

iThrive

Leadership, Science & Me



4-H Leadership Development Project

Grades 7 through 12



Youth Workbook

Developed by the University of California 4-H
Youth Development Program

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

This workbook is about experimenting, designing and through these experiences, becoming a thriving person!

In your 4-H Leadership Project, you have opportunities to feel valued, to reach your fullest potential and contribute to your community. This project is also about participating in the practices of science, engineering and technology where you may:

- ⦿ Experience excitement and interest to learn about phenomena in the world
- ⦿ Manipulate, test, explore, predict, question, observe and make sense of the world
- ⦿ Reflect on science and engineering as a way of exploring the world
- ⦿ Think about yourself as a scientist or engineer!

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Acknowledgements

The 4-H iThrive series was developed through the collaborative contributions of many...

The Thrive Foundation for Youth, whose vision for a thriving theory of change for young people, their partnership and their generous gift, made it all possible.

The 4-H Thrive Leadership Team: a small group of dedicated staff whose commitment to this project allowed us all to learn and grow professionally. Special thanks to Shannon Horrillo, Gemma Miner, Scott Mautte, Kali Trzesniewski, Keith Nathaniel and Annette Leeland.

The evaluation team: Kali Trzesniewski, Kendra Lewis, Latonya Harris, and Julia Singleton who collect and analyze data that improves 4-H program and advances youth development knowledge about how 4-H develops thriving youth.

The statewide 4-H Master Trainers: who did the hard work to pilot the curriculum, coach and support volunteers.

The 4-H Science, Technology, Engineering and Mathematics (STEM) Leadership Team who have provided tremendous support for high quality science, engineering and technology education in the 4-H Youth Development Program: Andrea Ambrose, Shannon Horrillo, Richard Mahacek, Lynn Schmitt-McQuitty, Martin Smith and Steven Worker.

The Cooperative Extension and State 4-H Office staff, 4-H adult volunteers and 4-H youth members who have embraced thriving as the unique brand of skill building in the University of California 4-H Youth Development Program and continue to find ways to infuse thriving concepts and language throughout 4-H.

Special thanks to Julia Singleton and Kendra Lewis for their contributions to Chapter 5, Growth Mindset in Science and Engineering.

Thank you all for your contributions of time, talent and resources to help California youth thrive!

Steven Worker & Gemma Miner







Step Up to Thriving -the introduction

Positive Youth Development

This curriculum supports the 4-H Thriving Model (Arnold, 2018) that supposes that youth who participate in a high quality, 4-H program context will thrive. Further, the model projects that thriving youth achieve key developmental outcomes. 4-H programs done well, embrace the concepts of developing Sparks, focus on quality with an emphasis on belonging, and foster youth-adult partnerships where the adults are caring, share power and challenge growth.

Youth Development Outcomes

The key youth development outcomes that we strive to achieve are described by Mary Arnold (2018) in the 4-H Thriving Model. The outcomes that you will see reflected in this curriculum include: competence, personal standards, connection, contribution, academic motivation and success, reduction in risk behaviors and healthful choices.

Science and Engineering Learning

Whether 4-H members are in an animal, environment, food, or any other project, they have opportunities to learn science, technology, engineering and mathematics. 4-H members will find a science and engineering connection in almost all 4-H projects! Science is all around us, from the food we eat, to the clothes we wear. Engineers and designers planned, prototyped and manufactured phones and computers using scientific knowledge and the engineering design process.

Why are we focusing on positive youth development and science and engineering learning?

1. The concepts in this program are based on years of positive youth development research. This research has shown that when youth have a spark, growth mindset, are able to set and manage goals and self-reflect they are more likely to reach their full potential and thrive.
2. Many people are not aware of how important science is. Even more significant, many people believe that they cannot learn science topics, do not have what it takes to become a scientist, think science is boring and/or think science is not necessary for them to achieve their dreams. People who believe these MYTHS will have trouble reaching their full potential.

What's in my iThrive workbook and how to use it

Each chapter guides you through the elements of thriving embedded in the practices of science and engineering. In each chapter, you will be presented with background information on one of the thrive concepts along with one or more of the eight scientific and engineering practices.

explore activities: hands-on activities where you will work with your peers in the 4-H Leadership Project

reflect activities: reflect on your experience, share it with others and start to draw connections between the concepts and your own life

stretch activities and real world applications: with other project members or on your own, learn more about the concept and apply the concept in the real world

All of the **explore and reflect** sections are designed to be completed at your project meetings. You may want or need to continue the **reflect** at home on your own and then figure out how you are going to share your reflections with each other at the next meeting.

When you complete 4-H **iThrive**, you will be eligible to be awarded a 4-H Thrive pin in recognition of your effort! This is an annual award and can be achieved multiple times. The first year that you complete the **iThrive** Leadership Project, you will earn the oval Thrive pin (see below). In following years, when you complete additional **iThrive** Leadership Projects, you will earn the round clovers to cluster around the Thrive pin. Each clover indicates an additional year of project completion.

Ready to launch....and **thrive!**





RECORD your progress!

