SETTING THE STAGE FOR INNOVATION

A background-building module designed to ignite students' passion for solving real-world problems using innovation and technology.

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The ARK EDUCATION INITIATIVE DIFFERENCE

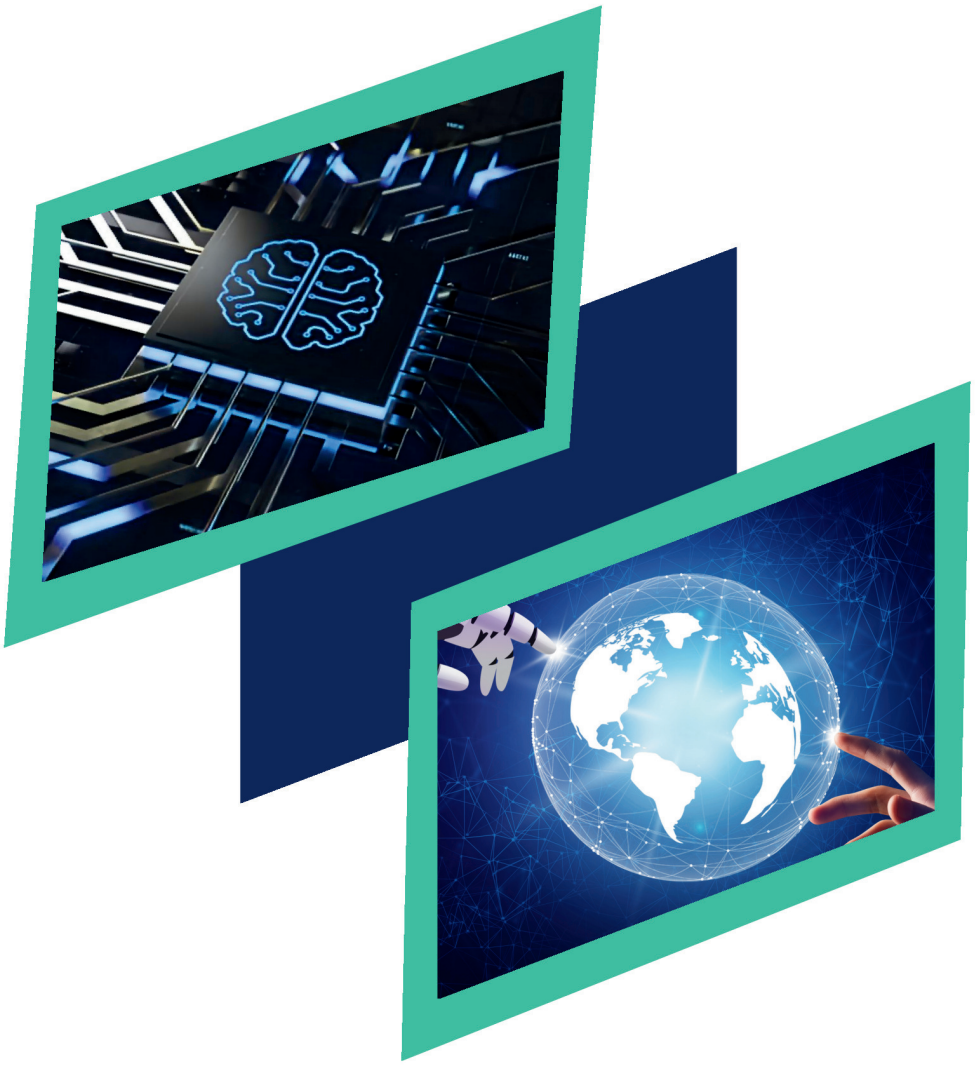
Igniting Tomorrow's Visionary Leaders

Founded in 2021 by Cathie Wood, the CEO of ARK Invest, the ARK Education Initiative is a nonprofit organization that works to improve education through technologically enabled **innovation**.

The ARK Education Initiative (ARK-Educate) difference begins with the belief that innovation solves real-world problems. Our programs make innovative thinking accessible to all students and educators, equipping them with the skills and mindset to manage profound technological change.

Our extended-day enrichment modules use research from ARK Invest analysts who acquire knowledge through exhaustive research and open, mutual sharing with other experts in various fields of technology. They provide insights into the opportunities and challenges driven by disruptive technological innovation.

Our modules go beyond STEM, teaching students how to synergize their science, technology, engineering, and mathematical skills along with their core content knowledge to solve real-world problems while using engineering design processes and innovative technology.



WHAT IS DISRUPTIVE INNOVATION?

Innovation goes beyond invention. Innovators are open to experimentation and exploration, resilient in the face of failure, capable of extracting lessons from temporary setbacks, and adept at thinking critically and with vision.

Disruptive Innovation refers to the introduction of a new product, service, or technology that significantly alters the existing market landscape. Over time, these innovations gain momentum, challenging and transforming industries by addressing unmet needs or creating new markets through a combination of technological advancement, affordability, and accessibility.

The Importance of Disruptive Innovation

Innovative education creates a template for life outside the classroom, developing a mindset of fearless inquiry and preparing students for future careers by helping students:

- develop future-ready workforce skills needed for a rapidly evolving job market.
- foster an entrepreneurial mindset by encouraging them to explore innovative solutions to new or existing problems.
- understand how technological advancements impact society and global citizenship.

DISRUPTIVE BY DESIGN

ARK-Educate offers transformative educational solutions that merge innovative technology, engineering design, career exploration, and a problem-first approach to learning.

Our programs are designed to revolutionize the educational landscape by equipping students with the skills, knowledge, and disruptive thinking needed to become tomorrow's visionary leaders.

MODULE OVERVIEW

This three-week module is designed to ignite students' passion for solving real-world problems through innovative thinking, technology application, and the engineering design process.

This module emphasizes the importance of documenting work as a way to organize thoughts, ideas, and progress over time while using the engineering design process. It also identifies how technology and innovation can help solve real-world problems at local and global levels. ARK-Educate's *Setting the Stage for Innovation* module gives students the foundational skills and knowledge needed to become effective problem solvers, changemakers, and leaders.

GETTING STARTED

- Module Lessons
- Module Key
- Scope and Sequence
- National Standards Alignment
- Engineering Design
- United Nations Global Goals for Sustainable Development
- Module Materials
- Module Preparation

MODULE LESSONS

Lesson 1	Exploring Your Tech Knowledge	60 minutes
Lesson 2	Mastering the Engineering Design Process through Documentation	60 minutes
Lesson 3	Empowering Changemakers	60 minutes

Lesson Structure

- Overview
- Objectives
- Materials
- Lesson Preparation
- Informal Assessment Opportunities
- Lesson Activators (warm-up activities)
- Lesson
- Lesson Summarizers (wrap-up activities)
- Extension Activities

MODULE KEY

Vocabulary Terms

Vocabulary terms are highlighted in bold green text. You can find a list of vocabulary terms and their definitions in the Appendix at the end of this module and in the student notebook.

