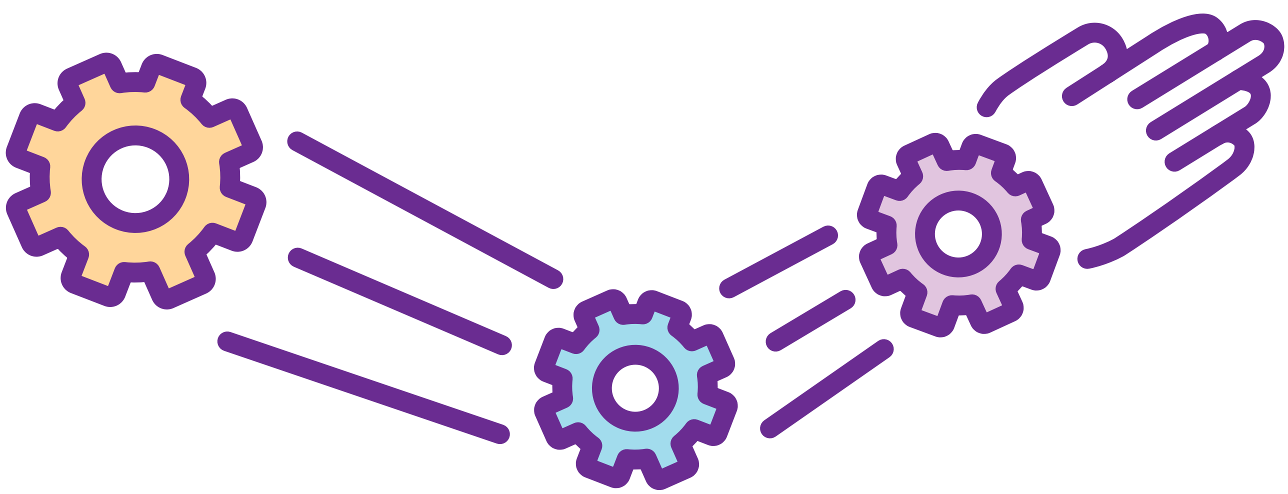
DESIGN FOR ALL
Designing for Dexterity

Grade Levels: 7-12

Duration: 120 min

Students work in teams to design a user-centered device for someone who has a specific need related to hand mobility. Teams work to improve their devices through testing and feedback, exploring how they can use household items to prototype a solution.



Outline

Frame the Challenge	15 min total
Activate Prior Knowledge	10 min
Introduce the Challenge	5 min
Design Challenge Part 1	**50 min total**
Define the Problem	10 min
Prototype (Create and Test)	20 min
Listen and Help Protocol	20 min
Design Challenge Part 2	**55 min total**
Review Criteria	5 min
Iterate and Improve	20 min
Gallery Review	20 min
Debrief	10 min

Grade Levels: 7-12

Duration: 120 min

Concepts/Skills
User-centered design, empathy, engineering, prototyping, assistive technology devices

Objectives
Students will:
- Use empathy to understand the needs of a specific user.
- Define criteria and constraints based on their user's situation.
- Design a device that meets the needs of a specific user.
- Critically analyze feedback to refine their designs.

Materials and Preparation

Materials

Handouts and Resources	Team Tools *(1 set per team)*
• Facilitation Slides • Sample User Cards (distribute 1 card per team) • Designing for Dexterity Student Packet (1 per student)	• Hole punch • Markers, writing utensils • Scissors • Sticky notes • Ruler • Crop-a-dile® ¼ in Power Punch (*Optional*: for punching holes in plastic and cardboard) *Optional:* • Box or paper bag to store designs • Poster paper for the Gallery Walk

Building Materials

Look for items that match the categories below.

- Try to provide several different types of items for each category. Don't limit yourself to the items on this list. Use whatever you have on hand. Be creative!
- Materials can vary among groups and do not need to be identical.