The 4-H Youth Development Program (YDP) is part of the national Land-grant University system. The first Land-grant Universities were approved by President Lincoln in 1862 with an Act of Congress that granted federal land to states in exchange for colleges that taught practical (and often hands-on) agriculture, science and engineering. 4-H enters the story in 1914 with the passage of the Smith-Lever Act. The Act created the Cooperative Extension Service with a mission to bring agricultural research from universities to farmers with 4-H being the youth outreach and education program. While the farmers were slow to adopt new practices and agricultural innovations, their children, the first generation of 4-H members, were eager to learn and try new agricultural techniques. In essence, 4-H members not only learned about science but helped advance scientific research!

Today, over one hundred years later, 4-H still helps young people learn, grow and contribute to the research. 4-H today is much broader than agricultural education, but we still work with youth to help improve society through the application of new innovations, ideas and knowledge. In 4-H we share what we know about youth development: what works, what's new and what's promising.

Collecting Data ... A Critical Practice of Science

A core practice of science is collecting data using rigorous, reliable and valid methods. Just as you are learning about the practices of science, the 4-H program is conducting scientific research about young people like you! One of the ways that we know what works and the impact of 4-H on your growth is by tracking your progress. This also allows us to continually improve the 4-H YDP and help ensure that it meets the needs of young people for the next 100 years.

You can help advance the research by answering questions in surveys that may be provided by your adult leader.



Kindle Your Inner Passion

What is your inner passion?

What gives you joy, energy and motivation?

Perhaps it is a hobby, a skill, sports, music, art, leading meetings, presenting or helping others.



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passion

A spark is something you're passionate about; it really fires you up and gives you joy and energy. A spark comes from deep in your gut and is an important part of who you are. A spark may be an interest, skill or quality. Your spark is also something you use to make a positive difference in the world. It might be anything from playing a musical instrument to rebuilding antique cars, from leading a 4-H project to caring for animals at a shelter.

What is one spark that you know you have so far? If you don't know, that's okay. Sometimes it takes a lot of trying new things to find out what you are passionate about.

Spark Champions

Research shows that when a young person has at least three caring adults in their life who support them and help nurture their Sparks, then they are more likely to have a sense of purpose, be more socially competent and physically healthy and they do better in school. We call these caring adults, Spark Champions. As you go through the year, think about the adults in your life who are already your Spark Champions. It's okay to ask an adult who has the same Spark as yours to be your Spark Champion.

The Questions that Drive Science and Engineering

Questions are the fundamental process of science and engineering. Scientists ask "What exists?", "What happens when?", "Why does it happen?", and "How do we know?" Engineers ask "What can we do to address a human need?", "How can we define the need?", "What tools could be developed to address this need?"

There are a wide variety of natural phenomena that have been investigated using science and built using engineering. There are hundreds of fields of science and engineering that work to study and design the world.

While science and engineering share similarities, they have several fundamental differences. Scientists strive to identify general rules of nature while engineers design solutions that satisfy particular needs. Engineering involves constraints in materials, finances and aesthetics that often require trade-offs. These constraints, while present in the process of science, should not affect scientific theories.

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Sparks of Science

Think about your spark and find a way to represent your spark with a drawing. If you don't know one of your Sparks yet, don't worry—sometimes it takes a lot of time to know your spark. Draw something that you think you might be interested in.

- ⦿ Once your drawing is complete, think about the ways science and engineering connect to your spark.
- ⦿ Select a Field of Science and a Field of Engineering card that you believe connect to your spark.
- ⦿ In groups, discuss how science and engineering connects to your spark.
- ⦿ Start to pose questions that scientists in that Field of Science might want to investigate around your spark. Start to pose questions that engineers in that Field of Engineering might want to address.

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What surprised you about connections between science and engineering with your spark?

After thinking about how science and engineering connect to your spark, what conclusions can you draw about science and engineering?

Share your ideas about any spark that someone can have that you think doesn't require science or engineering.

In your role as a leader, how could you help other youth explore and/or develop their spark? How can you help them discover how science is related to their spark?



istretch

Watch a 2 minute video about the Feynman method of learning found at:

<https://www.youtube.com/watch?v=tkm0TNFzleg>

- ⦿ *Discuss and share what Feynman might say about how you could best learn science. In what ways can you learn science and engineering while doing something related to your spark?*

REAL-WORLD Application Suggestions

The suggestions below will help you extend and apply your learning in real-world settings.

- ⦿ *Hold spark conversations with others, including your family and other 4-H members, using 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?*
- ⦿ *Take one or more of the questions you developed in the iexplore activity and design an investigation. Determine how you can find out more about the science and engineering aspect of your spark. Conduct the investigation and report back to the group.*



The Science of Risk



"Not learning by doing, but learning by risking." - Toba Beta

Consider this quote. Think about what this means to you.

Risk is an event or action involving uncertainty and often danger. Risk is the possibility of suffering harm or loss often balanced by the possibility of great reward. Taking risks may allow you to move outside your comfort zone and grow as a person, though other times risks may be unhealthy behaviors and could result in pain. Often risks may be both healthy and unhealthy. It is important in life to be able to identify appropriate risks. Unhealthy risks are often referred to as high-risk behavior and are things that have adverse effects on health and may prevent one from future success.

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Inquiry into Risks

Individually, write down on notecards the types of risks you might find in any teenager's life. These may be both healthy risks and high-risk or unhealthy risk behavior. Write down as many as you can think of. Write down one risk per notecard.

Analyzing and Interpreting Data

Two scientific and engineering practices are analyzing data and interpreting data. Data comes in many forms – numbers, text, graphs, photographs, stories – and requires a keen eye in order to make sense and derive meaning. Scientists look for patterns, trends and themes in the data that might indicate significant features.

