Brainstorming

Brainstorming helps engineers and designers of any age generate creative and innovative solutions. Using brainstorming throughout the design process can elicit a sense of excitement, foster collaboration, and prevent fixation on one single idea.

Innovation Design Process: **Imagine**

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At its heart, brainstorming is imagining. Brainstorming strategies can be applied at multiple stages of the design process, such as when students are:

- breaking down a problem.
- gathering shared knowledge to better understand a problem.
- generating shared vision and energy at the start of a project.
- imagining new ways to use materials while building.
- considering next steps after sharing and receiving feedback.

Divergent Thinking

Convergent Thinking

Generate lots of options.

expanding

narrowing

Start with a question.

End with an idea.

Brainstorming includes both divergent and convergent thinking. Provide opportunities for learners to generate a wide range of options before focusing on one idea.

Brainstorming is a skill that benefits from practice and support. Introducing learners to a variety of inclusive brainstorming strategies across a program or school year allows learners at any level to build critical thinking skills. Techniques, such as documenting all ideas without judgment, create opportunities for learners to practice being curious and bold, generating wildly creative ideas.

Inclusive Brainstorming

The goal of brainstorming is to get a multitude of ideas from everyone. However, brainstorming strategies vary in their accessibility. Factors such as personality traits (i.e. introverted or extroverted), group dynamics, cultural norms, and time constraints can lead to a lack of equity during group brainstorming. Try some of these techniques for leading inclusive brainstorming sessions.
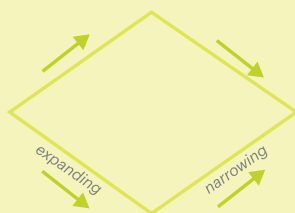
- When possible, let learners consider the problem or question individually before the group brainstorming session begins. Students who might hesitate to jump in and contribute in front of their peers will benefit from this "warm-up."
- Consider brainstorming strategies such as *Free Drawing* or *Investigating Materials*, which allow learners to explore independently at first and then share, one at a time, in their groups.
- Start with a brainstorming strategy that generates ideas without any talk, such as *Silent Circuit*. Then have students split into groups to discuss additional ideas.

Facilitation

- Choose a brainstorming strategy. (See some of **our favorites** or use one of your own.)
  - Allow 10–20 minutes for brainstorming depending on the method you select.
  - For group brainstorming, organize learners in groups of two to six.
  - Sticky notes are a useful tool for any brainstorm. We suggest 1 pad per learner, 1 idea per note.
- Establish the goal or purpose for the brainstorming session. Focus on the "why." Why are we designing a solution for this problem?
- Establish norms for brainstorming. (See some suggestions on the **next page**.)
  - Allow learners to take inspiration from other groups' ideas, but have them give the source of the idea credit. Learners should build on each other's ideas rather than copying them directly.
    - *For example:* "I heard Sofia mention trains, that gives me an idea to add tracks to our device."
- During longer sessions, move around the room and engage with learners to push their thinking in new directions or to refine a few ideas using facilitative questions.
- If learners will be building a physical device, make materials available for exploration during brainstorming.
- If you have examples of solutions (prototypes, photos, videos or related artifacts) make them available to learners to inspire questions and ideas. Let learners know that these objects are not meant to be directly copied.

Allow time to expand then narrow thinking

Remember that during brainstorming learners should be expanding their thinking and documenting multiple ideas without judging them.
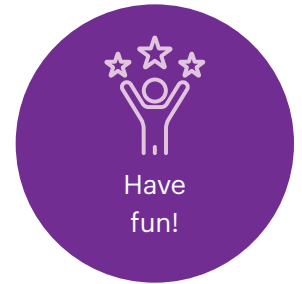
expanding   *narrowing*

Encourage learners to imagine multiple ways to approach the problem.

After brainstorming, provide a separate time for learners to constructively critique and narrow the ideas they have recorded.