2-4 items from each category below per team			10-15 fasteners total per team
Items to create reach and structure	**Items that can enable motion**	**Items that can stick, grip, or grab**	**Fasteners**
□ Cardboard □ Food and drink packaging □ Long cardboard tubes □ Paint sticks □ Rulers *Optional*: □ Broom or mop handles □ Long dowels	□ Craft sticks (wide) □ Hair bands □ Hair clips □ Plastic clips/ Chip clips □ Rubber bands □ Straws □ String or yarn	□ Gaffer's or painter's tape □ Hair bands □ Hooks □ Velcro™ □ Rubber bands □ Silicone bakeware	□ Hair bands □ Paper fasteners □ Pipe cleaners □ Rubber bands □ String □ Twist ties

Tips

- We leave tape and glue off this list on purpose. Forgoing tape and glue allows for rapid iteration of designs. This also will allow you to recycle and reuse materials for another session. If needed, you can give teams a few inches of masking tape on request.
- Have students help collect recycled items (such as cardboard and food packaging) in advance of the lesson.

Testing Materials and Setup

1. Testing for this activity will vary based on the criteria and constraints that students define. However, most sample users will need to conduct at least one of the following motions: gripping, reaching, managing item weight, holding small objects, twisting, or using one hand.
2. Teams can test in the same location where they are building.
3. Plan to have a variety of household items available to conduct these tests.

Sample Test Items

- ☐ Garden tool or bucket with handle
- ☐ Hair tie
- ☐ Item that twists (i.e., jar or bottle with twistable lid, doorknob, lamp with a light bulb)
- ☐ Trash items (i.e., paper cup, water bottle, food wrapper)
- ☐ Scissors and fabric/paper
- ☐ Drawing tool (i.e., pencil, paint brush, marker)
- ☐ Remote control or something of similar size and weight

Preparation

1. Review the **Sample User Cards** and decide how you will assign them to students. Options include pre-assigning the cards or having teams choose from a set.
2. Students will set the criteria and constraints based on the needs of their users. Be prepared to adjust the materials and setup for testing.
   - If doing the lesson over multiple sessions, consider giving teams a "budget" allowing them to bring in one or more materials targeted to their user's needs.
3. Organize and set up the materials.
   - Arrange materials by category for groups to browse "buffet" style.
   - If doing the lesson over multiple class periods, have a plan for labeling and storing team devices.
4. Build a device yourself. This will give you practice with the process, materials, and tools to be able to anticipate student's questions.

Extension: User Interviews

With additional time and resources, plan to have students conduct user interviews themselves.

- Instead of using the Sample User Cards, have students interview real people to understand and observe a challenge they are facing.
- After the interview, students can fill out the blank **Sample User Card** with information about their user.

Interviews can be conducted a variety of ways:

- Have students choose a family member or friend to interview.
- Arrange for one or more volunteers or special guests from the community that the students can interview. This can be done virtually or in person.

For suggested interview questions as well as additional tips, see the **Designing for Dexterity Unit Plan**.

Adaptations for Distance Learning

- **Introduction:** Frame the challenge in a live video session with students. Model gathering materials with a **Materials Treasure Hunt**.
- **Prototyping and Testing:** Have students use materials from around their home to design the device asynchronously.
- **Listen and Help Protocol:** Schedule a live video session, and use break-out rooms for teams to share solutions and give each other feedback.
- **Gallery Walk:** Have students share their designs using an online tool (slide deck, Flipgrid, Padlet, etc.). The debrief that follows can be part of a live video session.

For more tips on adapting Design Challenges to a virtual setting, see The Tech's **Educator Tips for Remote STEM Learning**.

The Tech Academies

This lesson was developed in partnership with educators from **The Tech Academies Fellowship program**. The Tech Academies Fellows learn to be leaders of engineering education while designing and testing STEM (science, technology, engineering and math) resources to be shared with other educators.

Background Information

This lesson is part of our Design for All series, which explores **social emotional learning** concepts around empathy and inclusion while developing design thinking skills. This activity encourages youth to think about the specific needs of a unique user as they design for their situation.

User-centered Design

Designers and engineers often rely on empathy and the ability to understand a user's perspective in order to make the best possible products. This is called **user-centered or human-centered design**. Designers research and interview real people and use that information to shape their product design. Reproducing this process in the classroom can often be difficult due to the challenges of finding individuals for students to interview in an authentic way. The Sample User Cards in this lesson were developed to model that process without requiring the time and resources of live interviews.

Although students will be designing for just one sample user, they will notice similarities across situations. Students may be interested in considering how they could use their ideas to create more universal designs that would meet the needs of a variety of users. In fact, "**designing for the margins**," a type of user-centered design, often results in products and solutions that work better for everyone. *For example*, when city planners started adding curb cuts to make public streets more accessible to wheelchair users, they also found it created a better experience for people pushing strollers, using a dolly, and riding skateboards or bikes.

