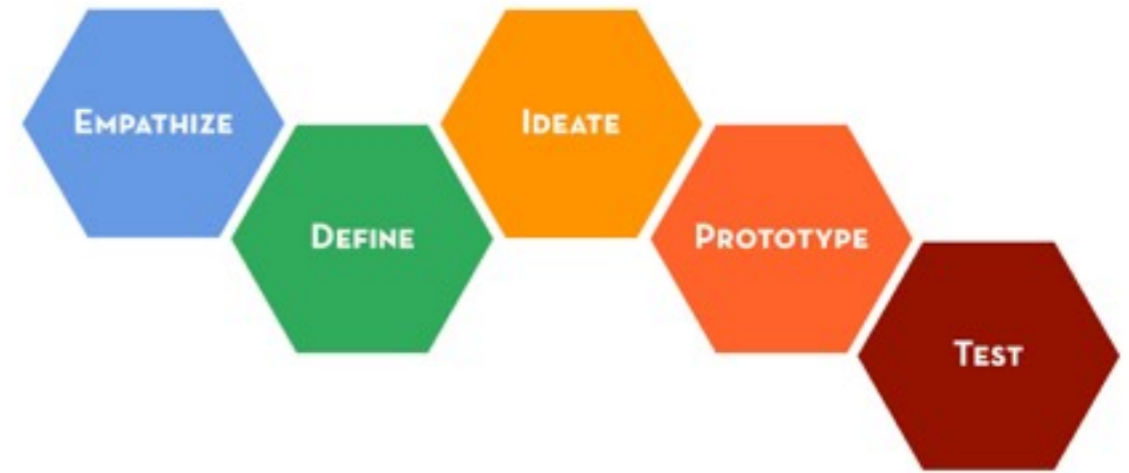# STEM @ FRES

Collaboration

Collaboration is fundamental to STEM. Students at all grade levels collaborate, starting in preschool. Students collaborate on design projects, problem-solving, giving feedback, and giving presentations. When students are collaborating, they practice the first step in the design process, EMPATHY. They listen to each other, and try to understand the problem or client.

GALLERY 1.1 Student collaboration

5th graders collaborate on body systems presentations.

Kindergarteners collaborate on designing their partner's "dream" gingerbread person. They have to listen to their partner's favorites before drawing their initial design. This is the third step in the design process, PROTOTYPE. They share the prototype with their client, and receive feedback. This leads to another step in the design process, ITERATION. Students work together to design, give and receive feedback, then redesign.

3rd graders collaborate to solve problems they find in the literature they're reading. One group tries to solve the problem of over-tapping sugar maples for maple syrup, then builds a possible solution and presents it to the entire class for intensive feedback. The feedback leads to another iteration of collaborative problem-solving.

5th graders collaborate to build a ship to transport colonists to America. After studying what colonists needed for a long sea journey, they work together to prototype and iterate their designs, finally building them to share with the rest of the school.

Every grade level has opportunities for students to collaborate on large and small projects. Projects can be related to literature, science, math, or social studies. They might involve writing, building, and speaking. Students work in pairs to learn collaborative skills and then learn how to work in groups of three or more; larger groups bring about different challenges.

While collaborating, students learn to listen, take turns, share, honor each others' ideas, make decisions, back up judgments with evidence, accept failure, and learn to try again. These skills, and others learned during collaboration, are critical to students succeeding in the 21st century.
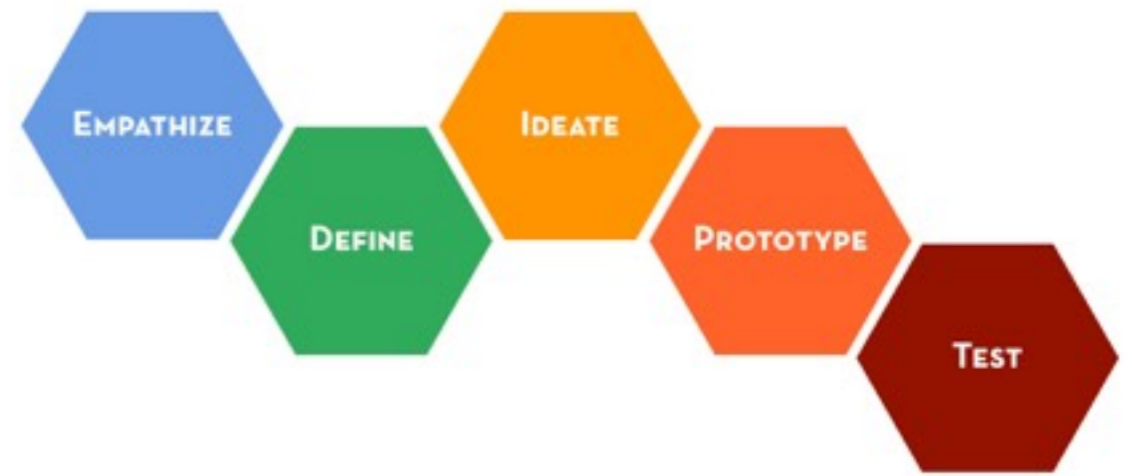
Creativity

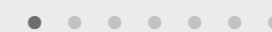Creativity is the second critical component in our STEM work. Opportunities for creativity allow students to think from and experience different perspectives, learn how to run with a partially formed spark of an idea, evaluate the merits of an idea, and find the joy in problem-solving.

