



AGENTS of STEM

Facilitator Notes

HELLO VOLUNTEER LEADERS!

I HOPE YOU'RE AS EXCITED TO EMBARK ON THESE MISSIONS AS YOUR AGENTS ARE!

WHETHER OR NOT YOU HAVE A BACKGROUND IN STEM (SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH), YOU'LL PLAY AN IMPORTANT ROLE IN GUIDING AGENTS THROUGH THEIR MISSIONS. AND I'M HERE TO HELP YOU.

Why STEM?

Take a moment and look around. How many things do you see that didn't exist 50 years ago? Or even a decade ago?

Our world is changing faster now than ever before. Innovations that once felt revolutionary, now feel routine. Globalization, technology and a changing economy are altering the way we live, learn, and work. At the same time, we are facing big challenges, like climate change, food security and sustainable agriculture. These tough problems don't come with easy answers.

That's where STEM comes in. STEM is a way of thinking critically and creatively to innovate and problem solve. It's about asking questions, testing ideas, learning from mistakes and working together to find solutions.

When you dive into The Agents of STEM Mission Manual with your group, your Agents aren't just solving puzzles and doing fun projects. They are developing the critical and creative thinking skills needed to thrive in a rapidly changing world. Through the mission activities, Agents will learn how to ask questions and test their hypotheses. They will practice collaboration, communication and reflection. They will also build their resiliency by discovering that failing isn't the end; it's just a step towards figuring things out. These are fundamental skills needed for today's world, and for the future too.

And the best part? STEM is already woven into so many 4-H activities and projects. The Agents of STEM Mission Manual is just more intentional. It shows youth how STEM connects to their everyday lives now and helps prepare them for the future.

Understanding Your Role

The most important thing you need to know is that you don't need to be a STEM expert to be a great facilitator. The mission manual is designed to explain the concepts and provide all the information you need to support Agents to complete their missions.

Your mission? Create a positive, supportive environment where Agents feel comfortable asking questions, exploring ideas, making a mess, taking risks, and maybe even failing.

Your goal? Encourage curiosity, support learning, and help Agents enjoy the process.

Use these Facilitator Notes to help you prepare and feel confident as you facilitate the Agents of STEM Mission Manual.

Getting Started

Before launching the mission, take a few minutes to review the full Mission Manual. Pay close attention to the key points, instructions, gather all the materials required, etc. so that you're aware of expectations and have everything ready.

If there are any unfamiliar terms or concepts, don't worry. The Mission Manual should supply all the explanations, but there are also resources included in this document for further reference.

About the Activities

The activities were designed to offer Agents an introduction to STEM - not a deep dive. The hope is that by piquing their curiosity and doing activities, Agents will develop the confidence to continue exploring STEM on their own.

There are two types of activities in the Mission Manual:

- 1. Mini Missions:** These are designed as quick activities that build confidence and draw on what youth may already know. They're mostly open-ended, with no right or wrong answers. Where answers or guidance are needed, notes are provided on the answer sheet.
 
- 2. Missions:** These are hands-on activities intended to let Agents explore larger concepts in an experiential way. They're also designed so that the Agents can take the lead themselves.
 



LIGHTBULB MOMENT

WHILE THE MISSION MANUAL HAS BEEN WRITTEN AS A NARRATIVE, THE ACTIVITIES THEMSELVES DON'T HAVE TO BE DONE IN ORDER. AFTER COMPLETING THE INTRODUCTION, AGENTS CAN JUMP TO ANY ONE OF THE STEM SECTIONS AND WORK IN THE ORDER THEY PREFER. YOU ALSO DON'T NEED TO COMPLETE THE MISSION MANUAL IN A SINGLE MEETING.

Blank spaces are also provided throughout the Mission Manual to allow Agents to record their discoveries, jot down ideas, answer mini missions, or make notes. Please encourage them to do so by making time for these important learning moments.

Facilitation Tips

- **Encourage questions.** Create an environment to think critically and creatively about the mission and to test their ideas throughout the activities. Make sure Agents know it's ok to ask questions or to say, "I don't know." Asking questions and being curious is the first rule of STEM. Check out 4-H Canada's *Supporting Creative and Critical Thinking Skills in Youth* in the resources section below to learn more.
- **Promote teamwork.** Many of these activities can be done alone, in pairs, or in groups - but teamwork is strongly encouraged. New STEM discoveries don't happen in isolation; there's always a team. Working in teams encourages Agents to share ideas and learn to work together.
- **Be patient AND flexible.** Mess and mistakes are encouraged. Even the best scientists and innovators fail more often than they succeed. This will require patience and flexibility on your part. If an activity isn't working, it's ok to pause, discuss, and try a new approach, or even come back to it later.
- It's ok to break the rules. Every Agent will have their own learning style. Give them space to explore their way of doing things, even if it's different than the set of instructions provided. That's all part of the discovery.
- **Celebrate the effort and the journey, not just successes.** Cheer on curiosity, creativity, teamwork, persistence, and resilience, even if the results aren't 'perfect' or what was expected. Remember, the primary goal of each mission is discovery, not getting it right on the first try (or ever).
- **Your attitude is contagious.** Your energy and positivity will keep the missions feeling fun and engaging, even when an activity goes off the rails.