Facilitator Tips and Notes

Facilitator Notes include additional directions related to instructional strategies, content support, extension activities, safety considerations, and much more.

Facilitator Tips include information, advice, strategies, and suggestions designed to streamline the instructional process and effectively deliver the content to support student engagement.

Student Handouts and Facilitator Reference Documents

Student pages, facilitator reference documents, and backline masters are provided at the end of each lesson. Student pages can also be found in the "Setting the Stage for Innovation" student notebook.

SCOPE AND SEQUENCE

Module Objectives

After this three-week module, students should be able to:

- Demonstrate how documenting work helps to organize thoughts, ideas, and progress over time.
- Identify ways technology can be used to help solve problems.
- Explain how innovation requires creativity and critical thinking.
- Identify the steps of the engineering design process.

Module Duration

- 3 lessons
- 1 lesson = approximately 60 minutes of instructional time

NATIONAL STANDARDS ALIGNMENT

Next Generation Science Standards*

Engineering Design

- 3-5-ETS1-1
- 3-5-ETS1-2

Next Generation Science Standards and NGSS is a registered trademark of WestEd. Neither WestEd nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and do not endorse it.

Common Core State Standards*

Common Core State Standards for Mathematics

- CCSS.Math.PRACTICE.MP1

College and Career Readiness Anchor Standards for Reading

- CCSS.ELA-LITERACY.CCRA.R.1
- CCSS.ELA-LITERACY.CCRA.R.8
- CCSS.ELA-LITERACY.CCRA.R.9

College and Career Readiness Anchor Standards for Speaking and Listening

- CCSS.ELA-LITERACY.CCRA.SL.1
- CCSS.ELA-LITERACY.CCRA.SL.2
- CCSS.ELA-LITERACY.CCRA.SL.6

College and Career Readiness Anchor Standards for Language

- CCSS.ELA-LITERACY.CCRA.L.1
- CCSS.ELA-LITERACY.CCRA.L.6

International Society For Technology In Education*

- ISTE 1.1 d Technology Operations
- ISTE 1.3.d Explore Real-World Issues

ENGINEERING DESIGN

Understanding the Engineering Design Process

The **engineering design process** is a systematic approach individuals (**engineers**, developers, scientists, inventors, etc.) use to solve problems and develop new products. It typically involves a series of steps that guide the creation, testing, and refinement of a product, system, or process.

This process differs from the scientific method since it involves designing, building, and testing a solution for a specific problem rather than conducting experiments and making observations. Although the **engineering design process** places more emphasis on inquiry, students should still be encouraged to act as scientists and researchers while they create diagrams, build **models**, use **technology**, apply mathematical principles, and employ technical literacy practices.

There is no single **engineering design process** that is universally accepted; however, the most common characteristic of such a

process is that it is iterative, which means that the steps can be repeated multiple times to allow for improvements after each test.

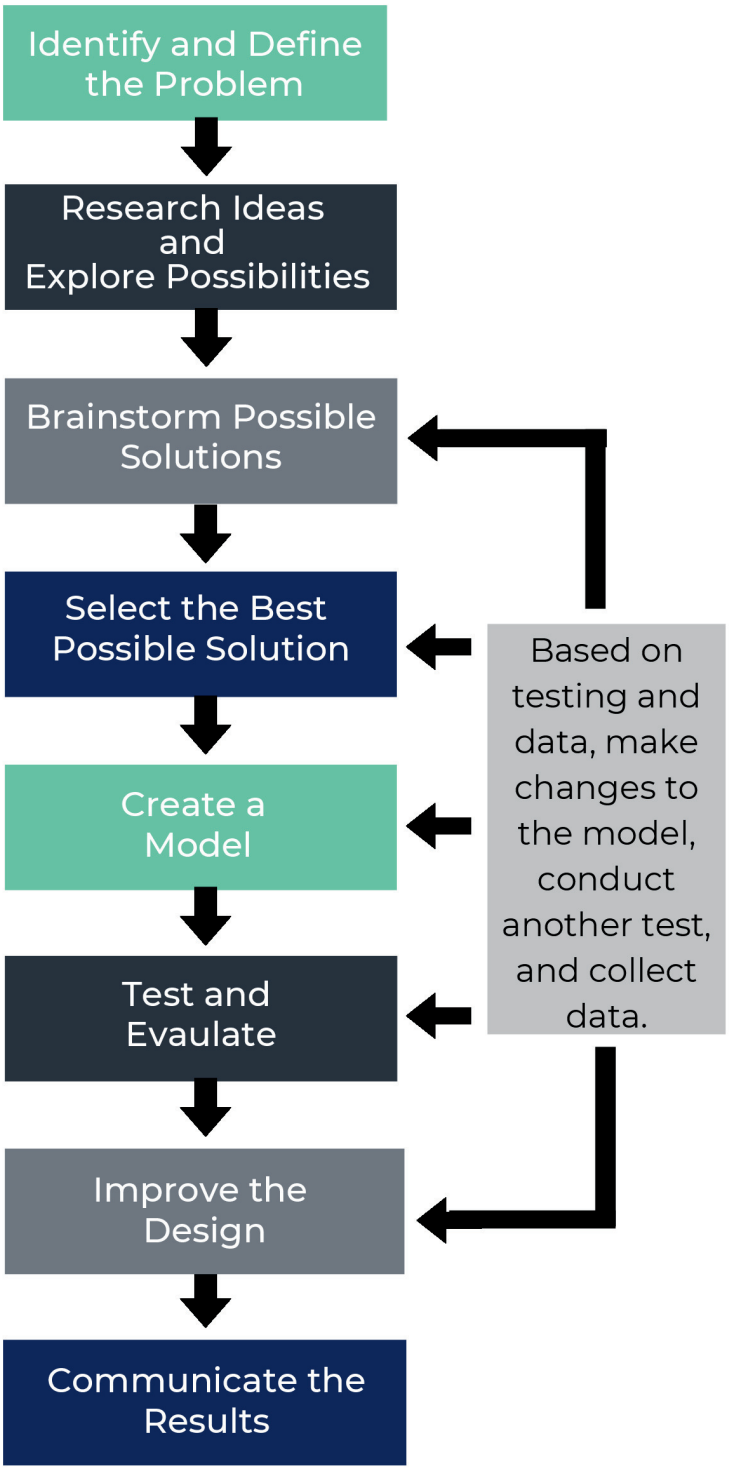
The following pages outline the engineering design process and associated descriptors used by ARK-Educate.

Facilitators of Inquiry

This module utilizes the **engineering design process**, thus transforming the role from a traditional instructional leader to an inquiry facilitator. When the facilitator asks probing questions and encourages teams to analyze their **designs** and data, students take ownership of their learning and learn how to navigate complex problems and uncertainty in a safe learning space.

