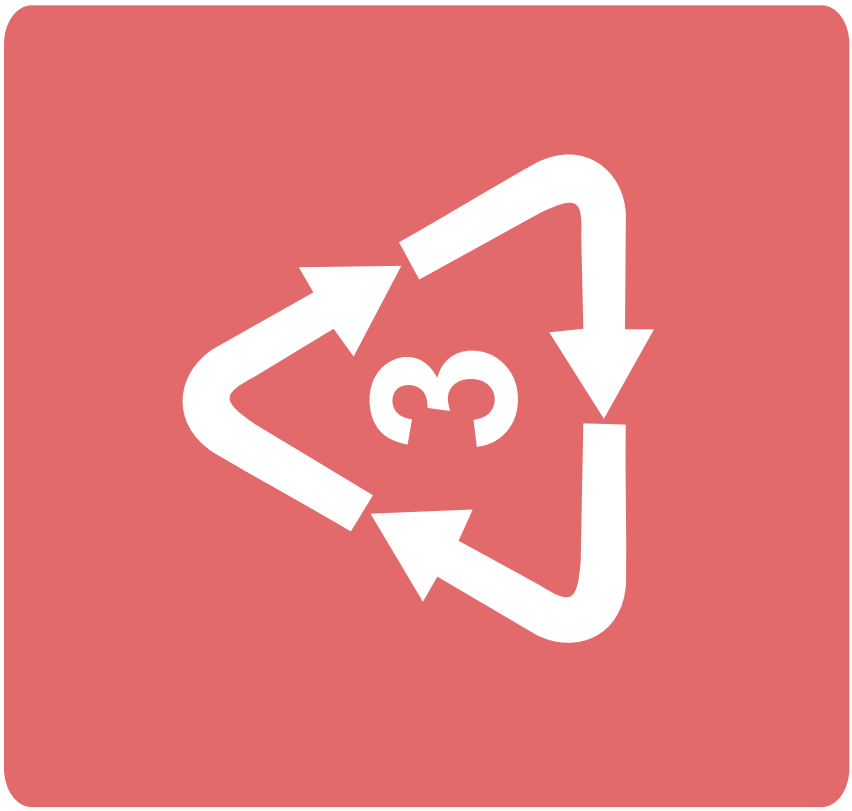

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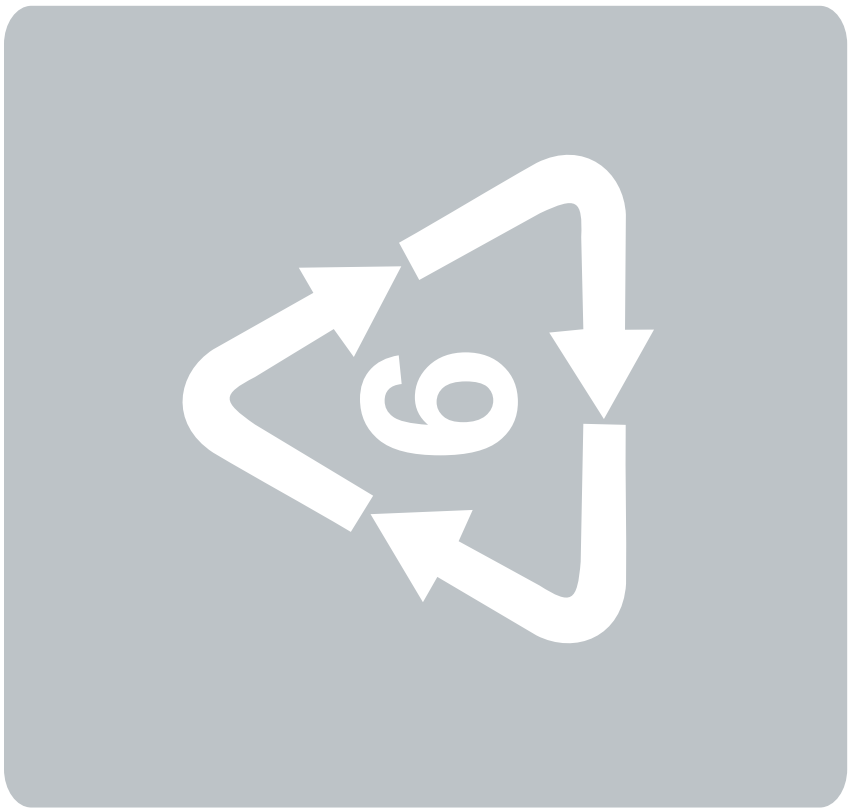

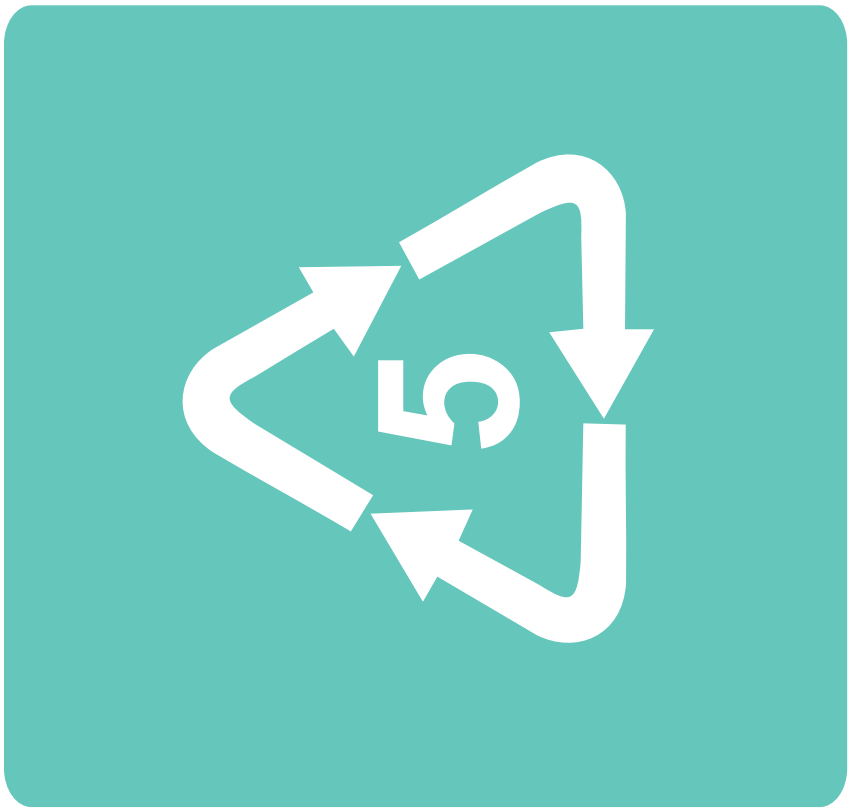

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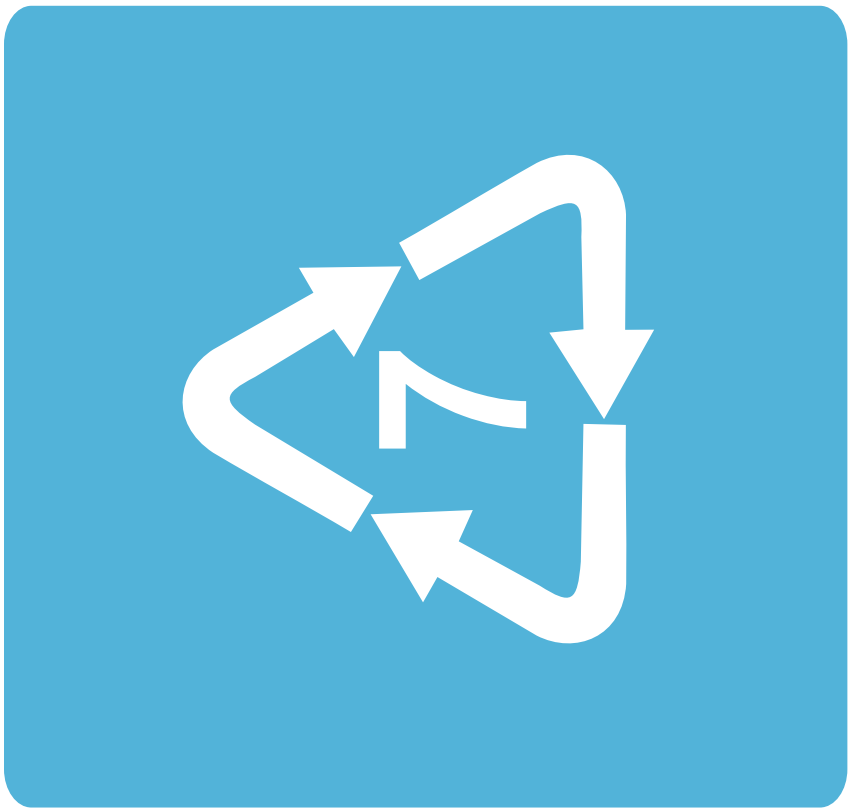


Module 4

Reduce, Re-use, Recycle

BY JENNIFER HENDERSON

Module Introduction

MODULE SUMMARY

In this module, youth will use the techniques of real-life recycling facilities to sort and separate different materials (**Activity A**). They will use their engineering design skills and re-use a plastic item to create something new (**Activity B**). After sorting materials using their physical properties, youth can recycle the paper they collected into new sheets in the optional activity.

Total lesson time needed for Module 4: **45–80 minutes**

MODULE FOCUS

Learning Objectives	• Youth will understand that some materials are re-usable. • Youth will understand that materials can be recycled and used again for the same purpose **or** a different purpose. • Youth will understand that some materials cannot be recycled.
Science & Engineering Practices	• Youth will engage in the following NGSS Practices: developing and using models; constructing explanations and designing solutions; obtaining, evaluating, and communicating information.