When all of the notecards of risks are collected, there should be a large set of data for you to analyze. In small groups, discuss potential ways you might sort these risks. What makes sense as a method to start to find patterns and trends in the data? Review the data; organize it in a manner that exhibits one or more patterns; interpret and explain.

ireflect

- What relationships can you explain between the scientific practices of analyzing data compared to interpreting data?
- What other methods or tools might be useful in analyzing and interpreting data?
- What were some of the common factors between the types of risks you investigated?
- What would you tell younger 4-H members about risk?

iStretch

Watch the 3 ½ minute video from Silvia Bunge at the University of California on the adolescent brain at <https://youtu.be/HvBNFJk4G8g>

From your understanding of the video, what advice would you give to a peer on risk taking? How would that advice change if given to an adult?

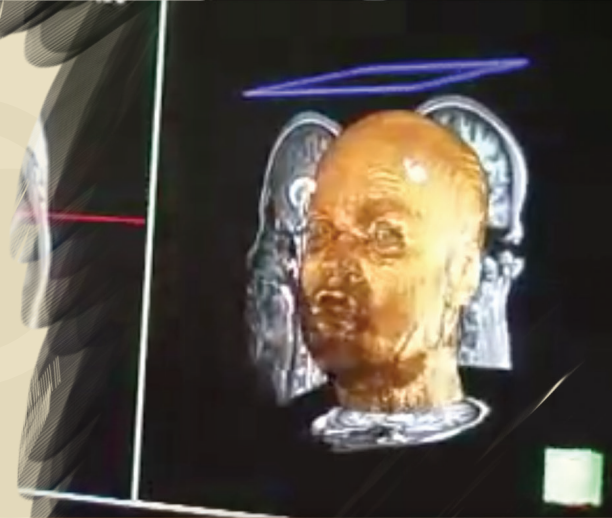
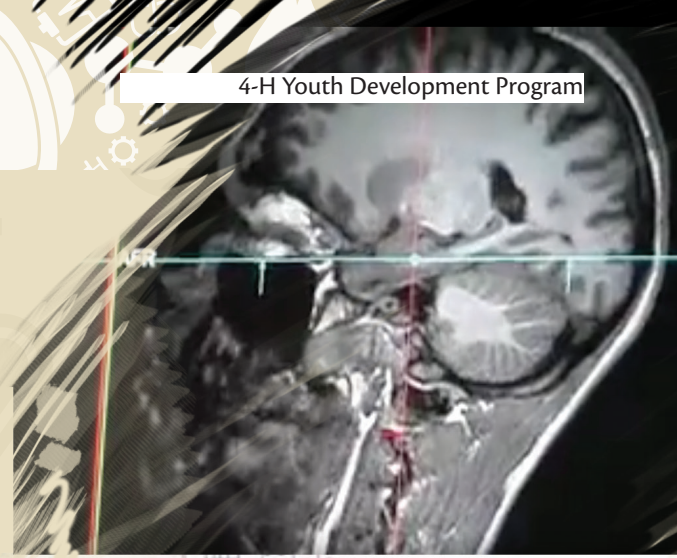
REAL-WORLD Application Suggestions



The suggestions below will help you extend and apply your learning in real-world settings.

Investigate your community's statistics for youth well-being and youth vulnerability on the "Putting Youth on the Map" website at <https://interact.regionalchange.ucdavis.edu/youth/>. Develop a proposal to address community vulnerability issues.

Coordinate a photovoice project with younger 4-H members on potential places for healthy and unhealthy risks in their homes, schools and neighborhoods. Photovoice is a process where photographs are used to initiate discussion based on youth's expression of themselves and their environment. Share at a 4-H meeting, at school, or with community organizations to help initiate community change.





A Community's Perspective



Communities are groups of people.

Often communities are defined as groups of people who live in one place and share a common history, social, economic and political interests. At other times, community is defined as a group of people sharing a common interest but who do not necessarily live in the same place. Regardless of the definition, members of a community interact with one another and each person brings a unique perspective. Reaching agreement on community goals requires the ability to think about multiple perspectives.

A Community of Scientists

Groups of scientists can also be considered a community. Think of a scientist at work. What does he or she do? Yes, scientists experiment, analyze data, develop explanations and use mathematics. All of this is done with other people! You can think of science and engineering as communities – the scientific community and the engineering community – and in order to become a scientist or engineer, you must learn how to participate in community activities.

While all eight of the scientific and engineering practices involve groups, two of them are specific to working with others:

- a) *engaging in argument from evidence; and*
- b) *communicating information.*



Both of these practices require someone who knows how to listen, compare and evaluate ideas, be respectful and think about multiple perspectives. Scientists and engineers use argumentation to listen to each other's interpretations and theories based on scientific merit. In science and engineering, merit includes scientific knowledge, research evidence, logic and consideration of economic, social, environmental and ethical factors.

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Multiple Perspectives, One World

Your adult leader will provide you with a copy of the case study. Or you may download the case study and read it at

<https://www.nationalgeographic.org/activity/marine-protected-area-stakeholder-debate/>

In this activity, you will debate whether or not the designation of an existing marine protected area (MPA) will be extended. An MPA is an area where human activity has been restricted, like fishing, for the purpose of conserving the natural environment or cultural and historical reasons.

