iGrow: Beyond Ready in Science

Facilitator Guide

A Six-Hour 4-H Leadership Development & STEM Learning Project for 9–12 year old youth (4-6th grades)

4-H Youth Development Program
University of California
Agriculture & Natural Resources

Second Edition

Summary

iGrow: Beyond Ready in Science is a 4-H leadership development curriculum for youth ages 9–12 (grades 4th through 6th) that blends positive youth development with engaging science and engineering experiences. Participants explore their Sparks, practice GPS goal management, strengthen a growth mindset, and build the habits and skills that help them become ready for work and life. The educational approach is experiential and inquiry-based, using a simple cycle of explore, reflect, and apply. Youth design and build artifacts such as a working flashlight, optimize paper airplanes, and create a kinetic confetti launcher, while discussing how scientists and engineers think, collaborate, persist, and improve. Activities include guided reflection and optional take-home istretch tasks to connect learning with family and community. Total instructional time is 6 hours across 8 sessions. Learning objectives include increased interest in science, stronger self-efficacy and persistence, practical goal-management skills, stronger teamwork and problem-solving, and clearer pathways for applying new skills to benefit others.

Second Edition Authors (2026)

Steven M. Worker, *4-H Youth Development Advisor in the San Francisco North Bay, University of California, Agriculture and Natural Resources*

Gemma Miner, *Interim Associate Director, 4-H Youth Development Program, University of California, Agriculture and Natural Resources*

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First Edition Authors (2013)

Steven M. Worker*, 4-H Science, Engineering, and Technology Coordinator, University of California, Agriculture and Natural Resources*

Gemma Miner*, 4-H Academic Coordinator, University of California, Agriculture and Natural Resources*

Shannon J. Horrillo*, Statewide 4-H Director, 4-H Youth Development Program, University of California, Agriculture and Natural Resources*

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Toward Being Beyond Ready in Science and Engineering

4-H is grounded in research-informed youth development practices that support positive outcomes into early adulthood. Core practices include physical and emotional safety, developmental relationships, youth engagement, community involvement, and intentional skill building. When youth feel safe and connected, they are more likely to engage. When engagement is strong, skill building follows. In short, with the right foundation in place, young people are ready to learn.

In iGrow, the facilitator creates these conditions and then uses the experiential cycle. Youth do in iexplore, reflect with guided prompts in ireflect, and transfer learning through istretch. This structure helps youth connect experiences to concepts and apply new skills beyond the meeting.

4-H, as a leader in out-of-school education, is committed to increasing science literacy through hands-on, inquiry-driven experiences. iGrow aligns with this commitment by engaging youth in investigations that use evidence and reasoning, and by inviting engineering design, in which youth apply science ideas to build and test solutions within real constraints (materials, time, cost). The goals are for youth to strengthen understanding, skills, and attitudes toward STEM; use STEM to make sense of their world; and connect learning to real situations where improved methods or technologies can solve problems.

Youth Development and Science Education Outcomes

The emphasis on positive youth development and STEM learning rests on a robust evidence base.

- Youth are more ready for work and life when they identify Sparks, strengthen belonging and relationships, stay engaged, practice growth mindset, learn to set and manage goals, contribute to others, and connect their work to real people and real problems.
- Many youth hold limiting beliefs about science (for example, “science is not for me”). The facilitator counters these myths by highlighting effort, strategies, relevance, teamwork, and community value, helping youth see themselves as capable contributors.

This integration of positive youth development with high-quality science and engineering experiences helps youth build the knowledge, habits, and confidence needed to become Beyond Ready, in 4-H, in school, and in their communities. The facilitator’s role is to safeguard the foundation (safety, relationships, engagement, and community), guide the experiential cycle, and make space for youth voice so learning is both meaningful and transferable.

About iGrow

Why is iGrow considered Leadership Development?

As you read through the materials, you will notice that the concepts are not the typical "leadership skills" list. In iGrow, the focus is on youth development and educational practices that strengthen the knowledge, habits, and dispositions associated with being ready for work and life through science, technology, engineering, and math (STEM). The belief is that when young people have opportunities to develop their spark, practice a growth mindset, manage goals, work with others, solve problems, and connect learning to contribution, they become effective leaders of themselves and more capable contributors to their communities.

The personal development and self-reflection skills gained through participation in iGrow help youth practice and apply those skills in emerging leadership roles. To connect science learning with positive youth development and Beyond Ready outcomes, the goals of this curriculum are to:

1. Provide opportunities for youth to develop STEM skills and abilities.
2. Help youth cultivate positive attitudes and aspirations toward STEM, including seeing STEM in their future and recognizing its relevance to everyday life.
3. Help youth build work and life readiness skills, including communication, collaboration, persistence, responsibility, and goal management.
4. Help youth apply their STEM learning by making a contribution in their community.

iGrow Highlights

- iGrow is designed specifically for 9–12-year-olds.
- iGrow is sequential. Each chapter is taught in order, with lessons laying groundwork for the chapters that follow.
- Each lesson helps build skills and habits that support readiness for work and life.
- Each chapter focuses on one or two scientific and/or engineering practices.
- Each chapter includes:
    - **iexplore** activity (hands-on, shared experience). Complete the iexplore and ireflect activities together during meetings.
    - **ireflect** activity (internalize and personalize what was learned).
    - **istretch** activity (apply learning through an optional extension). Use istretch as a follow-up activity after the primary lesson. If time is short, invite youth to complete it between meetings and report back next time.

About the Adult Facilitator's Guide

Each chapter provides the main points and key messages for the lesson.

- Review the "Keep in Mind…" notes for each Beyond Ready concept and each science/engineering concept so the core objectives and messages are covered.
- Use the complete activity descriptions, handouts, and worksheets as specified.
- Before each project meeting, read the iGrow chapter you will facilitate. Ensure you understand the activities, discussions, and key concepts, including applied science.
- Gather the supplies needed for each meeting.

Educational Practices

Experiential Learning

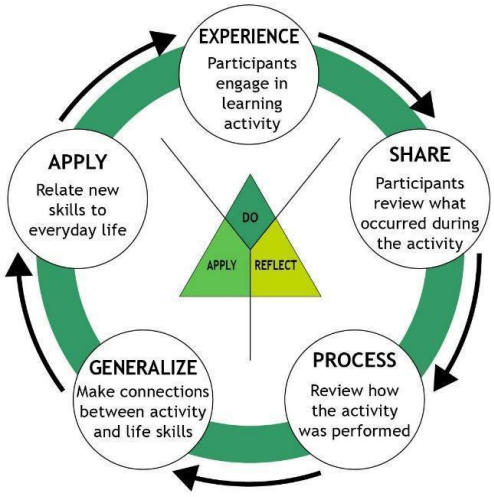
Every iGrow chapter's activity is designed around the experiential learning cycle. Youth first engage in a meaningful experience, then move through guided reflection to make sense of what happened, and finally apply their learning to new contexts. In iGrow, facilitators lead reflection through a group discussion that emphasizes sharing, processing, generalizing, and applying.

Hands-on activities alone are not enough; learning emerges when young people articulate ideas in their own words and connect activity concepts to the chapter's core ideas. Each lesson includes prompts to ensure concepts are surfaced, clarified with correct terminology, and discussed for importance before youth transfer learning beyond the activity.

Components of experiential education include:

1. **Experience (iExplore)**: An activity to engage learners in an investigation, observation, experiment or scenario.
2. **Reflection (iReflect)**: Seamless movement through three distinct phases (share, process, generalize) whereby the facilitator guides the learners to share thoughts and feelings with others in order to process and generalize their experience. The reflection should be focused on the concepts explored in the chapter.
3. **Application (iStretch)**: An opportunity for learners to apply new knowledge to authentic situations in order to help deepen and extend their understanding. The iGrow curriculum prioritizes the transfer of knowledge and skills beyond this curriculum. Each activity includes istretch, a concrete invitation for youth to apply new knowledge and skills in authentic settings, share work with others, and extend their projects. These extension ideas complete the experiential cycle by moving learning from the meeting room into real-world contexts and community.

Experiential Learning Model



Inquiry-based Learning

High-quality science learning in iGrow is youth-centered and inquiry-driven. Facilitators pose open questions, invite observation and investigation, and help youth design simple tests, gather and analyze data, and communicate their findings. The facilitator's role is to guide the process rather than deliver answers, so young people build understanding through exploration and reasoning. These inquiry moves are embedded within the experiential cycle above, ensuring that questioning and evidence are central to concept development. Science inquiry includes:

- Being able to ask a question about objects and events in the environment.
- The ability to plan and conduct a simple investigation.
- Skills to use tools and equipment to collect data and observe the world.
- Reasoning skills to analyze data and make conclusions.
- Competence to communicate findings.

Facilitator Tips

Reflection turns experience into learning. When we set aside time to notice, name, and connect ideas, youth remember more, build language for concepts, and are more ready to apply learning beyond the meeting. In iGrow, reflection is not an add-on. It is part of the experiential cycle. In iGrow, use these strategies to support iexplore (doing), guided reflection, and istretch (transfer).

Reflection moves that work

Create safety

- Offer a “pass” option. Participation grows as trust grows.
- Co-create brief group agreements before activities. Revisit them as needed.
- Normalize mistakes: “First tries show us what to try next.”

Start simple, then deepen

- Begin with low-risk prompts: “What did you notice?” “What surprised you?”
- Add sense-making: “Why do you think that happened?” “What evidence supports your idea?”
- Close with transfer: “Where could you use this this week?” “What is one next step?”

Honor wait time and multiple modes

- Allow quiet thinking time. Silence helps ideas surface.
- Invite different ways to reflect: talk, draw, act it out, write in journals, build a quick model.

Mix formats

- Whole-group circle for highlights.
- Pair or trio share for deeper processing.
- Small groups to “self-process” complex tasks, then report out.

Use specific talk moves

- Notice and name strengths: “I heard you compare two trials. That is data analysis.”
- Revoice and connect: “So you are saying… Does anyone want to add on or challenge with evidence?”
- Prompt evidence: “What in your data makes you think that?”

