STEM TROOPERS

Level 5

STEM Advancement Inc.

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Student Textbook

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TABLE OF CONTENTS

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WHAT IS STEM?

S	Science is how we process and understand the world around us. Science is meant to be built, touched, and experienced. As you embark on this journey to learn and experience science, remember the great scientists who came before you- they didn't simply memorize or imagine abstract concepts- science was real to them and that is what allowed them to understand it. This course ensures you get that chance to fully experience the science- hands and mind fully engaged.
T	Of course, we see how great a role technology plays in our lives. Work, medicine, transportation, play- is there an area where we don't see some aspect of a technological advance? If we want to stay current and keep ourselves relevant it is important that we understand how technology works- only then can we devise new ways that technology can safely and effectively help our society. We all know that just because someone knows how to text it doesn't mean they can build a touchscreen. We don't want to be enslaved to the technology other people design-we want to be able to harness the power for good.
E	What does it mean to be an engineer? Simply put, engineering is problem solving. The ability to assess a situation, weigh the pros and cons, allocate your resources, and search for an innovative solution reaches well past your school years. The critical thinking and problem-solving skills you acquire from this course will accompany you throughout life, and you will confidently come to rely on them as you face life's challenges. Never under estimate your ability to solve a problem- any problem.
M	Talking about math with students is always scary - nobody wants to admit how important the numbers really are. But they are important. You want to build a bridge? Angles matter. You want to figure out how fast the roller coaster can go without flying off the track? Math again. Instead of seeing math as the enemy, an incomprehensible set of rules for how numbers should and should not be combined- this course will teach you simple understandable ways to use math.

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THE ENGINEERING DESIGN PROCESS

Throughout this book you will come across some open-ended STEM CHALLENGES which allow you to problem-solve and find solutions to real world problems using your science, math, engineering and technology skills. the engineering design process shown below has 5 steps which will help guide your thinking and experimentation.

 **ASK**	**IN THIS STEP, YOU WILL BE PRESENTED WITH A REAL-WORLD CHALLENGE**
 **IMAGINE**	**IN THIS STEP, YOU WILL BRAINSTORM AND THINK OF MANY DIFFERENT POSSIBLE SOLUTIONS.**
 **PLAN**	**IN THIS STEP, YOU WILL DRAW A SKETCH OR DRAFT OF THE IDEA YOU PLAN TO CREATE.**
 **CREATE**	**IN THIS STEP, YOU WILL GATHER MATERIALS FROM YOUR TEACHER AND ATTEMPT TO BUILD YOUR SOLUTION.**
 **IMPROVE**	**IN THIS STEP, YOU WILL IMPROVE YOUR PRODUCT, AND POSSIBLY EVEN START OVER WITH A NEW PLAN IF YOUR FIRST ATTEMPT DID NOT WORK. ENGINEERS DO NOT GIVE UP.**

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HOW TO USE THIS BOOK

This book is divided into 26 lessons. Each lesson has 2 sessions.

Session 1:

- **Reading** – students will read about a new topic and highlight key terms or main ideas.
- **Group Worksheet**-students will answer questions based on the reading in preparation for the lab activity in session 2.

Session 2:

- **Lab activity** -students will collect materials from their teacher and complete a lab activity. Students will fill in the worksheet as they go along and record their results.

The symbols on the bottom of the pages will tell you when a session continues and when a session ends.

	The green arrow means keep working and go to the next page.
	The red stop sign means stop working and do not move on to the next page.

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Lesson 1: Session 1 Introduction to Engineering

Objectives:

Identify the four main kinds of engineering
Identify which branch of engineering a specific application belongs to
Define the job of a systems engineer
Predict which jobs belong to a designer and which to an engineer

Key Terms:

Engineer
Chemical Engineer
Mechanical Engineer
Civil Engineer
Electrical Engineer
Systems Engineer
Designer

The Four Main Types of Engineering

Welcome to the journey of becoming an **engineer**. Throughout this course, you will be asked to solve many real-life problems, and we hope you will learn that engineering is all about using your thinking skills and information you learn to solving problems. In short, engineering in its simplest form is problem solving, and the information you will learn in this STEM class will prepare you to be the best engineer you can be.

Let's begin by looking at the four main categories of engineering and what kind of problems they solve.