GALLERY 2.1 Creativity

4th graders create 3D representations of music

When students are creating, they are experiencing step two of the design process, EMPATHY, as well as the PROTOTYPE/BRAINSTORMING phase. They think of ideas big and small, finesse others' ideas, think practically and think "outside the box."

Students experience opportunities for creativity when their specials teachers integrate STEM into music, art, and PE. In music, students create 3D representations of song, or use apps to write their own music.

2nd graders learn about habitats by creating 3D presentations of their chosen habitat. They learn the details of their habitat through choosing how the most important aspects can be represented in print and 3D; this also involves evaluation and judgment. Students then continue their creativity by "designing" new animals to live in their habitat.

3rd graders read works of nonfiction and identify a problem that they think they can solve. They collaborate to create a model and written explanation of their solution. After their presentations to their class (during which they must explain the problem and how they arrived at their solution), the class gives written feedback to allow for a round of REITERATION...a chance to make their original designs even better.

5th graders learn about plant systems and demonstrate their learning with beautiful 3D models of the plants' components. Students get to practice and reinforce content while finding joy in creating something beautiful.

4th graders learn about astronomy, and get to let their creative juices flow creating colorful (but accurate) models of the solar system. The whole school gets to enjoy the visuals when they are posted in the hall.

Summer school students use geometry and physics to create indoor miniature golf courses. Younger students come play the "course" and give feedback so the older students can REITERATE and improve their designs for future play.

4th graders interview their principal to get criteria for a "proposed playground addition." They collaborate to create the perfect design and written justification, while staying "on budget" and trying to meet the criteria. Their final products are judged and the winning design is chosen...in case extra funding for playgrounds arrives!
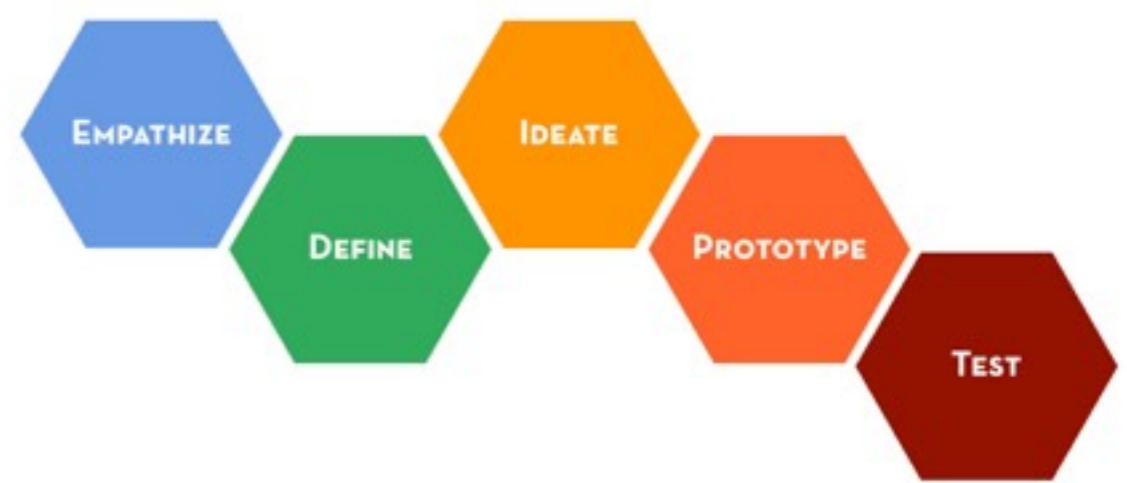
Critical Thinking

Critical thinking pairs nicely with creativity in STEM work. Students must examine the ideas they have for problem-solving, considering the possible outcomes and weighing their choices. Instead of blindly trying random ideas, they choose carefully and evaluate the success of their iterations.

GALLERY 3.1 Critical Thinking

1st graders try to solve robotics challenge

Critical thinking is an aspect of the next phase in the design process, FEEDBACK. Students think critically while problem-solving individually or with a team, and they also give each other feedback on their ideas. Whether it's helping another student improve their writing or asking challenging questions after group presentations, students use critical thinking to examine others' ideas and help make them better.