MODULE FOCUS *(CONTINUED)*

Concepts & Vocabulary

Incorporate and define vocabulary & concepts organically throughout the lesson. Check for understanding periodically to reinforce concepts. Encourage youth to use new terms.

- **Recycle:** collecting old material and processing them to make a new material or object.
- **Re-use:** finding a way to use materials again.
- **Property:** an attribute or quality of an item; how it looks, tastes, feels, sounds; qualities that can be observed or measured.
- **Magnetic:** attracted to or repelled by a magnet.
- **Floatation:** rises to the surface of a liquid.

Facilitator Preparation

BACKGROUND INFORMATION FOR THE FACILITATOR

Everyday objects can be made from one or more different materials. Materials such as metal, wood, glass, and plastic each have properties that are useful in many different applications. Some of the materials we use come from renewable or sustainable resources, others are nonrenewable. To lessen the negative impact of using nonrenewable resources, we can focus on responsible material usage through the three R's: **Reduce**, **Re-use**, **Recycle**.

Reducing is minimizing material waste produced by limiting initial consumption and the amount thrown away. **Re-using** is finding a way to use materials again instead of throwing them away. **Recycling** is collecting unwanted materials and processing them to make new materials. Each "R" contributes toward environmental responsibility, resource conservation, pollution reduction, and economic savings.

Examples of **reducing material waste**:

- Minimize consumption of materials, only purchase what is needed
- Buy things in bulk to reduce packaging waste
- Repair items instead of throwing them away
- Use all paper including both sides before recycling

Examples of **re-using materials**:

- Shop with re-usable cloth sacks
- Pack lunches and store food in re-usable plastic or glass containers or a lunch bag
- Donate or sell unwanted clothes, toys, furniture, etc.
- Use dishes, cups, and silverware that can be washed and used again

Examples of **common recyclables** and **how to recycle them**:

- Common recyclables include: paper, cardboard, metal cans, glass, and plastic
- Most schools and city communities have programs and designated bins that accept these items for recycling
- Most recyclable items are marked with a "recycle" symbol
- Some communities only recycle certain types of plastics — plastics can be identified by the number stamped on the item

Knowing which materials can be reduced, re-used, or recycled and practicing these habits will reduce negative impact on the land, water, air, and other living things around us.

PREPARING TO TEACH THIS MODULE

Estimated prep. time:	**15 minutes** for activity set-up
What to prepare:	**Activity A** • Adult leaders can pre-cut the newspaper, straws, and aluminum foil ahead of time, if desired. • Fill the rectangular cake pan (or water container) with water. • Note any safety hazards — for example, youth should not eat or drink any of the materials used in this activity. • Print and cut out the flashcards in **Appendix A** (or use real-life examples if able). • Consider how you will divide youth into pairs or small groups. [1]

[1] SciGirls
Girls benefit from collaboration, especially when they can participate and communicate fairly.

Activity B

- Rinse out and allow juice pouches to dry completely.
- Watch YouTube tutorial or read instructions on how to make re-usable pouch/wallet: https://youtu.be/LzwNwDEa-m0
- Make a sample pouch.

MATERIALS LIST FOR MODULE 4

Activity A:

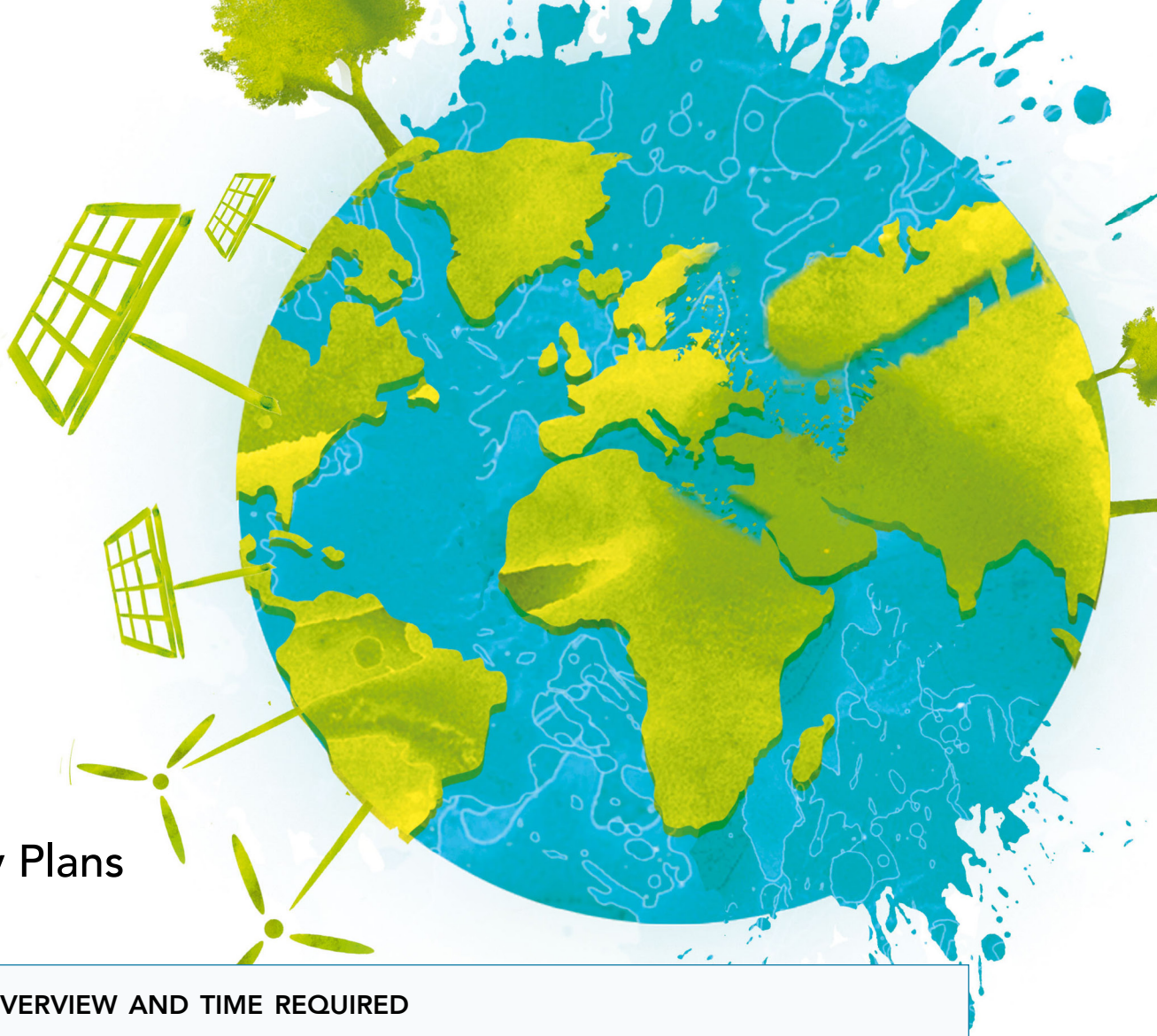
For each youth (or small group):

- ☐ Newspaper, about 2x2 inches, cut into 2–5 pieces of various sizes
- ☐ Plastic drinking straws or coffee stirrers, cut into 2–5 pieces of various sizes
- ☐ 5 metal paper clips, about 1 inch in length
- ☐ 1 magnet
- ☐ 1 piece of window screening (about 9x12 inches), mesh strainer, or slotted spoon
- ☐ 1 plastic dish pan or rectangular cake pan (9x13) or other container than can fit the mesh strainer inside (if using mesh strainer or slotted spoon)
- ☐ Water
- ☐ Blunt-end scissors

Activity B:

For each youth:

- ☐ 2 rinsed and dried plastic juice pouches (such as Capri Sun®) per youth
- ☐ Duct tape or stapler
- ☐ Small piece of self-adhesive hook-and-eye fastener, such as Velcro®
- ☐ Blunt-end scissors



Activity Plans

ACTIVITY OVERVIEW AND TIME REQUIRED

As a facilitator, plan to **arrive 15–20 minutes early to set up the lesson materials**.

Activity A: The Recycling Factory:	20–30 minutes
Activity B: Be a "Re-Use" Engineer:	20–40 minutes
Reflection on Module 4:	5–10 minutes
Total Lesson Time:	45–80 minutes

Activity A: The Recycling Factory

OVERVIEW

In this activity, youth will sort and separate materials based on their properties, just like a real-world recycling facility.

MATERIALS FOR ACTIVITY A

See page 6 for list of materials.

GETTING READY

- Fill the rectangular cake pan (or water container) with water.
- Create a pile of the printed flashcards from **Appendix A**.
- Divide youth into groups of 2 or 3.
- Distribute materials for each group (listed on **page 6**).
- Explain any safety hazards — for example, youth should not eat or drink any of the materials used in this activity.

OPENING QUESTIONS AND PROMPTS

- Have youth consider what they do with items after using them. Some example questions might include:
  - What do you do when you're done using an object and no longer need it?
  - What do you do with waste materials?
  - Do you think there is a "best" thing to do with an object?

Facilitator Tip
Help students discover that whenever possible, it is "best" to reduce the amount of trash we throw away. Examples of how to do this include first using re-usable items (like a refillable water bottle), second, recycling when possible, and then finally disposing in landfill as the final option.

OPENING QUESTIONS AND PROMPTS *(CONTINUED)*

- Individually, in small groups, or together as a class, have children sort the flashcards in Appendix A into "Recycle" or "Garbage" categories. For items that end up in the "Garbage," ask youth if it's possible to re-sort any of the items into a "Reduce" or "Re-use" category. How would they do this?
- In the activity, youth will use the same techniques as real-life recycling facilities to sort materials that end up in the "Recycle" category.