LIGHTBULB MOMENT

THIS PROGRAMMING IS INTENDED TO FOCUS ON BUILDING CURIOSITY AND THE CONFIDENCE TO EXPLORE AND LEARN. KNOWING ALL THE ANSWERS IS NOT NEEDED! DON'T BE AFRAID OF ANSWERING AN AGENT'S QUESTION BY SAYING "THAT'S A GREAT QUESTION. LET'S EXPLORE THIS TOGETHER" OR ASKING WHAT THEY THINK. RESEARCH THE ANSWER TOGETHER, USING THE RESOURCES PROVIDED, OR THE INTERNET.

- **Ask open-ended questions.** Instead of asking Agents if they got the right answer, try asking them, "What did you notice?" or "What would you try differently?" Check out the link for ACT for Youth, in the resource section, for a list of open-ended questions that support positive youth development. Some activity specific open-ended questions could include:
 - » Can you think of any other examples of friction?
 - » Where have you seen wind turbines at work?
 - » What surprised you when you were designing a Pest Detection Robot (PDR)?
 - » What new strategies might you try the next time you play Number Knockout?
- **Take breaks.** If Agents get restless or frustrated, take a short break to stretch, move around or talk about something completely unrelated. Move to a different activity before coming back to the one that stumped them.

Your support on these missions will make a huge difference. By fostering an open and encouraging space where Agents feel empowered to explore, you'll help them build skills and confidence that will extend well beyond this Mission Manual.

Evaluation

An important part of the Agents of STEM mission is evaluation. We ask all facilitators to support Agents in completing the pre- and post-mission evaluations included on pages 4 and 39 in the Mission Manual. Their answers will help us assess Agent's confidence, learning process and comfort level with STEM topics, pre- and post-mission.

We also ask that you complete the facilitator evaluation. These evaluations are designed to help us understand what worked well, what challenges you may have faced, and areas for improvement.

Your responses are important tools that will help inform future programming and initiatives to ensure they meet the needs of both volunteer leaders and members. Thank you for participating in this valuable process.

Please use the QR code to complete your volunteer leader evaluation after delivering the Agents of STEM content.



Remember: enjoy the experience, the successes AND the failures, and celebrate every discovery together!



Materials List

Materials in the kit:

- ✓ **Notebook and pen**
- ✓ **Alligator Clips**
- ✓ **Hobby motor**
- ✓ **Zinc covered nails**
- ✓ **Copper Wire**
- ✓ **LED Bulbs**

Materials needed:

MISSION 1 • page 14

THE FORCE FIGHTS BACK

- ✓ A **running shoe**
(or other type of shoe)
- ✓ **Strong tape** like scotch tape or duct tape
- ✓ **1 rubber band**
- ✓ **Scissors**
- ✓ **Ruler**
- ✓ Different **test surfaces**, such as grass, concrete, sand, carpet, wood floor, pebbles or stone

MISSION 3 • page 20

You're In For a Shock!

- ✓ **1 LED bulb**
- ✓ **4 lemons**
- ✓ **4 zinc covered nails** (such as galvanized roofing nails)
- ✓ **5 alligator clips** (with clips on both sides)
- ✓ 4 pieces of medium gauge **copper wire** (about the same length as the nail)
- ✓ Optional: goggles and gloves.

MISSION 2 • page 16

POP! POTENTIAL ENERGY INTO KINETIC ENERGY

- ✓ Colourful craft or **popsicle sticks** at least 20-30 per pair

MISSION 4 • page 23

BLOWING IN THE WIND

- ✓ Small **hobby motor** (6 volts)
- ✓ **1 LED bulb**
- ✓ **4 crafts sticks**
- ✓ **Small paper cup**
- ✓ **Medium paper cup**
- ✓ **Glue** (white glue, wood glue or hot glue - whatever you have on hand, but hot glue works best)
- ✓ **Scissors**
- ✓ **Drill** and **drill bit** the size of the motor shaft
- ✓ **Wind source** (a windy day or a fan)

Materials List (cont.)

MISSION 5 • page 28

DESIGN A BOT TO BATTLE PESTS!

