INVENT THE FUTURE CHALLENGE

COACHES GUIDE

2019-2020

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1 PROGRAM OVERVIEW

I. Overview

A. Introduction to Invent the Future Challenge

Beginning in 2017-2018, KID Museum partnered with MCPS to pilot the Invent the Future Challenge. Approximately 500 students from 30 middle schools participated in the first year and this number grew to more than 850 students who participated in the second year. Building on these successes, the Invent the Future Challenge is launching for the 2019-2020 school year.

B. About KID Museum

KID Museum aspires to create a world-class, "next generation" museum – a dynamic hub for informal learning that inspires and empowers all kids to invent the future with creativity and compassion.

We define our work around three core activities:

1. Deliver high-quality youth programs designed to build skills and interest in STEM, arts and culture through maker-based learning
2. Serve as a catalyst for change in the education system
3. Provide a unique community gathering place to promote intergenerational learning

In October 2014, KID Museum opened its doors at the current 7,500 square foot space, establishing a living prototype for the museum. KID Museum transformed the space into a "makerspace" for kids and families, featuring a fab lab (3D printing), a woodshop, an electronics studio, and a textiles studio. Today, the museum serves more than 55,000 people annually through school and group visits, weekend workshops, open explore activities, after-school programs, off-site programs, camps, and special events.

C. What do students do through the Challenge?

Students are invited to work through an iterative invention cycle: developing an idea, designing plans, making a physical prototype, and adapting when challenges arise. Students work collaboratively and use technical skills, creative problem-solving, and STEM concepts to develop solutions to a challenge question. In teams of 3-6, students build a physical prototype that illustrates their solution to the challenge question. Any type of prototype is encouraged, from the low-tech to the high-tech, with a $60 maximum materials budget. See the Invent the Future Challenge website for more information on guidelines around this budget. Teams present their prototypes and showcase their solutions at The Challenge Summit in May 2020, where multiple teams are recognized in a variety of categories.

D. Challenge Question

What will you make to protect life on this planet?

Think of an environmental problem, big or small, that needs to be addressed. Now, think of a solution to that problem; an invention that would address that problem. Use your imagination to push beyond today's limits to invent the future.

If you accept this challenge, your team must not only dream up an invention, but also design and prototype that invention. Use engineering, coding, and design techniques to turn your ideas into something tangible. High-tech or low-tech, mechanical or digital…What will you make to protect life on this planet?

The future is up to you.

E. Connection to the Next Generation Science Standards (NGSS)

These criteria align with a variety of Next Generation Science Standards, including but not limited to:

Engineering Design:

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria & constraints of the problem.
- MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Earth and Human Activity:

- MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Depending on the specific problem teams choose to solve, Challenge work may also cover additional standards in the following categories:

- MS-PS3. Energy
- MS-LS2. Ecosystems
- MS-ESS2. Earth's Systems
- MS-ESS3. Earth and Human Activity

II. Challenge Process - How do I get started?

A. When do I start?

You can start working as soon as you would like! The intention is that the Challenge can be a year-long experience where students can engage in a robust iterative design process. Below are some important dates:

MONTH	DATE	EVENT
September	Friday, 9/20	Team registration opens
October - April	Ongoing	For Schools: Invention Studio workshops at KID Musum For Individuals & Teams: Invent the Future: Skill Series weekend workshops at KID Museum
January	Friday, 1/31	Team registration deadline
April	Friday, 4/17	Summit Registration Deadline
May	Mid May	Challenge Summit

B. Invention Studio Overview

SCHOOLS

To supplement Challenge work, schools have the option to participate in Invention Studio. These workshops will help your students to prepare for the Challenge with a series of skill-building workshops at KID Museum. Build on what you know and learn new skills to invent your own solution to the Challenge Question. Invention Studio visits begin with a focus on developing skills in design, engineering, electronics, and coding. Throughout the sessions, KID Museum educators will guide students through focused brainstorming and designing, culminating in students building quick prototypes with tools and materials at KID Museum.

Visit 1: Introduction to Design & Engineering

Visit 2: Electricity & Coding

Visit 3: Coding & Sensors

Visit 4: Fabrication & Rapid Prototyping

Visit 5: Rapid Prototyping & Presentations

If you are interested in scheduling Invention Studio visits or would like more information, please fill out our online request form.

