Next Engineers Academy Unit 1 Overview

Unit	Employability skills hours	Design challenge hours	Pathways Planning hours	Total unit hours	
1	**6**	**11**	**4**	**±21**	
2	8	11	4	±22.5	
3	6	20	4	±30	**180 hours**
4	9	30	4	±43	
5	10	45	4	±59	
			Graduation and buffer	±4	

Overview

Unit 1 of the Academy sets the scene for the whole Academy program. It introduces and highlights the importance of several essential skills including productive failure, collaboration and creative thinking. It also introduces core engineering concepts like the engineering habits of mind and the engineering design process and offers students numerous opportunities to practice all of these skills.

During the unit, students will complete three short and relatively simple engineering design challenges initially developed for the Engineering Discovery program. For each of these challenges, you have a choice between two. Students will then complete a final, slightly longer and more complicated challenge. Students will not be required to present any of their designs.

In this unit students will also be introduced to a set of employability skills – the skills that will propel them to success in any post-secondary education or work setting. Throughout the unit they will participate in activities designed to provide a deeper understanding of the skill and an opportunity for practice.

The final component of the unit consists of Pathways Planning hours. During this dedicated time students will meet in small groups to plan and make progress towards their postsecondary plans.

Objectives

In this unit, facilitators will:

- Present the Academy purpose, schedule, and completion requirements to students
- Introduce students to the key concepts of the engineering habits of mind, the engineering design process, and the employability skills
- Facilitate the selected engineering design challenges and employability skills activities
- Organize and facilitate small groups for students to begin exploring postsecondary engineering pathways

Preparation

1. Read through all of the activity and design challenge facilitation guides.
2. Choose the design challenges you will implement.

3. Do the engineering design challenges yourselves as a facilitation team.
4. Collect and/or arrange all the materials that will be needed for each activity including an **Academy Journal** for each student. These journals can be simple hard or soft cover, lined or blank exercise books. The intention is that students will use these throughout the Academy to take notes, record research, draw design sketches, write down reflections etc. Students should be encouraged to bring these journals to every Academy session.
5. Read through the schedule below and plan when and where you will host sessions, paying particular attention to the sequence in which the various activities need to be completed and the estimated duration of each activity.
6. Plan when and where the career pathway planning meetings will take place and how you will configure the groups.

Schedule

Create a customized schedule with session dates and times that follows the order of activities listed below. Pathways Planning time should be distributed throughout the unit. Refer to the specific activity guides for detailed instructions.

Activity	Description	Duration
Introduction to the Academy	Students and facilitators will be introduced to each other and the Engineering Academy. The overall schedule and the schedule for unit 1 will be reviewed and group norms established in collaboration with students.	45 minutes
Pathways Planning sessions	These sessions are dedicated time for students to plan and prepare for postsecondary education. In Unit 1, facilitators will establish the small groups and set a meeting schedule.	4 hours, distributed throughout unit
Engineering Design Challenge 1	For the first design challenge, choose between: • **Radio Tower**: This is not your normal paper tower challenge. In this challenge, students need to build a really tall tower - a radio tower. Radio towers tend to be very slim but very tall metal structures where the main structural support is provided by guys (also called guy-lines, guy-ropes, guywires, or stays). These are tensioned cables attached around the tower at various heights. The countervailing forces in these guys keep the tower upright and stable even in extreme weather conditions. • **Drop Zone**: This simple hands-on activity is a great way to introduce students to the engineering design process, the importance of testing and iterating, and the notion of criteria and constraints. It uses very simple materials but gives students wide latitude to design, test, and re-design. In this process, students explore the concept of air resistance and think about how some engineering solutions take inspiration from nature – a process called biomimicry. Facilitate your chosen design challenge as per the instructions in the facilitation guide. Use this first challenge as an ice-breaker to help students further get to know each other in a fun and non-threatening way. When you create the challenge teams, make sure that students are with others they don't already know well. After completing design challenge 1, briefly discuss the following questions with the group. Have students respond in pairs first and then ask for volunteers to share with the rest of the group. 1. Which parts of the challenge did you find easy? What did you learn from these parts? 2. Which parts of the challenge did you struggle with? What did you learn from these parts? 3. If you had the opportunity to complete this challenge again, what would you do differently?	1 hour
The Engineering Design Process	This short activity introduces students to the engineering design process. It will help students to better understand what each step in the is for and why this process is followed by engineers of all kinds.	30 minutes
Employability Skills Overview	This brief presentation orients students to the five employability skill groups that they will develop throughout the Engineering Academy.	30 minutes
Increase Your Creativity	The activity begins with a short ice breaker to encourage students to think creatively. This is followed by a video and discussion about how to improve creative thinking skills.	1 hour