You will take on the role of someone who has an interest in this case. During the debate you will advocate for different stakeholder points of view in a town hall format. There are multiple types of roles: commercial crabber, local business owners, sport fisher, concerned citizen, recreational user, government representative, environmental club member, scientists and biomedical researcher.

After you have a role, consider the stakeholder's point of view, as well as the points of view of stakeholders who may support or oppose them. Prepare for a town hall-style debate on the pros and cons of establishing this new MPA. Develop arguments for or against, depending on your role's position. Craft your arguments using scientific evidence and delivered in a manner respectful of other people and perspectives.

Participate in the town-hall forum to reach a consensus on modifying and/or implementing the MPA.

This activity is adapted from National Geographic Education (© 2013 National Geographic Society.)

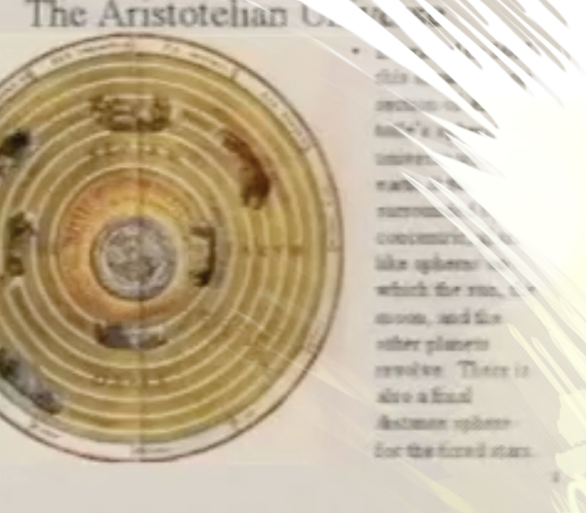


i reflect

What conclusions can you draw about engaging in argument using evidence in scientific and engineering communities?

How do you think your connections within your community help in reaching your goals? In what ways do you think connections with others are beneficial when people are on opposite sides of an issue or argument?

What is important to consider in reaching agreement in your 4-H community?



i stretch

View the first 3 minutes of physicist Lee Smolin talking about science and democracy (TED Talk) at

<https://youtu.be/MOLFTpAr7eU>.



He talks about how the scientific community works. As he puts it, “we fight and argue as hard as we can,” but that science works because scientists are members of ethical communities.

Reflect on whether you agree or disagree with Lee’s argument that science and democracy are similar because they are “a community bound together by ethics”?

What helps make the community of 4-H work?



REAL-WORLD Application Suggestions

The suggestions below will help you extend and apply your learning in real-world settings.

Identify a current community issue (you can look at recent City Council or commission notes). What stakeholders are interested in the issue? What are their perspectives? Think about ways that integrate multiple perspectives. Develop a plan for addressing this issue in a way that brings together multiple perspectives.

Investigate the connections in your 4-H Club to the community. What collaborators does your 4-H Club have? Develop a plan to strengthen connections between your 4-H Club and community organizations, agencies and groups.



ch. 4

Engineering a Plan to Reach Your Goals

Start Here

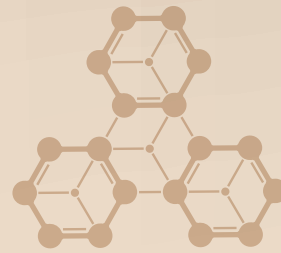
Goal management skills are used by almost all successful people in the world. It sure is easier to get somewhere when you **know** where you are going, how you're going to get there and what you're going to do when things get in your way. An easy way to remember these 3 steps is:

Goal Selection

Pursuit of Strategies

Shifting Gears (in the face of obstacles)

Yes... **GPS!**



Within the GPS model of goal management are different **dimensions** that help us understand the deeper meaning of the step. The words in **bold** are the phrases that describe the dimensions of **G**, **P** and **S**.

Goal Selection means that you....

...take initiative to choose **meaningful, realistic and positive goals**. The goals you choose are challenging and ones that will help you reach your full potential.

Pursuit of Strategies means that you...

...**stick to a plan** by making step by step actions to reach your goals.

...work your hardest and **show persistent effort** to reach your goals.

...**check your progress** toward your goals to see if changes are necessary.

Shifting Gears means that when you are having trouble reaching your goals, you...

...**seek help** from new people and resources.

...**substitute strategies** by figuring out which ones or parts of which ones don't work and change your strategies.

Engineering Design

Goal management skills are essential for people to thrive! Goal management has much in common with the way engineers go about their work.

Engineers use scientific knowledge to construct objects, buildings and solutions to address real world issues. The basic process of engineering design is iterative and cyclical. Iterative means that the cycle repeats itself multiple times as engineers **design** → **build** → **test** → **redesign** → **build** → **test**. Cyclical means that the design process is a cycle and not a set of linear and sequential steps. Engineers conduct investigations to identify the effectiveness, efficiency and robustness of their designs.



Identify the issue, challenge and opportunities (goal selection)

When presented with an issue, an engineer will first ask questions. These questions help an engineer understand the issue—“**What have others done?**” “**What is the scope of the issue?**” “**What is the goal of the solution—what do we want to ultimately achieve?**” These types of questions help engineers gain clarity and determine criteria for acceptable results.