INDIVIDUALS & TEAMS

Individual students or small groups and teams have the option to participate in Invent the Future: Skill Series, a weekend workshop series. This 4-part series will cover the same skills as Visits 1-4 of Invention Studio. In the spring, KID Museum will offer weekend Prototype & Build workshops to allow teams access to KID Museum's tools and equipment while building their prototypes.

III. Markers of Success

Throughout the year, teams should focus their work based on the Markers of Success: IDEA, PROCESS, PRESENTATION. A rubric for these markers is located on the Invent the Future Challenge Website.

IDEA

The Idea category celebrates a thoughtful problem choice and originality in developing an impactful solution to that problem. The project explores new ideas and approaches to protecting life on this planet, applies these ideas in innovative ways, and demonstrates the impact of the solution.

PROCESS

The Process category celebrates engaging in a robust, iterative, and collaborative design process. The project shows evidence of the team going through multiple stages of a design cycle, complete with incorporating feedback, learning new skills, and working together with teammates.

PRESENTATION

The Presentation category celebrates compelling and thoughtful communication of ideas, both through their method for presenting their work and the built prototype. The team's presentation of ideas is clear and compelling, and the prototype illustrates their solution to the Challenge Question.

IV. Challenge Summit

A. Overview

The Challenge Summit is a celebration of the inspiring work students have done throughout the year. Each team will have table space to set up their prototypes and any accompanying materials such as design notebooks. During the event, teams will present their work to peers, family, friends, and the broader community. Panels of experts will circulate to each team to informally interview them and assess their work based on the Markers of Success.

The Invent the Future Challenge Summit will occur during May 2020 over a weekend day. More information on the Summit will be posted on the Invent the Future Challenge webpage as it is available.

Teams will need to RSVP to the Summit through their team coordinator by April 17th, 2020. Only teams who have officially RSVP'ed to the event will be guaranteed space to set up projects, an opportunity to present to the panels of experts, and be eligible for awards.

All are invited to attend the Summit! Fellow students, teachers, administrators, families, and friends are all encouraged to attend. As a team coordinator, it is best to arrange permission slips, transportation, and all other necessary logistics for the Summit event as soon as possible. Keep in mind that teams will also need to transport their projects and other materials to the Summit location!

B. Student Service Learning (SSL) Hours

Students who have participated on a team throughout the year and present their project at the Challenge Summit may earn SSL hours.

Team coordinators are responsible for completing and distributing SSL forms to their team members. Each student who worked on an Invent the Future Challenge project can earn a maximum of 15 hours as follows:

- For showcasing their project at the Challenge Summit, each student can earn a maximum of 5 hours. Students who attend the Summit as an observer or a guest are not eligible for SSL hours.
- For their research, skill building and design time, each student can earn a maximum of 10 hours. This can include visits to KID Museum as well as time spent at school under team coordinator supervision.

2 RECOMMENDATIONS & RESOURCES FOR WORK

This is a collection of topics and concepts that will help students move their Challenge work forward. Throughout the course of their work, students should go through each stage of the design process in order to identify a problem, develop solutions, and refine those solutions. The Markers of Success and rubric will help guide their work towards a prototype, but we encourage teams to thoughtfully brainstorm, identify problems, develop solutions and determine how to communicate their ideas to others.

I. Introduce Students to Invent the Future Challenge

Invent the Future Challenge Video

- Introduce the Invent the Future Challenge by viewing this video: https://tinyurl.com/inventthefuture

