Educator Toolkit

A General Road Map with a Collection of Tools and Resources for Developing and Implementing a Successful STEM-Based Project.

Developed by:

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In Support of:

SAMSUNG

SAMSUNG SOLVE FOR TOMORROW

Educator Toolkit

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Introduction

The *Samsung Solve for Tomorrow Challenge* is designed to inspire public school students across Canada in grades 6 – 12 to explore issues they're interested in and engage them in ways to improve their local community by using Science, Technology, Engineering, and Math (STEM). As part of the challenge, participating schools identify real-world problems or issues that are important to their school communities, propose STEM-based solutions to those issues or problems, and follow through on implementing the proposed solutions. The *Solve for Tomorrow Challenge* supports you, as an educator, in making STEM learning interesting and relevant for your students to help them prepare for living and working in an increasingly digital age.

The value of engaging students in a project of this type is evident. The problem-solving, research, analytical thinking, communication, and collaboration skills your students will cultivate through this project are the kinds of skills they'll need to meet future employers' needs and expectations. They'll also use these skills to function as a citizen in today's fast-paced world with its multiple and complex issues and problems. These skills, often referred to as 21st-century skills, are the type that students learn best by doing. As a long-time supporter and promoter of the importance of STEM engagement, Let's Talk Science is pleased to partner with Samsung Canada on this initiative because, together, we recognize that STEM learning is an outstanding platform upon which to build these skills as well as an important preparation for future study and career opportunities.

Let's Talk Science's role in *Solve for Tomorrow* is to validate the STEM and curriculum connections inherent in this challenge. An award-winning national, charitable organization with more than 20 years of experience, Let's Talk Science helps children and youth fulfill their potential and prepare for their future careers and roles as citizens in a rapidly changing world. We do this by offering programs, services, and resources that help youth develop positive attitudes, critical skills, and career awareness, and by connecting the STEM and education communities to support youth development and strengthen learning.

To support your involvement, Let's Talk Science has developed this **Educator Toolkit**, which is intended to provide educators with a general road map for developing and implementing a successful STEM-based project for the *Solve for Tomorrow Challenge* as part of your teaching practice.

While there are a variety of approaches educators can use to address the real-world problem their students will examine, this toolkit uses a combination of project-based, problem-based, and inquiry-based learning approaches to provide structure and guidance.