Engineering Design Process

ARK-Educate



Engineering Design Process

ARK-Educate

Identify and Define the Problem	• What is the problem that needs to be solved? • Who or what population is the design product or solution for? • Why is it important to solve this problem? • What are the design criteria and constraints?
Research Ideas and Explore Possibilities	• Conduct research to identify if existing products or solutions already exist. • Explore who the users or customers were of each product or solution and its strengths and weaknesses.
Brainstorm Solutions	• Generate a list of design solutions and technology that could be used to solve the problem. • Withhold judgment to increase the number of potential solutions.
Select the Best Possible Solution	• Examine and analyze all brainstormed solutions to identify their strengths, weaknesses, and their ability to solve the design challenge. • Select one solution, draw an annotated diagram, and create a materials list.
Create a Model	• Build the model (design product) using the diagram and materials list. • If revisions are made to the model during construction, document these changes on the existing diagram and materials list.
Test and Evaluate	• Test the design product. • Record observations, measurements, and data taken during the test. • Evaluate how well the model solves the problem and meets the design criteria. • What improvements should be made to improve the design.
Improve the Design	• Modify the model using the notes, data, and observations collected from the test phase. • If revisions are made, document the changes on the diagram and materials list.
Communicate the Results	• Collaborate with team members to determine the best way to communicate the teams' design solution, how it should be displayed during the presentation, and how the results will be shared.

Student Collaboration

During this 10-week module, students will work in teams. When faced with challenges or obstacles during the design process, working together enables students to **brainstorm** ideas, share insights, and develop creative solutions as a team. This type of collaboration fosters the development of **communication**, active listening, idea generation, giving and receiving feedback, and conflict resolution skills, building their interpersonal relationship and project development skills, giving them the soft skills employers value in today's competitive job market.

Failure

Failure is essential to engineering design because it provides valuable learning opportunities. Analyzing what went wrong can deepen a team's understanding and reveal insights that lead to improvements in future iterations. Overcoming failure as a team builds resilience and perseverance. Failure in a design can be used as a teaching tool, allowing students to learn how to bounce back from setbacks and adapt to challenges as individuals and as a collective team.

UNITED NATIONS GLOBAL GOALS FOR SUSTAINABLE DEVELOPMENT

The *United Nations Sustainable Development Goals* (SDGs) provide a shared blueprint for peace, prosperity, and a more sustainable future. By integrating the SDGs into *ARK-Educate's* modules, students are able to learn about the interconnectedness of issues such as basic needs, innovation, empathy, collaboration, and sustainable development for a more equitable world.

United Nations. (n.d.). Sustainable Development Goals. Retrieved from https://sdgs.un.org/goals

Each 10-week ARK-Educate module will focus on specific Global Goals, directly linking them to the real-world design challenge presented in each module. This approach ensures that students understand these goals and apply them in practical and meaningful ways, fostering innovative solutions to local and global issues.

MODULE MATERIALS

Facilitator Use

- 1 laptop or desktop
- projector or SmartBoard
- 1 *Setting the Stage for Innovation* facilitator guide
- 1 *Setting the Stage for Innovation* slide deck
- 1 Merge Cube
- 3 sheets of 8.5" x 10" white copy/printer paper (facilitator provided) or make copies of the *It is technology?* backline masters (located at the end of Lesson 2)
- 1 roll of tape
- *Careers the Document Work* facilitator reference document (two pages, located at the end of Lesson 2)
- *Is it technology? Answer Key* (located at the end of Lesson 2)
- *Qualities of an Innovative Changemaker* facilitator resource document

Per Student

Materials provided for a class of 20 students.

- 1 pencil
- 1 pen (blue or black)
- 1 *Setting the Stage for Innovation* student notebook
- 1 *Show What You Know Pre Questionnaire*

Per Team

Materials are provided for five teams, each with four students.

- 1 box of crayons
- 1 box of thin colored markers

MODULE PREPARATION

Before the lesson:

- Identify a location where materials and equipment can be stored securely between class sessions.

Facilitator Notes:

- The concepts that students will learn in this module are intended to be applied in the "*Building the Future in 3D*" module.
- In this facilitator's guide, the term "module" refers to a set of lessons, the term "unit" can be used interchangeably when speaking with students, as this is a term they are more familiar with.

LESSON 1

Exploring Your Tech Knowledge

OVERVIEW

Lesson Activators

- Activity: Technology Profile
- Activity: Show What You Know

Lesson

- Background Building: The Exciting World of Technology

Lesson Summarizers

- Lesson Summary: Discussion of the lesson's key points and connections to real-world applications and careers.
- Student Questions: Encourage students to ask questions about the day's lesson.
- Lesson Preview: An overview of the content and activities students will experience in the upcoming lesson.

OBJECTIVES

Students will be able to:

- Identify their favorite technological device and explain why.
- Analyze different technology devices and apps and their ability to help solve real-world problems.
- Assess their level of understanding about the topics of technology, innovation, and the engineering design process.
- Identify the basic functions of the Merge Cube and its ability to apply augmented reality technology.

MATERIALS

Facilitator Use

- laptop or desktop
- projector or SmartBoard
- *Setting the Stage for Innovation* slide deck
- 1 Merge Cube
- 1 *Show What You Know Questionnaire Answer Key* (located at the end of this lesson)

Per Student

Materials are provided for a class of 20 students.

- 1 pen (blue or black)
- 1 *Setting the Stage for Innovation* student notebook
- 1 *Show What You Know Questionnaire* (A class set is included in the curriculum solution kit.)

Per Team

Materials are provided for five teams, each with four students.

- 1 box of crayons (optional)
- 1 box of thin colored markers (optional)

LESSON PREPARATION

Before the lesson:

- Ensure the projector, SmartBoard, and laptop/desktop are connected and working correctly.
- Open the *Setting the Stage for Innovation* slide deck and display the slide “Setting the Stage for Innovation” (slide 1).
- Students will complete a *Technology Profile* activity using a pencil; however, it is also suggested to provide students with crayons and markers.
- Watch the video “How does a Merge Cube work?”
    - “How Does the Merge Cube Work? | #mergecube.” YouTube, YouTube, 25 Aug. 2023, www.youtube.com/watch?v=aQ-yb4chHWk&t=9s.

INFORMAL ASSESSMENT OPPORTUNITIES

- Observations: As students complete various activities, note their individual levels of engagement and their ability to think critically and **communicate** effectively. Use their responses and observed interactions to informally assess their critical thinking abilities and communication skills.

- Questioning: Encourage students to explain their thinking, elaborate on their ideas, and consider alternative perspectives. Use those responses to informally assess students' conceptual understanding and critical thinking abilities.

- Written Responses: Review students' written answers at the end of each lesson. Analyzing written responses can yield valuable insights into a student's level of conceptual understanding to tailor future instruction accordingly to support students' individual learning needs.