"I Wonder" Board
This is a good place to use the I Wonder Board to find out what "wonders" children have about what happens at a recycling factory: What do they know (or think they know) about recycling? What do they wonder about?

PROCEDURE (EXPERIENCING)

- Have youth cut the newspaper, plastic drinking straws, and aluminum foil (if not already completed by adult leader).
- Have youth roll pieces of newspaper into small balls. Place these items mixed together on the sheet of window screening (or other filtering material) in a single layer.
- Youth should first slowly move the magnet over the items. The magnet may need to be brought very close to the objects. Collect any items picked up by the magnet into a small pile on the side. Be sure to emphasize that the items that were picked up are **magnetic**.

Science Journals
Have youth to write down or draw the items collected by each method in their science journals. If youth struggle with writing skills, adults may record their observations for them or youth may draw pictures.

Using Math
Count the number of items removed in each separation method.

- Take the remaining objects on the screen and carefully lower the screen into the water container so it is fully submerged. Youth should collect any items that are floating on the surface of the water and place into a second pile. Emphasize that **floatation** or **floating** is a specific property.
- Lift the screen from the water and place any remaining items into a third pile.

PROCEDURE (EXPERIENCING) *(CONTINUED)*

- If you have Internet access, show the video to the group:
  Reading Rainbow: How Trash is Recycled with LeVar Burton
  https://www.readingrainbow.com/video-field-trips
  (search by title)
  or YouTube at: https://youtu.be/w1l8HXa3HLk
- Explain that this video will be a trip to a recycling factory, so that we can see a real recycling factory in action! Ask children to watch for the different types of materials that are handled at this factory.

SHARE/PROCESS/GENERALIZE: ACTIVITY A

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
  - **How do you recycle at your home or apartment?** Talk about the differences within the community, for example some children may live in apartment buildings with a different system than children who live in single-family homes with a curbside bin.
  - **What items at home can be recycled?** If youth are unsure, talk about what items they place in recycling bins (or items they could place there). Be sure to consult with local recyclers in your area for helpful tips and diagrams.
  - **When you recycle an item, do you sort the material or does the city sort it?** In some cities, recycling may be single-sort (all in one bin), in others, recycling may be sorted before the city collects it.
  - **Are there ways that we can re-use these items in a different way?** Provide examples of used materials (such as empty cereal boxes, metal cans, or newspaper). Do we know if these items can be recycled?
  - **What happens to items we don't or can't recycle? Where do they go?** For example, depending on your city's recycling codes, certain types of plastics (# 1–7 in the "recycling triangle" imprinted on many plastic items) may not be accepted through the recycling stream.

Science Journals
Have youth to write down or draw, in their own words, what the three R's are and what they mean.

Activity B: Be a "Re-Use" Engineer!

OVERVIEW

In this activity, children have the opportunity to re-use a plastic item for something new.

MATERIALS FOR ACTIVITY B

See page 6 for list of materials.

GETTING READY

- Distribute materials for re-use wallets (see **page 6** for details about preparing materials).

OPENING QUESTIONS AND PROMPTS

- Begin a discussion on how we can re-use items instead of throwing them away. Some example questions might include:
  - Can the things we throw away in the trash can be useful?
  - Can we do something with these items instead of throwing them away?
- Challenge youth to think of ways they can re-use items. Examples of items that can be re-used:
  - Plastic shopping bags (used as a carrier for other items or liners in garbage cans)
  - Empty soda cans or bottles (used as a "piggy bank" or a flower pot)
  - Larger items like car tires (used as a tire swing or filled with dirt to make a gardening container)

PROCEDURE (EXPERIENCING): ACTIVITY B

- Youth will now have the opportunity to create a new item using plastic "trash."
- Adult leaders can show youth a previously made sample item and describe how it is made.
- Wallets can be made from two juice pouches with stapled or taped sides. A small piece of self adhesive hook and eye type fastener, such as Velcro®, can be used to secure the flap closed. Use the following instructions to make a wallet (see **Appendix B** for visual instructions):

    1. *(Adults should do this as a preparation step)* Rinse out juice pouches by cutting a hole in the bottom and washing the inside. Make sure it is completely dry before making the wallet.
    2. On one of the pouches, cut along the end of the curved label on the pouch, making one end of the pouch a semicircle.
    3. Place the two pouches on top of each other, with the non-label side facing you, making sure that the non-cut pouch is on the bottom and the cut pouch is on top. Line them up so that you can see the bottom half of the non-cut pouch, and the semicircle edge is on the very top.
    4. Fold the bottom un-cut half up towards the semicircle half.
    5. Connect the two pouches together by stapling the sides. You should place approximately four staples per side and make sure not to staple too close to the edge to ensure it is properly intact. Make sure that before you staple, the pouches are properly folded.
    6. Once stapled, there should be a semicircular flap. If necessary, staple the semicircular flap with itself to close the opening.
    7. Place the adhesive side of a piece of Velcro® on the top edge of the semicircle and place another piece of Velcro® on top of that (so the pieces are fastened together, and the other strip's adhesive side is facing outward). Fold down so the top of the pouch so that the other piece of Velcro® can be stuck on the other side of the pouch. Make sure that the semicircle has the label facing the outside when folded down.

- Encourage youth to make modifications or add additional features to their item 4

4 SciGirls
Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.

SHARE/PROCESS/GENERALIZE: ACTIVITY B

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **How can you use your new wallet?** Ask if youth added any modifications or ask if they have ideas on how to modify or expand their item (for example, adding an additional pocket for small items/change).
    - **How can you re-use other items for a new purpose?** Some examples of materials could be plastic shopping bags, empty soda cans or bottles, other disposable items.

Wrap Up

ENSURE CONCEPT UNDERSTANDING

Concept and Term Discovery

At this point, it is important to ensure that the terms **reduce**, **re-use**, **recycle**, and **property** have been introduced or discovered by the youth. The goal is to have the youth discover terms and concepts on their own. It may be helpful to have students explore properties by describing those used in this activity, such as **magnetic** and **floatation**. Be sure to have students explain how they knew whether or not a material exhibited a certain property.

Common misconceptions often occur around:

- Whether or not materials float if the object initially sinks but then floats to the surface.
- The belief that all metal objects are magnetic.

REFLECTION

Reflecting on experience is an essential part of learning and "making meaning of" an experience. Now is an opportunity to bring the children together and discuss the things they experienced throughout the module.

Facilitator Tip: *Circle Share*
You may want to use a "circle share" process to facilitate this discussion. Have children sit in a circle with you. Use a soft tossable object, such as a small toy as a "talking stick" object. Model to the children that you will ask a question, give them time to think quietly, then give your response while holding the "talking stick." You then gently toss the object to the next person for their turn to share. If you prefer, simply pass the object around the circle in order, eliminating the "toss" aspect.

- Some general reflection questions you can ask the children include:
    - What is something new you learned in this module?
    - Did you try something that you've never done before?
    - How were you a scientist or engineer today?
    - What questions did we explore the answers to? What questions do we still have?

"I Wonder" Board
If used, refer to your wonder board for this module — what questions did you explore the answers to? What questions do you still have?

SCIENCE & ENGINEERING IN EVERYDAY LIFE — CONCEPT APPLICATION

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.

The **Science At Home** activities are possible extension activities that can be used with your group as time/interest allows. You might also look to your "I Wonder" Board for questions you'd like to explore further. If you meet multiple times, you might invite children to do a take home activity or investigate an "I Wonder," and have them report back or bring in an item as described. This helps support application of the concepts you've explored in this module.

SCIENCE AT HOME ACTIVITY

Science At Home is a handout for you to copy and send home with the children. The handout gives a brief summary of the module and provides several activity ideas. It encourages families to engage in science learning together, supporting application of the concepts. Make one copy per child, or you may email the activity if you prefer.

FEEDBACK

We encourage instructors to collect feedback throughout this module and submit via this evaluation form: **4hpolymers.org/evaluation**

science at home

Be a 4-H Scientist!

Hello Families,

Your child continues to explore science and engineering in the Be a 4-H Scientist! Program. We learned about how to sort materials by their physical properties and about how some materials are reusable and recyclable. We hope you will try one or more of these "Science at Home" activities with your child. This supports your child in practicing the skills and reinforces what they've learned! We hope your child will tell us what you did at our next session! Thank you!

Try these "Science at Home" Activities:

- *Take on Trash Together*
  - What are your family's waste habits? Answer these questions together:
    - What type of bags are used when grocery shopping: paper, plastic or cloth? Are the bags re-used or disposed of?
    - Does your family recycle at home? If so, how many loads (full bin/bag) get recycled each week? If not, why?
    - How many trash bags does your family fill up each week?
    - Does your family drink water from tap or plastic bottles?
    - Are there any items your family re-uses? Which items and for what purpose?
  - Challenge youth to sort and properly dispose of recyclable and non-recyclable waste generated at their home for a week.

- *Recycling Field Trip*
  - Arrange a visit or tour of your local recycling facility.