Strategies to choose an idea:
- Sorting and combining similar ideas into an affinity diagram or mindmap.
- Anonymously voting on the top 5 choices with stickers, stars or circles.

Brainstorming

Brainstorming Norms

Dive in! Be bold.

Defer judgment.

Build on each other's ideas. "Yes, and…"

Keep it short, but go for quantity.

Have fun!

 Ask Guiding Questions

To break down a problem

- Is there a way to break this problem into smaller parts?
- What materials and tools do you have available?
- What do you understand about this challenge, and what seems confusing?
- How might you connect what you know already and what you don't know yet?

To expand thinking

- Think of an impossible way or imaginary to solve this problem. How might this idea lead you to a solution that is actually possible?
- What other perspectives can you use to approach this problem? Try imagining the problem from another point of view.
- What metaphors and analogies might help you connect to the problem?
- Is there anything in nature that might inspire ideas or solutions to the problem?
- How many other ideas can you come up with to solve this problem?
- If there were no criteria or constraints, how would you solve this problem?
- If you had unlimited time and resources, what would you do to solve this problem?

To focus thinking

- What problem are we trying to solve?
- Who will benefit from the solution?
- Are there other problems that are similar to this one?
- What is one thing you could try?
- Have any solutions to the problem already been imagined and implemented? Does a solution already exist in nature?

 Looking for more Tech Tips?
- Find out how to run a design challenge brainstorm in our **Brainstorming Video**.
- Explore all of our resources for **Design Challenge Learning**.

Picture Brainstorm

Individual or Group   10–15 min

- Give each individual a pad of sticky notes and a set of random images.
- Learners should choose an image and think about how they could use it to solve the problem.
- Have them write or draw each idea on a separate note and read their ideas aloud to their group as they post them on a board.
- Allow learners to post and share as many ideas as time allows.
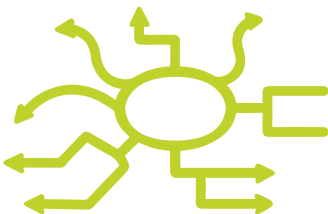
    *See template.

Free Writing or Drawing

Individual or Group   10–15 min

- Identify a topic, and have each learner write or draw any ideas that come to mind.
- Then give individuals time to share ideas within their group.
- After all have shared, have the group discuss additional ideas that emerged after listening to one another.

Mindmap

Individual or Group   15-20 min

- Put the central concept in the middle of a mindmap.
- Have learners record all their ideas related to the concept, clustering ideas and connecting related items visually with lines.

Storytelling

Individual or Group   15-20 min

- Learners can use rapid storytelling to brainstorm the details of several ideas, or focus on one idea at a time.
- Stories can take the form of a storyboard, series of images, roleplay, or narrative text.
- Learners can use prompts to outline.
    - Characters: Who are the stakeholders?
    - Setting: What kind of situations would they be in?
    - Action: What would happen if this idea was used to solve the problem?

Materials Investigation

Individual or Group   5-10 min

- Have each individual select a different material and share ideas for how it could be used in their group's solution.
- Encourage learners to "think with their hands" by tinkering with and manipulating materials while they come up with ideas.
- When time is up, either bring class together to share their ideas or allow each group to transition into prototyping.
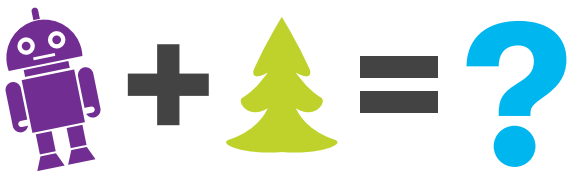
Superhero

Individual or Group   5-10 min

- Have learners imagine they are superheroes. What superpowers could they use to solve the problem?
- Then ask them to consider how to turn their superpower ideas into innovative solutions.

