

Innovation Curriculum

Classroom Lesson 2

Research, Brainstorm, Design

Lesson Overview

Students will continue the GSA Innovation Process by completing the following steps: 1) define and research the problem they want to solve; 2) brainstorm solutions; 3) choose their best design or concept to develop

Lesson 2: Research, Brainstorm, Design

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1. Define and research the problem they want to solve
2. Brainstorm solutions
3. Choose their best design or concept to develop

Time Frame: 2 weeks

- Part 1: Research - 45–180 min (in class), 1–2 weeks (outside class)
- Part 2: Brainstorm - 45–60 min (in class)
- Part 3: Design - 45–60 min (in class)

Core Concepts

- Focused research is necessary to define and understand a problem
- Brainstorming ideas freely, without judgment, can lead to innovative solutions
- Knowing how to evaluate ideas will help you select your best idea to design

Lesson Objectives

Students will be able to:

- Research and define a problem
- Brainstorm ideas for solving the problem
- Evaluate possible solutions and chose the best solution to design

Lesson Inquiry Question: What is involved in generating a viable and innovative idea to solve a problem?

Materials Needed

- Journals (optional)
- Library and/or Internet access
- Poster paper, sticky notes, and pens for each team
- Copies of any resources below that you wish to share with students
- Templates for Deliverable 2—see Appendix C

Journal Opportunity (optional)

Students who are keeping science journals may want to use them after each step (researching, brainstorming, and choosing an idea to design) to reflect on what they learned during that step.

NGSS Alignment

Lesson 2 provides opportunities for students to engage in the following Science & Engineering Practices (SEPs).

- **Practice 1** – Asking Questions & Defining Problems
- **Practice 6** – Constructing Explanations & Designing Solutions
- **Practice 8** – Obtaining, Evaluating & Communicating Information

This lesson is directly aligned with the following Performance Expectations.

- **HS-ETS1-1.** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **HS-ETS1-2.** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Educators may align the lesson to additional Performance Expectations and/or Disciplinary Core Ideas (DCIs) through challenge selection and/or the provision of specific related research resources.

Part 1: Research

Estimated Time

45–180 minutes (in class; 1–3 class periods, depending on time allotted for research)
1–2 weeks (outside class)

Preparation: Explain to students that the first step in this lesson is to research the challenge they chose. During this step, students will define the specific problem they want to solve and learn as much as they can about factors that contribute to the problem. Before they begin their research, share with students the following resources about how to conduct online research and interviews.

- [How to Do Internet Research](#): This resource from Frankfurt International School presents eleven rules to help students conduct effective online research
- [Evaluating Internet Resources](#): A tutorial from the Georgetown University Library on evaluating internet resources
- [More About Evaluating Internet Resources](#): Guidance from the University of California Berkeley Library on evaluating the appropriateness and credibility of online resources
- [Interviewing Experts](#): This resource from IDEO's Design Kit presents five steps to follow when interviewing an expert
- [Interviewing Individuals](#): IDEO's Design Kit presents four steps to follow when interviewing an individual, as well as a short video that offers an example of how interviewing individuals can help illuminate potential needs and/or resources
- [Interviewing Groups](#): IDEO's Design Kit presents four steps to follow when conducting a group interview

Procedure

1. Begin by having students identify an initial set of resources to use in their research.

These might include the following:

- Relevant articles and research papers, online or from the library
- Experts on the subject (advisors/mentors from Lesson 1 and/or new experts)
- People affected by the problem*

**Whenever possible, interviews with individuals affected by the problem can add depth and perspective to the scope and reality of the challenge. Perhaps solutions have been suggested in the past that have not worked. The people affected by the problem may have unique perspectives as to what the problem really is and why previous solutions were unsuccessful. Through interviews such as these, students can gain empathy that may help them to approach the challenge from a user-driven perspective. This perspective may lead to innovative and*

realistic solutions that address underlying challenges and really work.

Feedback Opportunity: Meet with teams or designated team members to review their materials and potential interview subjects, noting any issues (such as irrelevant or unreliable sources) or areas in which they lack sufficient resources.