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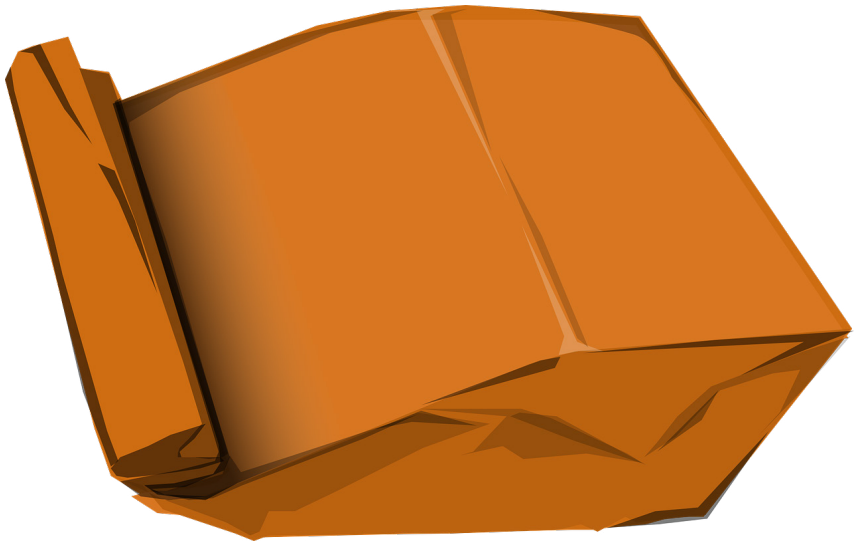
Appendix A



Appendix A


LEMONADE
MADE WITH REAL LEMON JUICE
LEMONADE
MADE WITH REAL LEMON JUICE

Appendix A

Appendix A

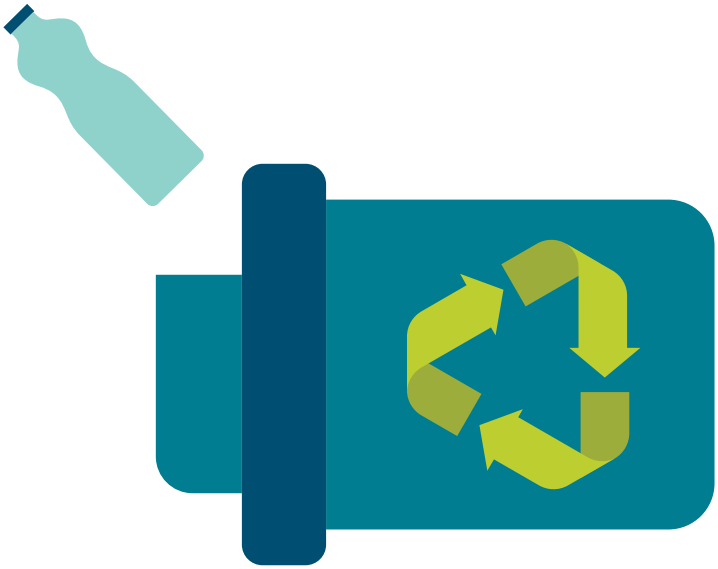

15€*
En bon d'achat
Par tranche de 100 €
Aujourd'hui, ouverture 9h/19h
LEROY MERLIN

Appendix A

Appendix A

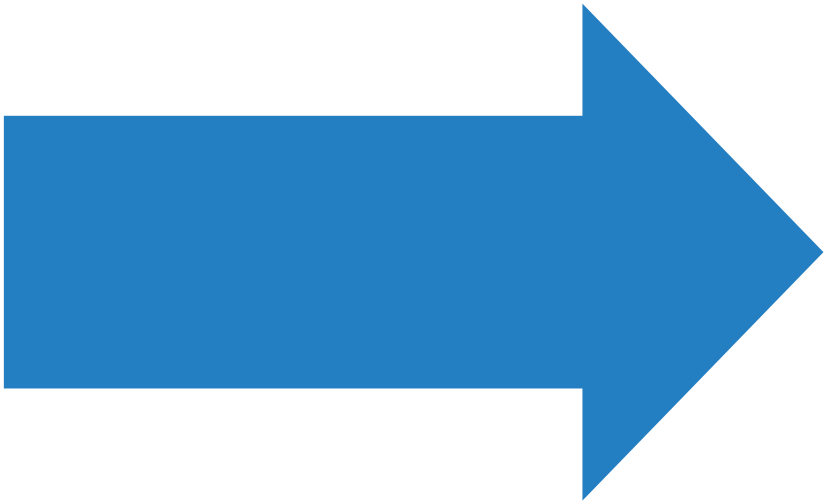
Appendix A

Landfill



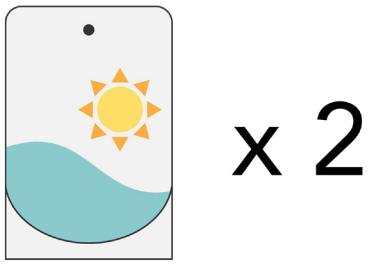
Recycle

Re-use

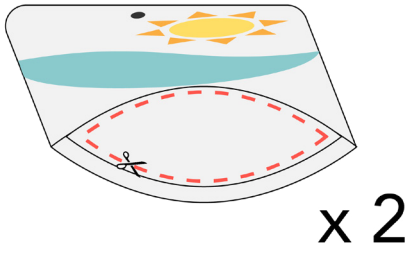


Reduce

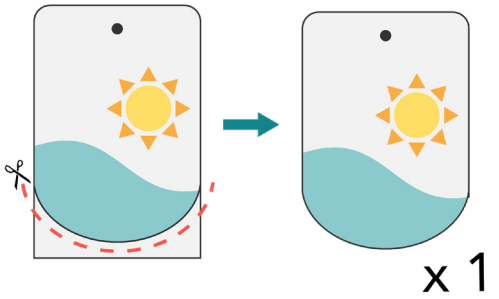
Appendix B



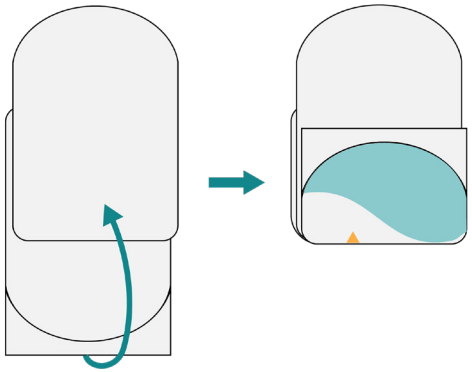
1. Collect 2 juice pouches per child.



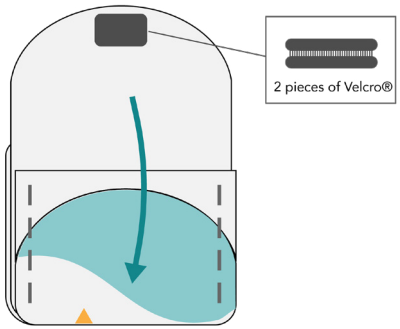
2. (*Adults should do this as a preparation step)* Rinse out juice pouches by cutting a hole in the bottom and washing the inside. Make sure it is completely dry before making the wallet.



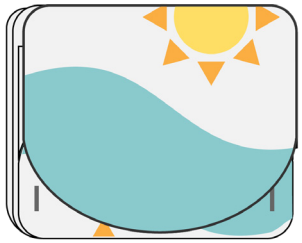
3. On one of the pouches, cut along the end of the curved label on the pouch, making one end of the pouch a semicircle.



4. Place the two pouches on top of each other (label side down), with cut pouch on top. Line them up so that you can see the bottom half of the non-cut pouch, and the semicircle edge is on the very top. Then, fold the bottom un-cut half up toward the semicircle half.



5. Connect pouches by stapling (or taping) the sides. Place approximately 4 staples per side and do not place staples too close to the edges. If desired, staple top flap closed. Place Velcro® on top flap, stick a second piece of Velcro® to the first piece, and fold flap down to adhere to bottom.



6. Once wallets are complete, encourage youth to make modifications or add additional features to their wallet.

Module 5

Renewable vs. Non-Renewable

BY JENNIFER HENDERSON AND ANNE STEVENSON

Module Introduction

MODULE SUMMARY

Activity A is a review activity similar to *Module 2: The many properties of materials*. Youth will explore common materials using a collection of material types. The purpose of this activity is to (re)acquaint youth to different types of materials as well as introduce the concepts of renewable and non-renewable. In **Activity B**, youth will discover some of the problems associated with using non-renewable resources. Youth will experience how difficult it would be to continue using resources that do not replenish after use.

Total lesson time needed for Module 5: **35–60 minutes**

MODULE FOCUS

Learning Objectives	• Youth will learn that some materials are made from resources that can be replenished or grown (renewable). • Youth will learn that some materials are made from resources that are limited (non-renewable).
Science & Engineering Practices	• Youth will engage in the following NGSS Practices: developing and using models; analyzing and interpreting data; obtaining, evaluating, and communicating information.

MODULE FOCUS *(CONTINUED)*

Concepts & Vocabulary

Incorporate and define vocabulary & concepts organically throughout the lesson. Check for understanding periodically to reinforce concepts. Encourage youth to use new terms.

- **Renewable:** a material made from naturally occurring resources that can be replenished, often within one person's lifetime.
- **Non-renewable:** 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).

Facilitator Preparation

BACKGROUND INFORMATION FOR THE FACILITATOR

When we look around at all the different materials we use everyday, one important property we should think about is whether it comes from a **renewable** or **non-renewable** resource. Some materials are made from resources that can be replenished or grown while other materials are made from resources that are limited. A resource is considered non-renewable if it can't be regenerated or takes thousands of years to generate. To help youth understand regeneration, it may be helpful to use the examples of paper from trees and plastic from oil. A new tree can grow within a few years and can then be cut down and made into paper products. People can use trees and replant new ones in order to make the paper products we need. Oil forms from prehistoric fossils over long periods of time (this could take millions of years!). Once we collect the oil to make plastic products, we are unable to create new oil to replace what we used.