Assistive Technology

This lesson focuses on individuals who face a range of hand mobility challenges and highlights the careers that support them. The field of assistive technology includes physical therapists and occupational therapists, as well as engineers and others who design tools for individuals or groups. In addition to using commercial products, these fields also make use of do-it-yourself (DIY) or household solutions. (See **Real World Careers** for specific examples.)

Much of assistive technology is traditionally developed for individuals with disabilities or older adults. However, it is important to note that most people at some point in their lives will find themselves in a situation that requires an adaptation in order to perform a specific task. In fact, much of the technology we use every day could be described as assistive devices (computers, cars, eyeglasses, pens, etc.). For this reason, the sample users in this lesson represent a spectrum of individuals that students can relate to, with permanent to temporary or situational use of assistive devices.

Some Notes on Inclusive Language

Empathy and inclusivity are closely intertwined and this expands to the language we use as well. These guidelines provide a resource for leading student discussions.

- Terms such as “the disabled,” "differently abled," or “handicapped” are less widely used due to their negative connotations and should be avoided.
- The most important thing is to respect the identity of the individual. Ask the person you are relating to what language they prefer. If this is not possible, you and your students can seek out the widely accepted terms used within each community. Try some of the practices below.
- **People-first language:** People-first language emphasizes referring to a person before a disability, focusing on the individual as opposed to defining someone by their disability. For example, we would say “adult with epilepsy” instead of “epileptic adult.” The intent behind this approach is for people to be thought of and discussed positively without being reduced to a tool they use or one aspect of their lives.
- **Identity-first language:** For some communities, often those whose conditions relate to different ways of perceiving or interacting with the world, identity-first language is preferred. One example of this is the Deaf community, where person-first language has been rejected — as well as terms like “hearing impaired.”
- **Pronouns:** The Sample User Cards all list the pronouns of each individual. This inclusive practice of stating personal pronouns up front addresses harmful assumptions that can be made about gender based on names and appearance. Encourage students to notice and use the appropriate pronouns for each sample user.

Tips for Redirecting and Modeling in the Moment

Correct statements briefly and continue the conversation. Keep it simple, positive, and moving forward. If you catch yourself making a mistake, model the appropriate response.

Student	Possible Response	Correcting Yourself
Uses the wrong pronoun, for example “she” instead of “they.”	“Oh, you mean they….”	“Sorry. They…”
“This device is for the handicapped.”	“Handicapped is a word that isn’t used much anymore. Instead, you can say ‘This is for people with one hand,’ because that’s specifically who you designed for, right?”	“I mean, this is designed for people with one hand.”

See **Additional Resources** for more examples of discussion questions, sample language, and terminology.

Frame the Challenge

Activate Prior Knowledge *(10 min)*

1. Begin this lesson with an opportunity for students to reflect individually on their own experiences and assumptions.
   - Have students take out a piece of scratch paper and write down five or more tasks they do every day.
   - Then tell them to choose one task and think about:
     - *What do you need to complete the task?*
     - *What body parts do you use? What muscles?*
     - *What if that part of your body were injured? What would you do instead?*
2. Next, ask students to think silently of a tool they use daily to complete a specific task. Have them consider:
   - *Does the tool meet your needs? Do you need to adjust it at all?*
   - *Why is that tool the one you use? How did cost, accessibility, resources or even longevity affect the tool you used and how you used it?*
3. Have students do a "popcorn" share-out, i.e. ask students to quickly name the tool they were thinking of.
4. Define the term "**assistive device**." It is:
   - Any device that is designed, made, or adapted to assist a person in performing a particular task.
   - These devices are typically designed to assist older adults or individuals with a disability, however, they can support a range of individuals in daily tasks and include everything from wheelchairs and prosthetics to adapted utensils and specialized game controllers.
   - Point out that all of the tools listed during the popcorn share-out would be considered assistive devices.
5. Lead a brief discussion about the types of careers in **assistive technology** that utilize and design these devices. Find out what students already know. If needed, supplement their understanding with some examples from the **Real World Careers** information.
   - Point out that in addition to designers and engineers who create commercial tools and assistive technology, professionals such as occupational therapists support individuals in adapting existing tools and resources to their specific situations.
6. Have students consider the factors that might lead someone to use an individualized solution (cost, accessibility, resources, longevity, etc.).