Categories of Engineering	What the Engineer Designs
Chemical	Medicine, Shampoo, Glue
Electrical	Computers, Phones, Batteries
Mechanical	Trains, Planes, Bikes, Gears
Civil	Bridges, Buildings, Roads

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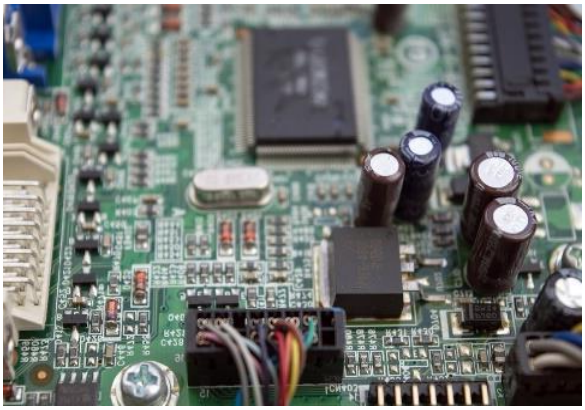
1) A **Chemical Engineer** is responsible for creating and developing new materials and chemicals.
Chemical engineers might work for the Food and Drug Administration, a government agency responsible for making sure new foods and medicines are safe for people to use. Chemical Engineers work in many different companies developing materials that are waterproof, hard to break, easy to bend, or any other kind of material a company needs for its products.

A chemical engineer making shampoo

2) An **Electrical Engineer** will work with circuits, batteries and electricity. This mean that any device you buy which using electricity, such as an oven, a remote-controlled car, a dishwasher, or an air conditioner has been designed or worked on by an electrical engineer. An electrical engineer might design your computer, work for Verizon Wireless, or be designing a new power plant in your neighborhood.



3) A **Mechanical Engineer** is in charge of making things move! Any job that needs mechanical energy is within the job of a mechanical engineer. Bikes, cars, trains, buses, airplanes, boats, etc.…All vehicles, motors, gears and even clocks will require a mechanical engineer to get them

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moving. Mechanical engineers use a lot of math and physics to make machines run. Robots and automatic machines are a anew area where mechanical engineers are needed.

4) A **Civil Engineer** is probably the type of engineer that you are most familiar with. Civil engineers often wear hard hats as they study roads and different areas where buildings and bridges will be built. Civil engineers are responsible for building and maintaining bridges, roads, and other architectural structures. Civil engineers will often work in construction or land developing.

The job of a systems engineer is as follows:

A systems engineer is a team leader. Often a project will need more than one specialized engineer working on it. The systems engineer makes sure that all the components created by different engineers will be able to work together, safely, and without spending too much money.

The job of the designer is as follows:

A designer oversees appeal. Designers and art are important to engineering, however, a designer does not have the burden of making a working product -that is the engineer's job. A designer needs to create design elements that will give the product a good look and make people want to buy and use it.

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LESSON 1: SESSION 1 — GROUP WORKSHEET

Main Branches of Engineering

R **The Essence of engineering can be stated very simply: Problem Solving.**

Houston-we have a problem!!

SOS! The Amazing Adventure Park has called down your team of engineers to help them- a group of kids got stuck upside down on the roller coaster!! Below is a list of tasks necessary for saving the kids and fixing the ride.

Your job is to correctly assign the tasks to each of the following people:

1. civil engineer
2. electrical engineer
3. chemical engineer
4. mechanical engineer
5. systems engineer
6. designer

Next to each task, write the name of the engineer who would perform that task:

1. creating a safe-landing pad for the kids in case they fall _____
2. making sure the landing pad is waterproof and nonflammable _____
3. building a ladder tall enough to reach the kids _____
4. adding wheels to the ladder in order to roll it under the roller coaster _____
5. rewiring the computer that controls the ride _____
6. making sure none of the wheels on the ride are twisted or off the track _____
7. developing a medicine to rid the kids of nausea once they come off _____
8. making sure the landing pad has a hole in the middle for the ladder _____
9. making sure the ladder doesn't look scary and looks fun for the kids _____
10. creating a tool that can rip through the seatbelts easily to release the kids _____

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LESSON 1: SESSION 2 LAB ACTIVITY

The Situation:

A few friends are gathered after school to work on a science fair project. It's dark outside when Jeremy cuts his finger open with the razor blade meant to cut shapes out of the model airplane. You quickly put some pressure on the wound and call the paramedics; thankfully, they are on their way. However, five minutes later you realize that since it is dark outside, even though you told them that you live at 11 Elm Street, the paramedics will have no way of knowing which house is yours! Use the materials below to construct an emergency sign to help the paramedics find you. Hurry!

The materials:

2 plastic straws

2 three volt batteries

2 colored LEDs

tape

The solution:

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