# TECH TIP: Designing a Design Challenge

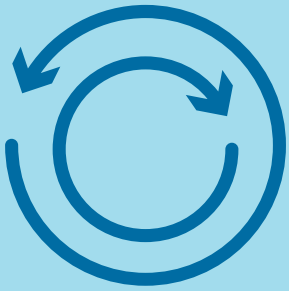
The central goal of all design challenges is to empower learners as problem-solvers and build their innovator mindsets. Designing your own design challenges allows you to customize according to your learning goals, setting and the needs of your students. Use the following instructions and our Designing a Design Challenge tool to guide you as you develop and test your own challenges.

Whether the design challenge is a short activity to build collaboration skills or a longer unit to bring in physics content standards, there are four key features that your challenges should include.

As you begin creating your own design challenges, keep these elements in mind.

## Key Elements of Design Challenges

Solvable by **multiple solutions**.



Provide opportunities for **iteration** where students can test and improve designs (physical builds or systems solutions).

Connect with **participant interests or prior experiences**.

Make explicit connections to **real-world problems** and **careers** (at some point in the challenge).

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## ❶ Developing your Design Problem

Impactful design begins with understanding the audience, in this case the learners.

**Reflect** on your learners and setting. Record your ideas. Keep them and revisit later in the process.

| Learners | Setting |
|---|---|
| • Areas of strength<br>• Areas of interest<br>• Areas for growth | • Learning goals and standards<br>• Additional program/organizational goals<br>• Allotted time<br>• Opportunities for connecting to curriculum or current projects<br>• Constraints |

**DEFINITIONS/EXAMPLES**

**Real-world problem**
Delivering vaccines, animal conservation, pollution.

**Learning goals and/or standards**
Innovator mindsets, science standards, STEM identity.

**Design product**
Building a mechanical device to perform an action, building an app, designing a process.

**Consider** what will influence your design challenge and develop your design problem statement.

What **learning goals or standards** do I need to address?

(Ex: collaboration skills, science or language arts standards)

What **real-world problem** do I want learners to think about?

(Ex: plastic in the ocean, cyber bullying, sending humans to Mars, United Nations Sustainable Developement Goals)

Is there a specific **design product** I want them to address?

(Ex: building a device to launch/transport collect, building an app to influence human behavior?)

This is a non-linear process! Consider each area and cycle through a few times to refine the focus for your design problem. One area might take precedence over the others depending on your setting and goals.

**Develop your design problem statement:**

- Think of a specific question or statement that can guide learners throughout the Innovation Design Process.
- A story or scenario will also help you frame the problem and connect it to your learners' setting and interests.

For sample design challenges and problems see the following lessons:

- Solve the Fall - Engineering Design Challenge
- Vaccine Distribution Challenge - Systems Design Challenge

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## ❷ Developing Criteria, Constraints and Testing Methods

**Criteria and constraints** focus your challenge while promoting multiple solutions and iteration. When determining criteria, think about whether learners will be designing a physical or systems solution.

**Testing methods** are based on criteria and should promote iteration. Considerations for how learners will test vary depending on the type of challenge; an engineering challenge with a physical build, a conceptual design, or systems challenge. When determining your testing method(s) think about the following:

| Engineering Design Challenge | Systems Design Challenge |
|---|---|
| • Testing process and rig<br>– How to test<br>– Where to test<br>– When to test<br>• Allows time for iteration and more than one test<br>• Encourages collaboration<br>– Whole team part of testing<br>– Teams can watch each other test<br>• Safety concerns and risk-mitigation<br>• Test results and feedback<br>– Data collection process<br>– Type (qualitative: "It flew!" or quantitative: "it flew 5 feet!") | • Review/feedback process<br>– Who gives feedback (peers, stakeholders, community members, end users)<br>– How/where to get feedback (ex: online, in person, formal presentation)<br>– When to get feedback<br>• Allows time for iteration and more than one round of review<br>• Review/feedback results<br>– Data collection process<br>– Type (qualitative: "What a cost-effective idea!" or quantitative: "awards ceremony, rating scale) |