LESSON ACTIVATORS

Activity: Technology Profile

1. Welcome students to class.

2. Tell the class that before they learn about **innovative technology**, they are first going to learn about each other by completing a *Technology Profile* activity.

3. Hand each student one *Setting the Stage for Innovation* student notebook, one pen, and one pencil.

   Tell students to complete the information on the front cover using a pen.

4. Ask students to open their notebooks to the page "*Technology Profile*" (page 3).

   Inform students that at this time, they are not permitted to look through their notebooks at this time as some of the pages will give away some answers.

5. Tell the class they will have ten minutes to independently complete this activity.
    - **Facilitator Note:** You will need to determine if students will be permitted to use crayons and thin markers when completing this activity.

6. Once students have finished, ask students to place themselves into teams of four.

7. Tell teams they will have ten minutes to share a few details from their *Technology Profile* document with their peers.

8. Once teams have finished sharing, hold a brief class discussion
    - **Facilitator Tip:** During the class discussion, help students connect the information they share to the lesson's objectives.

Activity: Show What You Know

1. Display the "*Show What You Know*" slide from the *Setting the Stage for Innovation* slide deck (slide 3).

2. Inform the class that before they begin to solve a real-world problem, it is important for each of them to identify their current level of understanding related to the concepts of **technology**, **innovation**, and the **engineering design process**.

   To do this, they will complete a "*Show What You Know*" questionnaire. Review the content on the slide.

   - **Facilitator Notes:**
     - This is an informal non-graded assessment.
     - Students should complete this activity using a pen.

3. Ask students to turn to the "*Show What You Know Questionnaire*" page in their notebooks. Remind students that they will have ten minutes to complete this activity.

4. Tell the class that they will not review the answers to the questions during this lesson; however, these questions and answers will be addressed as they progress through the module.

LESSON

Background Building: The Exciting World of Technology

1. State the following:

   "In this program, we will dive into the exciting world of ***technology****, exploring the* ***engineering design process*** *and learning about* **innovation***. Together, we will tackle real-world problems and find creative solutions. This is your opportunity to build your skills as future leaders and problem-solvers. Each of you will learn how to use your skills and imagination to make a difference!"*

2. Hold up the Merge Cube and ask the class what they think this object is and what it does.

   - **Facilitator Tips:**
     - Ensure that the side of the cube displayed to the class does not display the product's name.
     - Even if some students recognize what this object and what it does, refrain from telling the class the correct answers.

3. Display the slide "*The Exciting World of Innovative Technology*" (slide 4).

4. Before clicking on the *How does the Merge Cube work?* hyperlink, tell the class that:

   "We will watch a video clip showcasing the power of **technology**. This will give you a glimpse of the **impact** you can make with the tools you'll be using in this program."

   Play the "How Does the Merge Cube Work?" video **without sound**.

   - "How Does the Merge Cube Work? | #mergecube." YouTube, YouTube, 25 Aug. 2023, https://www.youtube.com/watch?v=aQ-yb4chHWk&t=9s
   - After playing the video clip without sound, ask students to turn to a partner to discuss what they just viewed. Once students have had a chance to discuss their thoughts, hold a brief whole-class discussion.

- Play the video again, but this time **with sound**.

- After playing the video clip with sound, hold a class discussion about what they just learned while listening and viewing the video.

5. After students have had an opportunity to share, emphasize that the Merge Cube allows users to use **augmented reality** technology to see virtual objects in the physical world.

   "This is the **technology** you will use to bring your innovative solution to life in the upcoming module, "*Building the Future in 3D*."

   - **Facilitator Tip:** Since this activity is meant to spark interest in the technology they will use in the upcoming module *Building the Future in 3D*, it is okay that at this time, students do not have a firm understanding of the Merge Cube and augmented reality technology.

   "Before you begin to solve your first real-world challenge, you must first learn about how technology, innovation, and global goals are connected."

LESSON SUMMARIZERS

1. Lesson Summary: Ask students to turn to a partner to discuss the key takeaways from the day's lesson, real-world applications, and career connections.

2. Student Questions: Encourage students to ask any final questions about the day's lesson.

3. Lesson Preview: To build excitement, provide examples of the content and activities students will engage with during the next lesson.

Technology Profile

Draw your favorite type of technology.

List two reasons why this is your favorite type of technology.

1. _____
2. _____

List two or three fun/interesting facts about yourself.

Do you have a favorite app or game you like to play on a phone, tablet, or computer? Explain what is it?

_____

_____

_____

_____

_____

Name: _____ Date: _____

Show What You Know Questionnaire

1. **Which of the following is an example of an innovative solution to a problem?**

   A) Using traditional farming methods to increase crop yield.
   B) Developing biodegradable packaging to reduce waste.
   C) Ignoring environmental concerns to maximize profit.
   D) Following the same process without changes.

2. How does technology impact society?

   A) It has no effect on social interactions.
   B) It can change how people communicate and work.
   C) It only affects large businesses.
   D) It decreases productivity.

3. **How does the engineering design process help solve real-world problems?**

   A) By providing steps to solve problems quickly.
   B) By encouraging creativity and innovation within guidelines.
   C) By avoiding testing and experimenting with ideas.
   D) By focusing on innovative ideas without practical use.

4. **What is augmented reality (AR)?**

   A) Overlays digital information onto the real world.
   B) Replaces the real world with a virtual environment.
   C) Enhances communication through holograms.
   D) Creates realistic graphics for video games.

5. **Short Answer: Describe a way you think technology might positively change the future.**

Show What You Know Questionnaire Answer Key

1. **Which of the following is an example of an innovative solution to a problem?**

   A) Using traditional farming methods to increase crop yield.
   B) Developing biodegradable packaging to reduce waste.
   C) Ignoring environmental concerns to maximize profit.
   D) Following the same process without changes.

2. **How does technology impact society?**

   A) It has no effect on social interactions.
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   A) Overlays digital information onto the real world.
   B) Replaces the real world with a virtual environment.
   C) Enhances communication through holograms.
   D) Creates realistic graphics for video games.

5. **Short Answer: Describe a way you think technology might change in the future.**

Answers May Vary

Sample Answer: I think technology might change the future by having more robots that help us. They could do chores like cleaning the house or even help with homework. This would make our lives easier and give us more time to participate in after-school clubs, spend time with family, and do activities and hobbies that we enjoy.

LESSON 2

Mastering the Engineering Design Process Through Documentation

Lesson 2: Mastering the Engineering Design Process Through Documentation

OVERVIEW

Lesson Activators

- Activity: What is technology?