    *See template.
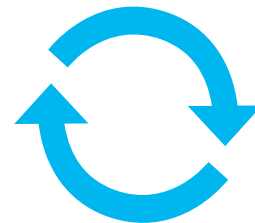
Mash-Up

Individual or Group   10-15 min

- A mash-up involves combining two random things to develop a unique solution to a problem.
- Distribute or have learners create two lists of fun ideas to mash-up.
- Have them randomly combine ideas from the lists to inspire solutions
    - Lists can be text or images.
    - The items in a mash-up can be ideas from previous brainstorms or things that learners enjoy, such as cats, holidays, or sports.
- Have learners randomly combine (mash-up) ideas from the lists to inspire solutions.

    *See template.

Silent Circuit

Group   10-15 min

- Tape 2–3 large pieces of paper in different places around the room. Write a different exploratory question at the top of each one.
- Give learners sticky notes. Ask them to walk around the room and silently add responses to each question for as long as time allows.

Name(s):   **Date:**
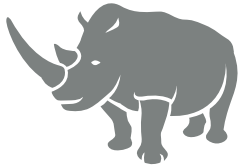
Directions: Cut out the images. Shuffle them and choose 1.

How could you use that item to solve your problem? Write down as many ideas as you can!
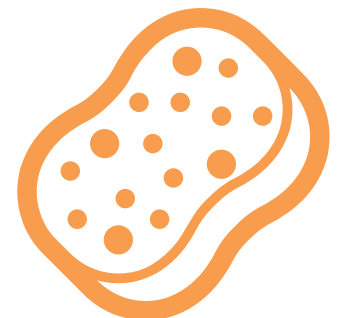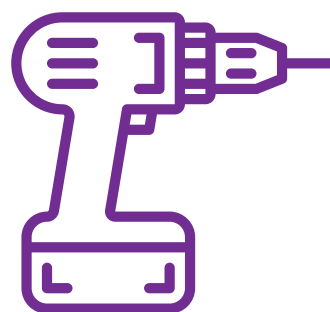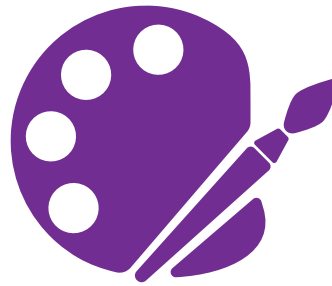
For example:

Endangered rhino   *Cell phone*   *Cell phones listen for poachers and send alerts that call for help*

Take on the role of superhero! This brainstorming exercise will help you come up with some superpower-inspired ideas for how to tackle a problem. Keep in mind that this is just a way to organize your ideas. Feel free to add more ideas than there are boxes!

Step 2: Superpower Ideas

Imagine you could do anything, no limits! What superpower would you use to solve the problem? Record your ideas below.

Example: I'll use my super-stretchy arms to reach the top.

Step 3: Innovative Solutions

Now think about how you can turn these superpower ideas into innovative solutions! What inventions could you design to do something similar?

Example: A retractable ladder that fits in my backpack!

Step 1: Problem

Write down the problem and any other important information.

Example: I can't reach an item on the top shelf.

Step 4: Narrow Your Solutions

Circle or highlight your top 3 ideas.

Brainstorming Solutions: Mash-Up

Name(s):   **Date:**

Spark innovative ideas by combining two random things. See where your crazy mash-up will take you! Keep in mind that this is just a way to organize your thoughts.

Step 1: Problem
Write down the problem and any other important information.
Example: I keep misplacing my toolbox.

Step 2: Simple Solutions
Write down as many solutions as you can think of. All ideas, even wild and crazy ones, are fine. One-word answers work, too!
Example: Metal detector, Alarm...

Step 3: Random Fun
We started this list of random fun things with some examples of our own. Add some things you like or whatever pops into your mind!

Robots   Biodegradable

Animals   Heroes

Music   Trees

Step 4: Mash-Up!
Draw lines between the ideas in Step 2 and Step 3 to create surprising combinations. Write down several crazy mash-ups and see if they inspire you. How might you design something similar?
Example: Flying metal detector — attach a large magnet to a drone to search the backyard.