Generate possible solutions and compare; select a solution (pursuit of strategies)

Once an engineer has identified the issue and defined the boundaries and constraints, they begin to imagine the possibilities. **This task can be creative and innovative!** Engineers generate ideas and possible solutions. After narrowing down their ideas, engineers evaluate and compare possible solutions to see which will best solve the problem. Engineers often use notebooks to write lists of needed resources and draw diagrams of designs. Engineers will also rely on help from other people. They will sketch designs and develop a **plan**. They initially stick to their plan, show persistent effort and check their progress.

Build and then test the design; re-design if needed (shifting gears)

Using their detailed plan, engineers build their device. After engineers have a working model, they test and redesign the technology. Engineers know that there is always room for improvement. Failure is a **beneficial** option that allows them to substitute strategies as it helps improve the device! They communicate and discuss the results of their tests and seek help from others. They modify their device and retest it. This step in the process ensures that engineers create the best possible product. Finally, engineers communicate the final product and share their solutions with others.

Planning and Carrying out Investigations

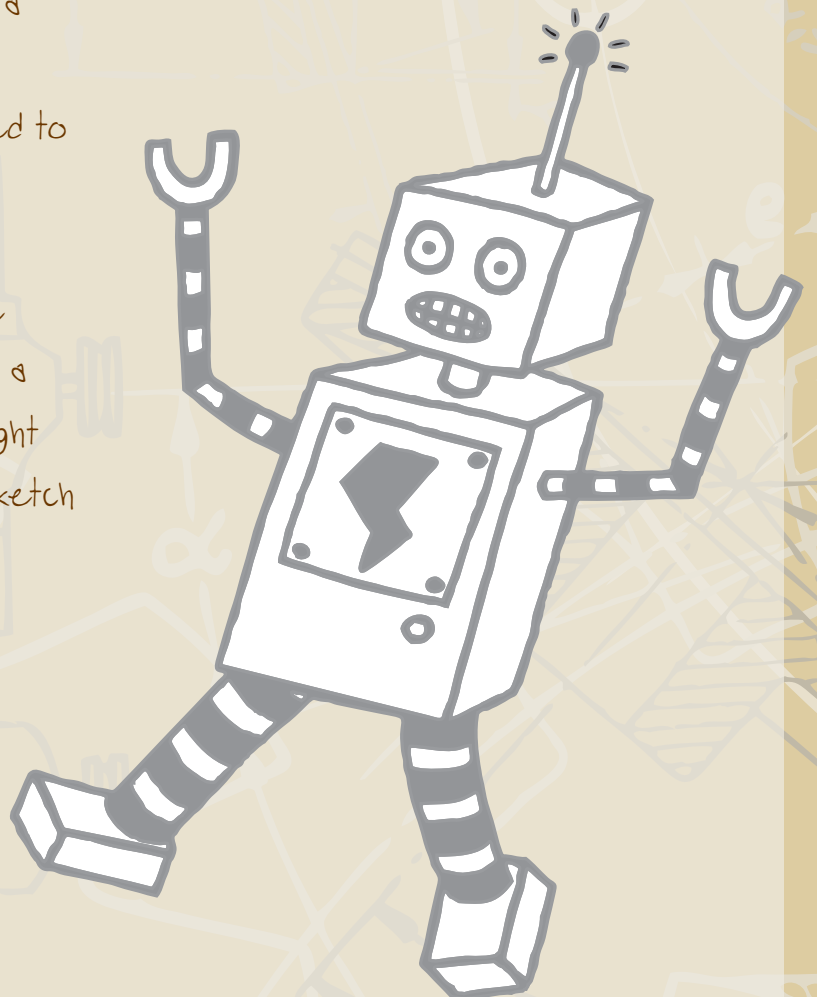
Engineering investigations identify the effectiveness, efficiency and durability of designs under different conditions. Scientists and engineers investigate and observe the world to systematically describe, explain and predict phenomenon.

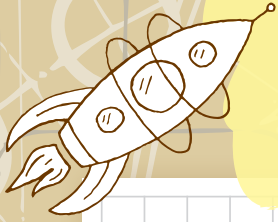
iexplore: Can-Can Robot

Scenario: A local art center has hired your team to build a device that will draw a piece of art on a large piece of paper. The device needs to be automated, meaning that it can draw without the aid of human intervention. They are providing a few supplies they thought might be helpful—a small motor, a battery, a cup, and felt markers. You may also use other materials available, like erasers, rubber bands, tape, wire, aluminum foil, craft sticks and anything else lying around that the project leader allows you to use.

Before you begin to construct a device, work with your group to identify what you are being asked to do. What are the constraints?

Once you have determined the scope of the challenge, develop a design. What type of device might work? Discuss as a group and sketch your design on the next page.





Design your device below. Share your design with the group.
Include the supplies you plan to use and how your device will draw on the paper.
Build your device and test. Redesign, substitute strategies and modify as needed.

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Record your experience by writing notes, drawing designs or making charts.

- ⦿ *From your experience with this activity, what advice would you give to new engineers as they design and build a device?*
- ⦿ *Share which aspects of GPS you found particularly helpful during this activity and which aspects were challenging. Describe a time when you had to shift gears.*



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MY GOALS & STRATEGIES

Goal Selection: Set two goals for the year. Your goals should be meaningful to you, realistic and stretch your skills.