The following are the common aspects of these learning approaches, which underpin this toolkit:
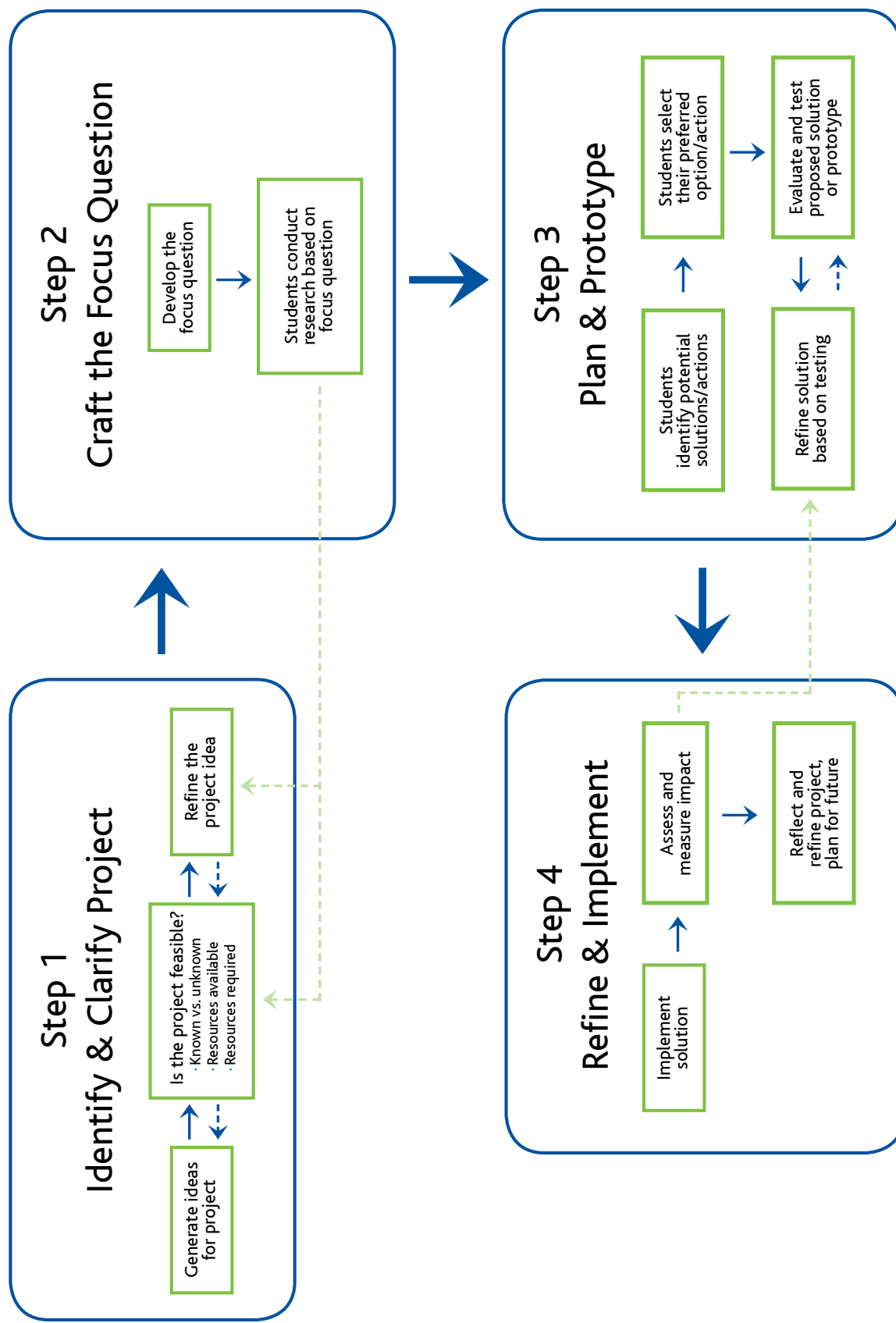
- Having students engage in authentic, open-ended, real-world activities;
- Using instructional strategies that are student centred with the teacher as facilitator or coach;
- Requiring students to seek out multiple sources of information to help them develop a strong understanding of the issue and identify potential solutions; and
- Emphasizing authentic, performance-based assessments.

These common characteristics provide opportunities for increased intellectual engagement, deep learning, and concept attainment on the part of students, as well as opportunities to develop the 21st-century skills (the four Cs) of critical thinking and problem solving, communication, creativity and innovation, and collaboration.

The learning approach described in this toolkit works well in technology-rich learning environments. In this toolkit, we've included suggestions for ways you and your students can incorporate various technologies to facilitate learning (e.g. search for current information, organize ideas, present and communicate ideas and new learnings to others, or to collect, analyze, and graph data).

Finally, while the learning approach suggested in this toolkit is presented in a linear manner, it is important to recognize that, particularly in the early stages, this is an iterative process, as shown in the graphic on the following page.

The Process of Inquiry-Based Learning

Step 1
Identify & Clarify Project

Generate ideas for project

Is the project feasible?
· Known vs. unknown
· Resources available
· Resources required

Refine the project idea

Step 2
Craft the Focus Question

Develop the focus question

Students conduct research based on focus question

Step 3
Plan & Prototype

Students identify potential solutions/actions

Students select their preferred option/action

Evaluate and test proposed solution or prototype

Refine solution based on testing

Step 4
Refine & Implement

Implement solution

Assess and measure impact

Reflect and refine project, plan for future

The cyclical nature of inquiry indicates that information gleaned at later steps of the process may result in new perspectives that may suggest revisions to earlier decisions and serve to help focus on the thinking and actions taken to address the identified problem or issue. A Project Planning template is provided in the appendix for your use as you plan your project idea.

STEP 1: Identify and Clarify Your Project Idea

When deciding to engage in the *Solve for Tomorrow Challenge*, identifying the problem or issue your students will investigate is perhaps the single most important part of the process; it can also be the most daunting! However, since most of the decisions you make after this step will flow from the problem you have identified, it is important to take the time to carefully consider your options. For the purposes of the *Solve for Tomorrow Challenge*, the problem or issue must be a real-world problem or issue. The STEM-based solution your students propose or develop must have the effect of improving the situation or resolving the problem or issue. The impact of your students' solution must be measurable.