Lesson

- Activity: Career Exploration and The Importance of Documenting Work
- Background Building: ARK-Educates' Engineering Design Process (EDP)

Lesson Summarizers

- Lesson Summary: Discussion of the lesson's key points and connections to real-world applications and careers.
- Student Questions: Encourage students to ask questions about the day's lesson.
- Lesson Preview: An overview of the content and activities students will experience in the upcoming lesson.

Lesson 2: Mastering the Engineering Design Process Through Documentation

OBJECTIVES

Students will be able to:

- Describe the purpose and steps used in the **engineering design process.**
- Describe the importance of documenting work during each step of the **engineering design process.**
- Explain how documenting work helps individuals reflect on and improve **designs**.
- Identify different careers and career fields that use documentation in their line of work.
- Identify several connections between the **engineering design process** and real-world applications of that process.
- Identify real-world applications that benefit from the engineering design process.

MATERIALS

Facilitator Use

- laptop or desktop
- projector or SmartBoard
- *Setting the Stage for Innovation* slide deck
- 3 sheets of 8.5" x 10" white copy paper (facilitator provided) or make copies of the blackline masters "*It is technology?*" posters (located at the end of Lesson 2)
- 1 roll of tape
- *Careers That Document Work* facilitator reference document (two pages, located at the end of Lesson 2)
- *Is it technology?* answer key (located at the end of Lesson 2)

Per Student

Materials are provided for a class of 20 students.

- 1 pencil
- 1 pen (blue or black)
- 1 *Setting the Stage for Innovation* student notebook

LESSON PREPARATION

Before the lesson:

- Ensure the projector, SmartBoard, and laptop/desktop are connected and working correctly.

- Take three sheets of copy paper and write the phrase "IS TECHNOLOGY" on the first sheet, "IS NOT TECHNOLOGY" on the second sheet, and "UNDECIDED" on the third sheet using a thick black marker. Select three corners of the room and hang one sheet of paper in each corner. Optional: A master set of these three documents is attached at the end of this lesson to make copies.

- Watch the video “Tacoma Narrows Bridge” to become familiar with the content.
    - “Witness the Tacoma Narrows Bridge Collapse into Puget Sound between the Olympic Peninsula and the Washington Mainland.” Encyclopædia Britannica, Encyclopædia Britannica, inc., www.britannica.com/video/21895/Collapse-Tacoma-Narrows-Bridge-Puget-Sound-Washington-Nov-7-1940. Accessed 25 July 2024.

- Display the slide "*Mastering the Engineering Design Process Through Documentation*" from the *Setting the Stage for Innovation* slide deck (slide 5).

INFORMAL ASSESSMENT OPPORTUNITIES

- Observations: As students complete various activities, note their individual levels of engagement and their ability to think critically and **communicate** effectively. Use their responses and observed interactions to informally assess their critical thinking abilities and communication skills.

- Questioning: Encourage students to explain their thinking, elaborate on their ideas, and consider alternative perspectives. Use those responses to informally assess students' conceptual understanding and critical thinking abilities.

- Written Responses: Review students' written answers at the end of each lesson. Analyzing written responses can yield valuable insights into a student's level of conceptual understanding to tailor future instruction accordingly to support students' individual learning needs.

LESSON ACTIVATOR

What is technology?

Facilitator Notes:

- This activity aims to give students the opportunity to formulate their own definition of "**technology**." For this reason, the definition should not be disclosed to students until the end the activity.

1. Ask students to sit next to the team they worked with during the previous lesson (teams of four students).

2. Ask each team to select one Materials Manager who will be responsible for gathering one student notebook and one pen for each team member.

   Tell students that they are going to build their background knowledge about the importance of documenting work.

3. Display the slide “Is *it technology?*” in the *Setting the Stage for Innovation* slide deck (slide 6).

   Engage the class in a **brainstorming** activity about technology. Ask students to share technological devices that has made their parents' or caregivers' lives easier and how that device has been able to do so.

4. Tell students to open their notebooks and read the "Is *it technology?*" page. Then, review the directions with the class. Emphasize that this activity is to be completed independently.

   - **Facilitator Note:** Students must use a pen while completing this activity to ensure they do not change their responses based on their peer's opinions.

   Give students time to independently complete the activity.

5. Next, tell the class they will complete a "Three-Corner Activity."

Ask students to stand.

Tell students to leave their pens at their desks, but they will need to take their notebooks with them as they move to different corners of the room.

6. Show the class the three signs, "IT IS TECHNOLOGY," "IT IS NOT TECHNOLOGY," and "UNDECIDED," posted in three different corners of the room.

7. Tell the class that you will say one item at a time from the "*Is it technology?*" page. After each item, students should move to the corner of the room that represents the thinking they documented in their notebooks.

8. Say the word "pencil." Once students move to their respective corners, give them time to discuss their thinking with other students located in the same corner of the room they are in.

Facilitator Tips:

- While students are conversing, move between teams to listen to their reasoning. During this part of the lesson, responses such as “correct” or “incorrect” should not be provided to students.

9. Continue this activity using the words *water* and *paper towels*.

   Additional words, such as *cell phone, medicine, computer, bike*, and *sandwich*, can be added or substituted as needed.

10. Ask students to return to their seats.

    Display the slide “Technology” from the Setting the Foundation for Innovation slide deck (slide 7).

    Take a few moments to review the definition of **technology** with the class and how it relates to the three items they just discussed.

11. Tell students that they will expand on their newly acquired knowledge about **technology** by learning about ***innovation***.

LESSON

Activity: Career Exploration and the Importance of Documenting Work

1. Tell the class that during this activity, they will build their background knowledge about the importance of documenting work.

2. Ask students to open their notebooks to the "*Career Exploration*" page.

   Have teams create a list of job titles and career fields that document information in their line of work.

   - **Facilitator Note:** A "*Careers That Document Work*" *facilitator reference document (two pages) has been provided. This document includes* a list of careers and examples of how documentation is used in that link of work.

3. Next, have teams share their ideas with the class. If teams have rows that are not completed, teams should record information that other teams share.

- **Facilitator Suggestion:** Create a class list of job titles and career fields teams share. This list could be displayed during Lesson 3 and new information could be added.

4. Tell the class that having a centralized place to keep their thoughts and ideas is a practice many engineers, inventors, and scientists use. It is also a great way to see how those thoughts and ideas change.

   The technical language and diagrams used in various professions are essential for creating reports that are shared with the public. As a result, the ability to accurately document information is a skill set that employers seek when hiring.

5. The next part of this activity will show students the steps of the building process and how it connects to the importance of documenting work.

Background Building: ARK-Educate's Engineering Design Process

1. Display the slide "*Tacoma Narrows Bridge*" in the *Setting the Stage for Innovation* slide deck (slide 8). Tell the class that the images on the slide are photographs of the Tacoma Narrows Bridge, built by engineers in 1940 in Washington State.

   Click on the "*Tacoma Narrows Bridge*" hyperlink (on the slide) to play a short clip of the bridge in 40 mph winds.