Expanded Understanding

The introduction of the challenge is an opportunity to shift student perspectives away from "us versus them" thinking. As students recognize that they also use assistive devices on a daily basis, they can begin to identify and empathize with the problem, noticing that instead of designing for an "other" group they are designing for everyone.

Introduce the idea of **universal design** and point out that designing for the margins can often lead to solutions that work for a larger audience. *For example:* The rubberized handles on Oxo Good Grips were designed to help people with arthritis and became a feature of many tools because of their comfort and ease of use for everyone.

Resources:

- **"What is Assistive Technology?"** website of the Assistive Technology Industry Association
- **"Why Are Glasses Perceived Differently Than Hearing Aids?"** Rebecca J. Rosen, *The Atlantic*, December 3, 2013.
- **"The Lows of High Tech,"** produced by Vivian Le, *99% Invisible*, July 27, 2021.

Real World Careers

There are a number of careers that involve working directly with individuals that use assistive devices. They include physical therapists as well as hospital physicians and technicians.

Occupational Therapist: Provides therapy that focuses on engagement in meaningful activities of daily life (such as self-care skills, education, work, or social interaction). Their goal is to enable participation in such activities despite impairments or limitations in physical or mental functions.

Before people can use assistive technologies, however, these devices need to be developed. There are a wide range of careers that develop and design assistive devices. Depending on its type, device development can involve a variety of scientists, engineers, and designers, for example biomedical engineers, mechanical engineers, electrical engineers, computer programmers, or materials engineers.

Rehabilitation Engineer: Designs and builds assistive devices and systems for mobility, communication, hearing, vision, or cognition. Rehabilitation engineering may involve research and observation or adapting existing devices or simple tools to meet individual needs. Complex rehabilitation engineering includes designing sophisticated technology using computers or other mechanical systems.

In addition, assistive devices and the individuals who use them are supported by careers in policy and advocacy. This would include everyone from disability lawyers to accessibility advocates at colleges and workplaces who help audit programs to ensure individuals have access to the resources they need.

Resources

- **"Rehabilitative and Assistive Technology,"** National Institutes of Health website
- **"Careers,"** PBS Kids Move to Include video collection
- **"AccessEngineering Profiles"** career descriptions, Do-It (Disabilities, Opportunities, Internetworking and Technology) website

Introduce the Challenge *(5 min)*

1. Introduce the design scenario and design problem. Address any questions students have.

Design Scenario	*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 needs of your client (the user). After a prototype is designed, you will then improve it based on user testing and feedback.*
Design Problem	Design a device that meets the needs of a specific user.

2. Introduce the building materials and the process for getting and distributing supplies. Let students know if there will be any constraints during prototyping, such as a materials budget or time limit for building.
3. Place students in teams of three to four and distribute the **Sample User Cards**.
   - Each team should take one card. Either assign cards or allow them to choose a card they are interested in.

Design Challenge Part 1

Define the Problem *(10 min)*

1. Distribute the **Student Packet** and have students refer to the constraints on Page 1.

All devices must also meet the following constraints:	
Schedule	Device must be built in _____ minutes.
Cost	Device must be made using only the supplies available, or common household items (with teacher approval).
Environmental impact	Device must be able to be disassembled and 90% of the materials reused or recycled.

   - Inform students of the time limit. (15-20 minutes is suggested for this first round of prototyping.)

2. Next, teams will need to define the criteria for their design. This will vary for each team depending on the needs of their user. Review the factors they should consider (functionality, cost, reliability, etc.).
3. Demonstrate the process of determining criteria with the sample user card for Talia.
   - Have students read the card and suggest criteria for Talia.
   - Record responses for the whole class to see, while redirecting any suggestions that may not meet Talia's needs.
   - See the **Sample Criteria** below for examples, if needed.

Category	Sample Criteria
Main Function	Device must be able to: • Pick up/grab T-shirts and other non-button shirts. • Assist the user in pulling the shirt over their head and arms. Device must be: • Operable by one person. • Worn/held without the use of fingers.
Safety	Device must have smooth or cushioned corners and edges. *(Think about what will be safe for a child to use without getting hurt.)*
Reliability	Device should work successfully at least three times in a row.
Social or Cultural Impact	Device should be: • repairable or have replaceable parts. • adjustable (able to be used by anyone aged five and over). *(Think about what a user will do if a part breaks. Think about how the device can be applied to other users or situations.)*
Miscellaneous (ex., Aesthetics)	Device should appeal to young children (i.e., by including customization or fun patterns).