Language for Students

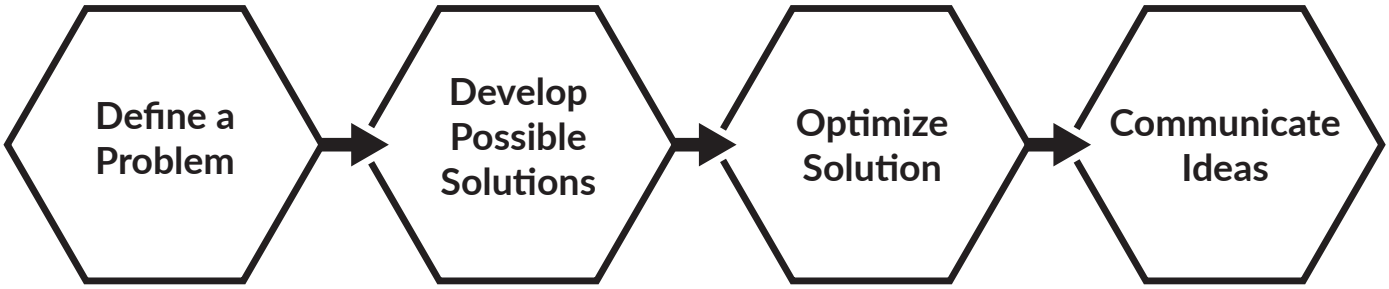
- The Invent the Future Challenge is a chance for you to work with a team to design, develop, and prototype an invention that answers the Challenge Question: What will you make to protect life on this planet?
- Challenge solutions can solve the actual problem or implement social change. In a team of 3-6 people, you will collaborate to build a physical prototype that illustrates your solution to the challenge question. Throughout the year, you will go through a process of designing prototypes, building them, testing, and building them again as you continue to refine your ideas.
- At the Challenge Summit, your team will showcase your prototypes and ideas. You'll have the opportunity to share your inventions with the whole community, and present them to panels of experts. The Challenge Summit is a celebration of the awesome work you'll do throughout the year, and a chance for all of you to show everyone how you will Invent the Future.

II. Review Markers of Success & Iterative Design Process

All students should be familar with the Markers of Success rubric before they begin substantive work on the Challenge. It will provide guidance and priorities for success. A rubric for these markers is located on the Invent the Future Challenge Website.

The Design Cycle

- Engineers go through a series of steps when solving problems. It is not a linear process, which means that steps repeat based on results. Different places call the steps slightly different names, but they are basically the same. Below is a graphic with the stages of the design process.



- Define a Problem:
  Do research on the problem, use empathy to explore the problem, and specify the requirements of the solution.
- Develop Possible Solutions:
  Generate ideas, make a plan for solutions, and build and test initial prototypes.
- Optimize Solutions:
  Create a final solution by testing and refining a solution based on prototyping and feedback.
- Communicate Ideas:
  Convey your process and solutions to others in a compelling way.

III. Brainstorming

Individually and as a group, students should begin brainstorming lists of problems that need solving. Use the following questions as guidance:

- What are environmental problems that affect me?
- What are environmental problems that affect my community?
- What are environmental problems that are important to me? Why are they important to me?

Remember that brainstorming is about quantity over quality. Students can write down anything that pops into their head.

IV. Identifying & Defining Problems

Students should identify and define a set of problems that they could solve. They don't need to select one yet, but they should have a few substantive ideas:

- Do these problems satisfy the Markers of Success?
- Are the problems narrow enough to solve feasibly?
- Is there a need for the problems to be solved?

Complete a brainstorming activity with your class. Give them a few different examples of environmental problems to spur their thinking. Then, present the six categories that projects may fall into along with an example for each category.

CATEGORY	DESCRIPTION	EXAMPLE(S)
Ecosystems & Wildlife	This category contains solutions to problems that affect ocean and freshwater habitats, land habitats, and the plants and animals that live on Earth.	Life Straw River Water Filter Lead-Detecting Device
Air Quality	Projects in this category will develop solutions that protect and improve the quality of the air and atmosphere, including addressing pollutants and emissions in the air and causes of climate change.	Respiratory Local Air Quality Sensor
Energy	From solar panels to wind turbines, more and more efforts are being made to implement sustainable energy practices in our society. Projects in this category will be aimed at conserving energy through clean, renewable sources and alternative fuels.	Respiratory Local Air Quality Sensor
Agriculture	Growing food to feed the expanding human population can lead to a variety of environmental problems. Projects in this category address the methods of food production and the problems surrounding agriculture.	A drone that pollinates crops
Waste Management	Each person in the United States makes 4.4 pounds of trash per day. This category creates solutions around waste management, preventing and improving how trash is discarded, recycled, cleaned up, or eliminated.	Home Dome
Humans and How They Live	These are solutions to problems that affect humans and our day-to-day lives. Projects in this category will implement social change and/or engineer human-centered solutions that positively impact the world in which we live.	Life Straw Bag ban in Bali Lunch skins

In order to define and select the problem that they would like to address, encourage students to:

- Research the problem to see if others have tried to address this problem. If so, have previous solutions been effective? Could you improve upon an existing solution? Is there a more specific version of this problem that you could solve?
- Research the environmental impact this problem causes. Have those problems been solved? If so, how?
- Talk to others to see: How does this problem affect other people? How might a solution to this problem benefit people or the environment? If you can, ask experts in the problem's field for their take on the problem.
- Think about: What science have you learned in or out of school that helps you to understand this problem?