   - "Witness the Tacoma Narrows Bridge Collapse into Puget Sound between the Olympic Peninsula and the Washington Mainland." Encyclopædia Britannica, Encyclopædia Britannica, inc., www.britannica.com/video/21895/Collapse-Tacoma-Narrows-Bridge-Puget-Sound-Washington-Nov-7-1940. Accessed 25 July 2024.
   - **Facilitator Note:** To learn more about the Tacoma Narrows Bridge collapse, click on the following link from *Structure Magazine*, 2022, https://www.structuremag.org/?p=19995.

2. *Ask students to turn to the "ARK-Educates' Engineering Design Process"* graphic in their notebooks.

   Display the slide "*ARK-Educates' Engineering Design Process*" in the *Setting the Stage for Innovation* slide deck (slide 9) and share the following with the class:

   *"The **engineering design process** is a step-by-step method **engineers**, scientists, designers, inventors, and many others use to solve problems, create **innovative** solutions, and prevent these types of mishaps.*

   *Before designing a **model** that represents a solution to a real-world problem, you must learn how to effectively use each step of this process."*

3. Display the slide "The *Engineering Design Process Descriptions*" in the *Setting the Stage for Innovation* slide deck (slide 10).

Ask students to turn to the "*The Engineering Design Process Descriptions*" page in their notebooks.

4. Tell students to read through the descriptions for each step in the **engineering design process** with their teammates.

   After teams have finished, hold a class discussion. Help students make connections between the importance of documenting work and the **engineering design process**.

   Tell the class that during the next module, they will need to start using these two pages as reference tools while trying to design a solution to a real-world challenge.

LESSON SUMMARIZERS

1. Lesson Summary: Ask students to turn to a partner to discuss the key takeaways from the day's lesson, real-world applications, and career connections.

2. Student Questions: Encourage students to ask any final questions about the day's lesson.

3. Lesson Preview: To build excitement, provide examples of the content and activities students will interact with during the next lesson.

Career Exploration

Career Field/Job Title	Job Related Skills

Careers That Document Work

1. **Video Game Designer**: Creates and documents new games, designing levels, characters, and stories. They keep track of all the ideas and how the game should work.

2. **Robotics Engineer**: Designs and builds robots. They write down all the steps, from drawing plans to testing the robots, to make sure they work correctly.

3. **Inventor:** Creates new gadgets or solutions to problems. They keep an inventor's notebook where they draw and write down their ideas, experiments, and how things work.

4. **Digital Artist:** Uses computers to create amazing artwork. They keep records of their design process, including sketches and final pieces, to show how their art develops.

5. **Food Scientist:** Experiments with new recipes and food products. They write down the ingredients, steps, and results to make sure everything tastes great and is safe to eat.

6. **App Developer:** Creates new apps for phones and tablets. They write down all the coding steps, test the apps, and document any changes or updates.

7. **Architect**: Designs buildings and other structures. They create blueprints and models, documenting every detail to ensure the construction is perfect.

8. **Urban Planner:** Designs cities and communities. They document plans for buildings, parks, and transportation to make sure cities are organized and enjoyable places to live.

9. **Mechanical Engineer**: Develops machines and mechanical systems. They keep detailed records of designs, prototypes, and tests to improve their creations.

10. **Virtual Reality/Augmented Reality Developer**: Creates virtual worlds and experiences that can be seen through special glasses or on your phone. They write down how they make these games and apps, what players think about them, and details to ensure everything functions as it should.

IS

TECHNOLOGY

IS NOT

TECHNOLOGY

UNDECIDED

IS IT TECHNOLOGY?

Next to each word, place a checkmark to indicate whether you think the item is technology, is not technology, or if you are undecided. Then, provide the **criteria** you used to make that decision.

Item	Is Technology	Is Not Technology	Undecided	What criteria did you use to make your decision?
pencil				
water				
paper towels				

IS IT TECHNOLOGY?

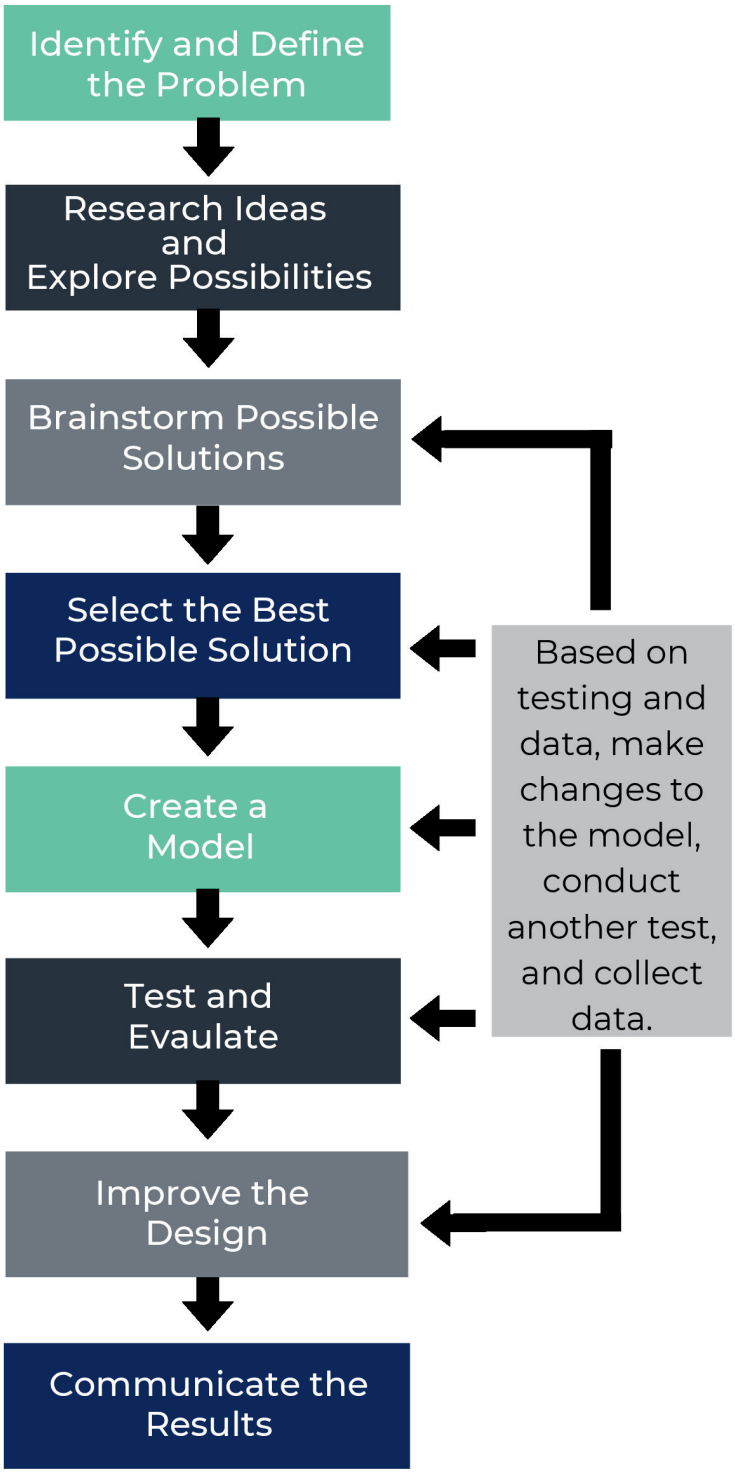
Answer Key

Next to each word, place a checkmark to indicate whether you think the item is technology, is not technology, or if you are undecided. Then, provide the **criteria** you used to make that decision.