Time it well

- Reflect briefly in the middle of challenges when a “teachable moment” appears.
- Always include a short close at the end of the lesson to consolidate learning and set up **istretch**.

Vary and keep it engaging

- Rotate methods to support attention and memory: gallery walks, quick writes, concept maps, commit-and-toss, fist-to-five check-ins.
- Treat debriefing as part of the fun, not something that happens after the fun.

Common pitfalls and better options

- **Pitfall:** Rushing to the next activity.
  Better: Schedule reflection minutes just like activity minutes.
- **Pitfall:** Leading youth to your answer.
  Better: Ask open questions and let youth build explanations with evidence.
- **Pitfall:** Only calling on the same few voices.
  Better: Use pair share, turn-and-talk, or a talking piece to widen participation.
- **Pitfall:** Equating reflection with long speeches.
  Better: Use quick protocols and sentence starters.

Sample iGrow reflection sequence

1. **Notice:** “During **iexplore**, what did you observe or try?”
2. **Make meaning:** “What pattern do you see in your results? Why might that be?”
3. **Name the concept:** Introduce or refine terms based on youth ideas.
4. **Transfer:** “For **istretch**, where could you apply this idea at home, school, or in your club?”

Educator checklist

- □ I planned a reflection opener, a mid-course pause if needed, and a closing transfer prompt.
- □ Youth can pass and our group agreements are visible.
- □ Everyone has at least one way to participate and one way to show thinking.
- □ I used strengths-based feedback and pressed for evidence.
- □ We ended by setting up **istretch** so learning carries beyond the meeting.

Additional Resources

SciGirls Strategies: How to Engage girls in STEM

James Cain, Michelle Cummings, and Jennifer Stanchfield’s 2005 book, *A Teachable Moment: A Facilitator's Guide to Activities for Processing, Debriefing, Reviewing and Reflection*

Material List (for all activities)

Activity 1 — "Sparks of Science"

- ☐ Sparks cards (set of 22) – 1 set per 5 youth
- ☐ Fields of science and engineering cards (set of 50) – 1 set per 5 youth
- ☐ Blank index cards – 2-3 per youth
- ☐ Writing utensils – 1 per youth
- ☐ Copies of Handouts 1 and 2 (double-sided) – 1 per youth

Activity 2 — "Map Your Spark & Find a Scientist"

- ☐ Sparks cards (set of 22) – 1 set total
- ☐ Fields of science and engineering cards (set of 50) – 1 set per 5 youth
- ☐ Community map (printed in color 3x4 foot poster and laminated)
- ☐ Dry-erase markers
- ☐ Tape (blue painters' or masking)
- ☐ Copies of Handouts 1 and 2 (double-sided) – 1 per youth

Activities 3 and 4 – "Design and Build a Flashlight"

- ☐ Copies of Handout 3 GPS worksheet – 1 per youth
- ☐ Copies of Handout 4-A & 4-B Flashlight worksheet – 1 per youth (stapled is ok)
- ☐ (optional) blank graph paper
- ☐ Writing utensils – 1 per youth
- ☐ Signs for GPS Dimensions (Meaningful, Realistic, Positive, Stick to a Plan, Show Persistent Effort, Check your Progress, Seek Help, Substitute Strategies)
- ☐ For flashlights (for each youth or pair)
    - Aluminum foil, tape (electrical or masking).
    - Mini light bulb (2v-6v) (incandescent or LED)
    - Battery (AA, AAA, or C)
    - Housing for the circuit (cardboard tube, cardboard square, pegboard, or plastic mesh).
- ☐ Optional materials at the front table:
    - Wire (18-22 gauge, like telephone wire)
    - Wood skewers
    - Craft sticks
    - Brass brads
    - Paper clips
    - Rubber bands
- ☐ Tools
    - 3-4 wire strippers/cutters
    - 4-5 hot glue guns
    - 4-5 scissors
- ☐ Optional: simple plastic flashlight that can be taken apart to understand how an on/off switch works

Activity 5 – "Create your Scientist!"

- □ Copies of Handout 5: Create Your Scientist – 1 per pair of youth
- □ Writing utensils
- □ Coloring pencils, crayons, or markers
- □ Flip chart paper or whiteboard and markers
- □ Posters of scientists (11 x 17 inch) – 8
- □ Fields of science and engineering cards – several sets for reference
- □ Scientist Mindset question slips – 1 set per pair of youth

Activity 6 — "You are an Engineer!"

- □ Copies of Handout 6: My Mindset – 1 for each youth to take home
- □ Blank paper
- □ Masking tape or blue painter's tape
- □ Measuring tape
- □ Optional:
  - o plastic straws
  - o index cards
  - o tape
  - o scissors
  - o paper clips
  - o or other small attachments

Activity 7 – "Seven-Station Beyond Ready Carousel"

- □ Handout 7: Ready Skills Passport – 1 per youth
- □ Printed copies of the 7 Station posters
- □ Clipboards
- □ Writing utensils
- □ Sticky notes
- □ Tape
- □ Timers or phone stopwatch
- □ Chart paper and markers
- □ Station 1: 6 to 12 sealed "black boxes" with different contents (for example: dried beans, coins, marbles, sand, cotton balls, or small blocks)
- □ Station 2: Paper, scissors, tape, and paper clips
- □ Station 3: Site Mini-Needs Menu cards
- □ Station 4: Craft sticks, index cards, paper clips, tape, and a ruler or tape measure
- □ Station 5: Object cards (for example: pencil, faucet, snack) and blank system-map sheets
- □ Station 6: Puzzle A and Puzzle B sheets, timers, mood dot stickers, and optional calm cards
- □ Station 7: GPS mini-plan cards

Activity 8 – "Kinetic Confetti!"

- □ paper confetti
- □ drinking straws
- □ string
- □ sheets of cardboard (approx. 8.5 x 11 in.)
- □ wooden spools
- □ paint stirrers
- □ rubber bands
- □ 8-oz. paper cups
- □ 4-oz. paper cups

- □ measuring tape or yardstick
- □ index cards or half sheets for design notes
- □ writing utensils

Optional

- □ 3 to 4 hot glue guns
- □ scissors
- □ other tools to help youth modify and attach objects

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Chapter 1: Sparks

Overview

Chapter 1 introduces “Sparks” as the passions, skills, or interests that give young people joy and motivation. All youth have Sparks, and caring adults called “Spark Champions” help them discover and grow those Sparks. The chapter links Sparks to science and engineering by showing that children are natural investigators and that many fields and practices can connect with what excites them. Objectives include helping youth understand what Sparks are, identify their own Sparks, recognize the value of Spark Champions, and plan how to find or engage those champions.

Links to Educational Standards

Activity 1 — “Sparks of Science”

Next Generation Science Standards

- 3–5-ETS1-1: Define a simple design problem reflecting a need or want that includes criteria for success and constraints (materials, time, cost). This fits when youth name a Spark “problem/need” they want to pursue and consider what success looks like.
- 3–5-ETS1-2: Generate and compare multiple possible solutions based on criteria and constraints (e.g., different ways to grow or explore a Spark).

Common Core State Standards for English Language Arts

- SL.5.1: Engage effectively in collaborative discussions; build on others’ ideas and express one’s own clearly (small-group Spark discussions).

Activity 2 — “Map Your Spark & Find a Scientist”

Next Generation Science Standards

- This activity supports asking questions and obtaining, evaluating, and communicating information as youth discuss where people practice their Sparks and where scientists and engineers work in the community.

Common Core State Standards for English Language Arts

- SL.5.1: Collaborative mapping and whole-group synthesis discussions.
- W.5.8: Gather relevant information from experiences and sources; summarize or paraphrase in notes.

Sparks Key Messages

By the age of 10, youth can fully understand the concept of a Spark. All youth have a Spark – a quality, skill, or interest they are passionate about—but they may not know it yet. A Spark comes from inside of us and when we express it, it gives us joy. Sparks must be nurtured over time by caring adults with whom youth interact.

What is a spark?

- A spark is a young person's inner interest, skill, or passion that gives joy, energy, and purpose.
- Many children can describe a spark by about age 10, but exploration starts earlier and continues over time.
- Sparks can grow and change. They are deeper than a single activity and often connect to values or ways of contributing.
- Sparks have the potential to make a positive difference in the world.

Why sparks matter

- Sparks fuel motivation, persistence, and well-being.
- Identifying and growing a spark supports positive identity, motivation, and a sense of purpose.
- Caring adults who notice, name, and nurture sparks are called **spark champions**.

Key messages for youth

- Everyone has sparks. You can discover yours and try new ones.
- Sparks grow with practice, feedback, and support.
- Spark champions help you explore safely, set goals, and reflect on progress.

What iGrow adds

- Each iGrow **iexplore** invites youth to try roles, tools, and ideas that can reveal sparks.
- **istretch** prompts encourage youth to extend learning beyond the meeting in ways that connect to personal interests.
- Reflection questions and journals help youth name sparks, track growth, and plan next steps with a champion.

How adults can nurture sparks

Notice
- Watch for moments when a young person lights up or shows focused effort.
- Listen for enthusiasm in talk, drawings, builds, and questions.

Name
- Say what you see: "I noticed how focused you were while coding that sensor. That might be a spark."

Invite
- Ask open questions: "What parts did you enjoy most?" "What would you like to try next?"

Support
- Offer small, doable next steps and resources.
- Connect youth with Spark Champions at home, school, clubs, or in the community.

Celebrate
- Recognize effort, strategy, and growth, not just outcomes.
- Encourage sharing with families or peers through showcases or quick demos.

Facilitator checklist

- □ Provide multiple ways to participate: building, drawing, testing, speaking, coding, or mentoring.
- □ Use inclusive language and give specific, strengths-based feedback.
- □ Help youth create a simple plan to find or strengthen Spark Champions.
- □ End sessions with a transfer prompt: “Where could you use this spark this week?”

Avoid common pitfalls

- Do not treat sparks as fixed labels or inherited traits.
- Do not force a direct match to a career. Keep exploration broad and youth-led.
- Do not equate spark with immediate talent. Passion often comes before proficiency and grows with practice.

