Aloha and Happy Teacher Appreciation Week!

Digital equity has been at the forefront of our minds throughout this extended classroom closure. Many members of our local community have only limited access to reliable hardware or Internet bandwidth; therefore, distance learning participation is a challenge for teachers, students, and parents/guardians. Please remember that STEM Pre-Academy is here to provide support as you continue to support your students.

Some of you might feel like you're awash in a sea of technology choices, while others may still be seeking the right fit for your enrichment needs. In our last newsletter we sent a list of free online tools to support multidisciplinary learning. We hope that you were able to find something to your evolving needs. In this newsletter we will focus on fun activities that engage students in the engineering design process (EDP) using everyday materials (craft/office/recyclable) with little to no technology required.

Now can be a great time to add an EDP activity because the choices are very diverse. EDP can be open-ended (support freeform creativity, personal expression, and enrichment) or target specific content learning objectives (support academic rigor through the use of engineering notebooks and reflective assessments). EDP can leverage a variety of low-cost materials that

students can easily find at home, including basic crafts supplies, office supplies, recyclable materials, or even broken items that are about to be thrown away. Whether you choose to inspire students with creative expression or targeted content, you can use EDP activities as a meaningful learning opportunity.

Here is a snapshot of some of our ideas (see full list of resources that follows this message or in the [attached document](#)):

- EDP with academic rigor (overview of EDP, distance learning integration ideas to help facilitate EDP, introduction to our EDP notebook and other creative assessment ideas)
- High-quality websites that feature EDP instructional materials and focus on using everyday materials ([ASEE's eGFI](#), [Exploratorium](#), [Harvard's Agency by Design](#), [PBS Design Squad Global](#), [CU-Boulder's TeachEngineering](#))
- Featured EDP activity: [Novel Engineering](#) (authentically integrate engineering design and literacy)

We know that it's important to stay connected, engaged with your students and keep the learning going outside of your classroom and we want to help you in any way that we can. [Drop us a line on the Leaves](#) to ask us questions or share how you are utilizing engineering design activities with your students. Want to share a new resource with everyone? Email resource ideas to us at stempre@hawaii.edu.

Together we can keep STEM learning hale and hearty!
Mahalo,
Shaunna Smith (STEM Specialist and Liaison)

👏 *A special thank you to all the teachers. Your dedication and commitment to teaching under challenging times have inspired so many of us. We extend a warm mahalo to each of you.*

Cheryl, Davin, Shaunna, Edwin and Caroline and the STEM Pre-Academy team

https://stempreacademy.hawaii.edu

Resources for Engineering Design Activities Using Everyday Materials and Academic Rigor

Engineering design process (EDP) activities can be a great opportunity to provide creative hands-on enrichment for your students. EDP can challenge students with prompts that they can complete using low-tech craft/office/recyclable materials easily located at home. EDP can connect to a variety of disciplines by using unique inspiration to structure problem statements, scenarios, and constraints.

This list contains information about facilitating a thorough EDP process with academic rigor, high-quality websites that feature EDP instructional materials, and our featured multidisciplinary EDP activity: Novel Engineering. Keep in mind, even though EDP is a structured process, you can assign it as optional enrichment or modify it to meet your students' needs.

EDP Process with Academic Rigor

You can add rigor by using the STEM Pre-Academy [EDP notebook](#) to scaffold the design process and help students document their work and progress each step of the way (Please note, our EDP notebook can be used as a printed paper packet or digital GoogleDoc that can be emailed or embedded on a class website). No matter which format you choose, you can decide whether or not you want to integrate distance learning technologies to help facilitate student learning that promotes communication and sharing. Our table below outlines the EDP process steps and optional ideas for distance learning technology integration.

Content Tag: multidisciplinary, art, CTE/STEM, language arts, math, social studies, science

EDP Process	Distance Learning Technology Integration Ideas
	• Sharing their completed "Ask" step with classmates will help to ensure they are

1. Ask
 	
   1. Identify Need
 	
   2. Define Problem
 	
   3. Define Specification
 	
   4. Conduct Background Research
	scoping the problem accurately.
	
	• Students can work collaboratively or individually to complete the "Ask" step using GoogleDocs. They can share and discuss ideas with classmates using asynchronous techniques by sharing their GoogleDoc and asking peers to add comments or ask them to record a video using FlipGrid and get peer comments.
	