Renewable material: a material made from a naturally occurring resource that can replenish itself to overcome usage or consumption (wind, water, sun, or living organisms) with proper use and management.

Examples of renewable materials:

- Plant or animal based materials (lumber/wood, paper, leather, etc.)
- Bio-based polymers/plastics (similar to traditional plastics but made from resources like corn or sugar)

Non-renewable material: a material made from resources that are only available in limited quantities or take too long to regenerate. Because they take a very long time to form, these resources will deplete faster than the time it takes for regeneration. Even with proper use and management, non-renewable resources will not replenish fast enough to sustain substantial consumption. These materials are considered non-renewable.

Examples of non-renewable materials:

- Fossil fuel based materials (from oils, natural gas, coal, etc.)
    - Gasoline
    - Most plastics
    - Styrofoam
- Mineral and metal based materials (from copper, iron ore, gold, diamonds, etc.)
    - Steel
    - Wire and cable
    - Electronics (gold connectors)

BACKGROUND INFORMATION FOR THE FACILITATOR *(CONTINUED)*

Determining if a material is renewable or non-renewable can be difficult. Some materials might be made using both renewable and non-renewable resources. There are some materials made from non-renewable resources (like aluminum cans) that can be properly recycled and used again.

PREPARING TO TEACH THIS MODULE

Estimated prep. time:	**15 minutes** for activity set-up
What to prepare:	**Activity A** • Gather items for each group (see **page 6** for list of items) • Note any safety hazards of items, such as fragile items or choking hazards. • Consider how you will divide youth into pairs or small groups. 1 **Activity B** • Adult leaders should hide one type of resource around the room. Resources can be hidden individually or in small piles (e.g. some locations are more abundant). **Note: youth should not be present while hiding objects.** • Create a chart on poster paper or a chalkboard/ dry erase board (create one column of "Round Number" and one column of "Objects Found").

1 SciGirls
Girls benefit from collaboration, especially when they can participate and communicate fairly.

MATERIALS LIST FOR MODULE 5

☐ Small collection of objects (can be re-used from Module 2) such as:

- cotton balls or fabric squares
- paper clips, keys, aluminum foil
- wooden items/craft sticks
- plastic items

Aim for 5–10 items per youth or small group. Be sure to include examples of objects made from renewable and non-renewable resources.

☐ Two varieties of resources; one renewable and one non-renewable variety

20–30 of each one for groups of <10 youth
30–40 of each one for group size of ~ 20 youth

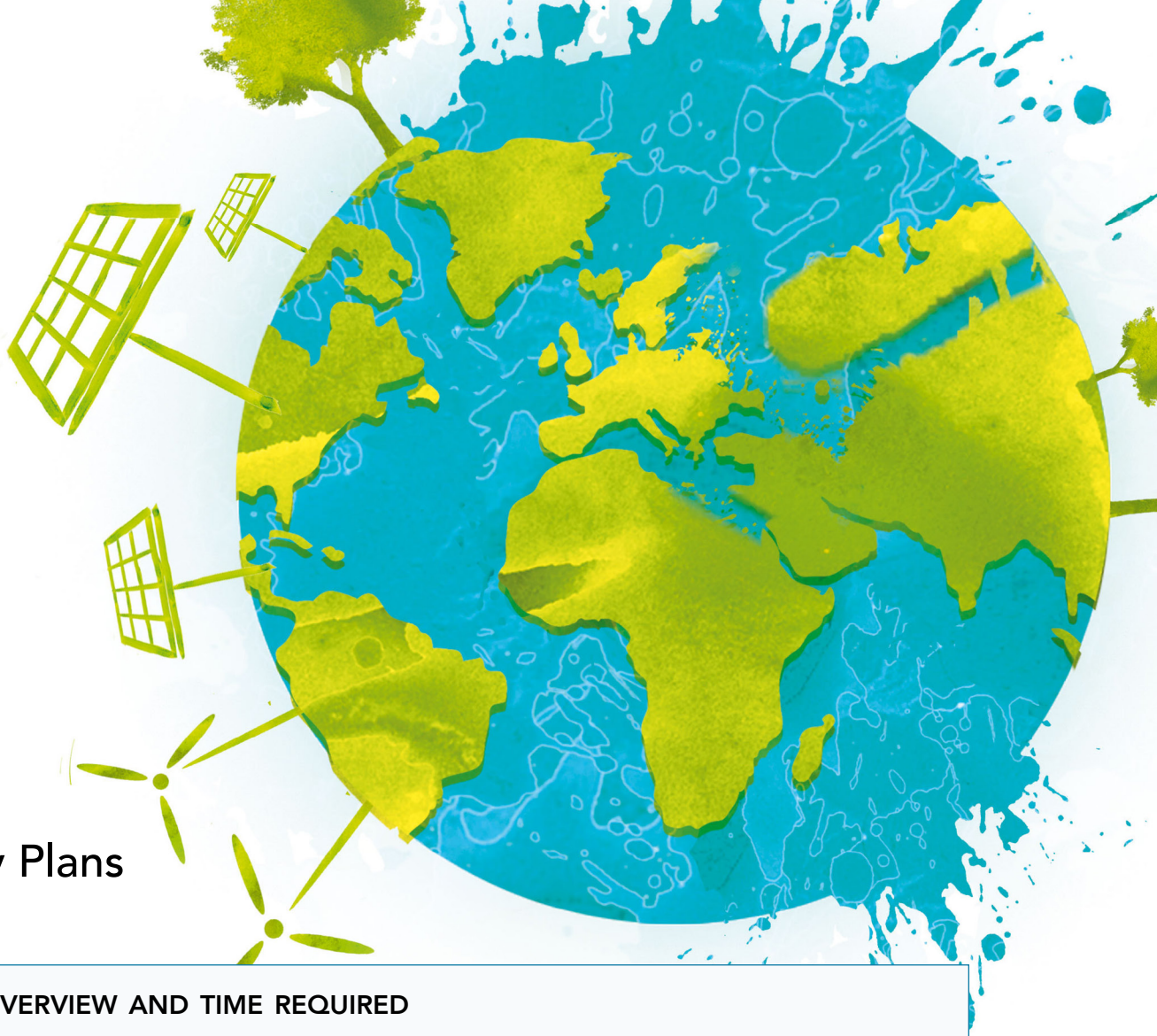
Examples include:

Non-renewable: Pennies
Renewable: Cotton balls

Non-renewable: Plastic poker chips
Renewable: Wooden craft sticks

☐ Optional after-activity discussion: Read a storybook about renewable resources such as:

- *America at Work: Forestry* (Jane Drake and Ann Love, 2002)
- *Be a Friend to Trees* (Patrica Lauber, 1994)
- *Trees to Paper* (Inez Snyder, 2003)
- *Johnny Appleseed* (Jodie Shepard, 2010)
- *Just a Dream* (Chris Van Allsburg, 2011)
- *The Lorax* (Dr. Seuss, 1971)



Activity Plans

ACTIVITY OVERVIEW AND TIME REQUIRED

As a facilitator, plan to **arrive 15–20 minutes early to set up the lesson materials**.

Activity A: Sorting Materials:	10–20 minutes
Activity B: Mining for Materials:	20–30 minutes
Reflection on Module 5:	5–10 minutes
Total Lesson Time:	35–60 minutes

Activity A: Sorting Materials

OVERVIEW

Youth will explore common materials using a collection of material types. The purpose of this activity is to acquaint youth to different types of materials as well as introduce the concepts of **renewable** and **non-renewable**.

MATERIALS FOR ACTIVITY A

See page 6 for list of materials.

GETTING READY

- Divide youth into groups.
- For each youth or group, provide a random selection of items on a table or workspace (see items on **page 6**).
- Explain any safety hazards — for example, youth should not eat or drink any of the materials used in this activity.

OPENING QUESTIONS AND PROMPTS

- Ask youth to think about what they would do if they run out of something they need. Some example questions might include:
  - What would you do if you needed a new piece of paper to draw on?
  - What would you do if you needed to put more gas in a car?
- Continue to move "backward" by asking students where items come from. Some examples might include:
  - Piece of paper < package of paper in the classroom < the store to buy the package of paper < the store gets the paper from the paper making factory < the factory uses wood to make the paper < the wood comes from trees in the forest
  - Gas - go to the gas station < the gas station gets the gas from the gas/oil company < the oil company gets the oil to make gas from drilling in the ground

OPENING QUESTIONS AND PROMPTS *(CONTINUED)*

- When youth have go "backward" to identify the source of a material, have youth think about what would happen if they needed more of that source. For example, how would you get more trees? How would you get more oil?

Science Journals
Have youth draw something renewable and non-renewable in their science journals. If it's renewable, be sure to have them draw what came before that. (e.g.: *paper* comes from *trees*)

PROCEDURE (EXPERIENCING)

- Using the objects provided, have youth sort items into groups based on the source material (the material these objects are made from). Examples include:
  - **Plants**: cotton fabrics, wooden items
  - **Metals/minerals**: paper clips, keys, aluminum foil
  - **Petroleum/oil**: plastic items
- Explain that objects we use everyday come from materials and resources obtained from the Earth. Youth may easily understand the source materials for some objects (e.g. wooden objects from trees) but may need to be told about the sources of other objects (e.g. plastic items come from petroleum/oil mined from the ground).
- Introduce the term **renewable**. Use examples of objects that come from living resources such as plants. Explain how these resources can regrow to create new starting material or use resources that are unlimited (like wind or solar energy).
- Introduce term **non-renewable**. Explain to youth how these resources take many years to form and can't be replaced over our lifetimes. Explain how oil/gas forms from fossilized plants and animals that take many millions of years to develop (you may begin by asking students how long does it take for a fossil to form).