Science Key Messages

Children are natural scientists who explore the world around them using their senses and reasoning skills. In doing so, they develop their own theories of the world.

- Every young person can learn science and engineering. Ability grows with effort, effective strategies, and supportive relationships.
- Curiosity, identity, and belonging matter. Youth engage more deeply when activities connect to their interests, cultures, and communities.
- Learning is social. Talk, collaboration, and reflection help youth make sense of ideas.
- Mistakes are information. We normalize trying, revising, and trying again.

How to respond when youth doubt themselves

Young people often hear messages that suggest they are not “smart enough” for science, engineering, or technology. iGrow takes a different approach. We emphasize that ability grows with effort, good strategies, and support.

- “This is challenging, and you can do hard things. I am here to help. What support would help you start?”
- “I used to feel unsure too. Practice and sticking with it helped me grow. Let’s try the first step together.”
- “We learn a lot from first tries. What did this attempt tell us to try next?”
- “I saw you take on hard things before, like when you [specific example]. Let’s build on that strength here.”

What science and engineering learning looks like in iGrow

- **Children are natural investigators.** They observe, play, test ideas, and build informal theories about the world. Our role is to guide them to use evidence to refine those ideas.
- **Purpose of science education:** Develop explanations about the natural world that are supported by evidence and shared with others.
- **Purpose of engineering education:** Use science to design, build, and test solutions that meet real needs, within constraints such as materials, time, and cost.

Core practices we use with youth

These practices are cyclical, not step-by-step. In iGrow activities you will help youth:

1. **Ask questions** and **define problems** that matter.
2. **Plan and carry out investigations** or design tests.
3. **Develop and use models** to think through ideas and designs.
4. **Collect, analyze, and interpret data,** including simple math or digital tools.
5. **Construct explanations** or **design solutions** grounded in evidence.
6. **Engage in respectful arguments from evidence** to compare ideas.
7. **Obtain, evaluate, and communicate information** in multiple formats.

Facilitator checklist

- □ Invite multiple ways to participate: talking, drawing, building, coding, acting out ideas.
- □ Use plain language and introduce correct terms after youth share in their own words.
- □ Ask open questions: “What do you notice?” “What makes you think that?” “What could we try next?”
- □ Celebrate process, not perfection: effort, strategies, collaboration, and reflection.
- □ Connect to transfer: end each activity with how the idea applies beyond the meeting.

Activity 1: Sparks of Science

Youth Development Outcome: Youth will identify one personal Spark and name one Spark Champion, then state one concrete action they will take this week to grow that Spark.

Science Outcome: Youth will match their Spark to at least one field of science or engineering and explain in 1–2 sentences how the field connects to their Spark.

Time: 45 minutes

Materials:

- ☐ Sparks cards (set of 22) – 1 set per 5 youth
- ☐ Fields of science and engineering cards (set of 50) – 1 set per 5 youth
- ☐ Blank index cards – 2-3 per youth
- ☐ Writing utensils – 1 per youth
- ☐ Copies of Handouts 1 and 2 (double-sided) – 1 per youth

Preparation: 5 minutes. Ensure there are duplicates in the Sparks cards.

Facilitator Tips: Youth may not know their Sparks yet, so give them time to review the cards.

Spark Card Samples

Field of Science and Engineering Card Samples

iexplore

Part A (Sparks)

1. Say:

"Today, we're going to learn about our Sparks. When I say the word Sparks, what does it make you think of? (Solicit responses).
Yep, those are all types of Sparks and the one I'm talking about is something that really interests you. It's something in your life that makes you really happy. It could be something you do, something you really care about, or even a particular way you like to live your life.

Not everyone knows their Spark yet and that's okay. As we go through our 4-H project together, you may discover it. Here are two more things to know about Sparks: One: your Spark should be something that you can use to make a positive difference in the world and Two: you don't have to be good at your Spark for it to be something that makes you happy."

2. Spread out the Sparks cards and invite youth to look at all of the cards. After reviewing them, ask youth to select one card that best represents their Spark.
    a. If someone doesn't know their Spark, either ask them to select a card based on something they are interested in. Or have them select the "I don't know" card.
    b. If someone has a Spark that is not represented by a card, have them take the "Other" card and write their Spark on an index card.
3. Have youth group in pairs or small groups (3 max). In each group, rotate through each person and ask them to share with each other their thoughts on the following prompts:
    a. Describe your Spark.
    b. Explain how you practice your Spark.
    c. What is something another person can do that would help you with your Spark?
4. After groups are done sharing, ask for a few individuals to share with the full group.

As the facilitator, listen to how youth describe and talk about their Spark to ensure they understand what Sparks are. Be sure to correct any misunderstandings—frequently, youth misunderstand that they have to be good at something for it to be their Spark. In order for something to be a Spark, it must be something positive.

Part B (Science)

5. Ask an opening question for the second part. Invite youth to think about how science and engineering are connected with their Spark.
   "What do you know about science?" or "What types of things have you seen scientists and engineers do?"
6. Spread out the fields of science and fields of engineering cards and invite youth to look at all of the cards. After reviewing them, ask youth to select one card (or two) that they think best connects with their Spark. Use the definitions on the back of the cards to help youth understand the different types of fields of science and fields of engineering.
7. Back in their pairs or small groups, ask youth to share with each other to describe the connection between their Spark and the field of science/engineering card they selected. As the facilitator, help guide youth as they question, share and compare their observations.

ireflect

Before asking youth these questions, collect the materials or have youth move to another location. We recommend having everyone sit in a circle. Help guide youth as they question, share, and compare their experience. You may choose one or more of the questions below as a prompt. Remember these questions are not about getting one right answer.

- What surprised you about fields of science and engineering?
- After thinking about how science and engineering connect to your Spark, what conclusions can you draw about science and engineering?
- What else do you want to know about your Spark?
- How can you use your Spark to make a positive difference in the world?

istretch

Encourage youth to complete the istretch activity on their own or in small groups and bring their answers to the next meeting. At the beginning of the next meeting, spend about 5 minutes sharing their thoughts. (Handout 1)

One suggestion might be to ask youth to hold Spark conversations with others, including family and friends, using the eight essential questions: What is your Spark? When and where do you live your Spark? Who knows your Spark? Who helps you get better at your Spark? What gets in your way? How can I help? How does science and/or engineering relate to your Spark? How will you use your Spark to make our world better?

Activity 2: Map Your Spark and Find a Scientist

Youth Development Outcome: Youth will place their Spark on a community map, list at least one local place to practice it, and record one adult they can ask for help.

Science Outcome: Youth will locate at least three places in the community where scientists or engineers work and justify each placement with one sentence of reasoning.

Time: 45 minutes

Materials:

- ☐ Sparks cards (set of 22) – 1 set total
- ☐ Fields of science and engineering cards (set of 50) – 1 set per 5 youth
- ☐ Community map (printed in color 3x4 foot poster and laminated)
- ☐ Dry-erase markers
- ☐ Tape (blue painters' or masking)
- ☐ Copies of Handouts 1 and 2 (double-sided) – 1 per youth

Preparation: 5 minutes. Hang the community map in a visible and easily accessible location.

Community Map Sample

iexplore

1. Say: “Today, we’re going to look more closely at our Sparks and where in the community we can find scientists and engineers who have something to do with our Sparks.”

Part A (Sparks)

2. Invite youth to look at the community map and discuss the map in relation to their own community. You may want to ask these questions to prompt thinking:
    a. What places do you spend the most time in our community? Where are they on this map?
    b. What are some similarities and differences between this map and our own community?
3. Spread the Sparks cards and ask youth to think about their Sparks again. Ask: “Can a few people remember some things about what Sparks are?” Since they have had time to reflect on the activity last meeting, have their Sparks changed? Invite youth to select one card that best represents their Spark.
4. In pairs or small groups, ask youth to think about who helps them identify and grow their Spark. Say, “The adults that help you identify and grow your Sparks are called Spark Champions! Where in the community can you do activities related to your Spark?”
5. Invite youth to place their Sparks card on the map where they believe it is best practiced. If a child cannot decide where to place the card, or they cannot choose one location from several, affirm that there may be many places their spark is practiced. Ask them to place it on the location of their choice.
6. Once all of the cards are placed, engage the full group in a discussion.
    a. Ask youth to notice and describe trends where they placed their Sparks cards. (For example, are most of them at school? Are certain types of Sparks at specific places?)
    b. Ask youth to make some guesses as to why some locations are better for practicing their Spark than others.

Part B (Science)

7. Ask an opening question for the second part, something like “Where do you think scientists and engineers do their work?”
8. In pairs or small groups, pass out a few fields of science and engineering cards. Ask groups to discuss where they think scientists and engineers that work in that job could be found in the community. Invite groups to attach the cards to the map. *[Note that there is no right or wrong answer; the important part is to get youth to think about why they are placing a scientist at a specific location; ask them to explain their thinking.]*
9. In the full group, ask youth to observe and describe trends. As the facilitator, help guide youth as they question, share and compare their observations.

ireflect

Before asking youth these questions, collect the materials or have youth move to another location. We recommend having everyone sit in a circle. Help guide youth as they question, share, and compare their experience. You may choose one or more of the questions below as a prompt. Remember these questions are not about getting one right answer.

- What relationships can you identify between locations in our community where you do activities related to your Spark and where scientists and engineers may be found?
- Discuss ways your Spark can make a difference in our community.
- If you were trying to teach someone else about Sparks, what would you say?

istretch

Encourage youth to complete the istretch activity on their own or in small groups and bring their answers to the next meeting. At the beginning of the next meeting, spend about 5 minutes sharing their thoughts. (Handout 2)

- If they have a Spark, ask youth to identify three Spark Champions and then think of ways they can help them practice, grow or get better at their Spark.
- If they don’t have a Spark, ask them to try three new things that they have never done before. Ask them if any of these gave them joy, passion or excitement. If so, find one adult and tell them about this thing.

Chapter 2: Goal Management

Overview

Goal Management (GPS) helps young people move from “having an idea” to actually reaching a destination. GPS is more than goal-setting—it's a lifelong cycle of: deciding where you’re going (Goal Selection), planning how to get there (Pursuit of Strategies), and adjusting when obstacles appear (Shifting Gears). In this chapter, youth practice GPS while designing and building a working flashlight, connecting personal goal skills with core engineering practices.