Project ideas can arise from a variety of sources. Regardless of the source, it is important to ensure that the topic of study is one that matters to your students (individually and as a group). This will help motivate and encourage students to do their best work. When searching for project ideas, try to identify problems that can be turned into opportunities. Encourage multiple perspectives when first identifying topics to guard against preconceived notions of what is possible or achievable. By engaging your students in the process of identifying and then refining potential ideas, together you will help identify relevant problems and serve to increase student *buy-in* to the project.

You'll find several strategies that can be used to engage students in group discussion and decision making on Let's Talk Science's **CurioCity**, a free, interactive e-learning program designed for teens and educators. Examples of these strategies include **Silent Discussion/Graffiti**, **Consensus Mat**, **Pros & Cons Organizer**, and **others**. Brainstorming may be completed as a whole class activity or as a smaller student focus group outside of class time that brings recommendations back to the whole class for ratification. If possible, engage colleagues outside your subject area. Keep in mind that while the solution your students work toward has to be STEM based, the participating educators do not have to be STEM based.

The following are good places that you may wish to start looking for potential topics for your project:

Curriculum documents: Identify curriculum outcomes that aim to have students develop a deep understanding of an issue or topic, which require them to apply what they have learned to new situations, or which are reflected in their local environment or community.

Your students: Brainstorm with your students to identify an issue or topic that resonates with them and which they can delve deeper into and come up with a solution or action. Ideas may arise from things they have read about, have done at home, or that they have found from media sources. Suggested CurioCity resources for facilitating brainstorming and discussion include **Think-Discuss-Decide** or **Key Ideas Round Robin** learning strategies. An additional brainstorming tool (Inspirations for Projects) is provided in the Appendix. Make use of the whole class or smaller student focus groups when brainstorming ideas.

Your community: Identify an issue in your local community (or school community) that students could investigate and take action to address. Such issues may relate to social justice themes, environmental problems, local governance concerns, economic sustainability, etc. Solicit input from other staff members, particularly for issues that are outside your specific subject area of expertise. Review local newspapers and other media websites to identify issues they have identified or covered recently.

CurioCity is a free web-based program developed by Let's Talk Science. As you brainstorm and research your *Solve for Tomorrow* project, you can explore curriculum-based, credible resources on interesting and current STEM topics in the form of

- Articles and videos on real-life STEM issues
- Backgrounders that provide in-depth explanations on issues
- Special features and case studies that explore certain topics in depth

ExploreCurioCity.org

Local organizations: Identify problems or challenges that local business, industry, hospitals, governments, municipal councils, museums, natural areas, etc. may have that your students can explore and offer solutions to address. Make use of your school's website and social media channels to communicate your interest to parents and members of the community who may be able to provide suggestions.

Project- or problem-based learning websites: If you are unfamiliar with the scope of such projects, make use of the Internet to review already completed projects that may serve as a springboard to an idea that works for your local application. This approach can also give you a better feel for the appropriate scope of such a project.

SolveForTomorrow.ca: Visit Samsung Canada's site for examples of award-winning global *Solve for Tomorrow Challenge* student projects for inspiration.

Clarify the Known and Unknown

When you have identified a topic of interest, your next step is to determine if it is an issue or problem that is appropriate for your students, particularly in terms of whether it is doable. Your first step is to identify what you know and don't know about the issue. Some questions to consider are the following:

- What do we know about the problem or issue? Where can we find the information?

- What is the background or history of the issue? Have others attempted to solve it before? If so, what did they do and what was the outcome?

- What is possible for the students to accomplish given the time and resources available?

- What supports do the students have to work with to address this problem? Are specific resources or materials required? Are funds available for necessary purchases?

- What skills and knowledge do the students bring to tackle the problem? What are the strengths and abilities of individual students? How best can the individuals be grouped to achieve maximum potential from each group member?

- Do the students have sufficient skills and knowledge to create a video to showcase their solution for the competition? If not, where will the students get support to create such a video?

- What is the most meaningful or effective action that can be undertaken to address the problem or issue?

- Can the entire problem be addressed or just one aspect of it? For problems in which specific actions are not appropriate, can scale models or prototypes be created to demonstrate proof of concept?