Grow a Growth Mindset	This activity introduces students to the concept of a growth mindset and how it differs from a fixed mindset. It very briefly explores some of the neuroscience behind how we learn new things and that we can exercise and grow our intelligence (our capacity to acquire and apply new knowledge and skills to solve problems). It gives students an opportunity to reflect on what kind of mindset they currently have in different areas of their lives.	1 hour
Engineering Design Challenge 2	For the second design challenge, choose between: • **Bionic Hand**: Water is a nearly incompressible liquid. This means that it is very effective at transferring force and power. Hydraulic systems take advantage of this fact and are used in many different industries to convert small forces applied over small areas into large forces applied over large areas. This is called Pascal's Principle or Pascal's Law and is the basic mechanism for how car brakes work, for example. In this activity, students will build a simple hydraulic powered 'hand' or gripper device to pick up, hold, and move a full soda can. • **Grabber**: Sometimes we need a little extra help to access the things we need. For example, people temporarily or permanently in wheelchairs can often struggle to reach what they need because it is too high, or they cannot get their wheelchair close enough to be able to grab it by hand. These people need an assistive device, something that can extend their reach and give them safe access to the things they need. Thankfully, we have engineers that are able to design and build such useful devices. Facilitate your chosen design challenge as per the instructions in the facilitation guide. Use this challenge to remind students about the importance of developing a growth mindset and to help them practice productive failure and using mistakes to learn. After completing design challenge 2, briefly discuss the following questions with the group. Have students respond in pairs first and then ask for volunteers to share with the rest of the group. 1. What mistakes did you make? 2. How did those mistakes make you feel? 3. How did you make the most of these mistakes? 4. How has your perception of failure changed?	1.5 hours
Learn from Experience	Students will develop an understanding of the importance of making mistakes, celebrating failure, and handling life stress. Students will engage in several activities including learning about the four types of mistakes, identifying failures and what the impacts were, and how to learn from mistakes.	1 hour
Engineer Your Habits of Mind	This activity introduces students to the concept of a habit of mind and the 16 general habits of mind which intelligent people tend to use to solve hard, complex problems. This leads into students learning about the six engineering habits of mind and discovering what they look like in practice. Finally, students get to reflect on how they may already be practicing these engineering habits of mind. It also helps them to connect the six engineering habits of mind to the engineering design process and to recognize which engineering habits of mind are most pronounced at each step in the process.	1 hour
Engineering Design Challenge 3	For the third design challenge, choose between: • **Working with Wind**: This activity focuses on how wind energy can be generated on both a large and small scale. Student teams design and build a working windmill out of everyday materials. Student windmills must be able to use the wind generated by a fan or hairdryer at medium speed about 30 cm (12 in) away to lift at least one teabag.	1.5 hours

	• **Save the Water**: This challenge explores the science behind some intuitive engineering designs. These include how parachutes, with their large surface area, increase the drag or air resistance experienced by a falling object and thereby slow its fall, and how objects with wide bases and low centers of gravity are more stable. Students will put these ideas to use in designing a device which will allow them to safely drop a cup of water while minimizing the amount of water spilled. Facilitate your chosen design challenge as per the instructions in the facilitation guide. During this challenge, remind students about the engineering habits of mind. Encourage students, at each step of the challenge, to think about which habits of mind they should deploy.	
Strengthening Teamwork Skills	In this activity students will work as a team to create towers from everyday objects to develop and strengthen their teamwork, communication, and leadership skills.	1.5 hours
Career Interest Inventory	Students will complete an interest inventory and explore how to use the information obtained from it to align their education and career goals with their interests, abilities, and personal qualities.	1 hour
Engineering Design Challenge 4: **Simply Complicated**	In this challenge, students are divided into teams and, using the materials provided and any other household materials and objects they can acquire, must build a Rube Goldberg machine to accomplish a simple task in the most complicated way possible. It provides an opportunity for students to practice the skills covered in this unit (productive failure, collaboration and creative thinking) as well as put their knowledge of the engineering habits of mind and the engineering design process into operation. Facilitate the Simply Complicated design challenge as per the instructions in the facilitation guide. Note that this challenge must be split over two days so that teams have time to collect whatever household materials and objects they need for their Rube Goldberg Machines.	4.5 hours (1.5 hour + 3 hours)