Links to Educational Standards

Activities 3 and 4 – “Design and Build a Flashlight”

Next Generation Science Standards

- 3–5-ETS1-1: Define a simple design problem with criteria and constraints (used when youth choose a flashlight purpose and success criteria).
- 3–5-ETS1-2: Generate and compare multiple solutions (used in sketching alternate flashlight designs and switch ideas).
- 3–5-ETS1-3: Plan and carry out fair tests; iterate to improve a model or prototype (used in build–test–redesign cycles).
- 4-PS3-2: Make observations to provide evidence that energy can be transferred by electric currents, light, sound, or heat (applies to bulbs, batteries, and simple circuits).

Common Core State Standards for English Language Arts

- SL.4–6.1: Engage effectively in collaborative discussions (design reviews; share–compare builds).
- W.4–6.7: Conduct short research/inquiry projects (identifying materials, constraints, and options for switches/housings).
- W.4–6.8: Gather and organize relevant information from experiences and sources (design notes, test observations, change logs).
- RST.6–8.3 (for grade 6): Follow multistep procedures/experiments (build guides/checklists created by teams).

Goal Management Key Messages

Goal management is the ability to use skills to reach a goal. In iGrow, we use the GPS system: Goal Selection, Pursuit of Strategies, and Shifting Gears. Youth who learn and practice these skills are more successful at reaching goals because they plan, act, check progress, and adapt.

Goal Selection, choosing the destination

- Youth take initiative to select goals that are meaningful, realistic, positive, and stretching.
- Teach MRS.D as a memory aid: meaningful, realistic, stretching, drafting.
- Explain drafting with the biking image. A strong goal can pull other goals along and make them easier to reach by using the same strategies for different goals
- Invite youth to visualize what success will look and feel like and to name criteria for success.
- Coaching prompts: “What makes this goal meaningful to you?” and “How will you know you have arrived?”

Pursuit of Strategies, planning the route and moving

- Youth create a step-by-step plan with details: by when, how, who, and where.
- Encourage action triggers that set conditions in advance. Example: “When it is 3:30 in the library on Tuesday, I will sketch two switch ideas.”
- Reinforce persistent effort and regular progress checks.
- Promote help-seeking as a strength. Youth can consult peers, mentors, and trusted sources.
- Coaching prompts: “What is your next small step?” and “What will you check to see if the step worked?”

Shifting Gears, adapting when the road changes

- Youth substitute strategies, adjust parts of a plan, or revise the goal when evidence shows a change is needed.
- Normalize setbacks as information. Failure is feedback that improves strategy.
- Model help-seeking from new people and resources.
- Coaching prompts: “What is not working and why?” and “Which part could you change first?”

Keep in mind while facilitating

- Shrink the change. Break large goals into bite-sized steps that feel doable this week.
- Notice and name small wins. This builds confidence and reinforces good choices.
- Lift up bright spots. Ask, “What is already working,” and scale that behavior.
- Encourage a growth mindset. Praise effort, strategy, and help-seeking.
- Avoid describing GPS as only goal setting, and avoid comparing it to S.M.A.R.T. goals. Keep the focus on the living cycle of select, pursue, and adapt.

Facilitator checklist

- □ “State your goal in one sentence, then list the first two actions.”
- □ “Let us do a progress check. What worked, what will you change?”
- □ “Whom could you ask for help right now, and what would you ask?”
- □ “What is a smaller version of this step that you could finish today?”

Science Key Messages

Engineering design and GPS work the same way

Engineers use scientific knowledge to design solutions to real problems. The engineering design process is iterative and cyclical. Engineers design, build, test, and redesign many times. They investigate the effectiveness, efficiency, and robustness of their solutions and make evidence-based improvements.

GPS aligned to engineering practice

- **Goal Selection** aligns with defining the problem. Youth identify the issue, the needs, and the opportunities. They ask clarifying questions such as “What have others done?” “What is the scope?” and “What criteria and constraints matter?” They set an ultimate aim and success criteria.
- **Pursuit of Strategies** aligns with generating and comparing solutions. Youth imagine possibilities, sketch designs, plan resources, assign roles, and choose a promising approach. They stick to the plan while checking progress. They document ideas in notebooks or design sheets.
- **Shifting Gears** aligns with building, testing, and redesigning. Youth construct a model, test it against criteria, analyze results, and modify the design. They treat failure as useful information, seek help from peers and role models, and retest until the solution meets the criteria. They communicate their results and justify design choices with evidence.

What this looks like in the flashlight activities

- Youth define purpose and constraints for a flashlight, such as brightness, reliability, durability, and safety.
- They sketch multiple housing and switch concepts, then select one after a quick comparison.
- They plan materials, steps, timing, and testing procedures.
- During build and test cycles, they collect simple data, such as the number of successful on and off cycles, brightness observations, and sturdiness after handling.
- They justify redesign choices by citing test results. Example: “The foil tab tore after five toggles, so we shifted to a paper clip lever.”

Facilitator checklist

- □ Post visible criteria and constraints so youth can reference them during checks.
- □ Schedule short tests and takepauses to make iteration routine.
- □ Centralize shared materials to encourage planning and resource management.
- □ Encourage teams to observe one another’s working solutions and adapt ideas with attribution.
- □ Prompt evidence talk. “What did your test show?” and “How does that result change your plan?”

Activity 3: Design a Flashlight

Youth Development Outcome: Youth will write a one-sentence goal for their flashlight that is meaningful and realistic, then list the first two actions they will take to reach it.

Science Outcome: Youth will diagram a complete simple circuit for their design and describe how their on/off switch will open and close the circuit.

Time: 30 minutes

Materials:

- ☐ Copies of Handout 3 GPS worksheet – 1 per youth
- ☐ Copies of Handout 4-A & 4-B Flashlight worksheet – 1 per youth (stapled is ok)
- ☐ (optional) blank graph paper
- ☐ Writing utensils – 1 per youth
- ☐ Chart paper or whiteboard and markers
- ☐ Signs for GPS Dimensions (Meaningful, Realistic, Positive, Stick to a Plan, Show Persistent Effort, Check your Progress, Seek Help, Substitute Strategies)
- ☐ For flashlights (for each youth or pair)
    - Aluminum foil, tape (electrical or masking).
    - Mini incandescent light bulb (about 2.5 V). Optional facilitator note: If you use LED bulbs, also provide 3 V coin cell batteries.
    - Battery (AA, AAA, or C)
    - Housing for the circuit (cardboard tube, cardboard square, pegboard, or plastic mesh).
- ☐ Optional materials at the front table:
    - Wire (18-22 gauge, like telephone wire)
    - Wood skewers
    - Craft sticks
    - Brass brads
    - Paper clips
    - Rubber bands
- ☐ Tools
    - 3-4 wire strippers/cutters
    - 4-5 hot glue guns
    - 4-5 scissors
- ☐ Optional: simple plastic flashlight that can be taken apart to understand how an on/off switch works

Preparation: 30-60 minutes.

1. Gather materials

2. Make signs on colorful paper with one of each of these words or phrases per sheet: Meaningful, Realistic, Positive, Stick to a Plan, Show Persistent Effort, Check Your Progress, Seek Help, Substitute Strategies, then hang these GPS Dimensions signs around the room, use them for both activities in this chapter—use these phrases and words to help youth overcome challenges during the activity. Use them to describe strategies and prompt youth to think about them.

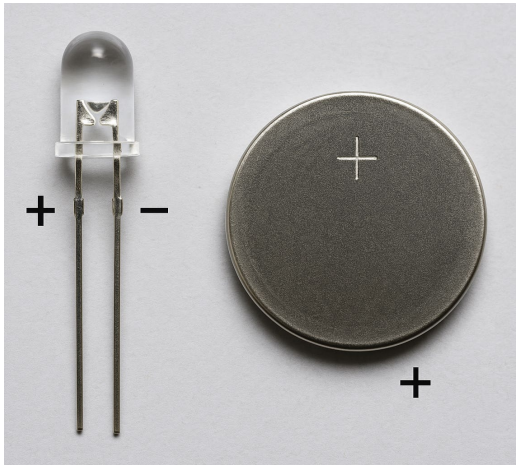
Facilitator Tips:

- We suggest that youth work individually (or in pairs) and sit at a shared table so they can ask for help and look at other designs.
- We recommend that you place materials in a center table instead of handing out a packet of materials to each group. This may allow groups to be more creative in their design.
- Encourage groups to share ideas and adapt ideas from each other—in GPS language, that's "adapting the strategies of others". In engineering, learning from others is an important part of being efficient.
- In a "short circuit" (for example, touching both ends of the battery with aluminum foil), the battery will get very hot. While unlikely to burn, there may be exclamations of surprise.

Lightbulbs and Voltage

*Old "mini" holiday bulbs (**incandescent bulbs**)*

- These bulbs are typically rated about 2.5 volts (V). They were designed to run in long series strings, which is why a single loose bulb often lights dimly on one 1.5-volt AA or C battery.
- To prepare, cut the string and then strip ½ inch of the wire to expose the wire.
- To light, touch one stripped lead to the negative battery end and the other to the positive end to complete the circuit. It does not matter which side is on the positive (+) or negative (-).



LED bulbs (Light Emitting Diode)

- LED bulbs need more voltage typically about 3.0–3.6 V, thus they will not light on a AA or C battery. You will need a higher voltage battery, like a CR2032 coin cell (3 V).
- Single LED + CR2032: long leg to the "+" side of the coin cell, short leg to the flat "–" side. For short demos you can omit a resistor because the coin cell's internal resistance limits current, but brightness and battery life will be limited.

iexplore

1. Say:
   "We're going to be experimenting with circuits and designing and building a flashlight. One of the things we're going to learn is how to set a goal and build strategies to reach it. The most successful people in the world all use some form of system to reach their goals. The first step in that system is to know how to set a goal. Another way to think about this is 'Where are we going? What does it look like at the end?' First, let's explore how circuits work."