When students consider feedback they've received from teachers, students, or volunteers, they must also think critically. Students examine the strengths and weaknesses of their original ideas, as well as the feedback they've received. Students become thinkers who ask questions and look for evidence. Students are asked to think deeply and give evidence in all subjects, including fiction and nonfiction reading, written responses, math, social studies, and science.

Students can practice critical thinking in engaging ways through STEM experiences at all grade levels. 1st graders use iPads to solve robotics challenges, while summer school students are given unusual materials to solve a hands-on challenge. In both cases, students must ask questions, make judgments and decisions, and evaluate outcomes.

4th graders test racing prototypes to understand mechanics and physics. Intermediate grade students participate in robotics club and tournaments, working as a team to use critical thinking to design their own VEX robot that can (hopefully) win the challenges at the next tournament. 3rd and 4th graders use materials and technology to solve problems with hand-made prototypes. Prototypes are tested and students make changes depending on outcomes.

Kindergartners learn about penguins and come up with questions they want to know more about. After researching, they "test" their original "wonder" and write about what they learned. 3rd graders solve 3D puzzles and build models, using critical thinking to create and test hypotheses.

When students think critically, they look deeply at ideas and content. Allowing them to ask questions, challenge assumptions, and find evidence for their ideas is far more engaging than memorizing facts. Students learn more content while also learning important thinking skills for 21st century success.
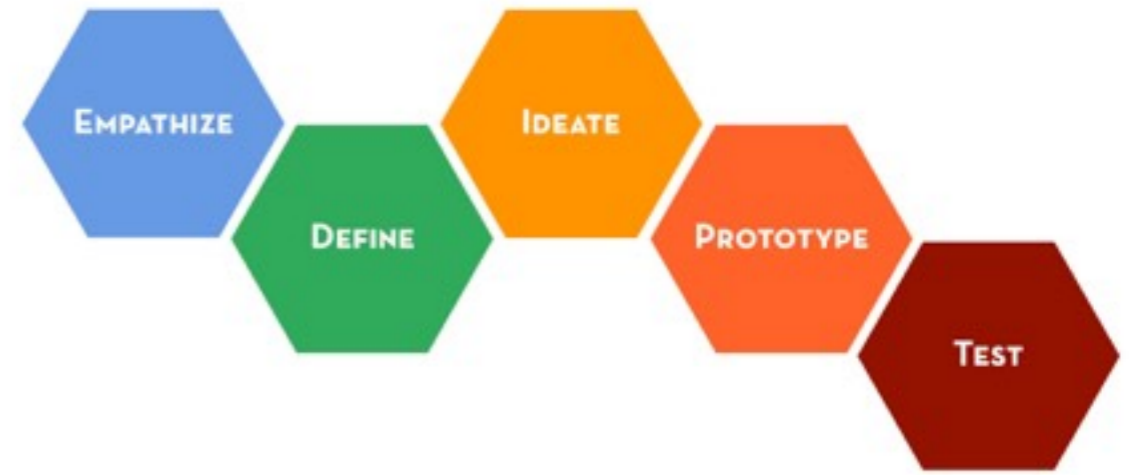
Communication & Information Literacy

Communication and Information Literacy round out the skill set of our STEM work. In addition to collaborating, creating, and thinking critically, students must be able to clearly communicate their ideas and be able to navigate the extraordinary amount of information available to them in the Information Age.

GALLERY 4.1 Communication and Information Literacy

Students collaborating in computer lab.

It is not enough for students to think of ideas and examine them; they must also be able to speak and write about their thoughts in order to share with others. Students articulate their thoughts, learn how to listen to others, and also learn how to improve their original communication after receiving feedback. Students have opportunities to communicate through group work, live presentations (both watching and presenting themselves), online editing and video-conferencing communities, and with adult volunteers and parents.

Students also learn strategies for finding information online and in text, as well as how judge the worthiness of the information. Students as young as kindergarten research information on topics they are passionate about, while also creating informative writing, visual projects, and speaking presentation to share what they found with others.

Parents and volunteers who are knowledgeable and passionate about the STEM fields share with students through daily enrichment/extension op-portunities, as well as special class presentations and community nights.

1st graders practice active listening so they have the information they need to solve their robotics problem, as well as be able to work with their team. Students of all ages do STEM presentations on any topic of their choosing for the whole school to enjoy at STEM Night.

3rd graders formulate their opinions, find evidence, share ideas, and listen to each other while thinking critically about their reading. 2nd graders figure out how to communicate while solving a challenging math problem.

Students look for examples of STEM in the news and post the articles for others to enjoy. Students in all grades work on coding in the lab, collaborating to figure out how to communicate their ideas clearly.

Students work with partners to start on a challenge, practicing important communication skills such as eye contact, positive body language, and writing. Students of all ages improve their skills with live and online communication and information literacy to prepare for 21st century jobs and success.