4. Once teams understand the process, have them define criteria for their own sample user. Make sure students know that the criteria can be adjusted later if needed.
5. When a team has finished, have them share their criteria with you for approval before they begin prototyping.

Supporting Beginning Engineers

Students may need help understanding the difference between criteria and constraints. Refer back to the examples and definitions as needed.

Criteria	Constraints
Things the design needs to be successful	Limitations on the design
Come from the client/user	**Come from real-world factors (laws, Americans with Disabilities Act, available resources, etc.)**
Example: The car needs to have four doors. *Example:* The device needs to keep cargo from breaking on impact.	*Example:* Passengers need to fit inside the car. *Example:* Budget for building the car is $50,000.

- Use sentence starters to support students in developing detailed criteria:
  - The device should...
  - The device must be able to...
  - The device includes...
- Some teams may be tempted to start brainstorming solutions right away, but remind them to keep their criteria and constraints broad. If they are inspired, they can track their ideas on separate paper or sticky notes to refer back to during prototyping.

Prototype (Create and Test) *(20 min)*

1. Once their criteria is approved, teams can begin building their devices.
2. Start a timer to track the prototyping time once most teams are ready.
   - Give students occasional reminders on time, criteria, and constraints to help them monitor their own progress.
3. Teams should explore the materials, brainstorm and imagine solutions while they are creating.
   - Encourage them to test the properties of materials (adherence, flexibility, strength, etc.); how materials move and can be manipulated; and components of their design ideas (*for example*, how to build reach or how they will grip the objects).
4. During prototyping, teams can take notes and collect data in the Prototyping and Testing section (page 2) of the **Student Packet**.
5. Teams will need to test the prototype based on their specific criteria, and the needs of the user. Have students consider:
   - *How will you test that it works for the user?*
   - *What would the user consider success?*

   Testing may include:
   - Marking a specific distance with tape.
   - Choosing specific objects to test with their device. For example, using the device to open a jar with a lid or a using the device to put on a hair tie. If you do not have a specific object, use a similar sized/shaped object.
6. During this time, walk around and support teams. Ask facilitative open-ended questions to guide their process.

Prototype Questions

Just Starting Out

- *What do you notice about the materials? How might you use them?*
- *What ideas do you have for a design so far?*
- *What function is most important to your user? How might you achieve that function?*

After Testing

- *In what ways is your device meeting the needs of your user?*
- *What components of your device are most critical to its function? How do parts of it work together?*
- *How can you make the mechanics of your device more reliable?*

Problem Solving

- *What aspects of your design work best for your user? How do you know?*
- *What parts of your design might your user struggle with?*
- *How might your team start to alter that part of the design?*
- *Which parts of the device can your team test to inform the overall design?*

Improving and Iterating

- *What can your team try that would make this design even better?*
- *What is a different way to solve the problem?*
- *If you only had time or budget to make one improvement, what improvement would be most important to your user? How do you know?*

Respect During Testing

Empathizing with someone else's experience is different than having that experience ourselves. Encourage students to focus on the mechanical requirements of their design during testing, rather than acting out the user's disability.

Resource: **"Why I won't "try on" disability to build empathy in the design process (and you should think twice about it.),"** Amelia Abreu, Prototypr.io, May 1, 2018

Listen and Help Protocol *(20 min)*

1. Introduce the Listen and Help Protocol. Teams will take turns demonstrating and sharing their devices with another team while receiving feedback.
    - In a true user-centered design, teams would prototype their designs with the user and receive feedback through user testing and interviews.
    - In this lesson, another team will take on the role of the "user" as they listen, test, and provide feedback.

- Encourage students to focus on strengths and next steps in their feedback. If using simple sentence frames, introduce them at this time.

Requesting Feedback	Giving Feedback
Does the device ____? Why or why not? Would you ___ with the device? Can you ____?	I liked that the design _____. I wonder what would happen if _____. I had difficulty with ____.

2. Pair teams with one another. Assign one team to share first.
3. Act as timekeeper for the class. After the first team has shared and received feedback, the teams should switch roles and repeat the process.
4. After both teams have shared, have students take a few minutes to reflect on the feedback and think about its effect on how they view their solutions.
   - Teams can take notes on these ideas in anticipation of Part 2 of the design challenge.