Part A (Pre-Activity, Basic Experimentation with Circuits)

This is a basic introduction to circuits. It may take some youth only a few minutes, while others may need more time. For those who complete the task quickly, provide them with a second (or third) bulb and challenge them to make all of them light up.

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2. Say:
   "I'm going to give your first goal: using the available materials, make the light bulb light up."
3. After everyone is able to make their bulb light up, ask groups to draw a diagram of the circuit. You may then want to draw a diagram on a poster/whiteboard for the entire group to see. Ask for and invite further discussion or counter-evidence. Tip: Pull the group away from their materials to explain--especially if they all seem stuck and are not making progress after about 10 minutes.
4. Collect the materials.
5. Say:
   "Here is another goal: how could you add an on/off switch?"
   Prompt youth to think about the types of on/off switches they have used before - squeeze, blow, touch, flip, or throw switches. Having a simple flashlight on hand that they can look in, may help prompt ideas.

Part B (Choosing a Goal: Design on paper)

6. Ask an opening question to prompt thinking:
   "Think about the types of lights and lamps you have seen before. In what ways are the lights and lamps you've seen similar or different? Have you ever seen any interesting or unusual lights and lamps?"
7. Now that youth have a basic understanding of circuits, using graph paper, challenge youth to design (not build yet) a flashlight device that includes an on/off switch. They can plan to use whatever materials are available. The design does not need to look like a normal flashlight. As the facilitator, help guide youth as they question, share and compare their observations.
8. After everyone is satisfied with their design, move directly to the ireflect exercise.

ireflect

Before asking youth these questions, collect the materials or have youth move to another location. We recommend having everyone sit in a circle. Help guide youth as they question, share, and compare their experience. You may choose one of the questions below as a prompt. Remember these questions are not about getting one right answer.

- Discuss the ways in which you were doing science and engineering.
- If we just put a bunch of stuff in the middle of the table and said ‘Do something with this stuff, ’ what types of things would we have seen being created? Can you explain why selecting a goal is important?
- When you are working on a project, how does knowing the final destination help you? “That’s setting a goal and that’s what you did when you drew the design for your flashlight.”
- If you were trying to teach someone else about being successful at reaching their goals, what would you tell them?

istretch

Encourage youth to complete the istretch activity on their own and bring their answers to the next meeting. At the beginning of the next meeting, spend about 5 minutes sharing their thoughts. (Handout 3)

Make copies of the handout and ask youth to do Step 1: Goal Selection only: identify one goal they have in their own life.

Activity 4: Build a Flashlight

Youth Development Outcome: Youth will conduct at least one progress check, seek help from a peer or adult once, and document at least one strategy shift based on evidence.

Science Outcome: Youth will build a flashlight that turns on and off five times in a row without repair and justify one redesign choice using test results.

Time: 45-60 minutes

Materials: *Same materials from Activity 3.*

Preparation: 5 minutes. Prepare materials and hang the GPS Dimension signs..

Facilitator Tips:

- As the facilitator, it is important for you to know and use the labels of the dimensions of Pursuit of Strategies and Shifting Gears. You will not be teaching these labels to youth directly, instead by using the language and supporting behaviors that demonstrate the dimension, you will reinforce that behavior in a positive direction. Be sure you can use phrases such as:
    - "I see that you're sticking to your plan! That's a great way to see if your strategy works."
    - "You are really trying hard to make that flashlight. That's showing persistent effort!"
    - "Let's take a few minutes to check your progress. How are you doing toward reaching your design goal?"
    - "I see that you are really getting frustrated by that one step. Remember, there are lots of other people in the room who you may be able to seek different help from."
    - "Hmmm, what else could you try? Do you think it's time to substitute one strategy for another?
- Youth should work in the same pairs as they did in the last activity, while each builds their own flashlight. It is best if they can sit around a larger table to share ideas as they build their design.
- We suggest placing materials on a center table rather than handing out a packet to each person. This may allow them to be more creative in their design. Encourage them to share ideas and adapt ideas from each other—in GPS language, that's "adapting the strategies of others". In engineering, learning from others is an important part of being efficient.
- There are many ways to design the on/off switch using conductive materials such as paperclips, aluminum foil-covered craft sticks, etc. If youth are struggling with how to incorporate the switch, ask questions to prompt their thinking.
- Another idea is to have youth deconstruct or take apart an inexpensive flashlight to see how it works.

iexplore

1. Resuming from Activity 3, review what youth designed last time and hand out their flashlight plans.
2. Sticking to a Plan and Showing Persistent Effort: Build the Design. Once youth have a design, ask them to construct their design.
3. You may need to float around the room, providing assistance. Your role is that of a facilitator, ask questions to prompt thinking. There are no right or wrong ways to build their device.
4. Checking Your Progress: Test and Reflect. Prompt youth to reflect on their designs as they build and test them. Does your design work as expected? How will the on/off switch work?
5. Seeking Different Help: Share ideas with others. At some point, you may find it useful to stop everyone, have them join you at a side of the room (leaving their devices behind), and conduct a full group reflection: label a poster/whiteboard in two columns: a) What's working with my device; and b) What's not working with my device. Ask youth to share and record them on the poster.
6. Substituting Strategies: redesign & test. Ask youth to continue working on their devices, testing and redesigning.
7. Once youth are finished, have them share their devices with the full group.

If some complete the flashlight early, you may encourage them to:

- Optimize their design with fewer parts. Materials cost money in the real world. What is the least number of parts they can use in building their flashlight?
- Improve the aesthetics of the design. People like nice-looking products. How can they make their flashlight more visually appealing?
- Make the flashlight brighter. People like brighter lights. How can they increase the brightness of their flashlight? (for example, using two batteries in a series circuit; or encasing the light in a reflective material like aluminum foil).

ireflect

Before asking youth these questions, collect the materials or have youth move to another location. We recommend having everyone sit in a circle. Help guide youth as they question, share, and compare their experience. You may choose one of the questions below as a prompt. Remember these questions are not about getting one right answer.

- From your experience with this activity, what advice would you give to new engineers as they design and build a device?
- Let's talk about which of your strategies worked really well. Can someone tell me about how they really stuck to their design plan?
- How do you think sticking to your plan can really help you with other goals that you have for yourself?

- What about someone who had to substitute a strategy—did someone have to change their design plan—tell us about that.
- Since we know that sticking to a plan is a good idea and substituting strategies is a good idea, how do you know when to move from one to the other?
- If you were trying to teach someone else about being successful at pursuing strategies to reach their goals, what would you tell them? (Try to get at seeking other help, checking progress and persistent effort).

istretch

Encourage members to complete the istretch activity on their own and bring their answers to the next meeting. At the beginning of the next meeting, spend about 5 minutes sharing their thoughts. Continue having youth work on their GPS handout and complete Step 2 and Step 3. (Handout 3)

For younger youth, the strategies will be very simple and may actually look like small goals to get to the bigger goal. That's okay! At this point it's less important what they write, and more important that they start to understand the process. By the time they are 11 years old, their strategies may be just a little more sophisticated.

Younger youth may not be able to concretely think of something that can get in the way of reaching their goal and may struggle with the shifting gears portion. It is okay to make suggestions that seem to make sense to most children. A good one is something like, "I may not have a ride," or "I may have a lot of homework and won't be able to practice."

Chapter 3: Growth Mindset

Overview

Chapter 3 helps youth understand that abilities grow with effort, effective strategies, and help-seeking. Youth first “Create your Scientist!” to name the habits and practices real scientists use, then apply those same habits in “You are an Engineer!” by iterating on a simple design. Across both activities, they practice the iGrow cycle: do in iexplore, make sense together in ireflect, and transfer learning in istretch, so ideas connect beyond the meeting. Expected outcomes include naming what a growth mindset looks and sounds like, using wise strategies during challenge, and seeing themselves as capable science and engineering learners.

Links to Educational Standards

Activity 5 – “Create your Scientist!”

Next Generation Science Standards

- This activity supports asking questions, developing and using models, and obtaining, evaluating, and communicating information.

Common Core State Standards for English Language Arts

- SL.4–6.1: Engage effectively in collaborative discussions. (Pairs and groups plan, compare ideas, and present skits.)
- W.4–6.8: Recall or gather relevant information and organize ideas for sharing. (Teams use posters/cards to plan and communicate about their scientist and tools.)

Activity 6 — “You are an Engineer!”

Next Generation Science Standards

- 3–5-ETS1-1. Define a simple design problem with criteria and constraints. Youth identify what scientists and engineers try to accomplish and what “success” looks like.
- 3–5-ETS1-2. Generate and compare multiple solutions. Youth describe different scientific practices and tools that could address a problem.
- 3–5-ETS1-3. Plan and carry out fair tests and use results to improve a model or prototype. Youth connect growth mindset habits to testing, evidence, and revision.

Common Core State Standards for English Language Arts

- SL.4–6.1. Engage effectively in collaborative discussions.
- W.4–6.8. Gather and organize relevant information from experiences and sources. (Design notes, test observations, and change logs.)

Growth Mindset Key Messages

Growth mindset is the belief that intelligence, abilities, and personality can grow with effort and persistence. This matters for how youth see themselves in science and engineering. Even when they fail, they can learn something useful and try again. Fixed mindset is the belief that talents, skills, and personality are mainly inherited and cannot change much. With a fixed mindset, people often avoid challenge and mistakes because they doubt they can improve. The intention of this chapter is to help youth shift from “I cannot do that. I am not a science person.” to “If I keep trying science activities, even when they are hard, I will get better.”

How the brain changes with learning

When we learn and practice new things, including science, the brain builds and strengthens connections among neurons. With repeated practice, these pathways become faster and more coordinated. Challenge, deliberate effort, and strategy use support these changes. What starts out difficult becomes easier. Youth can notice science and engineering feeling more doable over time.

Your role as facilitator

Model a growth mindset in your language and actions. Name your own effort, strategy shifts, and help-seeking. Guide youth through **iexplore**, **ireflect**, and **istretch** so they connect experiences to how learning works. Emphasize growth mindset and its attributes rather than labeling youth as “fixed.” When youth hear both labels, some may apply “fixed” to themselves and feel discouraged. Give youth opportunities to see themselves moving toward growth.