	• Alternatively, if you can get students to login at a specific meeting time, you can use synchronous techniques with online web-conference meeting tools like Discord, GoogleHangout or Zoom.

2. Imagine
 	
   1. Brainstorm Possible Solutions
 	
   2. Sketch Designs
 	
   3. List Materials Needed
	• Sharing their brainstorming and sketches with others will ensure students are being innovative and are not recreating something that already exists.
	
	• Asynchronously, students can share their completed "Imagine" step in a shared folder or record a video using FlipGrid and get peer comments.
	
	• Synchronously, students can share their brainstorming and sketches with classmates using online web-conference meeting tools like Discord, GoogleHangout or Zoom.

3. Plan 1. Evaluate Criteria	• Encourage students to share their "Plan" with at least one other person in order to get feedback. This can be done by uploading their document to a shared folder, email, or online web-conference meeting tools like Discord,

2. Select Optimal Design 3. Plan Steps for Building Prototype	GoogleHangout or Zoom. - For added challenge, you can ask students to develop mid-project presentations using GoogleSlides to share the "Plan" information. This is what an engineer would do in order to gain manager approval for their prototype.

4. Create
 	
    1. Build Prototype
 	
    2. Test Prototype
	- Encourage students to get a family member to test their prototype in order to gain insights.
	
	- Students can share their prototype online with classmates by uploading a photo of actual prototype and "Test" data in a shared folder or in web-conference meeting tools like Discord, GoogleHangout or Zoom.
	
	- Encourage students to get feedback from family members or classmates. Feedback should be objective and actionable, such "one thing I like is…" and "one suggestion for improvement is…".

5. Improve
 	
    1. Re-imagine
 	
    2. Re-plan
 	
    3. Re-create
 	
    4. Re-test
 	
    5. Share
	- Emphasize to students that the "Improve" step is important because all effective designs go through iteration. It's a good opportunity to fix minor errors, try different approaches, or explore other materials.
	
	- Synchronously, students can share their completed project with classmates using online web-conference meeting tools like Discord, GoogleHangout or Zoom.
	
	- Alternatively, students can use their culminating reflections to create a

	multimedia demonstration of the final design solution using a variety of tools (e.g., infographic poster: Piktochart; video: Adobe Spark Video, FlipGrid).

For more ideas about integrating EDP in your classroom, check out activities and lessons that STEM Pre-Academy teachers have shared on our website.

High-Quality Websites That Feature EDP Instructional Materials and Design Challenges

This is a collection of high-quality websites that provide engaging instructional materials to help you facilitate engineering activities or design challenges. Some of these websites have complete instructional units while others have inspiring videos and prompts to spark curiosity and creative design explorations. All of these websites have multidisciplinary aspects that highlight the connections between design processes and multiple content knowledge and skills. Each website on our list includes description, overview video, content tags, standards connections, and a brief list of recommended activities to help get you started on your quest to integrate engineering and design.

- ASEE's Engineering Go For It (eGFI)
  - **Description**: eGFI is a series of engineering education resources that include an interactive website, magazine, e-newsletters for teachers and students. The website includes standards-based lesson plans, thematic class activity challenges, information about outreach programs, and more. Content is organized by grade level (K-5, 6-8, 9-12). Check out their STEM @ Home Resources, which includes a diverse list of engineering learning opportunities for students, teachers, and parents.
  - Overview Video (ASEE YouTube Channel)
  - **Content Tag**: multidisciplinary, CTE/STEM, math, science
  - **Standards Connections**: Common Core, NGSS

- **Recommended Activities**:

    - [Backyard Weather Station](#) (Explore weather patterns to design and build "backyard weather stations" to gather data to make actual weather forecasts.)

    - [Paper Table Challenge](#) (Explore shapes and structure to build a sturdy table using newspaper.)

    - [Pedal Power](#) (Explore forces, energy, and efficiency with a bicycle experiment.)

    - [Wristwatch Design for the Visually Impaired](#) (Explore accessible design to build a wristwatch prototype with everyday materials.)