2. Direct students to use the resources they have identified to conduct their research, exploring additional resources that they discover in the process and learning as much as they can about the problem they plan to address. Point out that regardless of the challenge they have chosen, their research should answer the following basic questions.

- What problem will we attempt to solve?
- What causes and factors contribute to this problem?
- Whom does the problem affect?
- What other solutions have been attempted? What were the results of these solutions?

3. As they conduct their research, students should create brief summaries of the key information learned from each source. Most teams will benefit from designating one member (the Director of Research or similar role) to keep track of and compile a list of sources used and related summaries. Advise students to keep careful records of their sources so that they can cite them in their final report if needed.

4. The Communications Director (or similar role) should continue to be the point person to reach out to experts and organize interviews.

5. Students may need considerable time to complete the research. Consider one or both of the following options.

- Offer additional classroom sessions for continued research and information sharing
- Encourage students to plan out-of-school time to complete research and meet as a group to compile information

Part 2: Brainstorm

Estimated Time

45–60 minutes (in class)

Preparation: Explain that the next step in the process is to brainstorm solutions to the problem. During this step, students will generate as many possible solutions as they can.

Brainstorming is an essential part of the design process. It offers an opportunity for every team member to contribute ideas and bring his or her unique experiences, background, and perspectives to the process. As students brainstorm together, each student's ideas typically spark other students' ideas. Be sure to allow students plenty of time for this step.

Before teams engage in their first brainstorming session, invite them to review the following resources for guidelines and ideas about how to brainstorm effectively. Each of these resources can be found in the [Bootcamp Bootleg](#) created by the dSchool at Stanford University's Institute of Design. You will need to download the PDF and then go to the noted page. Alternatively, the cards are numbered.

- *Brainstorm Rules*: card 28; page 31. [Brainstorm Rules](#) can also be accessed as a webpage in IDEO's online Design Kit. This resource offers seven rules for productive, creative brainstorming.
- *Facilitate a Brainstorm*: card 29; page 32. This resource provides the "why?" and the "how?" of facilitating a brainstorming session.
- *How Might We?:* card 26; page 29. This four-step method for turning challenges into design solutions can also be found as a webpage in [IDEO's Design Kit](#).

Procedure

1. Distribute poster paper and sticky notes. Ask each team to appoint a facilitator to lead their brainstorming sessions. The Project Manager would be a good choice, if they have this role. You might also want to print and distribute one or more of the above resources for teams to refer to as they brainstorm.

2. Invite students to conduct their first brainstorming session, reminding them to listen and record all ideas without judgment. Students can start by writing or sketching ideas on sticky notes and then posting the notes to the poster paper or wall. As initial ideas are shared, conversations will begin, and new ideas will come up. Be sure that *all* ideas are recorded—even those that seem unlikely, silly, or ridiculous. Unlikely ideas often lead to clever or

interesting solutions that work! Students will evaluate their ideas during the next step.

Feedback Opportunity: Sit in on a few minutes of each team's first brainstorming session to observe what's happening and provide guidance and structure as needed.

3. Encourage students to conduct additional brainstorming sessions as necessary until they feel that they have generated sufficient ideas.

Feedback Opportunity: Review each team's list of ideas before they move on to the next step, guiding them to do additional brainstorming as needed.

Part 3: Evaluate Ideas and Design a Solution

Estimated Time

45–60 minutes (in class)

Preparation: Explain to students that during this step they will evaluate the ideas they generated during brainstorming and choose their best idea to develop and design.

Procedure

1. Share the following resource with students and ask each team to choose a method (Post-It, Four Categories, or Bingo) to use for the initial step in the selection process.

- [Brainstorm Selection](#): Stanford University’s Institute of Design offers advice on selecting the best ideas from a brainstorming session in their Bootcamp Bootleg (see card 30; page 33)

2. Guide teams to narrow the ideas generated during brainstorming according to the method they selected in Step 1. Encourage students to retain any ideas that the team is excited about or intrigued by. Remind students that this is just the first step in the selection process—they are not yet choosing a final idea and do not need to narrow their ideas *too* much.