Key messages for youth.

- A growth mindset means your basic qualities and abilities can change and grow. Through effort, the right strategies, and getting help from others, you can do more than you thought you could.
- Mindset influences many parts of life, including how capable you feel in science and engineering. Your abilities can improve with effort and persistence.
- Some people operate with a fixed mindset, believing that intelligence or personality cannot change. When tasks feel hard, they may quit early because they do not expect success.
- Life presents challenges. Most times, you can improve by:
    - increasing effort
    - adjusting strategies
    - seeking help

Objectives. Youth will:

- understand that current brain research can help them reach goals
- understand how the brain thinks thoughts and builds pathways
- understand that the brain acts like a muscle that grows stronger with challenge
- understand the unique opportunity for nurturing brain growth in pre-adolescence
- learn that growth mindset is about applying effort, trying strategies, and seeking help
- consider the value of a growth mindset in their own lives

How to coach a growth mindset

- **Model** your own growth mindset: show effort, try new strategies, and seek help.
- **Praise specifically** what youth can control:
    - “I can see the effort you are putting into this.”
    - “I like how you keep trying new ways to get there.”
    - “You tried hard and then asked for help when you were stuck. Great!”

- **Use wise praise** that conveys three points:
  - “I have high expectations of you.”
  - “I know you can do it.”
  - “I will help you.”
- **Normalize challenge** and emphasize that the brain grows with challenge.
- **Notice patterns** without labeling. Help youth build self-awareness about when they use growth or fixed thinking.
- **Plan strategies** together. Ask, “What could you try next?” and “Who could you ask for help?”

Wise praise in practice

When a young person falls short of a standard, acknowledge the high standard and express confidence with support. For example:
“In order to meet the high standards for this award, these items need to change. I would not be telling you this if I did not think you could meet them. Let me know when you have made the corrections.”

Phrases you can use with youth.

- “That is being a good learner.”
- “Great job. I can see you really worked hard on that.”
- “You picked the hardest one. I bet you learned a lot.”
- “I made a mistake. Let”s celebrate. Mistakes help me learn.”
- “Awesome effort. Keep going.”
- “That was challenging and just by trying, your brain grew. How cool is that?”
- “I know you are disappointed that did not work. Keep trying. Your effort will pay off.”
- “Based on what you learned, what will you try next time?”
- “How can you use what you learned before to help with this challenge now?”
- “What is going to help you learn the most?”
- “What have you achieved so far?”
- “You are learning.”

Helpful responses to “I cannot.”

- If youth say, “I cannot do that. I am not smart enough,” avoid empty reassurance. Try:
  - “It seems hard right now, and I see you working hard. Being smart is about working hard.”
  - “You chose the hardest task. With persistent effort you can do it. If your strategies are not working, what else could you try?”
  - “Our expectations are high and I know you have the skills to reach them. I am here to help. What support would be useful?”

Avoid.

- Labels like “smart,” “dumb,” or “talented”
- Talking as if “easy” is good and “hard” or “failure” is bad
- Over-labeling youth as “growth” or “fixed.” Teach the intervention and let belief develop through experience
- Implying that personality or ability is inherited or predetermined

Science Key Messages

A young person may have a growth mindset in sports and a fixed mindset in science. iGrow helps youth build interest in science and engineering and see themselves as people who, through effort and persistence, can do science.

Interest often emerges in upper elementary and middle school

Youth frequently become excited about a specific domain such as plant science, woodworking, robotics, or astronomy. This focused interest is positive and can be a doorway into broader science and engineering learning.

Becoming proficient is more than memorizing facts

Learning science involves:

- experiencing excitement, curiosity, and motivation to learn about natural and physical phenomena
- generating, understanding, and using concepts, explanations, arguments, models, and facts
- manipulating, testing, exploring, predicting, questioning, observing, and making sense of the natural and physical world
- reflecting on science as a way of knowing
- participating in scientific activities with groups of people
- thinking about oneself as a science learner and as someone who knows about, uses, and sometimes contributes to science

Connect mindset to practice

Use **iexplore** to engage in hands-on inquiry, **ireflect** to make sense of evidence and strategies, and **istretch** to plan where youth will use those strategies in school, home, and community.

Treat failure as feedback

In engineering design and scientific investigation, define the problem, imagine and compare solutions, build and test, use evidence to revise, and try again. Growth mindset language makes this cycle safe and motivating.

Activity 5: Create your Scientist!

Youth Development Outcome: Youth will name at least two growth-mindset behaviors used by their scientist and compose one self-talk phrase they will try during a challenge.

Science Outcome: Youth will identify at least three scientific practices (for example, testing, using models, arguing from evidence) and illustrate each with an example from their skit.

Time: 45 minutes

Materials:

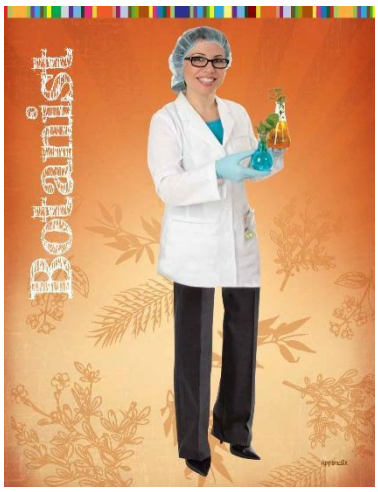
- ☐ Copies of Handout 5: Create Your Scientist – 1 per pair of youth
- ☐ Writing utensils
- ☐ Coloring pencils, crayons, or markers
- ☐ Flip chart paper or whiteboard and markers
- ☐ Posters of scientists (11 x 17 inch) – 8 sample posters
- ☐ Fields of science and engineering cards – several sets for reference
- ☐ Scientist Mindset question slips – 1 set per pair of youthof Handout 5 Create Your Scientist – 1 per each pair of youth

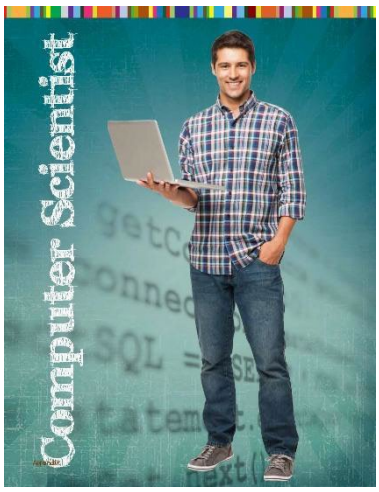
Preparation: 30 minutes. Gather supplies, copy Create Your Scientist handout, copy and cut slips (one per pair of youth) of the Scientist Mindset questions

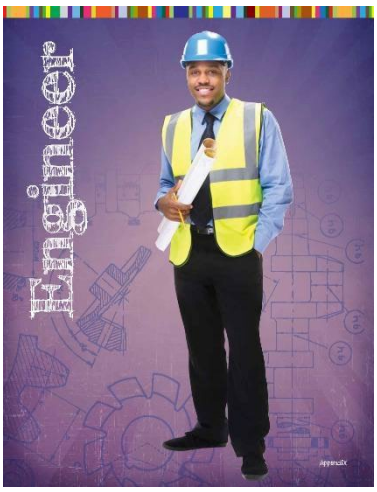
Facilitator Tips

- Youth focus on growth mindset in this activity. Keep the worksheets available in case you want to display them later or refer back to them during reflection.
- When going around to the groups during the activity, help prompt youth to think about how this applies to themselves as well as other people (and scientists).

Scientist Poster Examples







iexplore

1. *Say:*
   "We're going to think about how scientists learn. Scientists do not succeed because they always get things right the first time. They learn by trying, noticing what happened, getting feedback, and trying again.

   When you learn and practice, your brain builds stronger connections. That means hard things can get easier over time. Effort, good strategies, and help from others all matter.

   The term I want you to remember is 'growth mindset.' A growth mindset means you can grow your abilities through effort, strategies, practice, and help from others. First, we're going to explore what we think about scientists and the ways they work."
2. Have youth work in pairs. Pass out blank Handout 5: Create a Scientist worksheets.
3. Ask youth to discuss how they want to create their scientist. If needed, prompt with questions such as what type of scientist is it? What types of things do you think they do? Allow the youth to look at the scientist posters, or the Field of Science and Field of Engineering cards to gain further ideas.
4. Have youth think about the ideas in the Perk box and complete the Tool box. Youth may not know the names of certain tools. Ask the youth to draw their tools and describe what they do if they cannot name them.
5. Have youth color in the Growth Mindset meter--invite youth to think about these questions when they are completing the growth mindset arrow.
   a. What does their scientist do when their work doesn't turn out as planned?
   b. How do they react to criticism and feedback?
6. Have youth start to respond to the Scientist Mindset questions. Ask them to discuss and reach agreement on these questions. Let youth know that they will be using their responses to these questions later in the activity.
7. After the groups have completed the worksheet, ask them to prepare a skit about their scientist that includes each of the questions they discussed. Their skit can be acted out, a song or poem, a dance, or anything else they think will best share their scientist. Have the youth write down their skit on the back of the scientist worksheets.

ireflect

Before asking youth these questions, collect the materials or have youth move to another location. We recommend having everyone sit in a circle. Help guide youth as they question, share, and compare their experience. You may choose one of the questions below as a prompt. Remember these questions are not about getting one right answer. When you compare your scientist to other groups' scientists, what were the similarities and differences?

- Do you believe that your scientist has a growth mindset? Explain how you know.
- What conclusions can you make about what it may take to be a scientist?

- All the things you wrote and talked about for your scientist are qualities of a growth mindset. In what ways do you practice using a growth mindset in your life? Be sure to correct any misunderstandings of the definitions of a growth mindset.
- What encouragement could you tell someone who said, “I can’t do that because I’m not good at science!”

istretch

Encourage members to complete the istretch activity on their own or in small groups and bring their answers to the next meeting. At the beginning of the next meeting, spend about 5 minutes sharing their thoughts.

With members of your family, discuss how you think you practice a growth mindset and how that helps you think of yourself as a scientist. Discuss how you and other family members might work to promote a growth mindset within your family. (Handout 6)

Activity 6: You are an Engineer!