Item	Is technology	Is Not technology	Undecided	What criteria did you use to make your decision?
pencil	✓			
water		✓		
paper towels	✓			

Engineering Design Process

ARK-Educate



Engineering Design Process

ARK-Educate

Identify and Define the Problem	• What is the problem that needs to be solved? • Who or what population is the design product or solution for? • Why is it important to solve this problem? • What are the design criteria and constraints?
Research Ideas and Explore Possibilities	• Conduct research to identify if existing products or solutions already exist. • Explore who the users or customers were of each product or solution and its strengths and weaknesses.
Brainstorm Solutions	• Generate a list of design solutions and technology that could be used to solve the problem. • Withhold judgment to increase the number of potential solutions.
Select the Best Possible Solution	• Examine and analyze all brainstormed solutions to identify their strengths, weaknesses, and their ability to solve the design challenge. • Select one solution, draw an annotated diagram, and create a materials list.
Create a Model	• Build the model (design product) using the diagram and materials list. • If revisions are made to the model during construction, document these changes on the existing diagram and materials list.
Test and Evaluate	• Test the design product. • Record observations, measurements, and data taken during the test. • Evaluate how well the model solves the problem and meets the design criteria. • What improvements should be made to improve the design.
Improve the Design	• Modify the model using the notes, data, and observations collected from the test phase. • If revisions are made, document the changes on the diagram and materials list.
Communicate the Results	• Collaborate with team members to determine the best way to communicate the teams' design solution, how it should be displayed during the presentation, and how the results will be shared.

LESSON 3

EMPOWERING CHANGEMAKERS

OVERVIEW

Lesson Activator

- Activity: What is innovation?

Lesson

- Background Building: Global Goals
- Activity: Innovative Changemakers

Lesson Summarizers

- Lesson Summary: Discussion of the lesson's key points and connections to real-world applications and careers.
- Student Questions: Encourage students to ask questions about the day's lesson.
- *Building the Future in 3D Module* Preview: A brief overview of the module and activities students will experience.

OBJECTIVES

Students will be able to:

- Describe the concept of **innovation** and provide examples and non-examples.
- Discuss the *United Nations Sustainable Development Goals* and their significance in addressing global challenges.
- Identify an innovative changemaker's qualities and recognize their potential as changemakers and future leaders.

MATERIALS

Facilitator Use

- laptop or desktop
- projector or SmartBoard
- *Setting the Stage for Innovation* slide deck
- *Qualities of Innovative Changemakers* facilitator reference document (provided at the end of Lesson 3)

Per Student

Materials are provided for a class of 20 students.

- 1 pencil
- 1 *Setting the Stage for Innovation* student notebook

Per Team

Materials are provided for five teams, each with four students.

- 1 box of crayons
- 1 box of thin colored markers

LESSON PREPARATION

Before the lesson:

- Ensure the projector, SmartBoard, and laptop/desktop are connected and working correctly.

- Display the slide *Empowering Changemakers* from the *Setting the Stage for Innovation* slide deck (slide 11).

- Watch the “Malala Introducing The World's Largest Lesson” video to become familiar with its contents.
    - “Malala Introducing The World's Largest Lesson”, Vimeo, 16 Jan. 2024 https://vimeo.com/138852758

INFORMAL ASSESSMENT OPPORTUNITIES

- Observations: As students complete various activities, note their individual levels of engagement and their ability to think critically and communicate effectively. Use their responses and observed peer interactions to informally assess their critical thinking abilities and communication skills.

- Questioning: Use probing questions to encourage students to explain their thinking, elaborate on their ideas, and consider alternative perspectives. Use student responses to informally assess their level of conceptual understanding and critical thinking abilities.

LESSON ACTIVATOR

What is innovation?

1. Start this part of the lesson by asking students to turn to a partner and discuss what "**innovation**" means to them. Students should be encouraged to give examples of what comes to their mind when they hear this word.

2. Hold a brief class discussion, allowing students to share their thinking and provide examples.

    - **Facilitator Note**: At this time, students' answers should not be identified as "correct" or "incorrect." Your job as a facilitator is to help students process and deepen their thinking by asking probing questions.

3. Display the slide "*What is innovation?*" in the *Setting the Stage for Innovation* slide deck (slide 12).

    Read the contents of the slide aloud to the class and hold a class discussion. Have the class discuss to real-world

applications that relate to the concept of *innovation*.

4. Tell the class that today, they are going to learn about an innovative change-making agency that is on a global mission.

5. Display the slide "*An Innovative Change-Making Agency on a Global Mission"* in the *Setting the Stage for Innovation* slide deck (slide 13).

6. Click the "Malala Introducing The World's Largest Lesson" hyperlink (on the slide) to play a video that provides an overview of the *United Nations Sustainable Development Global Goals*.
    - "Malala Introducing The World's Largest Lesson", *Vimeo*, 16 Jan. 2024 https://vimeo.com/138852758

7. Ask students to sit with their team (teams of four students). Each team will select one Materials Magager responsible for acquiring one student notebook and one pencil per team member.

8. Display the slide “The United Nations Sustainable Development Goals” in the *Setting the Stage for Innovation* slide deck (slide 14). Ask students open their notebooks to the two-page article titled “*A Global Changemaker*.”

9. Tell teams they will need to read through this three-page article together.

   Once teams finish reading, take a few minutes to discuss the article's content.

   - **Facilitator Note:** It is important to help students make connections between the content in the article and its real-world applications.

9. Conclude this part of the lesson by telling the class they will revisit this article during each upcoming module (a.k.a. unit).

LESSON

Background Building: Innovative Changemakers

By the end of this activity, students will be able to identify the qualities of **innovative** changemakers and recognize their own potential as changemakers.

1. Display the slide "*What is an innovative changemaker*" in the *Setting the Stage for Innovation* slide deck (slide 15).

2. Tell the class they will independently complete the next part of this lesson.

3. Ask students to open their notebooks and go to the page "*Innovative Changemakers*." Spend a few minutes reviewing the content on the page.