- ✓ **Notepad** or paper
- ✓ **Pens, pencils, crayons** – anything you want to use to draw or sketch your designs

MISSION 7 • page 34

NUMBER KNOCKOUT

- ✓ **2 dice** per game
- ✓ **1 game board** per player or team
- ✓ **Pencil or pen**

MISSION 6 • page 30

MAKE IT FLOAT!

- ✓ A **rock** – about the size of a walnut (or larger if you're feeling brave!)
- ✓ **Notebook** or paper
- ✓ **Pen, pencil or crayons**
- ✓ **Household materials** to build Dwayne's personal floatation device
 - Options: string, rope, cork, bubble wrap or Styrofoam, paper towels, cardboard tubes, glue, sticks, foil, containers, straws, etc. Get creative!
- ✓ A **water vessel**, such as a bucket, pail, tub, large bowl, etc.
- ✓ **Water**
- ✓ Optional: materials to decorate Dwayne! Draw a face or add googly eyes or even hair if you want!

MISSION 8 • page 36

Planting Projections

- ✓ **Pens and pencils**
- ✓ **Paper**
- ✓ **Tables** below
- ✓ Optional: calculators (or cellphones)

Answer Sheet

Introduction

pages 4–11

MINI MISSION • page 4 STEM stands for science, technology, engineering, and math.

MINI MISSION • page 5 There are no right or wrong answers here, this is just about observation. Agents can include examples of careers or jobs, items in their home, ways they used STEM that day, etc.

MINI MISSION • page 6 The hidden word is CURIOSITY. Curiosity is one of the most important features of an Agent of STEM.

MINI MISSION • page 7 There are no correct answers here – these rules should be generated by what the group decides!

MINI MISSION • page 9 Depending on the activity selected, Agents may discover:

- Ice melts faster in plain water than salt water. In the plain water, the melted water from the ice is cold and sinks away from the ice cube. This allows the warmer plain water to touch the ice and melt it faster. In salt water, the cold water that melts from the ice floats and surrounds the ice cube. The melted water keeps the ice cool and slows melting.
- On the Heat'o'Metre, the colour black should be hotter as black absorbs more heat than white.

Science

pages 12–17

MINI MISSION • page 12 There are so many other fields of science, including: chemistry, physics, environmental science, geology, zoology, astronomy, medicine, astrophysics, planetary science, horticulture, agronomy, agricultural engineering, biotechnology, crop science.

MISSION 1

The Force Fights Back • page 14

- There are no right or wrong answers for this experiment. The results for this mission are entirely what Agents discover for themselves.

MISSION 2

Pop Potential Energy into Kinetic Energy • page 16

- Here's a great video that demonstrates what should happen: <https://youtu.be/r7j7I39ZAsU?si=5Wlq6YtmxITl2uVH>



Answer Sheet (cont.)

Technology

pages 18–25

MINI MISSION • page 18 When it comes to what items Agents might include when they think about technology, there are no right or wrong answers.

MINI MISSION • page 19 Again, there are no right or wrong answers, but hopefully Agents will now think more broadly about both old tech and new, and perhaps include things like bicycles, airplanes, combines, lights, air conditioning, etc.

MISSION 3

You are in for a SHOCK! • page 20

- Link to help you make a lemon battery: <https://www.youtube.com/watch?si=mqx8vzefpT8Yb8RP&v=WNx-bwITATI&feature=youtu.be>
- Learn how to reuse the lemons to make invisible ink: <https://www.education.com/science-fair/article/invisible-ink-oxidation/Invisibleink/>

MISSION 4

Blowing in the Wind • page 23

- Link to a video demonstration to support building your wind turbine <https://www.exploratorium.edu/snacks/light-wind>

Engineering

pages 26–31

MINI MISSION • page 27 Type of Engineering & Design and Build

- **Aerospace:** Machines that fly, like planes, drones and rockets
- **Biomedical:** Technologies and machines for healthcare, everything from x-rays and MRIs to prosthetics
- **Chemical:** Foods, medicines and fuels using chemicals
- **Electrical:** Power systems, like EV charging stations
- **Agricultural:** Machines, tools and systems to improve farming
- **Environmental:** Systems that protect and manage natural resources
- **Nuclear:** Systems that use nuclear energy as a power source



Answer Sheet (cont.)

Math

pages **32-38**

MINI MISSION • page 32 This is open-ended, there are no right or wrong answers. Types of answers can include computer programming, baking, planting crops, driving (distance/speed), sports, travelling, etc.

MINI MISSION • page 33 Words should be filled in, in the following order: Measuring, Multiply, Convert, Geometry, Division, Fraction.