Youth Development Outcome: Youth will describe one time they used effort, feedback, or a new strategy after a setback and explain how that helped them improve.

Science Outcome: Youth will run at least three fair flight tests, record distances, and explain one specific design change that improved performance.

Time: 45 minutes

Materials:

- Copies of Handout 6: My Mindset – 1 for each youth to take home
- Blank paper
- Masking tape or blue painter's tape
- Measuring tape
- Optional:
  - plastic straws
  - index cards
  - tape
  - scissors
  - paper clips
  - or other small attachments

Preparation: 30 minutes. Gather materials

Facilitator Tip

As with other engineering activities, there is no correct answer. The paper airplanes in this activity are a metaphor for improving over time by learning, adapting and growing through effort and persistence.

iexplore

1. Say:
   "What is an example of one thing you remember learning last week about how a scientist thinks? What are some other ideas? (Make sure they capture phrases like "growth mindset", "effort", and "persistence").

Today, you're going to practice using your effort and persistence skills as an airplane engineer. A new aeronautics company has asked us to design an airplane that flies as far as possible, using only the materials they provided us in this kit. Take a few minutes to look at all of the materials and then start building."

2. Have everyone build a paper airplane. Allow creativity.
3. Mark one starting line. Each youth does Flight Test 1. Measure and record the distance.
4. Make the top fliers the "Team Leaders" and split youth into a group with these team leaders. Have each team come up with a team name.
5. Have the team leaders show their group how they designed their airplanes. Ask each youth to design and construct another plane similar to their Team Leader but with a few modifications they think will make it fly even further.
6. Do Flight Test 2 from the same starting line and in the same way. Measure and record the distance.
7. Invite youth to compare Test 1 and Test 2 and explain which change helped most.
8. If time allows, repeat once more.
9. Compare the top fliers each round. Encourage youth to analyze the distance of the top fliers each test (how did it change?). Also, ask youth to look at the designs of the planes over time – how did they change?
10. Optional: Show the video at https://vimeo.com/230426221 and ask, "What does this video show about how practice helps the brain learn?"

ireflect

Before asking youth these questions, collect the materials or have youth move to another location. We recommend having everyone sit in a circle. Help guide youth as they question, share, and compare their experience. You may choose one of the questions below as a prompt. Remember these questions are not about getting one right answer.

- Describe what you did in the face of challenges and setbacks.
- How did you react when your plane did not fly the farthest?
- How did you react to criticism and feedback? How do you think people can use criticism and feedback?
- How persistent were you in this activity?
- In what ways does this activity relate to a growth mindset?

- What connections can you make between this activity and science and engineering?
- What encouragement could you tell someone who said, “I’m not smart enough to be an engineer.”

istretch

Encourage members to complete the istretch activity on their own or in small groups and bring their answers to the next meeting. At the beginning of the next meeting, spend about 5 minutes sharing their thoughts.

In the next week or two, ask youth to identify a time when they saw themselves learning from experience. Ask them to write it down: What was it? How did they feel? What did they learn? (Handout 6).

Chapter 4: Ready for Work and Life

Overview

Chapter 4 helps youth understand and practice what it means to be ready for work and life while doing science and engineering. The chapter draws on the 4-H Beyond Ready framework and makes key readiness skills visible through hands-on work. Youth rotate through brief investigations and design tasks that ask them to try new ideas, collect simple data, model systems, support teammates, manage focus, connect their efforts to people and place, and set a short plan for follow-through.

By the end, youth can describe several Beyond Ready skills in their own words, give one piece of evidence from their work, and set one small plan to use those skills in future science and engineering tasks.

Links to Educational Standards

Activity 7 – “Seven-Station Beyond Ready Carousel”

Next Generation Science Standards

- 3–5-ETS1-2: Generate and compare multiple possible solutions based on how well they meet the criteria and constraints.
- 3–5-ETS1-3: Plan and carry out fair tests, controlling variables and considering failure points to improve a model or prototype.
- 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

Common Core State Standards for English Language Arts

- SL.4.1; SL.5.1; SL.6.1: Engage effectively in collaborative discussions; follow agreed-upon rules; build on others’ ideas; express one’s own clearly.
- L.4.6; L.5.6; L.6.6: Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases.

Beyond Ready Key Messages

In iGrow, being Beyond Ready means building the knowledge, habits, and relationships that help youth succeed in school, work, and life. In 4-H, readiness grows through strong developmental settings (Sparks, Belonging, Relationships, and Engagement) and through experiences that build project skills, work habits, leadership, responsibility, purpose, caring and connection, goal setting and management, and growth mindset.

For this chapter, youth practice seven readiness skill areas through science and engineering tasks:

1. **Curiosity and Problem Solving (“Try New Ideas”)**
   Ask questions, test ideas, and use evidence to make sense of what is happening.

2. **Growth Mindset and Persistence (“Keep Improving”)**
   Believe that effort, strategies, practice, and feedback help you get better.

3. **Purpose and Contribution (“Make It Matter”)**
   Connect your work to something meaningful that benefits people or place.

4. **Teamwork and Communication (“Work Well with Others”)**
   Listen, cooperate, communicate clearly, and support others while solving problems together.

5. **Systems Thinking and Community Awareness (“See the Bigger Picture”)**
   Notice how parts connect in larger human and natural systems.

6. **Focus and Self-Management (“Use Feelings to Help You Work”)**
   Use routines that support calm, focus, and follow-through.

7. **Goal Setting and Follow-Through (“Plan, Do, Check”)**
   Set a goal, plan steps, monitor progress, and adjust when needed.

What this looks like in practice

- Plan for multiple readiness skills. Design activities where youth can show problem solving, teamwork, persistence, and follow-through, not just content knowledge.
- Notice and name skills in the moment. For example, “You changed your test based on evidence. That is problem solving,” or “You kept working after a setback. That is persistence.”
- Make purpose visible. Ask, “Who or what benefits if this worked outside our room?” to connect science learning to contribution and community.
- Teach simple self-management routines. Before a timed task, try a 60-second reset. Youth can compare performance and describe how focus supported their work.
- Model bigger-picture thinking. After observations, ask, “If this part changes, what else shifts?” to help youth think in systems.

Facilitator checklist

- Prompt: “What is one new idea you will try first, and why?”
- Reframe: “What strategy will you try next?”
- Connect: “Who benefits if we solve this, and how will we know?”
- Structure: “Use clear roles and signals so everyone can contribute.”
- Extend: “Add two more connections to your system map and predict a ripple effect.”
- Regulate: “Pick a quick reset before testing and record how it affected your focus.”

Science Key Messages

Science is the study of the natural and designed world. It is a human enterprise that constructs and organizes knowledge as testable explanations about the universe.

There are several branches of science, including natural science, formal science, and social science.

- **Natural science** focuses on the natural world and identifies rules, theories, and laws that describe it.
- **Formal science** focuses on logic and mathematics.
- **Social science** focuses on human behavior and social patterns.

While all of these branches use scientific methods, they use different methods and tools suited to their questions.

Skills in science and engineering

In science and engineering, people do more than learn facts. They ask questions, make models, plan investigations, analyze information, use mathematics, build explanations, discuss evidence, revise ideas, and work with others.

In iGrow, Beyond Ready skills can be observed through what youth do and say during science and engineering tasks. Facilitators can look for evidence in plans, teamwork, persistence, communication, revision, and contribution.

Helping youth understand these skills can be challenging. The terms used in this activity have been described and studied in different ways for many years. How a skill is defined and how it is studied, for example with observations, reflections, or performance tasks, influences how results are interpreted and the conclusions that follow.

Activity 7: Seven-Station Beyond Ready Carousel

Youth Development Outcome: Youth will collect one piece of evidence from each station, connect it to a Beyond Ready skill, and set one two-step plan for using that skill in the next week.

Science Outcome: Youth will perform at least one observation, one model/drawing, and one simple measurement, then communicate one brief finding to a partner.

Time: 60 minutes

Materials:

- ☐ Handout 7: Ready Skills Passport – 1 for each youth
- ☐ Printed copies of the 7 Station posters
- ☐ Clipboards
- ☐ Writing utensils
- ☐ Sticky notes
- ☐ Tape
- ☐ Timers or phone stopwatch
- ☐ Chart paper and markers
- ☐ **Station 1:** 6 to 12 sealed “black boxes” with different contents (for example: dried beans, coins, marbles, sand, cotton balls, or small blocks)
- ☐ **Station 2**: Similar supplies to Activity 6.
  - Paper (regular 8.5 x 11” is fine, or strips of paper)
  - Scissors
  - Tape
  - Paper clips
- ☐ **Station 3**: Site “mini-need” menu card
- ☐ **Station 4**:
  - Craft sticks
  - Index cards
  - Paper clips
  - Tape
  - Tape measure
- ☐ **Station 5**: Object cards (pencil, faucet, snack), blank system-map sheets
- ☐ **Station 6**:
  - 2 short pattern puzzles labeled Puzzle A and Puzzle B
  - Timers (like sand timer or kitchen timer)
  - Mood dot stickers
  - (optional) Calm cards that show box breathing steps
- ☐ **Station 7**: GPS mini-plan cards (Goal, Plan, Several checkpoints)

Preparation: 30 minutes. Print Passports and post the Seven Station poster with space for sticky notes. Set up seven stations with materials and a simple direction card at each.

Facilitator Tip: When circulating among groups, prompt youth to think about how each skill applies to themselves, other people, and the work of scientists and engineers.

iexplore

1. Say:
   "Today you will rotate through seven quick stations. Each station lets you act like scientists and engineers while also practicing a skill that helps people become ready for work and life. Work in pairs, stay with your rotation, and collect one short piece of evidence at every stop. When you hear the timer, finish your sentence and move to the next station.
2. Within each pair or trio, assign roles that can rotate halfway: Builder or Investigator, Recorder, Timekeeper and Materials Lead. Remind youth to switch roles.
3. Say:
   "Choose roles for the first half: Builder or Investigator, Recorder, and Timekeeper and Materials Lead. After three stations, please switch so everyone has a chance to build and record."
4. Run 4 to 5 minutes per station.
5. Give a one-minute warning and a clear **move** signal to the next station.
6. If a group finishes early, ask them to add one more observation or a quick labeled sketch.

ireflect

Before asking youth these questions, collect the materials or have youth move to another location. We recommend having everyone sit in a circle. Help guide youth as they question, share, and compare their experience. You may choose one of the questions below as a prompt. Remember these questions are not about getting one right answer.