Sample Listen and Help Protocol

Time	Presenting Team	Audience Team

3 min	• Read user card aloud.
	• Introduce device:
	  – Share how it is intended to work.
	  – Share how it meets the user needs.
	• Give device to Audience Team for testing.
		• Review Presenting Team's user card.
		• Listen and take notes.

4 min	Answer questions.	• Test Presenting Team's device: Consider if the user could do the task by using the device. • Ask clarifying questions.
3 min	Listen and take notes.	Provide feedback.
Switch Roles		

Trade-offs and Prioritizing

As teams enter the next part of the design challenge and begin iteration, they will need to determine which suggestions and changes they should prioritize. This can be aided by asking explicitly which criteria should be prioritized during the Listen and Help Protocol. *For example:*

- Which function of this design would you prioritize? What do you think would be most useful?
- If we had time or budget to make one improvement, what do you think is most important to change?

Teams can incorporate this feedback into their own decisions of what to change in the next part of the design challenge.

Experienced engineers can look more closely at these **trade-offs** and think about how similar calculations of budget and schedule occur in the real world.

Design Challenge Part 2

Review Criteria *(5 min)*

1. Before teams begin to improve their designs, have them review the feedback they received during the Listen and Help Protocol and take notes on action steps. (Page 4 in their **Student Packet**.) Use sentence frames as needed. For example:
   - ***The user reported _______. The user experienced________.***
     - The user reported that the device seemed too tight for their hand.
   - ***Based on the feedback I received _____, I will________ because____.***
     - Based on the feedback I received, I realized users come in different sizes. I will need to adjust my device to accommodate the anatomy of different patients because no two people are the same.
2. Have teams check their criteria and constraints and see if they need to adjust them at all. They should also review if the feedback and "user testing" shows that they are meeting their criteria (Page 5 in their **Student Packet**).
3. Next, teams can choose from one of these three options for their iterations:

Option 1	Option 2	Option 3
Focus on Feedback Look closely at the feedback you received during the Listen and Help Protocol and use it to improve your device.	**New Constraint: Supply Chain Issues** One material you were using is no longer available. Redesign without it.	**Universal Design** Adjust your device to also work for additional users i.e., someone larger/ smaller, someone in a different situation.

Iterate and Improve *(20 min)*

1. Teams should continue prototyping their designs, refining and iterating on them based on the feedback they received.
2. Once again, during this time, walk around and support teams. Ask open-ended **Prototype Questions** to guide their process.
3. Set a timer and provide reminders of the time limit during prototyping.

Real-world Examples

If students are struggling or need inspiration, share some of these examples of assistive devices.

- **Engineering at Home** website shares adaptations one user engineered with unlikely household items.
- **Among the Giants (YouTube video, July 2013)** highlights the work of the Adaptive Design Association, which uses cardboard and other common tools to create custom adaptive equipment. See more examples of their work on their **blog**.
- **Fixperts** is a learning program developed by *Forth*. Their collection of films present a variety of user stories and the adaptations designed for them.
- **Maker Nurse and Maker Health** (website) programs support nurses and hospitals in developing unique prototypes for their patient's needs.

In addition, ask students to consider household items that can grip, grab, and pick-up.

Gallery Review *(20 min)*

1. Give teams five minutes to create a short poster that they can display alongside their device during the Gallery Review.
   - Pass out art materials (plain paper or poster board and writing materials).
   - Review the expectations for the poster and the process for the gallery review.

Poster Should Include	• Summary of their sample user's needs. • Reasons their team designed their device the way they did and how they think it meets the user's needs. • Iterations and changes they made while building. • Changes they would make if they had more time.

2. Have teams set up their devices and posters throughout the room.
3. Give each team sticky notes and a writing utensil. Have them review the different posters and leave comments for at least three other teams.
   - They should leave at least one sticky note with positive feedback and one with constructive feedback.
   - Once again, they can use simple sentence frames such as "I like…" or "I wonder…".