FIRST GOAL

SECOND GOAL

Ideas for choosing your goals:

1. Find your spark if you don't already know.
2. Learn more about how science and/or engineering is/are related to your spark.
3. In your leadership role, help others understand that science is all around us.
4. In your leadership role, help others engage their inner scientist or engineer.



Pursuit of Strategies

What are 3-4 action steps that you will take to move you toward reaching each goal? Be specific about each task, include things like when, where and how you will take each step.

STRATEGIES: FIRST GOAL

STRATEGIES: SECOND GOAL

Shifting Gears

What are a few things that could get in the way of achieving your goals or pursuing your strategies?
What will you do if this happens?

FIRST GOAL

Things that could get in my way

SECOND GOAL

Things that could get in my way

.....
If this happens, I will...

.....
If this happens, I will...


If you are a Junior or Teen Leader for a 4-H Project, be sure to go into your Record Book and record your goals for the year—you may even use the ones you just did. You will notice that the Junior/Teen Leadership Development Report form follows this same process.

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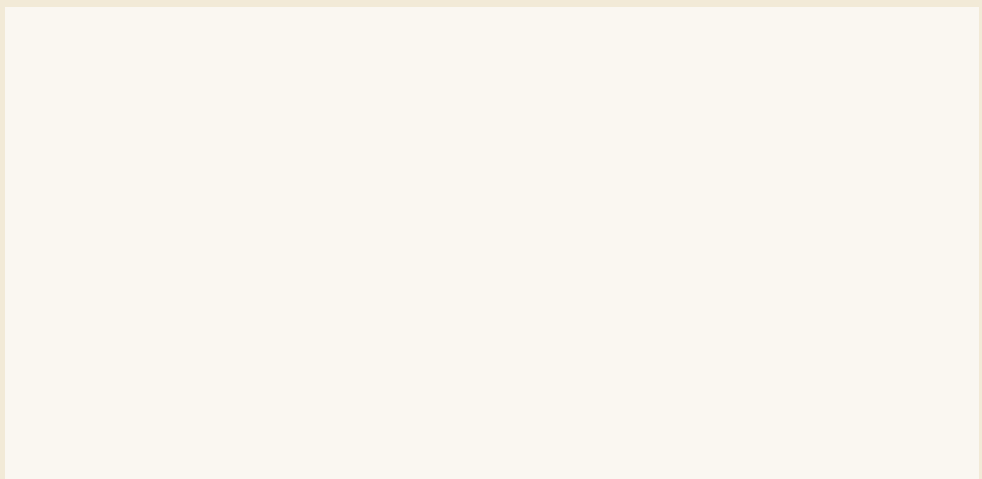
Things change, new opportunities arise and sometimes you have to seize the moment and choose different goals. How would you decide which path to choose—keep the existing goals you have or go after the new opportunity?



How could you use science to help you decide?



What advice would you give to someone else if they were struggling to reach a goal?



istretch

Watch the 3 minute video "You Can Change the World" at <http://www.youtube.com/watch?v=cp5y7MO6Q9w>



- ⊙ *How would you categorize the skill or qualities these people have in common as they tried to achieve their goal?*

- ⊙ *If you have a goal that feels overwhelming, describe how the dimensions of GPS can help you manage your goal?*

Real-world Application Suggestions

The suggestions below will help you extend and apply your learning in real-world settings.

- Thinking about your spark, and the two goals you've set for the year, identify places in your community where you might find adult spark champions/mentors to help you reach your goal. Approach individuals at these places, share your goal, and see how they might help you pursue your goals.
- Using the tools available to you, like the Internet, library, family and friends, find out if others have similar goals to you. See how they have pursued their goals and what they have done when faced with obstacles. How have they shifted gears?





ch. 5

Growth Mindset in

SCIENCE

Have you ever heard someone say,
"I can't do that, I'm not good at science."?

That's a myth! The TRUTH is that the more you learn and practice new things—yes even about science!—you make new connections in your brain. In fact, the used brain areas actually grow bigger as your knowledge increases. You will find that science becomes easier when you put forth effort and persist through challenges. You will start to think about science as something you can master, and you will actually notice yourself feeling smarter.

The brain has an amazing ability to change, grow and develop. When you know this, we say that you have a growth mindset. It means you know that you and other people can learn and change.

And importantly, you know that labels people use for themselves like "dumb" or "science person" aren't real, because everyone can improve.

THE GROWTH MINDSET

Watch a brief 1-minute video overview on a growth versus fixed mindset at

<https://youtu.be/65uDxduGyT0>

What is a growth mindset?

The growth mindset is the belief that your basic qualities and abilities are things that you can change and grow. Through effort, the right strategies and getting help from others you can get better at science and engineering.

What is a fixed mindset?

Some people don't know abilities change and they operate with a fixed mindset.

These people believe that they are not a "science person" and only have a certain amount of intelligence that cannot be fundamentally changed. When they encounter something that is very hard for them—like science or engineering—this belief causes them to quit too early because they don't think they can succeed.

Your brain grows through effort and challenging exercise.

How does it affect you?

Having a growth mindset about your science intelligence can affect many parts of your life. As you explored in the Sparks chapter, science and engineering are all around us and connected to almost everything humans relate to. When someone says the S word (science!), RELAX! Your ability to adopt a growth mindset about the task, challenge or activity—even if it's hard work—will increase your intelligence about science.

How do you develop a growth mindset?

It's easy! All you have to do is believe you can increase your abilities and then work hard to make yourself smarter.