- [Exploratorium](#)

    - **Description**: The Exploratorium is a museum in San Francisco, CA that explores collaborations between science, art, and human perception. They have amazing resources online, including [education resources](#) supporting online teaching and learning, [interactive online experiences](#) to feed your curiosity, [tinkering projects](#) to encourage you to "think with your hands" using items you already have around the house, and [easy food experiments](#) you can do in your kitchen. Exploratorium activities highlight the importance of human curiosity and thoughtfully consider the connections of multiple disciplines involved in everyday life.

    - [Overview Video](#) (YouTube)

    - **Content Tag**: multidisciplinary, art, CTE/STEM, language arts, math, social studies, science

    - **Standards Connections**: can be adapted for Common Core, NAEA, NGSS

    - **Recommended Activities**:

        - [Cardboard Automata](#) (Explore mechanical elements to create sculptures that move.)

        - [Chain Reaction](#) (Create a Rube Goldberg-inspired cause and effect contraptions using everyday materials and found objects.)

- - **Light Painting** (Create striking images and illusions using nothing more than a camera, a light source, and a little practice.)

  - **Toy Take Apart** (Make exciting and surprising discoveries as you explore broken toys.)

  - **What Are Viruses?** (Use common materials to model virus behaviors.)

- **Harvard's Agency by Design**

  - **Description**: Agency by Design (AbD) is a multiyear research initiative at Harvard's Project Zero investigating the promises, practices, and pedagogies of maker-centered learning experiences. Their resources focus on a framework for developing the creative maker capacities of "Looking Closely", "Exploring Complexity", and "Finding Opportunity", which are applicable to the arts, design, engineering, and writing. AbD Thinking Routines (several mini-strategies to encourage active processing and build on learners' background knowledge. AbD Activities & Practices offer suggestions and guidelines for teaching a variety of maker-centered learning activities. AbD Documentation and Assessment Tools offer a range of techniques and activities that help learners and educators reflect on thinking and learning and be intentional in their efforts to improve the learning process.

  - **Overview Video** (YouTube)

  - **Content Tag**: multidisciplinary, art, CTE/STEM, language arts, math, social studies, science

  - **Standards Connections**: can be adapted for Common Core, NAEA, NGSS

  - **Recommended Activities**:

    - **Elaboration Game** (Deepen sensitivity to design through drawing, observing, questioning, and collaborating.)

    - **Imagine If** (Encourage divergent thinking, new possibilities, and convergent thinking to choose an effective approach to build, tinker, re/design, or hack an object or a system.)

- **Materials Exploration** (Promote noticing, play, and exploration to gain an understanding of the affordances, possibilities, and constraints inherent in a variety of making materials.)

- **Parts, Purposes, Complexities** (Learn to slow down and make careful, detailed observations to stimulate curiosity, questions, and inquiry.)

- PBS Design Squad Global

  - **Description**: PBS Design Squad Global is a unique multimedia effort designed to show kids that engineering is active, fun and collaborative. Resources include an interactive website for kids that has web-based games, activity challenges, and social media style design challenges to participate in. Additional resources include lessons and guides for teachers and parents and video series that demonstrates students using engineering to design solutions for clients (available on PBS DSG website or DSG YouTube channel. Check out the "Stuff Spinner" to make the most of materials you have access to at home.

  - Overview Video (YouTube) or Video of Engineering Design Process in Action (PBS DSG website)

  - **Content Tag**: multidisciplinary, art, CTE/STEM, language arts, math, social studies, science

  - **Standards Connections**: NGSS, can be adapted for Common Core, NAEA

  - **Recommended Activities**:

    - Design Challenge "Stuff Spinner" (Tell the "spinner" which materials you have access to and it suggests DSG activities you can build.)

    - On Target (Create a zipline that can transport small objects.)

    - Rubber Band Car (Build a two-wheeled car powered by rubber bands.)

    - Sneaker Challenge (Design eco-friendly sneakers using recyclable materials.)

    - Watercraft (Build a watercraft that can hold 25 pennies and

stay afloat for 10 seconds.)

- CU-Boulder's TeachEngineering

  - **Description**: TeachEngineering is a digital library of standards-aligned engineering curricula for K-12 educators to make applied science and math come alive through engineering design. Educators have free access to this ever-growing collection of activities, lessons, units, maker challenges, informal learning "sprinkles", and real-world data sets in "living labs". All resources are searchable by curriculum type, subject area, engineering process, media, grade level, and time required.