SHARE/PROCESS/GENERALIZE: ACTIVITY A

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **Are there items in the "non-renewable" pile that can be replaced with items from the "renewable" pile?** Have youth look at the items in the front of them that are sorted into "renewable" and "non-renewable." If there are non-renewable items that youth can't think of a substitute for, have youth think of ways to re-use the items in a different way.

Activity B: Mining for Materials

OVERVIEW

In this activity, youth will "mine" for resources. After each round, as resources are depleted, resources will be much more difficult to find. To simulate a renewable source, resources will "replenish" after each round.

MATERIALS FOR ACTIVITY B

See page 6 for list of materials.

GETTING READY

- Adult group leaders should hide the non-renewable resource around the room (**Note: youth should not be present while hiding**). Resources can be hidden individually or in small piles (e.g. some locations are more abundant).
- Create a chart on poster paper or a chalkboard/dry erase board (create one column of "Round Number" and one column of "Objects Found"). For each round, have the youth chart the number of objects they found. Use this chart to discuss the activity.

OPENING QUESTIONS AND PROMPTS

- Begin a discussion about renewable and non-renewable resources. Some example questions might include:
  - Is it important to use renewable materials and resources?
  - Why might it be important? (Examples: renewable resources never run out, might be free to collect, won't harm the environment as much.)

"I Wonder" Board
This is a good place to use the I Wonder Board to find out what "wonders" children have about renewable resources and where materials come from. What do they know (or think they know)? What do they wonder about?

PROCEDURE (EXPERIENCING): ACTIVITY B

- Adults should hide the non-renewable resource around the room (in this example, the resource will be pennies). Do not tell the youth whether this resource is renewable or non-renewable.
- Explain to youth that all the objects we use everyday come from materials and resources obtained from the Earth. In order to make useful objects, we must collect these resources as starting materials. Hidden around the room are the resources we need. It is the youths' job to locate and "mine" these materials so they can be used. (Explain parallels between mining for coal to use for energy or mining for metals to use for things like cans) 3

3 SciGirls
Girls enjoy hands-on, open-ended projects and investigations.

- Give youth 5 seconds to locate and collect as many pennies as possible. These pennies will be kept in a separate pile.

Using Math
Throughout this activity, after each round help youth count how many objects were collected and record them on the chart.

- Without replenishing the hidden pennies (non-renewable resource), allow youth another round of 5 seconds to locate and collect more pennies. Count and record pennies collected.
- Repeat search procedure for an additional 1–2 rounds of 10 seconds. This concept can be used to illustrate how even with additional time, resources are still hard to collect. Count and record pennies collected.
- Have youth compare how many pennies were collected in the first round compared to those found in later rounds.
    - Was the task easier or more difficult?
    - Why was it hard to find more pennies in the later rounds?
- Adults should hide the renewable resource around the room (in this example, the resource will be cotton balls). Note: youth should not be present while hiding.
- Explain to youth that the first resource, pennies, represented an non-renewable resource. Once that resource was collected, the source did not replenish itself. Add in a real-life example of a non-renewable resource here to help youth understand the objects represent something else. The cotton balls now represent a renewable resource, one that does replenish itself over time. Add in a real-life example of a renewable resource here to help youth understand the objects represent something else.
- Give youth 5 seconds to collect cotton balls. At the end, have youth count and record cotton balls collected.

PROCEDURE (EXPERIENCING): ACTIVITY B *(CONTINUED)*

- Adults should re-hide these balls before the start of the next round.
- Allow youth another 2–3 rounds of 5 seconds to locate and collect more balls. After each round, count the number of balls collected. Re-hide any balls located before beginning the next round. Add the numbers to the chart for 3 or 4 rounds.

6 SciGirls
Girls gain confidence and trust their own reasoning when encouraged to think critically.

- Have youth compare how many balls were collected in the first round compared to those in later rounds. 6
  - Was the task easier or more difficult than last time?
  - What was different between trying to find the pennies versus trying to find the cotton balls?

SHARE/PROCESS/GENERALIZE: ACTIVITY B

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
  - Share with youth a story about trees (one option would be to read aloud a storybook listed in the materials or adults can create their own story).
  - **Why is it important to ensure that resources, such as trees, are replenished?** Have youth consider what would happen if people didn't plant/replant trees or seeds (e.g. there wouldn't be any more trees to use for wood or food to eat).
  - **Why it would be important to make sure resources (like trees) are replenished?** Youth may explain it is important so we can use them again in the future.
  - **How can you use renewable resources in your life?** You can guide youth by asking them what renewable alternative could be used to replace non-renewable option. Examples include: using cloth or paper bags instead of plastic bags, using glass bottles instead of plastic bottles, using solar energy instead of gas, recycling materials that can be re-used again like metal cans, paper, not wasting water). 2

2 SciGirls
Girls are motivated by projects they find personally relevant and meaningful.

Wrap Up

ENSURE CONCEPT UNDERSTANDING

Concept and Term Discovery

At this point, it is important to ensure that the terms **renewable** and **non-renewable** have been introduced or discovered by the youth. The goal is to have the youth discover terms and concepts on their own. Adults may want to emphasize that even though some materials are non-renewable, they can be recycled to be used again (such as metal cans).

Common misconceptions often occur around:

- Recyclable and renewable being the same or equivalent. In reality, some items can be recycled but are made from non-renewable resources.
- Time scales for renewable/non-renewable. For example, trees may take many years (which may seem like forever from the youths' perspective) to replenish but if managed properly, is considered a renewable resource. It may be helpful to frame these time scales as whether or not they can occur within a person's lifetime.

REFLECTION

Reflecting on experience is an essential part of learning and "making meaning of" an experience. Now is an opportunity to bring the children together and discuss the things they experienced throughout the module.

Facilitator Tip: *Circle Share*
You may want to use a "circle share" process to facilitate this discussion. Have children sit in a circle with you. Use a soft tossable object, such as a small toy as a "talking stick" object. Model to the children that you will ask a question, give them time to think quietly, then give your response while holding the "talking stick." You then gently toss the object to the next person for their turn to share. If you prefer, simply pass the object around the circle in order, eliminating the "toss" aspect.

- Some general reflection questions you can ask the children include:
    - What is something new you learned in this module?
    - Did you try something that you've never done before?
    - How were you a scientist or engineer today?
    - What questions did we explore the answers to? What questions do we still have?

"I Wonder" Board
If used, refer to your wonder board for this module — what questions did you explore the answers to? What questions do you still have?

SCIENCE & ENGINEERING IN EVERYDAY LIFE — CONCEPT APPLICATION

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.

The **Science At Home** activities are possible extension activities that can be used with your group as time/interest allows. You might also look to your "I Wonder" Board for questions you'd like to explore further. If you meet multiple times, you might invite children to do a take home activity or investigate an "I Wonder," and have them report back or bring in an item as described. This helps support application of the concepts you've explored in this module.

SCIENCE AT HOME ACTIVITY

Science At Home is a handout for you to copy and send home with the children. The handout gives a brief summary of the module and provides several activity ideas. It encourages families to engage in science learning together, supporting application of the concepts. Make one copy per child, or you may email the activity if you prefer.

FEEDBACK

We encourage instructors to collect feedback throughout this module and submit via this evaluation form: **4hpolymers.org/evaluation**

science at home

Be a 4-H Scientist!

Hello Families,

Your child continues to explore science and engineering in the Be a 4-H Scientist! Program. We learned about renewable and non-renewable materials and some of the problems associated with using non-renewable resources. We hope you will try one or more of these "Science at Home" activities with your child. This supports your child in practicing the skills and reinforces what they've learned! We hope your child will tell us what you did at our next session! Thank you!

Try these "Science at Home" Activities:

- *Conserving Together*
    - What do you do at home to help use resources wisely? For example, use cloth shopping bag, refillable water bottle, hang clothes on the line outside, or turn off the faucet when you brush teeth. Help your child find an object or story to bring to our next program to share.
- *Make Your Own Bio-Plastic!*
    - Helpful Video: https://youtu.be/xLzal95x5MQ
    - Materials: Ziplock bag, 1 tbs of cornstarch, 2 drops of corn oil, Water
    - Food coloring (optional)
    - Procedure:
        - Combined cornstarch and water in a ziplock bag. Mix by squeezing the bag.
        - Add two drops of vegetable oil. You may also add food coloring.
        - Again, mix the contents by squeezing them together in the bag.
        - Do not fully seal the bag. Microwave on high for 20–25 seconds. Careful! It will be hot!
        - After the plastic has cooled, you can touch and play with your plastic!

Center for Sustainable Polymers

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University of Minnesota Extension Driven to Discover℠

Module 6

Scientists and Engineers

BY ANNE STEVENSON AND STEVEN WORKER

Module Introduction

MODULE SUMMARY

In this module, youth have the opportunity to review how they have acted as scientists and engineers. In **Activity A**, youth review the many things that scientists and engineers do and the skills they use. Through a children's book about engineering, youth further explore the role of engineers. In **Activity B**, children use their creativity to make up their own stories about scientists and engineers.

Total lesson time needed for Module 6: **65–80 minutes**

MODULE FOCUS

Learning Objectives	• Youth will identify who scientists and engineers are and what they do. • Youth will recognize that (or confirm how) they have been acting as scientists and engineers in this curriculum.
Science & Engineering Practices	• Youth will engage in the following NGSS Practices: obtaining, evaluating, and communicating information.

MODULE FOCUS *(CONTINUED)*

Concepts & Vocabulary

Incorporate and define vocabulary & concepts organically throughout the lesson. Check for understanding periodically to reinforce concepts. Encourage youth to use new terms.