Science can be challenging! So, it is important to understand and believe that your science ability can increase.

Work on improving your science ability by

- increased effort
- adjust strategies
- seeking help

as a result, they reach even
Higher Levels
of achievement

vs

as a result, they may plateau early and achieve
Less than

learn from
Criticism

vs

ignore useful negative
Feedback

vs

Avoid
challenges

25

see Effort

as a path to

Your brain grows through effort and challenging exercises.

Developing and Using Models and Simulations

Scientists and engineers use models and simulations to think and explore the world in new ways. Models allow scientists to better understand a phenomenon and develop a possible explanation. Engineers use models to analyze systems, identify potential flaws, test possible solutions and optimize designs. With models, ideas may be examined, communicated to others or tested. A few examples of models include analogies and metaphors, computer simulations, physical models, diagrams, sketches and formal representations like mathematics.

ieexplore

Learning in Plane Sight

Scientists and engineers use models to think and explore the world in new ways. Models allow scientists to better understand a phenomenon and develop a possible explanation. Engineers use models to analyze systems, identify potential flaws, test possible solutions and optimize designs. A few examples of models include analogies and metaphors, computer simulations, physical models, diagrams, sketches and formal representations like mathematics.

One important reason to develop models is as an aid in optimizing a solution or design. Optimization is a process engineers use to make something as functional and effective as possible.

Build your favorite paper airplane using the supplies provided. Conduct a test to see which airplanes fly the farthest. Identify the top fliers then design and make a new plane based on one of the most successful designs. Continue optimizing planes to develop a plane that flies even further.

LEARNING AND THE BRAIN

What is learning? What is happening in your brain when you learn?

When you think or practice something, the neurons in your brain communicate by sending messages through a network of connections. The dendrites grow and lay down new connections with each other. The more you learn the more connections and the bigger the nerve cell network!

These growing networks process information faster and faster as they grow stronger. This means that you can think and remember something better, as the brain cells repeat and repeat their communication patterns.



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Oh, the Places You'll Grow

Learning makes your brain grow and increases your brain's network of neural connections! Learning also helps you on your pathway to thriving. Learning is not only about knowledge and facts, but includes skills, abilities, attitudes, behavior and identity. Where does your brain have opportunities to learn and grow?

Where do you nurture your growth mindset? On notecards or sticky notes, write down as many places that you can think of where you can and do nurture your growth mindset.

Discuss potential ways you might sort these places. Review the data; organize it in a manner that exhibits one or more patterns; interpret and explain.

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Where or under what conditions do you strengthen your growth mindset the best

Based on your own experience, what about these spaces promotes or hinders a growth mindset? Please explain.

As a leader, how can you support what, when, where, or how others learn?

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Ability Improved! (with Effort)

In science, many people believe that it takes a naturally gifted individual to do truly great things. Those who are the “top of the class” are the ones who go off to the prestigious universities to become scientists. We paint scientists as prodigies destined to become the most innovative thinkers, who emerged from the womb already able to do difficult math equations and identify chemical compounds.

What gets lost during all of this glorification is the fact that many successful scientists were not naturally the highest in their class. In fact, many have experienced significant failure at some point in their careers; failure that we rarely hear about. We see the finished product the men and women who mapped out how to fly around the world for the first time, or the brilliant minds determined to find a cure to cancer - but we are not aware of how much training and hard work went into the product.

We sometimes assume that successful scientists are born into already high achieving families, who are put in science classes since they are little and are always tracked into the higher lanes of math and science classes; the role of attitude and the mind is severely discounted.

The following stories, supported by science, shows that scientific ability is much more than one’s natural propensity for science and their raw scientific ability.

Nikola Tesla



Nikola Tesla is credited for his design of the alternating current, an electrical supply system that is widely used. But Tesla's contribution was not immediate. Born in Serbia, Tesla had a long way to go before he became one of the great innovators of the 19th century. Tesla's father was a priest and his mother made mechanical appliances for the home, but Tesla was fascinated with math and electricity. After going through rigorous schooling, Tesla came to the US to work for Thomas Edison. Although Edison and Tesla did not get along very well, Tesla kept following his instinct and eventually teamed up with George Westinghouse where he made his name as one of the most accomplished scientists in history. So while Nikola Tesla is often called a genius, his accomplishments did not come easily, and only came with his continued determination, effort, and time.

Marie Curie

Marie Curie's Growth Mindset enabled her to not only follow her dream of science, but become one of the first great female scientists. Curie, born in Poland, was the first woman to win a Nobel Prize and the only woman to win a Nobel Prize in more than one field. Despite the oppression that many women lived under during her time, and the lack of education available to women, Curie persevered and worked hard to be one of the leaders in radioactivity research. She won a Nobel Prize in both Physics and Chemistry, and her studies made great discoveries that are used as the base of our knowledge today. Despite the constant amount of setbacks, prejudice, and ridicule she faced along the way, Curie knew that with hard work, she could accomplish her dreams even if other people believed it was not possible.





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Think about the articles that you just read. What are all the reasons why scientists say that people's ability can grow and get better with effort and practice?

In the opening information and the two iexplore examples, you learned 3 things:

- a. When you work hard and learn new things, your brain grows new connections and you get smarter.
- b. The more you challenge yourself, the smarter you will become.
- c. Smart people are the people who have practiced more—they have built up their brain "muscles."

