TECH TIP

Framing the Challenge

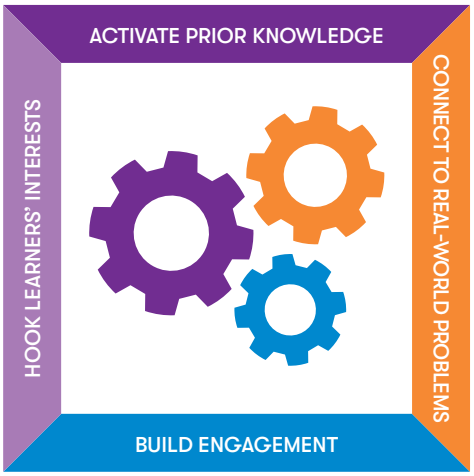
Framing the challenge introduces the design problem to learners. To engage learners in the iterative design process, frame the challenge with a design scenario that is relevant and meaningful. Framing helps structure the activity by initially defining the problem, the criteria, and the constraints. Right from the start, learners will gain insight into what they will focus on and why it is important.

Frame the Challenge by introducing the:

- **Design scenario:**
  What is the overarching problem?
- **Criteria and constraints:**
  How can this problem be solved?

A well-framed design challenge will engage all of your learners, including those who feel less confident with or connected to STEM, design, or building.

Framing a challenge will:



Use some of these techniques and tools to frame a design challenge.

Images | Objects | Video | Discussion | Guiding questions | Real-world examples

Design Scenarios

Introducing a strong design scenario, or narrative related to the problem, is a powerful way to build engagement throughout a design challenge. Design scenarios help learners understand the big picture — the real-world problem that's at stake — while also hooking their interest.

Choose a design scenario that aligns with the age and interests of your learners. Look for ways to incorporate open-ended narratives that support imaginative thinking and empathy.

Examples of design scenarios

Building for Birdie (K-2) 	Today we will pretend that we are wildlife veterinarians — doctors who take care of wild animals. Your team will design a home for a bird to stay in for a short time, until it is ready to go back into the wild. Think about the kind of home your bird will need to keep it safe. **Design Problem:** Design and build a home sturdy enough to keep a bird safe.
Cupcake Delivery (3-5) 	Imagine you want to deliver a yummy cupcake (or precious package) to someone special. It's a very windy day, so you've decided to build a wind-powered device to carry your gift. But think carefully! Make sure your gift won't get smashed or broken along the way. **Design Problem:** Design and test a wind-powered device that can safely deliver a gift.
Wildfire Warning (6-8) 	Strong winds can drive fast-moving wildfires toward communities, putting lives and property in danger. People need to be warned when these winds change, so they can evacuate themselves and their pets or livestock well before the wildfires reach them. Your engineering team will create a device to alert members of the community in time. **Design Problem:** Build a device that can detect changes in the strength of the wind.
Designing for Dexterity (9-12) 	You are an occupational therapist. You have a client who wants a low-cost assistive device to help them perform a specific task related to hand mobility. Before you design the device, you will need to understand the situation and the needs of your client (the user). After designing a prototype, you will make improvements based on testing and feedback from the user. **Design Problem:** Design a device that meets the needs of a specific user.

Think about incorporating some of these elements into your scenarios:

Whimsy: At The Tech we have found that imaginative, whimsical scenarios (like delivering cupcakes) foster a more inclusive learning environment and lower the barrier for participation for many students.

Empathy: Research conducted by The Tech, in partnership with other organizations, found that empathy has a strong effect on students as they work on Design Challenges. When an activity incorporated empathy, on average students displayed twice the number of engineering practices (such as problem scoping, testing, and iteration) and participated in the activity three times as long.[1]

Future innovators!

Help learners imagine themselves in real-world roles by using job titles, such as scientist, engineer, or designer. When possible, highlight specific STEM careers (wildlife veterinarian, civil engineer) related to a design scenario. Use these terms throughout the activity to extend the scenario and build confidence:

- *Welcome, designers!*
- *Today we are working as structural engineers...*
- *Five minutes remaining, scientists!*

What's the story?

Storytelling is a fun way to introduce K-2nd grade learners to a design challenge. Make up your own story, or use a picture book or video. Exploring how a similar problem plays out among characters in different settings can help make challenging concepts easier to grasp and demonstrate the positive impact of successful problem-solving.

Criteria and Constraints

Establishing criteria and constraints is essential to defining the problem and launching the challenge. It creates a structure that pushes learners to optimize a design while creatively considering its potential impact.

Criteria	Constraints
Desired features: Guidelines and features that define a successful design	*Design requirements:* Real-world limits on the design
Examples: function and style	*Examples:* time, materials, accessibility, environmental impact, and budget
Framing criteria: • The device needs to keep cargo from breaking on impact. • Passengers should have at least two ways of exiting the vehicle. • The device should move a distance of 8 feet without human intervention.	*Framing constraints:* • The new gutter system needs to be designed before the rainy season starts. • The CO_2 filter must be made with non-essential materials of the Apollo 13 spacecraft. • We are out of wooden dowels. What else can you use in their place?

Tip: Include materials constraints that fit the available build time (using fewer materials is often helpful if teams have less build time).

Defining criteria and constraints across grade bands

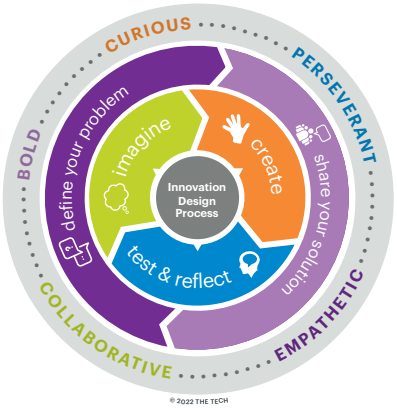
K-2	**Beginning innovators**	Start by providing the criteria and constraints for learners. For this age group, the Next Generation Science Standards refers to them as desired features and design requirements.
3-5 6-8	**Developing innovators**	Give basic criteria and constraints, then ask learners to define additional criteria or constraints based on their examination of the problem. Work toward having learners identify all criteria and constraints themselves in subsequent sessions.
9-12	**Experienced innovators**	Learners should increasingly develop the criteria and constraints for challenges on their own. Given a specific challenge, learners should define criteria and constraints that invite imagination, connect to the real world, and incorporate their experiences while staying open enough to inspire multiple solutions.

Guiding questions for framing the challenge

- What do you already know about this type of problem?
- What does this problem remind you of?
- Where else have you seen problems like this one?
- Who is affected by this problem? What would they want or need in order for this solution to work for them?
- How can we find out what they need/want?
- How will we know if the designs are successful (criteria)?
- What rules (constraints) might limit the design?
- What are potential real-world constraints that will limit our design possibilities?

Defining the problem throughout a challenge

The Innovation Design Process is non-linear. So after framing the challenge, learners may revisit and redefine the problem multiple times based on their experience with testing, getting feedback, and considering the user's perspectives.



Looking for more Tech Tips?

- See how to hook learners' interest in our **Framing the Challenge Video**.
- Explore all of our resources for **Design Challenge Learning**.

[1] For more information on this research or using narratives to support empathy and engineering practices, check out **Using Narratives to Support Empathy and Engineering: A Guide for Museum Practitioners.**