STEM challenges are not recipes to follow, step-by-step instructions that guide students in creating identical projects, or processes that lead them to the same outcome. STEM is about allowing students to apply their content knowledge, creativity, critical thinking, and other skills as they work to solve a problem and create a solution.

STEM challenges will take time, so plan accordingly. Squeezing it in or treating STEM practices as "extra" may communicate that the skills and practices are not valuable. Our attitudes and beliefs are important as teachers; who we are informs who our students become. According to Hoffer, "If we model optimism, confidence, and courage about STEM in our classroom each day, students will absorb those" (2016, p. 3).

It is our hope that the STEM challenges included in this book will help you teach 21st century skills and STEM thinking, that these practices become a natural part of your classroom, and that STEM becomes a way of thinking and planning for you.

Before you begin the design challenges . . .

Teach, model, and practice the Engineering Design Process.

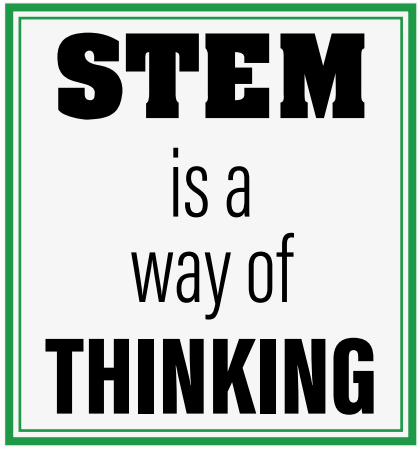
Take time to review what happens and set expectations for student actions and behaviors during each phase. This is especially important for younger students or students who are new to the EDP.

Provide opportunities for students to build/strengthen their communication, creativity, collaboration, and critical thinking skills.

Students will be more successful during the challenges if they understand and can apply these skills.

Read the challenge and the design challenge card. Read them again.

Consider the skills and abilities of your students, the materials you have available or need to gather, advance preparation that may be required, and special materials or equipment needed to complete the challenge or test prototypes. Work through the challenge before doing it with your students. Ask, "What do I need to do to make the challenge work for me and my students?"



Though these challenges are aligned with specific grade level skills and TEKS, they may be used across grade levels. If you choose to do a challenge that was written for a grade level different from the one you teach, take note of the background knowledge students should have, and consider the difficulty of the challenge in relation to your students' knowledge and abilities. **Be prepared to differentiate (simplify or add complexity to) the challenge to meet the needs of your students.**

Consider how you will manage materials and time.

Set up procedures for distributing materials. Especially with younger students, practice proper use of each tool. If the challenge will take more than one class period, determine what students should accomplish each day.

Remember that *STEM is a way of thinking*.

Some students will approach the challenges with ease and no fear while others will need multiple experiences and a little coaching to confidently approach each STEMulating design challenge.

Challenge Components Overview

The *Key Question* provides focus for the students during the challenge.

The *Problem* sets the stage for the challenge. Most of the time, the problem will provide a real-world connection for the challenge.

The *Design Challenge* informs students and student teams about the challenge and provides a guide for answering the key question or a clue for the solution to the problem.

The *Teacher Notes* are for the teacher, not the students. These notes will include a brief description of what students are expected to do during the challenge along with science content students should have learned prior to attempting the challenge. The notes also include additional information such as student misconceptions, research, and keyword notes as they relate to the science content of the challenge. Content support for the teacher may also be found here and should not be read aloud to students.

The *Vocabulary* words listed are words that students will need to present or discuss this challenge. They may be science or other academic vocabulary words.

The *Materials* list(s) contain materials *suggested* for completing the challenge. You may read the challenge and determine that a material you have, that is not listed, will work well in challenge. Feel free to use what you have or materials similar to those listed, keeping in mind that the materials listed are there to help student successfully complete the challenge. In some cases, if you do not have a specific material, it may be wise to postpone the challenge.

The materials listed as *For the teacher* could be materials the teacher will need to facilitate the challenge or materials that all teams will need to access a specific amount (e.g., 30 cm of tape or string) and the teacher should prepare these materials ahead of time.

The materials listed as *For each student/team* are materials teams will choose from to complete the challenge. Keep in mind that each team could use the listed materials, so you will need to have enough material for each team. Many of the materials can and will be used for future challenges.

SAFETY NOTE: Be aware of student allergies (gluten, latex, peanut, etc.) and manage materials accordingly.

The *Advance Preparation* notes are things that should be done or made ready prior to beginning the challenge. The things noted here need to be collected or completed at least one day prior to beginning the challenge with students. If you wait until you begin the challenge to complete these things, you may be sad and unprepared. It is suggested that you read through the challenge first for overall comprehension and a second time to make notes of what is needed and to plan for implementation.

The *Suggested Time Frame* segments are just that, ***suggested***. The times listed here are intended to help you plan your time for this challenge. However, you know your students and how your classroom works, so adjust the times to suit your class and schedule. If you and/or your students are new to STEM thinking and challenges, you may need more time than listed, but do not rush through these. Schedule time that allows students to fully investigate the challenge. As students gain more experience, the amount of time they need to complete a challenge may decrease. Be flexible.

Texas Essential Knowledge and Skills (TEKS) and *English Language Proficiency Standards (ELPS)* are listed so that you can make sure your students have a basic understanding of the content with which each challenge is aligned. The TEKS and ELPS sections list science content and process skills TEKS and ELPS that will be applied through the challenge.

Sentence Stems and *Facilitation Questions* are meant to be a guide for student thinking. Students are not expected to write or discuss each one.

Kindergarten

Challenge 1: Catch My Drip

Key Question

What can we do to help keep melting treats from dripping on our hands or the ground?

Problem

People like eating frozen treats on hot summer days, but nobody likes having dirty, sticky hands. Adults do not like the drips falling to the ground as the treat melts because then the floor is sticky.

Design Challenge

As a team of design engineers, plan and build a tool to catch and collect the drips that fall from a melting frozen treat.

Teacher Notes

Students will create a tool to catch and collect drips from a flavored frozen treat. Students may think of an idea that is similar to one they have seen, used, or found online, which is allowed. Students will benefit from the process of designing, engineering, and replicating the tool. You may choose to allow each student to create a drip catcher or have students work in teams to create one for their team. If you plan to allow each student to have a flavored frozen treat at the end of the challenge, plan materials and time accordingly.

Kindergarten students should understand that the addition or removal of heat causes change (TEKS K.5B). The addition of heat causes some solids, like ice, to melt into a liquid.

Kindergarten students are in the early stages of developing their understanding of states of matter, thermal energy, and physical changes. They most likely have had experiences with a frozen treat melting and dripping, but may not understand that this is a physical change, and that is okay. This change from solid to liquid occurs when heat is added to a system or transferred to a solid. Not all solids melt when heat is added (e.g., some burn or decompose). Solids that are not cold or frozen, such as butter, chocolate, and crayons, may melt as heat is added. Heat is a measure of thermal energy. The movement of particles determines the degree of thermal energy. The addition of more heat equals a higher level of thermal energy.