**Decide on the materials.**
When considering materials, try to use items that are versatile and adaptable in a variety of ways. Think about offering a variety of materials:

- Everyday objects used in new ways (ex: recycled cardboard)
- Materials that are new to your learners (ex: dowel rods)
- Whimsical objects (ex: pom poms)
- Real science and building materials tools (ex: drill and screws)

When organizing your materials, group by type or function. Ex: fasteners, structural materials, items with surface area.
For systems design challenges consider how students will research, develop and visually present their ideas (paper, online tools, whiteboards, charts, physical prototypes) to ensure you have the tools needed.

See Tech Tips: Materials Strategies for Engineering Design for specific ideas!

**Criteria**
Determine success of the solution. For example: can a device deliver cupcakes to customers, can a structure withstand three seconds of shaking, or land within a target area.

**Constraints**
Provide limitations. For example: real-world conditions, budget, time, device size. Think about how constraints can make your challenge easier or harder for different ages or levels of ability.

**Engineering Design Challenges**
Learners create and test a physical device.

**Systems Design Challenges**
Learners design a multifaceted solution (process, communication or logistics plan).

**Design challenges are collaborative.**
When planning consider student group size and processes.

**Recommendations**
Groups of 2-4 students for engineering challenges and 4-6 students for systems challenges.

**Double check that your design problem aligns with the four key elements:**

- Solvable by multiple solutions
- Opportunity for iteration
- Participant interest
- Real-world/career connections

## 3 Test Your Challenge!

Put your challenge into action and test it out yourself. Ideally, you can use a test group of sample participants or other educators! This will help you determine accessibility, difficulty, and modification before you implement.

**Test that:**

- ☐ The design problem is clear.
- ☐ Design problem and materials encourage development of different solutions.
- ☐ Materials for a physical build provide an appropriate level of difficulty for the participants.
- ☐ Testing procedure generates useful data for iteration.
- ☐ Testing procedure is accessible for all participants.

**Take note of:**

- ☐ Length of time it takes to build and test. (This will help inform your lesson flow.)
- ☐ Is your test group engaged?
- ☐ What questions arise as people do the challenge?

**Once again, double check that you have optimized the key elements of a design challenge.*

**Iterate on your challenge.** Check back on your initial thoughts on the goals for your learners and setting.

- Are you meeting those goals?
- Do you need to adjust any aspects of your challenge?

## 4 Lesson Flow and Preparation

**Create your lesson flow**

Think about timing and the processes and procedures you will use to run a successful challenge. Revisit the Innovation Design Process and consider how to incorporate opportunities for iteration, reflection and sharing out.
As you design your lesson flow:

**Define the problem**

- Are you framing the challenge with a short introduction, video, field trip, visiting professional?
- How are you introducing the design problem to students?
  - Are you giving criteria and constraints to the students, or do they need time to discuss and create themselves?

**Imagine**

- Will brainstorming happen organically as they build or require more scaffolding, requiring additional time?

**Create, prototype, test and reflect**

- How much time will be needed for creating, testing and iterating?
- How will students record and reflect on their process?
- Will you provide time and resources for researching the problem (for example: online resources, user interviews, industry professionals)?

**Share your solution**

- What format will you use for sharing solutions? (short team presentations, at a school-wide function, or with a poster?)
- How much time do learners need to prepare?
- How much time is needed for share-out?

**Final preparation**

Collect and organize materials and additional resources including images, links or background research.
Plan your space layout. Plan when and how you will assess the intended learning outcomes.

## 5 Do the Challenge!

Remember to reflect on how it went with your learners. Celebrate their process and designs.
Remember this is a design challenge. Be prepared to iterate and improve!

**Share out**

Share your process and successes with others in person or via social media. Colleagues, community members and even students can be excellent partners in Designing your Design Challenge.