- What outside-the-classroom links exist? What links can we make to outside agencies, groups or experts?

Resources Required

When your class has identified a problem to address, your next step is to identify the resources available to access. The available resources will impact the scope of the problem that your class can tackle. For example, if the original project idea is to have students use an expensive piece of equipment that the school does not own, the project will have to be scaled back unless you can acquire the necessary access. In addition to online resources, course textbooks, equipment, and other school resources, look to the following:

- **Local experts:** These include post-secondary education and industry-based experts, parents, NGOs, and other community members who have knowledge of the problem.

- **Internet resources:** Perform searches related to the topic and determine what background information is available, both free and for purchase

- **Experts at a distance:** Locate institutions that are researching, or have people knowledgeable about, the subject of your investigation. Make contact early to determine their availability or interest in providing support. Contact Let's Talk Science by **email** or phone 519-474-4081 or 1-877-474-4081 for help with identifying potential resource people, through our free Outreach program.

- **Educator colleagues:** Reach out to school board or district support specialists, teacher associations, members of your own staff or department, particularly those whose subject area specialty is different from you own, and the same subject teachers in other schools, for example. All of these resources can bring different perspectives, complementary knowledge, or access to individuals who may not be in your network of contacts.

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Need Some Help?

If you find yourself needing some help at any stage of your *Solve for Tomorrow* project, Let's Talk Science can help

- Answer questions about this Educator Toolkit and related resources;

- Identify and connect you and your students with our STEM community of volunteers who are post-secondary students and faculty at universities and colleges, as well as industry professionals across Canada.

STEP 2: Craft the Focus Question

The **focus question** drives student work and orients students to explore further in their pursuit of addressing the problem or issue. An effective focus question will take students beyond the basic content knowledge of the curriculum and support the development of their critical-thinking skills. It will also help address other 21st-century skills as well as specific school or school district goals. The focus question should aim to be the following:

- Compelling or provocative so as to spark students' imaginations and curiosity;
- Realistic;
- Open ended with no obvious or easy answer; and
- Of a rigour that will require students to conduct significant research.

The most compelling questions are those that students come up with themselves. After you and your students have identified the problem or issue they wish to explore, engage them in the development of a focus question or questions. The CurioCity strategy **Question-Answer Relationship** will help students develop appropriate questions. Where you as the teacher may finalize the focus question, your students could use the Question Development chart template (in the Appendix) to develop sub-questions that will get at the heart of the focus question.
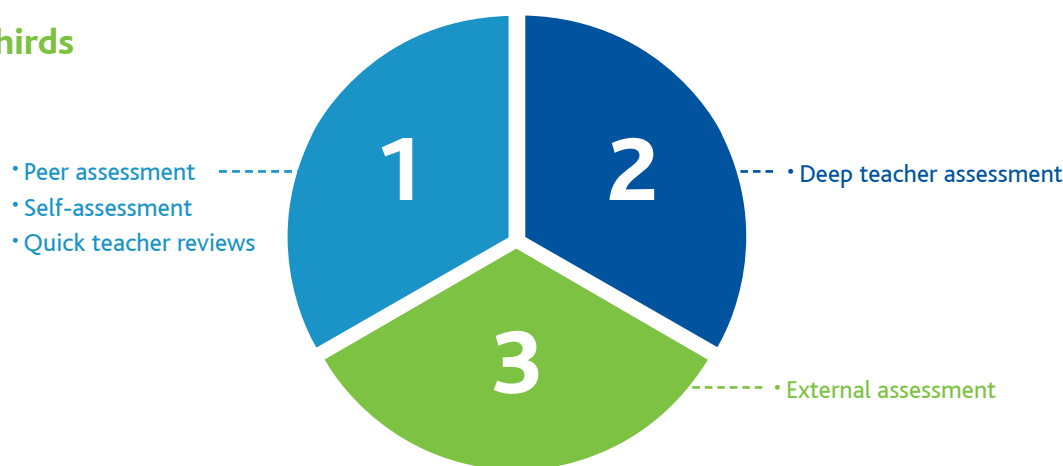

STEP 3: Plan the Assessment

Developing your assessment plan should take place at the same time as you finalize your project idea and develop your focus question. Your assessment plan will provide the direction in which the project will take the students and will provide an endpoint for which to strive. The first step is to determine the cumulating product(s) that will provide evidence that students have achieved the curricular outcomes you have set. The product can be a tangible item, an action the students will carry out or both. The next step is to determine how the product(s) will be evaluated. As with any form of assessment, it is recommended that you include a variety of assessment strategies, which take place at all stages during the project activity. In addition to providing a greater number of data points upon which to base the final grades, when you include a variety of assessments during the course of the project, it reflects the reality of the real-world work experience that your students will eventually have, as well as the interdependence of the various activities your students engage in while creating their final product(s).