- **Scientists:** people who asks questions to learn about the world around them.
- **Engineers:** people who use knowledge to invent, design, or improve a solution to a specific problem.

Facilitator Preparation

BACKGROUND INFORMATION FOR THE FACILITATOR

In modules one through five, children have been engaging in the practices and processes of science: asking questions; collecting data; analyzing and interpreting evidence; developing and using models; planning and carrying out investigations; making inferences and constructing explanations based on data; engaging in argumentation from evidence; and communicating results.

Children are natural scientists and engineers, exploring and changing the world through design, making, and playing. Most children do not realize they do similar things to scientists and engineers but rather think of people in these fields wearing lab coats and using specialized tools. The goal of this module is to help children become aware of the science and engineering they do and begin to personally identify with science and engineering.

While the professional communities of science and engineering often require specialized training and tools, anyone can learn to engage in the processes and practices of science!

PREPARING TO TEACH THIS MODULE

Estimated prep. time:	**15 minutes** for activity set-up
What to prepare:	• For each youth or group, provide a selection of art supplies (see page 5 for **Materials List**). • Note any safety hazards of supplies, such as sharp items. • If doing **Activity B: Option 3**, collect student photos of each youth. • Obtain a children's book on science and/or engineering such as: *Dream, Invent, Create — Engineer the World* (Start Engineering, 2013) *Engineering Elephants* (Emily Hunt, 2010) *Rosie Revere, Engineer* (Andrea Beaty, 2013)

MATERIALS LIST FOR MODULE 6

☐ Art supplies such as:

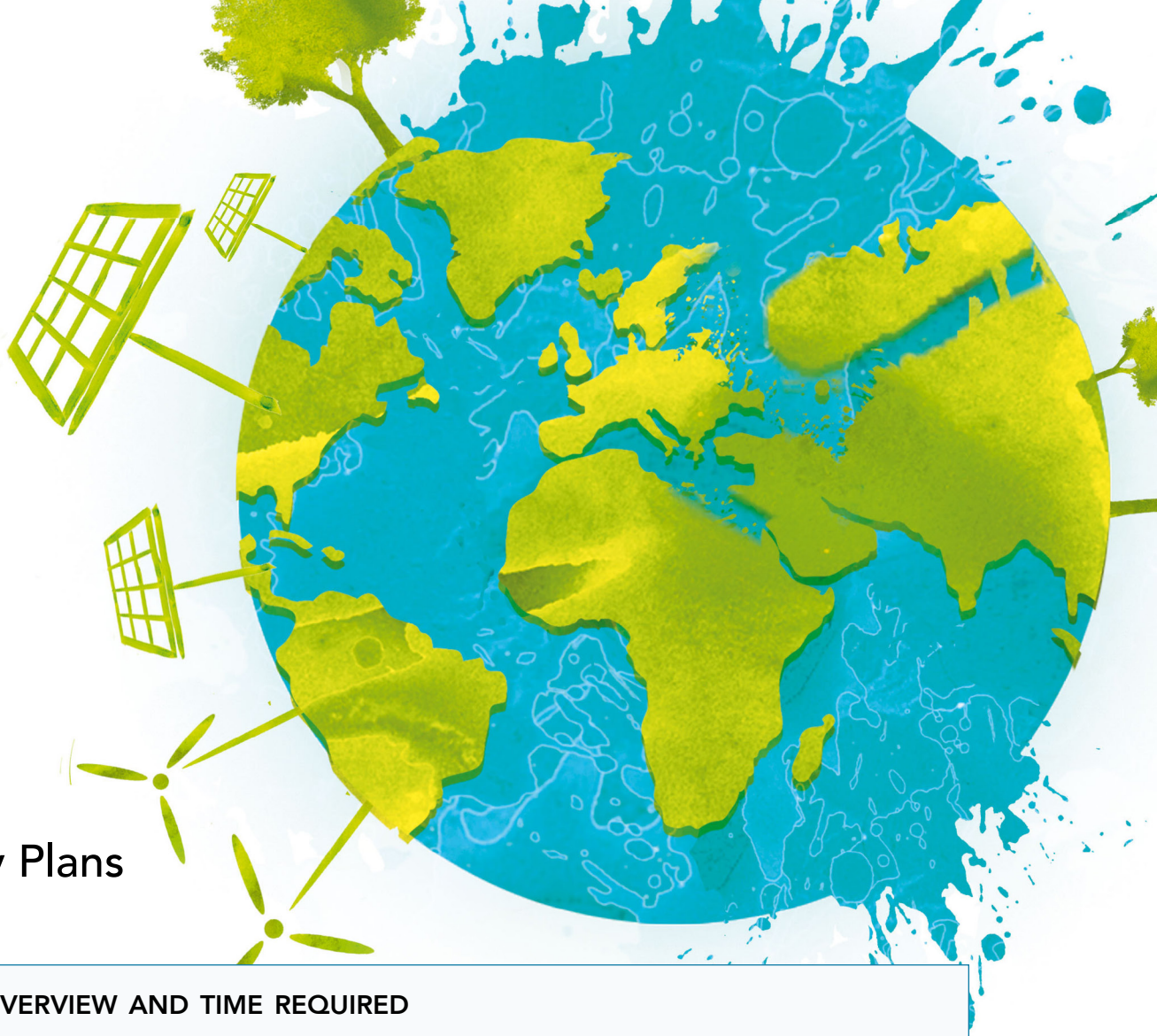
- Scissors
- Glue
- Markers/Crayons
- Construction paper
- Stickers

☐ Poster or butcher paper

☐ Student photos (if doing **Activity B: Option 3**)

☐ Children's book on engineering, such as:

- *Dream, Invent, Create — Engineer the World* (Start Engineering, 2013)
- *Engineering Elephants* (Emily Hunt, 2010)
- *Rosie Revere, Engineer* (Andrea Beaty, 2013)



Activity Plans

ACTIVITY OVERVIEW AND TIME REQUIRED

As a facilitator, plan to **arrive 15–20 minutes early to set up the lesson materials**.

Activity A: An Engineer's Tale:	30 minutes
Activity B: YOU are a Scientist or Engineer!:	30–40 minutes
Reflection on Module 6:	5–10 minutes
Total Lesson Time:	65–80 minutes

Activity A: An Engineer's Tale

OVERVIEW

Children are natural scientists and engineers, with innate curiosity to explore and change the world. The exploration of the world and drive to make and build the environment are similar to the processes and practices of scientists and engineers. This activity helps children realize that they can do engineering and thus, begin to self-identify with the scientific and engineering enterprise.

MATERIALS FOR ACTIVITY A

Children's book on engineering, such as:

- *Dream, Invent, Create — Engineer the World* (Start Engineering, 2013)
- *Engineering Elephants* (Emily Hunt, 2010)
- *Rosie Revere, Engineer* (Andrea Beaty, 2013)

OPENING QUESTIONS AND PROMPTS

- Facilitate a group discussion to get youth thinking about scientists and engineers. Some example questions might include:
  - What do we remember from previous lessons about who **scientists** are and what they do?
  - What skills do they use?
    - Make a list of skills. If needed, see **Appendix A** for a list of science practices for prompt ideas.

"I Wonder" Board
Add questions to the "I Wonder" Board. (e.g. "I wonder if there is a scientist who does __ or an engineer who could solve this __ problem?").

- Explain to youth that they're going to take a look at some of the things **engineers** do, and some of the jobs that engineers might have. You may ask what do youth know, or think they know, about engineers.

Using Math
Create a list and count the number of things they do know about engineers.

PROCEDURE (EXPERIENCING)

7 SciGirls
Girls benefit from relationships with role models and mentors.

- Read the book about engineers aloud to the youth. 7

SHARE/PROCESS/GENERALIZE: ACTIVITY A

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **Do any of the things engineers do surprise you?** Have the youth give specific examples and why specific things surprised them.

4 SciGirls
Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.

    - **In what ways are you like an engineer?** Have youth think about problems or difficulties they might experience and how they solve them. You may even pose challenges to see how youth would solve them (for example, to reach an item on a very tall shelf, how would youth try to reach it?). 4

Activity B: YOU are a Scientist or Engineer!

OVERVIEW

In this activity, children use their creativity to make up their own stories about scientists and engineers.

MATERIALS FOR ACTIVITY B

See page 5 for list of materials.

GETTING READY

- Gather art and drawing supplies listed in the **Materials List**.
- Note any safety hazards of items, such as fragile items or choking hazards.
- If doing Option 3, distribute photos of youth.

OPENING QUESTIONS AND PROMPTS

- Ask youth to think about scientists and engineers. Some example questions might include:
  - What do you think scientists and engineers look like?
  - Why do you think they look like that?
  - Who can be a scientist or engineer?

PROCEDURE (EXPERIENCING): ACTIVITY B

Option 1: *Youth draw a scientist or engineer on poster paper.*

- Provide paper and markers and ask youth to draw a scientist or engineer.
- Ask youth to select three words to add to their drawing to show what their scientist or engineer does. If youth need help with writing skills, adults may add the words for them.

Option 2: *Youth perform about scientists and engineers.*

4 SciGirls
Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.

- Ask youth to come up with a story, skit, song, poem, or something else about being a scientist or engineer. Depending on size of the group, the leader may want to do this as a small or full group activity. 4
- After each child or group has finished, invite them to present to the full group.

Option 3: *Youth use photographs of themselves taken as they've completed activities in the 4-H Polymer Science curriculum to create a story of themselves doing science and engineering.*

2 SciGirls
Girls are motivated by projects they find personally relevant and meaningful.

4 SciGirls
Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles.

- In groups (or individually), provide large paper and photos of youth. Ask them to arrange them and create a story about themselves doing science or engineering. 2
- Ask groups to come up with a story, skit, song, poem, or something else about themselves as scientists or engineers. 4
- After their stories are complete, invite youth or small groups to present to the full group.