   Facilitator Notes:

   - When reviewing the content, clues about what an **innovative** changemaker is and does should not be provided at this time.
   - This activity aims to get students to begin to see

themselves as **innovative** changemakers; however, this activity is designed to have students struggle when answering Parts 1 and 2 because an "innovator" or a "changemaker" does not readily present themselves as a superhero would in a movie.

4. Tell the class they will have ten minutes to independently complete Parts 1 and 2.

   Facilitator Notes:

   If a student struggles to complete this activity, the following supports can be provided:

   - Instead of a definition, students can create a list of words or phrases.
   - Students can complete Part 2 while they think about responses for Part 1.
   - It is permissible if students do not complete both parts of the activity in ten minutes.

5. After student finish, ask the class to discuss their responses to Part 1 with their teammates.

6. Hold a class discussion related to what qualities they think an "innovative changemaker" would/should have.

7. Ask the class, "Who did you draw as an 'innovative changemaker'?" (Listen for responses that state, "I drew myself" or "I drew a student.")

    - **Facilitator Note:** The majority of students will not see themselves as "innovative changemakers." If no one in the class shares that they drew themselves, ask the following question, "Why didn't you not draw yourself?"

8. Explain the characteristics of **innovative** changemakers and address any misconceptions students may have. **Emphasize that anyone, including themselves, can be an "Innovative Changemaker."**

    - **Facilitator Note:** At the end of this lesson, a "*Qualities of Innovative Changemakers*" facilitator resource document has been provided. This document includes a list of qualities innovative change makers might have, along with a description of each.

9. Tell the class that innovative changemakers can come from any age group. In the next two slides, they are going to be introduced to six young, **innovative** changemakers.

   Display the slides "*Young Innovative Changemakers*" in the *Setting the Stage for Innovation* slide deck (slides 16-17).

   Take time to read the bio of each young changemaker while clarifying terms students might be unfamiliar with. Examples:

   - Indigenous: the descendants of the people who first lived in the Americas, the Pacific, and parts of Asia and Africa. They are native to the area and have their own special traditions and cultures.
   - Telecommunications: the use of technology such as phones, the Internet, and television to send messages or talk to people who are far away.

10. To reinforce the idea that each student has the potential to become an "innovative changemaker," students will be

asked to draw themselves.

Ask students to open their notebooks to the page "A Future Innovative Changemaker." Tell students that now that they have an understanding of who can be an innovative changemaker, their assignment will be to draw themselves as one!

- **Facilitator Tip:** Although this is an individual activity, give each team one box of crayons and one box of thin-colored markers to share.

11. Display the slide "*A Future Innovative Changemaker*" in the *Setting the Stage for Innovation* slide deck (slide 18). Review Steps 1 and 2 with the class.

To help students identify the qualities of **innovative** changemakers, display the slide "*Qualities of Innovative Changemakers*" in the *Setting the Stage for Innovation* slide deck (slide 19).

- **Facilitator Note:** Inform the class that this list does not

include every quality of changemakers; however, it is a list of qualities to use when they get stuck.

12. Once students finish, ask the class if there are any students who would like to share their illustrations and/or qualities.

LESSON SUMMARIZERS

1. Lesson Summary: Ask students to turn to a partner to discuss the key takeaways from the day's lesson, real-world applications, and career connections.

2. Student Questions: Encourage students to ask any final questions about the day's lesson.

3. Module Preview: To build excitement, provide examples of the content and activities students will interact with in the next module.

EXTENSION ACTIVITIES

- Research and Present: Students can research a specific **innovation** or technological advancement that has significantly impacted an industry. They can create a presentation highlighting the innovation's history, development, and **impact**.

- Future Predictions: Ask students to imagine what the future might look like regarding **technology** and industry. They can create a multimedia presentation, write a short story, or **design** a futuristic poster showcasing their predictions.

A GLOBAL CHANGEMAKER

The United Nations (U.N.) is a global organization with the goal of promoting **cooperation**, **development**, **security**, and **peace** among nations worldwide.

In 2000, the U.N. created **17** “Sustainable Development Goals” to **promote worldwide collaboration**, **action** and **improvement** by the year 2030.

United Nations. "Sustainable Development Goals." United Nations, 2024, https://www.un.org/sustainabledevelopment/sustainable-development-goals/

These 17 *Global Goals for Sustainable Development* can guide you toward a better understanding of how issues such as:

basic needs

innovation

empathy

collaboration

sustainable development

are connected by

innovation

technology

industry

INNOVATIVE CHANGEMAKERS

PART 1: Complete the table below.

WHAT IS YOUR DEFINITION OF A INNOVATIVE CHANGEMAKER?	
WHO CAN BECOME A INNOVATIVE CHANGEMAKER?	
LIST NAMES OF INNOVATIVE CHANGEMAKERS (if you know any)	

PART 2: In the box below, draw an “innovative changemaker.”

A FUTURE INNOVATIVE CHANGEMAKER

Qualities of Innovative Changemakers

- Creativity - They can think outside the box and come up with unique ideas that others may not have thought of.
- Vision - They have a clear picture of the positive change they want to create/make.
- Empathy - They try to understand where other people are coming from and their needs.
- Collaboration - They are able to effectively work with others.
- Critical Thinking - They analyze situations before making decisions.
- Resourceful - They know how to use available resources to solve problems.
- Leadership - They inspire and motivate others to join their cause.
- Communication - They are able to clearly explain their ideas and thinking to others.

APPENDIX

VOCABULARY TERMS

BRAINSTORM	to suggest and discuss ideas for solving a problem
COMMUNICATE	to share information orally, in written form and/or graphically through various forms of media
CONSTRAINT	a limit or condition on the features or functions of a design
CRITERIA	a list of items (specifications) that must be met in order for a solution to be considered successful
DESIGN	the process for creating structures or systems to meet specific needs
ENGINEER	a person who designs structures and systems that address specific needs
ENGINEERING DESIGN PROCESS	a series of flexible problem solving steps that move a model from problem to solution
IMPACT	the effects of an engineering design
INNOVATION	process of creating new ideas, processes, services, or products that solve problems in new or improved ways
INNOVATIVE TECHNOLOGY	new or improved tool, system or process that introduces significant improvements or solve problems in new and clever ways

MODEL	a diagram, replica, mathematical representation, or computer simulation used to analyze a system for flaws, test a solution, visualize or refine a design, and/or communicate design features
MODIFY	changes made to a design/build
PLAN	a systematic approach to solving a problem
PROCESS	a series of steps that form a pathway to a solution
REFINE	to improve through small changes
REFLECT	to analyze a course of action, process, or experience in order to generate a future improvement or modification
TECHNOLOGY	any tool system of process created by humans to solve problems or make tasks/life easier
TOOL	anything that helps people shape, build, or produce things to meet their needs
TEST	to determine whether or not a design, model, process, or system meets the criteria as a possible solution