- What did you notice about the different kinds of skills you used across the stations?
- What surprised you about how your feelings or strategies affected your results?
- Where did you change your plan, and what evidence told you to do that?
- How did your team show helpful behavior, and how did that support the science work?
- Where did you notice a connection to a larger system, and what ripple effects did you predict?
- Which readiness skill felt most natural for you today, and which one do you want to grow?
- What would make your investigation fairer or your model clearer next time?

istretch

Encourage members to complete the istretch activity on their own or in small groups and bring their answers to the next meeting. At the beginning of the next meeting, spend about 5 minutes sharing their thoughts.

With members of your family, discuss one skill from today that helps people become ready for work and life. Talk about how you are practicing that skill now and how your family can help you keep building it.

Station 1. Try New Ideas

(Curiosity and Problem Solving)

Goal: Use 3 tests to figure out what is in a closed box.

Steps:
1. Pick one box. Do not open it.
2. Listen.
3. Feel how heavy it is.
4. Roll or tip it.
5. Make one new test.
6. Write your best guess and the clues.

Hint: Compare two boxes.
Challenge: Teach your new test to another team.

Station 2. Keep Improving

(Growth Mindset and Persistence)

Goal: Make a paper flyer. Change one part. Test again.

Steps:

1. Make a flyer.
2. Pick one start spot.
3. Test it once.
4. Change one part.
5. Test it again from the same spot.
6. Circle the better test.

Hint: Change only one thing.
Challenge: Draw the best version.

Station 3. Make It Matter

(Purpose and Contribution)

Goal: Pick one small real problem and make a simple plan to help.

Steps:

1. Read the menu.
2. Pick one problem you care about.
3. Write who or what is helped.
4. Write one small action.
5. Write how you will check if it helped.
6. Pick a day and time.

Hint: Small plans work best.
Challenge: Add a helper and one more way to check.

Mini-Needs Menu Options
(Pick ONE you can finish fast)

- Do a “lights off when empty” sweep of two rooms.
- Time how long taps run during handwashing; make a 20-second song sign.
- Check 2 sinks for drips and report one if you find it.
- Set up a scrap paper tray by the printer.
- Do a 5-minute litter pickup along one walkway (gloves or grabbers).
- Clear one high-traffic floor area of hazards and neatly coil one cord.
- Create a “push-in chairs” or “shoes tied” reminder at a meeting spot.
- Write a thank-you note (custodian, cafeteria, office, bus driver, leader).
- Welcome a new or quiet person: invite them to join an activity today.

Station 4. Work Well with Others

(Teamwork and Communication)

Goal: Build the tallest tower you can without talking.

Steps:

1. Look at the materials.
2. Make a silent plan.
3. Build a wide base.
4. Build up.
5. If it falls, try a new idea.
6. Measure the tower.

Hint: Strong shapes help.
Challenge: Build it taller with fewer pieces.

Station 5. See the Bigger Picture

(Systems Thinking and Community Awareness)

Goal: Show how one object is part of a bigger system.

Steps:

1. Choose an object.
2. Write it in the center.
3. Add 3 connected parts.
4. Draw arrows to show the connections.
5. Write what changes next if one part changes.

Hint: Think from start to finish.
Challenge: Add one way to improve the system.

Objects

- Pencil
- Notebook
- Lunch tray
- Backpack
- Light switch
- Sink faucet
- Paper towel
- Trash can
- Printer
- Apple
- Broom
- Bus
- Bicycle
- Tree
- Battery

Station 6. Use Feelings to Help You Work

(Focus and Self-Management)

Goal: Try a calm reset and notice how it changes your focus.

Steps:

1. Do Puzzle A for 60 seconds.
2. Sit tall and do box breathing.
3. Do Puzzle B for 60 seconds.
4. Count how many you got right.
5. Circle the feeling that helped.

Hint: Breathe slowly.
Challenge: Make your own reset routine.

Station 7. Plan-Do-Check

(Goal Setting and Follow-Through)

Goal: Make a small plan you can finish this week.

Steps:
1. Pick a small science or engineering task.
2. Write your goal.
3. Write 2 steps.
4. Write how you will check your progress.
5. Pick a check time.
6. Write a Plan B.

Hint: Pick something you can control.
Challenge: After your check time, write one change you will make next.

Chapter 5: Celebrate

Overview

Pairs or small groups design and build a device that launches confetti. Provide a shared materials bank and prompt multiple solutions. Allow 15–30 minutes to build, test, and modify, then facilitate a brief reflection on what surprised youth, what they would change, and highlights from the project overall. Have a vacuum ready for cleanup. Time: 30–45 minutes. Materials: paper confetti plus common prototyping supplies.

***Celebration options**. Co-plan with youth a simple or more elaborate gathering that may include families. Youth can demonstrate launchers, explain design iterations, thank Spark Champions, and share one idea they will carry forward.*

Links to Educational Standards

Activity 8 – "Kinetic Confetti!"

Next Generation Science Standards

- 3–5-ETS1-1. Define a simple design problem with criteria and constraints. Youth frame a launcher goal and choose success measures such as height or spread.
- 3–5-ETS1-3. Plan and carry out fair tests to compare solutions. Youth iterate and compare versions based on consistent trials.

Common Core State Standards for English Language Arts

- SL.4.1 / SL.5.1. Engage in collaborative discussions, building on others' ideas and clearly expressing one's own, during team design and share-outs.
- W.4.2 / W.5.2. Write informative texts to examine a topic and convey ideas clearly, optionally as short design notes or a one-paragraph explanation of how the final launcher works.

Celebration Key Messages

Positive Youth Development

The celebration capstone recognizes growth across the project and invites youth voice in planning and leading the event. You will draw on what you know about each young person's Spark, use GPS goal-management language, and build in reflection so youth name progress and next steps. The chapter checklist emphasizes youth-involved planning and optional end-of-project surveys to close the loop.

- **Lift youth voice and partnership**. Involve young people in planning the celebration. Use the same strengths-based youth-adult partnership practices from the rest of iGrow: invite choices, share decisions, and keep the tone strengths-based.
- **Connect back to Sparks and GPS**. Prompt each youth to name one way their Spark showed up in the build or in the teamwork, and one GPS-style next step they will try after iGrow. This strengthens identity and transfer beyond the project.
- **Close with reflection and contribution**. In the circle debrief, invite "one thing I learned that will help me now and in the future" and "one idea I can teach or lead others about." Position the celebration as a contribution to family and community.

STEM Learning

Youth engage in concise engineering design with a joyful build-test activity, then connect design choices to evidence from trials. In iGrow, the larger STEM aim is for youth to strengthen understanding, skills, attitudes, and real-world application of science and engineering; your celebration continues that arc.

- **Make the engineering visible**. Treat the confetti launchers as mini design stories. Ask youth to name their criteria, constraints, and the change that most improved performance. Highlight iteration as a normal part of engineering and celebrate evidence-based tweaks.

Keep it simple and joyful. The event can be modest or more elaborate. Focus on safety, inclusion, and recognition of effort and growth. Consider quick thank-yous to Spark Champions and optional pins or certificates for completion. Optional iGrow pins are available from All Action Awards, Woodland, CA, https://www.allactionawards.com/4h-pins

Activity 8: Kinetic Confetti

Youth Development Outcome: Youth will state one way their Spark or GPS skill grew during iGrow and express thanks to at least one Spark Champion or teammate.

Science Outcome: Youth will design, test, and compare at least two confetti-launcher versions, then explain which change improved launch height or spread using evidence from a fair test.

Time: 45 minutes

Materials:

- ☐ paper confetti

Have these supplies available at the front table.

- ☐ drinking straw
- ☐ string
- ☐ sheets of cardboard (approx. 8.5 x 11 in.)
- ☐ duct tape
- ☐ wooden spool
- ☐ paint stirrers
- ☐ rubber bands
- ☐ 8-oz. paper cups
- ☐ 4-oz. paper cups

Optional

- ☐ 3 to 4 hot glue guns
- ☐ Scissors
- ☐ other tools to help youth modify and/or attach objects

Preparation: 30 minutes. Gather supplies

Facilitator Tips

- As with other engineering education activities, there is no right or wrong way to build a device. If some groups are having difficulty, a good technique is to stop all groups, gather them around and ask people to share “what’s working” and “what’s not working” as a way to get youth to share.
- You may want to have a vacuum handy for cleanup.

iexplore

1. Split youth into pairs or small groups.
2. Say:

   “Your challenge is to build a device that launches confetti. First, decide what success means for your team. For example, your confetti could go at least 3 feet high, spread at least 3 feet wide, or launch in a controlled way.
3. Build Version 1 using the materials at the table.
4. Test Version 1 from the same starting spot each time.
5. Measure the height or spread and record the result.
6. Change one part of the design.
7. Test Version 2 from the same starting spot in the same way.
8. Compare the two tests. Decide which change helped most and why.
9. Before the celebration share-out, ask each group to write 2 or 3 sentences or draw a labeled sketch that explains how its best launcher worked and what change helped most.”
10. If time remains, invite groups to make one more change and test again.
11. Celebrate by inviting each group to demonstrate its launcher and briefly explain its best design change.

ireflect

Before asking youth these questions, collect the materials or have youth move to another location. We recommend having everyone sit in a circle. Help guide youth as they question, share, and compare their experience. You may choose one of the questions below as a prompt. Remember these questions are not about getting one right answer.

- What did your team change between Version 1 and Version 2?
- How did you try to make your test fair?
- What evidence showed that one version worked better?
- Where did you see a Spark, GPS skill, or growth mindset during this activity?
- What is one idea from iGrow that you want to keep using after this project?
- surprised them during the kinetic confetti activity?