SHARE/PROCESS/GENERALIZE: ACTIVITY B

5 SciGirls
Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as effort, strategies, and behaviors.

- Help guide youth as they question, share, and compare their observations. You may choose one of the questions below as a prompt. If necessary, use more targeted questions as prompts to get to particular points. Remember these questions are not about getting one right answer. 5
    - **What surprises did anyone have about scientists or engineers?** Follow up by asking them why they were so surprised.
    - **What type of people do you think can become scientists or engineers?** It's important that youth understand that many different types of people can become scientists and engineers (including themselves!). Try to emphasize traits such as "curious" or "hard-working" rather than "intelligent" or "smart".
    - **What type of scientist or engineer might you be interested in learning more about?** Give examples of specific types of scientist or engineers (chemist, physicist, etc.) to help encourage students. If they are unsure of the specific field, youth can also describe what types of problems these scientists or engineers solve.

Wrap Up

ENSURE CONCEPT UNDERSTANDING

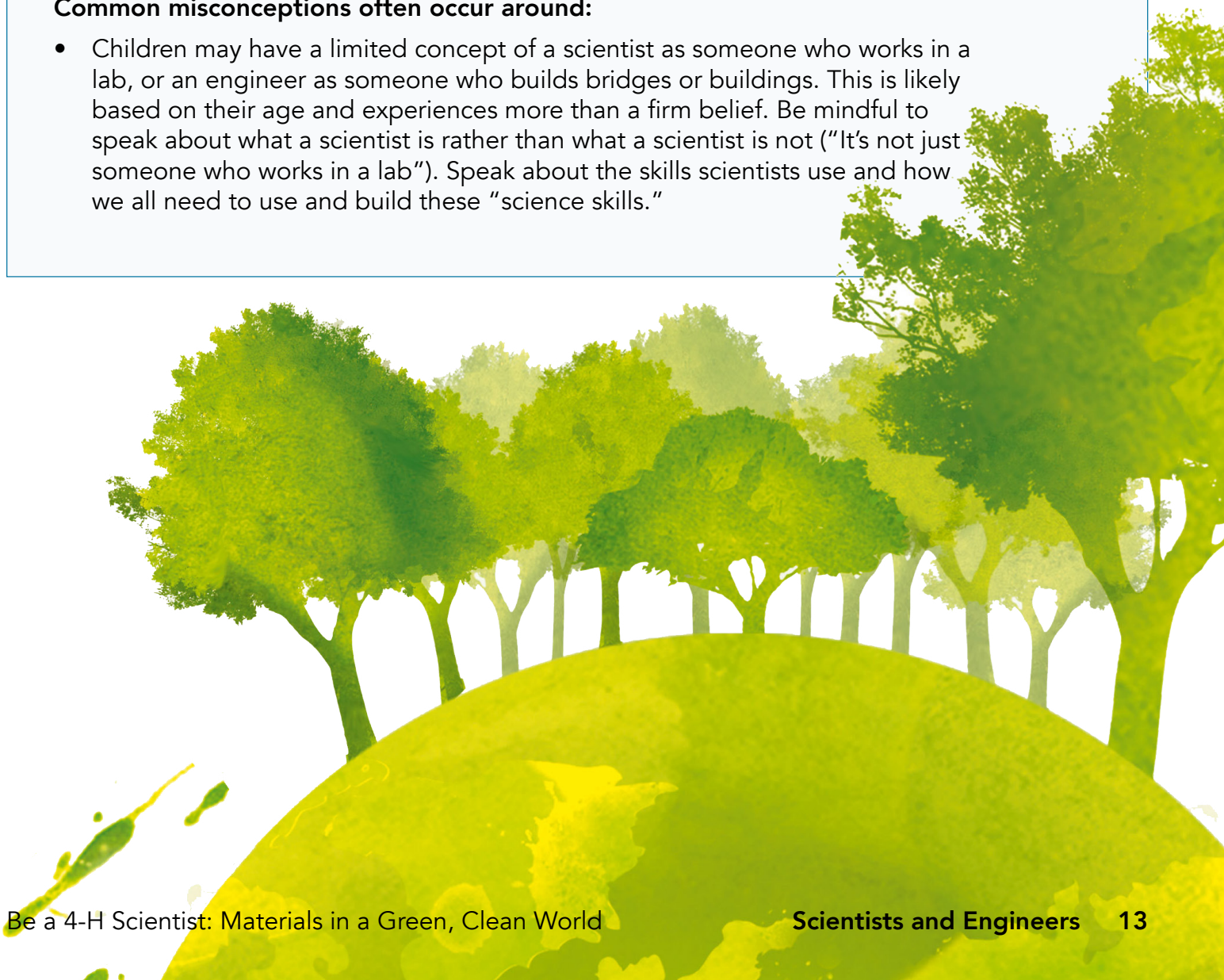
Concept and Term Discovery

At this point, it is important to ensure that the terms **scientist** and **engineer** have been discovered by or introduced to the youth. The goal is to have the youth discover terms and concepts on their own, defining them with their own words. Help ensure that children understand scientists and engineers are people who use curiosity and questioning to explore the natural or "designed" world and to solve problems. Scientists and Engineers use many skills, such as asking questions, observing, collecting data, sharing what they discover, etc.

We all use many of these skills every day! Many different careers and jobs involve science and engineering design.

Common misconceptions often occur around:

- Children may have a limited concept of a scientist as someone who works in a lab, or an engineer as someone who builds bridges or buildings. This is likely based on their age and experiences more than a firm belief. Be mindful to speak about what a scientist is rather than what a scientist is not ("It's not just someone who works in a lab"). Speak about the skills scientists use and how we all need to use and build these "science skills."



REFLECTION

Reflecting on experience is an essential part of learning and "making meaning of" an experience. Now is an opportunity to bring the children together and discuss the things they experienced throughout the module.

Facilitator Tip: *Circle Share*
You may want to use a "circle share" process to facilitate this discussion. Have children sit in a circle with you. Use a soft tossable object, such as a small toy as a "talking stick" object. Model to the children that you will ask a question, give them time to think quietly, then give your response while holding the "talking stick." You then gently toss the object to the next person for their turn to share. If you prefer, simply pass the object around the circle in order, eliminating the "toss" aspect.

- Some general reflection questions you can ask the children include:
    - What is something new you learned in this module?
    - Did you try something that you've never done before?
    - How were you a scientist or engineer today?
    - What questions did we explore the answers to? What questions do we still have?

"I Wonder" Board
If used, refer to your wonder board for this module — what questions did you explore the answers to? What questions do you still have?

SCIENCE & ENGINEERING IN EVERYDAY LIFE — CONCEPT APPLICATION

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.

The **Science At Home** activities are possible extension activities that can be used with your group as time/interest allows. You might also look to your "I Wonder" Board for questions you'd like to explore further. If you meet multiple times, you might invite children to do a take home activity or investigate an "I Wonder," and have them report back or bring in an item as described. This helps support application of the concepts you've explored in this module.

SCIENCE AT HOME ACTIVITY

Science At Home is a handout for you to copy and send home with the children. The handout gives a brief summary of the module and provides several activity ideas. It encourages families to engage in science learning together, supporting application of the concepts. Make one copy per child, or you may email the activity if you prefer.

FEEDBACK

We encourage instructors to collect feedback throughout this module and submit via this evaluation form: **4hpolymers.org/evaluation**

science at home

Be a 4-H Scientist!

Hello Families,

Your child has had many opportunities to act like scientists and engineers in the Be a 4-H Scientist! Program. We reflected on all these opportunities and further explored the stories of scientists and engineers. We hope you will try one or more of these "Science at Home" activities with your child. This supports your child in practicing the skills and reinforces what they've learned! Thank you!

Try these "Science at Home" Activities:

- *Field Trip*
  - Organize a field trip to visit scientists and/or engineers at work or invite a scientist or engineer to visit you.

- *Virtual Field Trip*
  - Use digital technology to take a virtual field trip with a scientist or engineer.
    - SciGirls videos: http://pbskids.org/scigirls/videos
    - Kids.gov Videos: https://kids.usa.gov/watch-videos/science/index.shtml
    - NOVA The Secret Life of Scientists & Engineers: http://www.pbs.org/wgbh/nova/blogs/secretlife/
    - Cornell Lab of Ornithology conservation scientists: http://www.crossingboundaries.org/conservation-scientists-670.php

Center for Sustainable Polymers

NSF

Cornell University Cooperative Extension

University of California Agriculture and Natural Resources

University of Minnesota Extension Driven to Discover℠

Appendix A: The types and things scientists and engineers do

Abilities

Build/Construct

Categorize/Order/Classify

Collaborate

Collect Data

Communicate/Demonstrate

Compare/Contrast

Design Solutions

Develop Solutions

Draw/Design

Evaluate

Hypothesize

Invent/Implement Solutions

Infer

Interpret/Analyze/Reason

Measure

Model/Graph/Use Numbers

Observe

Optimize

Organize/Order/Classify

Plan Investigations

Predict

Problem Solve

Question

Redesign

Research a Problem

State a Problem

Summarize

Test

Troubleshoot

Use Tools

Practices (NGSS)

Asking questions (science) and defining problems (engineering)

Developing and using models

Planning and carrying out investigations

Analyzing and interpreting data

Using math and computers

Constructing explanations (science) and designing solutions (engineering)

Engaging in argumentation

Obtaining, evaluating and communicating information