V. Ideate & Develop Solutions

Once the team has decided on a specific problem to investigate, they should shift to the Ideate/Developing Solutions phase of the Design Process.

- It is likely that students have begun to think through possible solutions through the process of choosing a specific problem. Students should be considering the research they have done about possible problems and existing solutions to those problems when developing their own original solution.
- Once all students on a team understand and are comfortable with the selected problem, they should all have the opportunity to brainstorm a variety of solutions. Even if students feel like they have a strong idea already, encourage them to brainstorm other solutions. They might be surprised with what they come up with, and even incorporate more than one idea into their prototype.
- Students can do similar brainstorming exercises from the problem definition phase in order to develop innovation ideas for solutions to their problem.

As solutions are developed, keep in mind the following:

- How do the solutions meet the rubric criteria? How can you use the rubric to continue to refine and improve the solution?
- What skills have we learned that will help prototype the solutions? How can we represent the solution in a prototype? Will we build a model of the whole solution, a particular portion of the solution, or a combination?
- What kinds of materials and tools can we use to build the prototype?

VI. Prototype, Build, & Refine

Students should figure out how they can build and communicate their unique solution.

- What are the important components that need to be communicated to other people? What pieces of this solution are most exciting to others? How can we help people understand how this solution solves the chosen problem?

As students begin to prototype and build, they should have the following components or information developed and documented:

- Specific problem that the team is addressing
- A solution to that problem that the team has developed
- Sketches, plans, and ideas of the prototype the team wants to build. Students should understand if they are building a prototype of the whole solution, a model of the solution, a component of a larger invention, or what form their project will take.
- List of possible materials to use in building the prototype (wood, cardboard, recycled materials, electronics, Micro:bit, Arduino board, etc.

Students are encouraged to build early stage prototypes as they develop ideas for solutions. These can be out of simple materials (paper, masking tape, popsicle sticks, etc.)

Students can get feedback from others on their ideas and prototypes. Incorporating this feedback is a valuable step in the design process!

*Building simple, quick, and rough prototypes will help students visualize their ideas. Once they have something tangible, they will have a better sense of what to build, how to improve their ideas, and how to elaborate on existing prototypes.

REMEMBER: Prototypes that are presented at the Summit only need to be a physical representation of your idea. They do not have to be fully functioning. They should be a model, a component of a larger invention, or a representation of the developed solution. Students should be able to communicate how their physical prototype relates to their developed solution to the Challenge Question.

VII. Other Resources

Micro:bit

- Students can make MakeCode accounts and use the the block coding to prototype programming a Micro:bit microcontroller.
- If teams have purchased a Micro:bit microcontroller, they can use this as part of their prototype. If they have not, the program has a simulator that can be used.
- There is a large open-source community around Micro:bit! If you are looking for tutorials,
    - http://microbit.org
    - http://www.sparkfun.com
    - http://www.adafruit.com

VIII. Preparing to Present at the Challenge Summit

Students should consider the following questions when preparing to present their work at the Challenge Summit:

- What is most compelling about the project?
- How will you communicate the ideas to others?
- Does your team have a clear Team Name in order to introduce yourselves and your project easily to others?

Students should determine what to practice and create for the Challenge Summit:

- Will the team utilize visuals? Poster, slideshow on laptop, handout, etc.
- Does every team member understand all aspects of the problem, solution, and prototype? Is everyone prepared to discuss these points?
- Does every team member understand the rubric and how their project satisfies the criteria?
- Does the team have documentation of their process throughout the year, through each stage of brainstorming, developing solutions, prototyping, and testing.

It is important to remind students that their projects do not need to be "finished." The Summit is an event at which they should present their process and share ideas of how they could continue to improve their prototype.

Rubric Self-Assessments

- Students can try looking at their project as if they don't know anything about it. They can even have one team member be the "judge" and another be the "presenter". Students should try to rate their project honestly on the rubric and then use those results to continue to refine and elaborate on their project.

We look forward to seeing you at the Summit!
Please contact us at inventthefuture@kid-museumm.org with any questions.