Sources of assessment data should include both summative and formative tools and occur at all stages of the project activity. Non-traditional assessment items (e.g. presentations, engagement and participation, model building, videos, flow charts, etc.) will require the development of associated rubrics to ensure students are clear of what is expected and to help reduce subjectivity in grading.
To ensure you are not overwhelmed by the amount of assessment that could occur, you could use the **rule of thirds** as outlined on the next page.

Rule of Thirds

- Peer assessment
- Self-assessment
- Quick teacher reviews

1

2 — Deep teacher assessment

3 — External assessment

One-Third

- **Peer assessment** can help measure the contribution of each group member. This should be completed regularly throughout the project and can be used to provide feedback as well as to keep track of group progress. Peer assessments can also be used as part of the summative assessment of each group's final product(s).

- **Self-assessment** can provide opportunities for students to reflect and comment on their experiences as a member of the group, as an individual with specific goals and duties within the group, as well as their attainment of intended outcomes. Peer and self-assessments could be in the form of **admit slips**, **exit slips** or journal entries, which could be completed using an online tool such as Google Docs.

- **Quick teacher reviews** can include various samples of student work, checklists, and anecdotal comments of student engagement and participation, quick comments on selected journal entries, admit or exit slips, etc. Most of these will be for formative purposes and to provide checks that students are on task and on target.

One-Third

- **Deep teacher assessment** can include any assessment tool traditionally used to assess the outcomes addressed in the project (e.g. tests, essays, etc.) as well as various performance assessments as deemed appropriate. This third is generally more detailed and includes significant depth of analysis, review, and feedback. It can be either formative or summative in nature.

One-Third

- **External assessment** can also provide real-world evaluations and feedback on the product(s) from those who are knowledgeable about the problem or issue being addressed. While typically occurring at the final project presentation, this form of assessment can take place at any point along the project timeline as well. Educators will need to provide external assessors with guidance of what to look for, potential questions to ask, etc.

STEP 4: Launch the Project

By engaging your students in the identification of the problem and crafting the focus question, you'll be inviting them to make an emotional investment in the success of this project. There are a number of ways to continue to spark students' interest and responsibility for their own learning throughout the project. As the full scope unfolds through your discussions and planning, you can foster even greater student interest with the following activities:

- Invite a guest speaker who has a strong connection or interest in the issue to talk about the issue or to address the need for a solution to a problem. For example, your local mayor or council member could speak about such things as the problems caused by a need to develop near a watershed area, or a director of a homeless shelter could talk about the causes of homelessness. Such an address to your students could take place in person or virtually.

- If a guest speaker is unable to present directly to the class, invite him or her to send a letter that either thanks the students for selecting this issue to investigate or outlines the issue and requests them to assist by developing a solution to the issue. Such a request will demonstrate the value of the work the students are about to engage in and solidify the connection and relevancy of their work to the real world.

- Use the **Pros & Cons Organizer** or **Think Discuss Decide** learning strategies from **CurioCity** to help students focus on the topic and drive their classroom discussions.

- Have students review a website or video related to the topic they will study. Use the **Key Ideas Round Robin** learning strategy to help students identify the main issue.

- Take students on a field trip (real or virtual) to get a close-up look at the issue or problem.

- Have students conduct interviews with local people who are also affected by the issue to get their perspectives.

STEP 5: Manage the Project

A successful conclusion is strongly correlated with effective planning. The following are key points to keep in mind:

- **Identify tasks, activities, and resources.** What are the project goals? Is the overall project task subdivided between various groups? If so, identify the groups and assign their topics. If the final project is to be an amalgamation of the work done by individual groups, establish the process for bringing it all together. Identify your resources and the resources you need to acquire. Establish communications with external groups or experts as soon as you identify your project idea. Refer to the Appendix for the Project Planning Template to help with this aspect of project management.