1 Think about an example from your own life. What is something you did not do well at first, but then you practiced using a good strategy and became really good at it. Write about it and explain how you became good at it.

2 Imagine a friend who is struggling with science. This friend used to do pretty well in science but now is having a hard time and is starting to feel dumb. Write a letter to your friend to encourage him or her—tell him or her about what you just learned about the brain and why he or she shouldn't be discouraged.

3 In your leadership roles what are some ways that you could reinforce the growth mindset, especially when someone says, "I'm not good at science" or "I'm not smart enough to be a scientist."

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View the 3-minute video on How We Learn at <https://vimeo.com/230426221>



- ⦿ *As a leader, how can you help 4-H members or others “cross their ravine?”*

REAL-WORLD Application Suggestions

The suggestions below will help you extend and apply your learning in real-world settings.

- ⦿ *Discuss fixed vs. growth mindset with one of your project leaders. Discuss how you will help the 4-H members in the project develop a growth mindset. Refer to <http://www.mindsetworks.com/> for help.*

The screenshot shows the Mindset Works website. The main heading is "Motivate Students to Grow their Minds!" with a sub-heading "Become a Growth Mindset School!" and a "Get started here" button. There are "Free Preview" and "Buy" buttons. Below the main heading, there is a paragraph of text and a small image of a person. At the bottom, there is a quote from "Svenja Carol Dweck - Growth Mindset as a Key to closing the achievement gap" and a "Share This Page" section with social media icons.

- ⦿ *What do you find challenging, related to science and engineering, in pursuing your spark? Discuss this with family, friends, 4-H leaders, research on the Internet, and determine how others have approached this challenge or would recommend approaching this challenge. Plan a goal to meet this challenge head-on. Share at your next 4-H project meeting.*





ch. 6

Thriving in

Science

You have the power to make a positive change in the world through your leadership and using science and engineering. 4-H Thrive is about you learning and practicing the skills necessary to be the person you want to be. You have spent time during the year reflecting on your own growth and thriving journey with science, engineering and technology.



Start
Here

iexplore POSTER SESSION

An important scientific and engineering practice is obtaining, evaluating and communicating information. Communicating information may be done in many ways, including diagrams, graphs, models, presentations, posters and papers. The 4-H Youth Development Program also emphasizes public speaking and presentations.

Prepare a poster that conveys key concepts and your reflections from the Leadership Development Project this year. Include the following on your poster:

- ⦿ Your progress in identifying and practicing your spark.
- ⦿ How your Spark Champions help build your spark.
- ⦿ Your spark's connection to science or engineering.
- ⦿ Your progress in pursuing a goal related to science or engineering.
- ⦿ What you think about your capacity to be a scientist or engineer.

Share your posters with others in your Project and/or your 4-H Club

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- ⦿ In what ways did each group's presentation format communicate key ideas?
Discuss each format's effectiveness in communicating information.

- ⦿ What Thrive elements have been the most challenging for you this year?
- ⦿ During the year, how have you applied Thrive concepts to your work and life inside and outside of 4-H?



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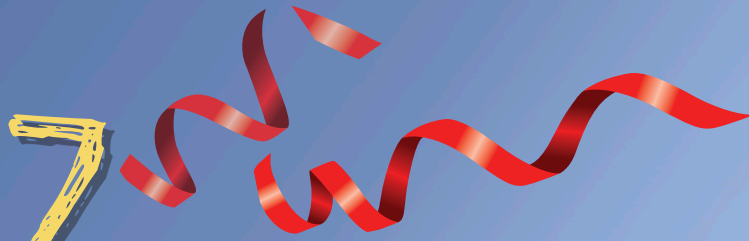
Reflect back on the goals you set in Chapter 2. Evaluate how you are doing on pursuing the strategies to reach your goals. Think about how you took initiative to:

- ⦿ **choose meaningful, realistic and positive goals**
- ⦿ **stick to a plan** by making step-by-step actions to reach your goals.
- ⦿ work your hardest and **show persistent effort** to reach your goals.
- ⦿ **check your progress** toward your goals to see if changes are necessary.
- ⦿ **seek help** from others and seek additional resources.
- ⦿ **substitute strategies** by figuring out which ones are not working and change your strategies.

$$\Delta v = v_e \ln \left(\frac{m_i}{m_f} \right)$$



ch. 7



Celebrate!



You have spent a lot of time and energy reflecting on where you are on your path to developing skills. The skills you learned included identifying and/or nurturing a Spark; developing and using a growth mindset, and practicing goal management skills.

You have learned about the practices of science and engineering! You have asked questions, defined problems, used models, analyzed and interpreted data and communicated information. Now, let's celebrate the efforts you have made and the growth you have achieved!

i Celebrate Kinetic Confetti

Confetti makes every celebration better! You will design and build a confetti launcher to help celebrate your journey. You may build a slingshot, catapult, levers or something completely novel!

Compare your launcher with the others.

If it wasn't as high or wide or fluttery as you had hoped, how can you change it to meet your vision?

When you have completed 4-H iThrive, you have earned the Thrive recognition pin. Your project leader may want to order pins ahead of time so that each person receives one during your celebration. If this is your first year of iThrive, you earn the Thrive pin. If you already earned that pin, then you receive a Thrive clover pin to place around the Thrive pin.

Applause! Cudos! Amazing Effort!



NOTES