MISSION 6

Planting Projections • page 36

How many squares do you have within your plot of land? $10 \times 10 =$ 100

TABLE 1: Project the Number of Plants

| Crop | A | B |
|-----------|-----------------------------|---|
| | Number of plants per square | Number of plants per plot of land (A x 100) |
| Onions | 5 | 500 |
| Potatoes | 4 | 400 |
| Carrots | 16 | 1,600 |
| Corn | 6 | 600 |
| Tomatoes | 4 | 400 |
| Cucumbers | 2 | 200 |



TABLE 2: PROJECT YOUR INCOME

| Crop | A | B | C | D |
|-----------|-----------------------------|---|------------------|----------------------|
| | Number of plants per square | Number of plants per plot of land (A x 100) | Income per plant | Total Income (B x C) |
| Onions | 5 | 500 | \$0.86 | \$430 |
| Potatoes | 4 | | \$3.20 | \$1,280 |
| Carrots | 16 | | \$0.20 | \$1,170 |
| Corn | 6 | | \$0.33 | \$198 |
| Tomatoes | 4 | | \$8.20 | \$3,280 |
| Cucumbers | 2 | | \$11.28 | \$2,256 |

Resources

Want to explore more? These 4-H resources, books and websites are great opportunities to take the STEM learning further!

4-H Resources

1. Supporting the Creative and Critical Thinking Skills of Youth <https://4-h-canada.ca/wp-content/uploads/2024/02/supporting-the-creative-and-critical-thinking-skills-of-youth.pdf>
2. Supporting the Development of STEM Skills in Youth <https://4-h-canada.ca/wp-content/uploads/2024/02/Supporting-the-Development-of-STEM-EN-web.pdf>
3. Making a Splash <https://national-canada.files.svdccdn.com/production/images/making-a-splash-activity-book.pdf>
4. Food for Thought https://national-canada.files.svdccdn.com/production/images/Food-For-Thought-Activity-Book_EN.pdf
5. Powered Up <https://national-canada.files.svdccdn.com/production/images/powered-up-activity-book.pdf>
6. Dig into Soil <https://national-canada.files.svdccdn.com/production/images/digintosoil-activitybook-en.pdf>

Books

1. *Awesome Chemistry Experiments for Kids*, by Adrian Dingle (Rockridge Press, Emeryville CA, 2021)
2. *Awesome Physics Experiments for Kids*, by Erica L Colon PhD, (Rockridge Press, Emeryville CA, 2019)
3. *Home Activity Lab*, by Hack Challoner (DK & Smithsonian, New York NY, 2024)
4. *Make This! Building, Thinking and Tinkering Projects for the Amazing Maker in You*, by Ella Schwartz (National Geographic Kids, Washington DC, 2019)
5. *Maker Comics: Build a Robot*, by Colleen AF Venable (First Second, New York NY, 2021)
6. *Maker Comics: Conduct a Science Experiment*, by Der-Shing Helmer (First Second, New York NY, 2021)
7. *Solve This! Wild and Wacky Challenges for the Genius Engineer in You*, by Joan Marie Galat (National Geographic Kids, Washington DC, 2018)
8. *Stay Curious and Keep Exploring: Next Level*, by Amily Calandrelli (Chronicle Books, San Francisco CA, 2024)
9. *Superpower? The Wearable-Tech Revolution*, by Elaine Kachala (Orca Book Publishers, Canada, 2022)
10. *Try This! Extreme*, by Karen Romano Young (National Geographic Kids, Washington DC, 2017)

Resources (cont.)

Websites

1. Act for Youth Open-Ended Questions https://actforyouth.org/resources/pyd/pyd_4-3_open-ended.pdf
2. Agriculture in the Classroom Canada (AITC-C) <https://aitc-canada.ca/en-ca/>
3. Amazing Invention: This Drone will Change Everything, Mark Rober <https://youtu.be/DOWDNBu9DkU?si=BNMLw-D-eXuQ8Yhs>
4. CrunchLabs <https://www.youtube.com/@CrunchLabs/featured>
5. Education.com <https://www.education.com>
6. Good in Every Grain <https://goodineverygrain.ca/>
7. How to reuse the lemons to make invisible ink: <https://www.education.com/science-fair/article/invisible-ink-oxidation/Invisibleink/>
8. Khan Academy <https://www.khanacademy.org/>
9. Let's Talk Science, STEM at Home <https://letstalkscience.ca/topic/stem-at-home>
10. My STEM Space <https://mystemspace.ca/>
11. National Inventors Hall of Fame, STEM Resources for Educators <https://www.invent.org/educators/resources>
12. Ontario Science Centre <https://www.ontariosciencecentre.ca/teachers-plus-students/teacher-resources/stem-education-toolkit>
13. Science Buddies <https://www.sciencebuddies.org/>
14. Youth Science Canada <https://youthscience.ca/>



960 Carling Avenue, Building 106
Ottawa, ON K1A 0C6
1-855-759-1013
4-h-canada.ca
info@4-h-canada.ca