Debrief *(10 min)*

1. After students share their solutions, bring the conversation back to the engineering concepts and what they learned.
2. Lead a short debrief with some of these questions.
   - *What did you notice about the process of designing for a specific user?*
   - *What did you learn from the user you were designing for?*
   - *What similarities and differences did you notice between the prototypes?*
   - *How did designs change after receiving feedback? What factors impacted these changes?*
   - *What questions and feedback would you seek from users if you had more time and resources?*
   - *How could these designs be adapted to other users? Could any of them be used for a more universal design?*

Extension

- **Design Swap:** Have teams whose users face similar challenges swap devices. Tell them that their users are interested in adapting these new devices for their own needs. See what new adaptations the teams can come up with.
- **DIY Manual:** Introduce an additional design scenario. The occupational therapist wants to share these ideas with other clients so they can recreate them and continue to adapt them. Have teams design DIY manuals for their devices. For assessments and rubrics for this extension, see the Unit Plan.

Next Generation Science Standards

Grades	Standard		Description
6-8	Performance Expectation	MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
6-8	Performance Expectation	MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
9-12	Performance Expectation	HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
9-12	Science and Engineering Practices	HS SEP 6.5	**Constructing Explanations and Designing Solutions:** Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12	Disciplinary Core Idea	HS-ETS1.B	**Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
9-12	Crosscutting Concepts	HS CCC 6.1	**Structure and Function** Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.
Additional Standards:		DCI ETS1.A	

Common Core State Standards

Grades	Standard	Description
6-8	CCSS.ELA-LITERACY.WHST.6-8.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
11-12	CCSS.ELA-LITERACY.W.11-12.2	Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

Tech Tips

Encourage students to reflect on their use of empathy throughout the lesson. Check out the Innovator Mindsets Tech Tip (**PDF**, **Video**) for specific strategies.

See our **educator guides and videos** for more design challenge facilitation techniques.

Vocabulary

For more tips on vocabulary and common engineering terms see our **Tech Tip: The Language of Engineering**.

- **Assistive device:** Any device that is designed, made, or adapted to assist a person in performing a particular task. (See also "assistive technology.")
- **Assistive technology:** A device, resource, or system that assists a person in performing a particular task. (See also "assistive device.")
- **Designing for the margins:** that focuses on those who are most disadvantaged within a group. This often results in products and solutions that work better for everyone. For example, when city planners started adding curb cuts to make public streets more accessible to wheelchair users, they also found it created a better experience for people pushing strollers, using a dolly, and riding skateboards or bikes.
- **Disability:** A condition that affects a person's physical, intellectual, or mental well-being and ability to take advantage of opportunities.
- **Empathy:** The understanding of or the ability to identify with another person's feelings or experiences.
- **Human-centered design:** An approach to the design process that puts human needs, capabilities, and behavior first. Designers aim to develop empathy for their users and utilize techniques like interviews, observations, and co-design. (See also "user-centered design.")
- **Inclusive:** Accessible, and not limited in who is represented or heard.
- **Occupational therapist:** Provides therapy that focuses on engagement in meaningful activities of daily life (such as self-care skills, education, work, or social interaction). Their goal is to enable participation in such activities despite impairments or limitations on physical or mental functions.
- **People-first language:** Emphasizes referring to a person before a disability, focusing on the individual as opposed to defining someone by their disability. For example, we would say "adult with epilepsy" instead of "epileptic adult," or "child with dyslexia" instead of "dyslexic child."
- **Rehabilitation engineer:** Designs and builds assistive devices and systems for mobility, communication, hearing, vision, or cognition. Rehabilitation engineering may involve research and the development of accommodations using existing devices or simple tools. Complex rehabilitation engineering includes the design of sophisticated technology using computers or other mechanical systems.
- **Trade-off:** Balancing between two desirable but incompatible criteria.
- **Universal design:** The process of creating products that are accessible to all people, regardless of ability.
- **User-centered design:** An iterative design process where designers focus on the users and their needs during each phase in the process. (See also "human-centered design".)

Additional Resources

1. **"Disability Language Style Guide,"** National Center on Disability and Journalism website, August 2021
2. **"Perspectives in Assistive Technology - Who is Disabled?"** a classroom lesson by David L. Jaffe, MS, August 2021
3. **"Perspectives in Assistive Technology - Questions for Contemplation,"** a classroom lesson by David L. Jaffe, MS, August 2021
4. **"Pronoun Guide,"** GLSEN website
5. **"Learn How We Describe Our Limb Differences!" video (YouTube)**, uploaded by Stump Kitchen, April 9, 2019