Engineering Lesson Plan ToolKit: A Quick Start Guide for Volunteers & Members
Introduction

The Lesson Plan Tool Kit is intended as a "self-contained how-to" kit to enable IEEE operating units to conduct teacher and/or student workshops:

- **Teacher workshops** are designed to introduce these lesson plans to the teachers so they can bring engineering into their classrooms. Our approach is to model how to implement the lesson plan by doing the design challenge with the teachers and providing opportunities for the teachers to reflect and debrief on how they can modify the lesson to meet their student’s needs.

- **Student workshops** are designed to engage students in engineering design challenges to introduce them to engineering. Ideally the workshop would be held in partnership with a school(s) or possibly other community organizations.

*IEEE recommends all unit volunteers familiarize themselves with guidelines and procedures for working with children.*
Lesson Plan Toolkit Library

- Currently there are five lesson plans in the toolkit library*
  - Robot Arm
  - Tall Tower
  - Toxic Popcorn
  - Wind Energy
  - Electric Dough

- Each lesson plan resource contains the following:
  - Full Lesson Plan
  - Slide Deck
  - Overview Video

* Additional lesson plans will be added as the toolkit expands
Assessing Local Needs and Resources
Is There a Need?

Is your IEEE Section or Student Branch looking for new activities and has decided to explore offering a pre-university STEM education activity?

▸ Before making a decision you should ask these questions:
  - Does this align with the goals/objectives of your section?
  - Are you aware of specific requests for this type of activity/service?
  - Do you have the resources/expertise to deliver the program?

▸ If you’ve answered “Yes” to all of these questions than this may be the opportunity for you!
Making a Determination

Assess if there is a need in your community by:
- Contacting local schools/teachers
- Consulting local community educational groups
- Investigating the current STEM resources available to educators and students

Move forward if your assessment indicated:
- There is clear interest from local teachers/school administration
- There are gaps in the STEM resources
- The program fits into the goals/objectives of your unit and you have the resources to plan and organize an effective program
Lesson Plan Overview
Lesson Plan Overview

TryEngineering.org makes it easy to teach engineering concepts by providing access to over 130 complete, low-cost, easy to implement lesson plans that give you everything you need to help students apply a variety of engineering principles in the classroom.

Each lesson plan is designed to be a complete roadmap that’s easy to follow, no matter your familiarity with the topic.
Prepare to Deliver the Lesson

- Watch the Overview Video
- Read the lesson plan
- View the slidedeck
- Gather materials
- Build prototype solutions
- Construct the testing scenario
- Test your prototypes
- Revise the lesson plan or slidedeck as needed
- Implement the lesson with students
Critical Elements for Engineering Education

We must be explicit about the link between the engineering design challenges we do with students and engineering careers. Each of the slide decks includes these key elements to help us make those critical connections:

- What is Engineering?
- Engineering Design Process (EDP)
- Productive Failure
- Engineering Notebook
- Engineering Habits of Mind (EHM)
- Engineering Design Challenge
- Engineering Applications, Dig Deeper, and Materials
- Engineering Fields

See these elements in the following slides
What is Engineering?

Learn about engineering and how engineers are creative problem solvers and innovators who work to make the world a better place.

Source: TeachEngineering YouTube Channel
The Engineering Design Process

Learn about the engineering design process (EDP). The process engineers use to solve problems.

Source: TeachEngineering YouTube Channel
Engineering Design Process (EDP)

- Divide into teams of two (or more- up to 4 max)
- Review the challenge and criteria & constraints
- Brainstorm possible solutions (sketch while you brainstorm!)
- Choose best solution and build a prototype
- Test then redesign until solution is optimized
- Reflect as a team and debrief as a class
Productive Failure

The engineering design process involves failure: test, fail, redesign. Iterate again and again until you have the best possible solution.

It is important to document your iterations to keep track of each redesign. Use your engineering notebook to sketch ideas, document interactions and any measurement and/or calculations.