3. If teams are unsatisfied with the results of Step 2, encourage them to repeat the step. Instead of repeating the same method used in Step 2, they may wish to choose a different method from Brainstorm Selection, or try the Gut Check method below. Share the following resource with teams who might benefit from it.

- [Gut Check](#): IDEO’s Design Kit presents four steps for evaluating the ideas from a brainstorming session

Feedback Opportunity: Check in with each team to find out how their selection process is going. If teams are struggling, sit in on a selection session and offer guidance. Encourage teams to try different selection methods as appropriate.

4. Once teams have selected their most exciting and promising ideas, it’s time to group related ideas into more complex, robust solutions. Share the following resource for teams to use as a guide to group ideas. Teams should create several bundles of ideas, and ideas may be included in more than one bundle.

- [Bundle Ideas](#): IDEO’s Design Kit offers 4 steps to group related brainstorming ideas

5. Now it's time for teams to choose their best bundle of ideas and shape it into a concept or design that they will develop and test during Lesson 3. Share the following resource to guide students' work.

- [Create a Concept](#): IDEO's Design Kit shares five steps for refining ideas into a design concept

Students should record their final concept or design in Deliverable 2, along with a brief description of the research and brainstorming that led to the solution.

Deliverable 2

Using the Deliverable 2 template (Appendix C), outline the following in one page or less.

- **Proposed Solution:** Describe the design or concept you will test. Briefly summarize the research and brainstorming that led you to this solution.

Presentation (optional)

Using Deliverable 2, have students practice their oral presentation skills by presenting their solutions to the class.

Additional Resources

Research

This resource from BrainPOP includes several lessons on conducting effective Internet research and evaluating online sources.

- <https://educators.brainpop.com/bp-topic/internet-search/>

Brainstorming

For further information on the *hows* and *whys* of effective brainstorming, check out these sites.

- <https://k12teacherstaffdevelopment.com/tlb/how-can-i-facilitate-brainstorming-in-the-classroom/>
- <https://www.mindtools.com/brainstm.html>

Lesson 2 Hyperlink Index

[How to Do Internet Research](#): Eleven rules for effective online research from Frankfurt International School. <http://esl.fis.edu/learners/advice/internet.htm>

[Evaluating Internet Resources](#): A tutorial from the Georgetown University Library on evaluating Internet resources. <http://www.library.georgetown.edu/tutorials/research-guides/evaluating-internet-content>

[More About Evaluating Internet Resources](#): Guidance from the University of California Berkeley Library on evaluating the appropriateness and credibility of online resources. <http://guides.lib.berkeley.edu/evaluating-resources>

[Interviewing Experts](#): Five steps to follow when interviewing an expert from IDEO's Design Kit. <http://www.designkit.org/methods/43>

[Interviewing Individuals](#): Four steps to follow when interviewing an individual from IDEO's Design Kit. <http://www.designkit.org/methods/2>

[Interviewing Groups](#): Four steps to follow when conducting a group interview from IDEO's Design Kit. <http://www.designkit.org/methods/20>

[Bootcamp Bootleg](#): Resource cards created by the dSchool at Stanford University's Institute of Design. <https://dschool.stanford.edu/resources/the-bootcamp-bootleg>

- *Brainstorm Rules*: card 28; page 31
- *Facilitate a Brainstorm*: card 29; page 32
- *How Might We?:* card 26; page 29
- *Brainstorm Selection*: card 30; page 33

[Gut Check](#): Four steps for evaluating the ideas from a brainstorming session from IDEO's Design Kit. <http://www.designkit.org/methods/42>

[Bundle Ideas](#): Four steps to group related brainstorming ideas from IDEO's Design Kit. <http://www.designkit.org/methods/30>

[Create a Concept](#): Five steps for refining ideas into a design concept from IDEO's Design Kit. <http://www.designkit.org/methods/31>