  - Overview Video (source)

  - **Content Tag**: multidisciplinary, CTE/STEM, math

  - **Standards Connections**: Common Core, NGSS

  - **Recommended Activities**:

  - **Recommended Activities**:

    - Catapult Marshmallow Launch (Build accurate and precise catapults using common materials.)

    - Design and Build a Rube Goldberg Machine (Use everyday materials to design a complicated gadget to perform a simple task.)

    - Edible Rovers (Use food and everyday materials to build a rolling rover.)

    - Engineering Pop-Up Books (Learn about applied forces to create pop-up-books.)

    - Leaning Tower of Pasta (Explore load by building different structures using spaghetti and marshmallows.)

    - Mobile Forces (Build a hanging mobile sculpture to explore balance, forces of gravity, and convection air currents.)

    - Paper Airplanes (Learn about aircraft parts by building and testing four different paper airplane and glider designs.)

    - Spaghetti Soapbox Derby (Use different types of pasta to

support different functions of a simple car.)

- Straw Bridge (Use everyday materials to build a bridge that can span a gap while holding as much weight as possible.)

Featured Multidisciplinary EDP Activity: Novel Engineering

Looking for a fun hands-on design activity that naturally integrates multiple disciplines? Try this multidisciplinary EDP activity that authentically integrates engineering design and literacy.

- Novel Engineering
  - **Description**: Novel Engineering was designed by a group of educators and researchers from the Tufts University Center for Engineering Education and Outreach. Their team has assembled an authentic way to integrate the engineering design process with a clear focus on literacy outcomes. Novel Engineering uses common recyclable materials, easy to access craft supplies, and encourages students to dive deeper into books and stories in order to create unique solutions for problems the characters are facing. The process essentially involves students using the engineering design process (EDP) and common craft/office/recyclable materials to design and build prototype solutions that solve problems presented in novels/books. (NOTE: Sometimes it is important to remind students that they are not recreating something from the book, but rather they are inventing something new that does not exist in order to solve a problem presented in the book.) Novel Engineering can be used to support any book from any genre, but there is a curated list of Novel Engineering Books that can be a great place to start. NSTA has also published a new book on Novel Engineering that includes classroom case studies on best practices, assessment strategies, and more. Also consider using some of the resources from STEAM: STEM and the Arts novel engineering professional development website. The Novel Engineering steps are as follows:
    1. **Read a book and define problems that the character(s)**

is/are facing.
   a. Discuss while reading, clarify as needed, identify design constraints.
   b. Use a [visual guide handout](#) to help keep designers on task.
2. **Examine problems and brainstorm solutions for character client(s).**
   a. The novel/book is the context and characters are the client. Try to empathize with what they need in their situation.
   b. Make inferences from text, brainstorm solutions, define criteria. Be innovative and don't recreate something that already exists in the book.
3. **Design solutions and plan the design.**
   a. Consider and discuss what materials are available/needed for the design.
   b. Consider and discuss how the design will work.
   c. Sketch what will the design look like.
   d. Share and discuss designs and criteria/problem.
4. **Create functioning prototypes.**
   a. Test it and reflect.
   b. Get feedback during Mid-Design Share Outs with fellow designers.
   c. Reflect on feedback and make notes of changes you want to make or questions you have.
5. **Improve design.**
   a. Revise and make design better after feedback and testing.
   b. Make note of changes.
6. **Share final design solution and design process.**
   a. Show off final solution to peers/audience.
   b. Use a [summative reflective assessment](#) to help students communicate their artifact and learning with others.

- [Overview Video](#) (NSF Teaching & Learning Video Showcase)

- **Content Tag**: multidisciplinary, art, CTE/STEM, language arts, math, social studies, science

- **Standards Connections**: Common Core, NGSS

- **Free Books Available Online**: If students don't have a book at home, suggest they get a free eBook or audiobook:

  - [Audible for Kids](#) (audiobooks)

  - [Bookshare](#) (audiobooks, audio + highlighted text, braille, and large font eBooks)

  - [Hawaii Public Library OverDrive eBooks](#) (eBooks and audiobooks)

  - [Project Gutenberg](#) (eBooks and audiobooks)

  - [Tales2Go](#) (audiobooks)

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