It’s also important to showcase the fact that there can be multiple solutions to the same problem. There’s no one “right” solution.
Engineering Notebook

An engineering notebook is typically filled with grid or graph paper to aid. The goal of the notebook is two-fold:

1. **Brainstorming**: During this creative phase it is helpful to have student sketch their ideas in their notebook or write ideas (can even be just words) as brainstorming is typically rapid! Ideas come pouring out and excellent to help students capture them in their notebook.

2. **Documenting**: It is important to document your iterations so they can keep track of each redesign, including the final design. Students should use the engineering notebook to document interactions as well as any measurement and/or calculations.
Engineering Habits of Mind (EHM)

EHM is about how engineers think everyday. The core of the engineering mind is about making things that work and making things work better.

- **Systems thinking**: Seeing whole systems and parts and how they connect.
- **Problem-finding**: Identifying and defining a problem.
- **Visualising**: Manipulating materials and sketching—mental rehearsal of practical design solutions.
- **Improving**: Relentlessly trying to make things better by experimenting, designing, sketching, and prototyping.
- **Creative problem-solving**: Generating ideas and solutions with others with many iterations.
- **Adapting**: Testing, analysing, reflecting, & rethinking.

Engineering Application section showcases real-world engineering applications and/or makes local connections to their community.

Dig Deeper section focuses on STEM content including the lesson vocabulary.

Materials section includes required materials and optional materials. It is recommended to have a “table of possibilities” where the optional materials reside. To increase or decrease the level of difficulty of the design challenge you can consider removing or adding certain materials. The materials are suggested, you can adjust as needed.
Engineering Fields

Each slide deck includes a “related engineering fields” section with links to engineering fields on the TryEngineering.org site. It is important to show them the breadth and depth of the engineering profession. We want them to be able to see themselves as engineers.

We suggest you handout or share the link for this Engineering Fields Infographic.
Organizing Workshops
Workshop Planning

Designate a leader for the event/initiative who has overall responsibility for planning and success of the workshop

- Develop the program
- Create a Timeline
- Determine budget needs (lesson materials, venue, food etc)
- Recruit volunteers as needed
- Delegating tasks and responsibilities
- Post event to VTools (marketing, registration, report out)
- Do a post workshop report/evaluation
Measuring Success

Develop 3 to 4 SMART Goals:

- **Specific** – the goal needs to be clear and unambiguous
- **Measurable** – the goal must have measurable criteria
- **Attainable** – the goal must be able to be accomplished
- **Relevant** – the goal must be relevant to your mission and needs
- **Timely** – the goal must have a set time-frame for completion

Examples: Hold three 1 hour teacher training workshops during the year (event focused); Attract an average attendance of 10 - 15 teachers per session (attendance focused); In the post activity survey, 75% of the teacher attendees indicate they found the session valuable (satisfaction focused)
Evaluation/Survey

Develop an evaluation/survey to distribute to the participants that specifically address your SMART goals.

- Google forms are a great tool for creating digital surveys
- Consider giving a pre- and post- survey so you know if your engagement with the teacher or student had a minimal or significant impact.
- Consider asking knowledge and/or attitudinal questions. For example “Can you see yourself as an engineer?” (student); “Do you feel confident bringing engineering into your classroom?” (teacher)
Fundraising and Sponsorship

- Compile a list of the corporations around your area (include small and medium sized businesses). Ask for money and in-kind contributions (such as food, giveaways, etc.)
- Talk to everyone in your Section - ask for contacts in corporations & for an introduction
- Check with your University/Section about guidelines/restrictions for contacting corporations
- Don’t forget about individuals. Student Sections can reach out to alumni
- Use “Crowdfunding” sites like GoFundMe
- Develop a basic 'script' and the marketing materials
- Thank your sponsors publicly and feature their names/logos in printed and online material

*Donations to IEEE, whether cash or in-kind, may be tax-deductible for the donor.*
Post Workshop

- Send thank you notes to the speakers/presenters and sponsors
- Review the session evaluations
  - Assess what worked well and areas that need improvement
- Write up a lessons learned to be used in planning future events
- Start planning your next event
For more engineering lesson plans and resources like games, engineering careers, and STEM opportunities visit IEEE’s TryEngineering.org