- **Create a timeline.** Begin by looking at the date you have to submit your *Samsung Solve for Tomorrow Challenge* Letter of Intent and your video, and then map backward, giving your students sufficient time to complete the necessary aspects of the project. Map out the start and end dates for each component of the project. Include milestones, due dates, tests, as well as regular school dates such as assemblies and holidays. Keep it digital by using an on online timeline creation tool such as Timeglider (www.timeglider.com) or Timetoast (www.timetoast.com). Build and share timeline and associated tasks with your students.

- **Establish the management process.** How will you communicate updates and clarifications to students? Can you make use of an electronic process such as Evernote (www.evernote.com) or other online services such as a text messaging service, for example Remind (www.remind.com)? How will you maintain regular contact with each group? Would an online service such as Google Docs (www.google.ca/docs/about) work for your class? Set a schedule to ensure you visit with each group and have time to discuss their progress. How will student assignments be submitted or collected?

- **Plan your celebration!** The completion of your project will represent a significant amount of work completed by your students. All student projects are valuable, so please share your final project output with your students and their families, teacher colleagues and their students, as well as your education industry contacts. Identify an appropriate location to exhibit the final product(s) and book that location when you start the project. Send guest invitations out a month prior to your planned date. Assign student roles for the event as appropriate: greeters, ushers, emcee, presenters, demonstrators, etc.

How to Avoid Pitfalls

Even with a great plan, a tantalizing focus question, and an engaged group of students, successful completion of a large-scale, long-term project is sometimes difficult. Here are some tips to avoid a stalled or stopped project:

- **Be flexible.** Expect that changes may need to be made during the course of the project.

- **Don't expect that students will understand how to work in groups.** Plan to teach appropriate group behaviour prior to embarking on the project. Ensure group members have assigned roles and specific tasks to complete. Discuss what is acceptable and what is not acceptable during group work. Communicate clear expectations and provide frequent reminders.

- **Set and check expectations.** Ensure students understand the tasks associated with their project and what is expected of them.

- **Provide regular feedback.** Make use of assessment tools that will both help assess students' progress throughout the project and provide them with rich and targeted feedback.

- **Keep a tight focus on what you want to address.** Be wary of scope expansion or scope creep. Keep referring back to the focus question to ensure students stay on topic.

- **Plan accordingly.** Ensure you build sufficient time in your project plan if students need to learn new skills or technology as part of the project.

- **Limit the duration of the project.** Plan the project duration to ensure there is a sense of urgency, with a timeline that must be met, while being realistic and flexible. Long drawn-out projects are at a greater risk of running out of steam.

Conclusion

In this toolkit, we have provided you with a learning approach to support your participation in the *Solve for Tomorrow Challenge*. The educational research literature makes a clear case for the many benefits students gain from engaging in the type of hands-on, minds-on activities that are engendered in this contest. These benefits include increasing students' depth of understanding of curricular topics, improving their motivation to learn curricular content, reducing achievement gaps amongst students, and developing valued 21st-century skills, as well as improving teacher job satisfaction.

We hope you find the process described herein and the resources referenced at CurioCity helpful. We also hope that your students achieve what they set out to accomplish and have fun along the way.

Thank you and best wishes for your participation in the *Solve for Tomorrow Challenge*!

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Appendix

Project Planning Chart

Project Idea	Curriculum Connection (Concepts & Competencies)	Assessment & Products	Entry Events	Learning Activities
Driving Question			Presentations of Learning	

Timeline - Dates

Timeline - Milestone Events

Inspirations for Projects

Directions: On your own, list as many ideas as you can for potential projects for each category. When directed, pair with another student and share your ideas. Then, record your best ideas on a clean sheet. Pair with another set of partners to form a group of four. Compare your ideas and identify one or two under each category to bring back to the whole class for consideration.

Student Interests	Local Community Needs

Sustainability Issues	Local Events

Question Development Chart

Hey, students! Use this chart to create questions related to the issue or problem you are interested in exploring as your teacher instructs.
Create questions by selecting a word from the left-hand column and one word from the top row. Write your question in the space where the column and row intersect.

	Is/Are	Did/Do/Does	Can	Would/Could	Will	Might/Should
Who						
What						
When						
Where						
Why						
How						

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