SAFE Chips Project

Business Tech, Grades 9-12

DRAFT

SCALE K-12
SCalable Asymmetric Lifecycle Engagement
Precollege Microelectronics Workforce Development

INSPIRE
Research Institute for Pre-College Engineering

PURDUE UNIVERSITY

Cover Information

Unit Title: SAFE Chips Project
Grade Level Range: 9th-12th Grade

Acknowledgments

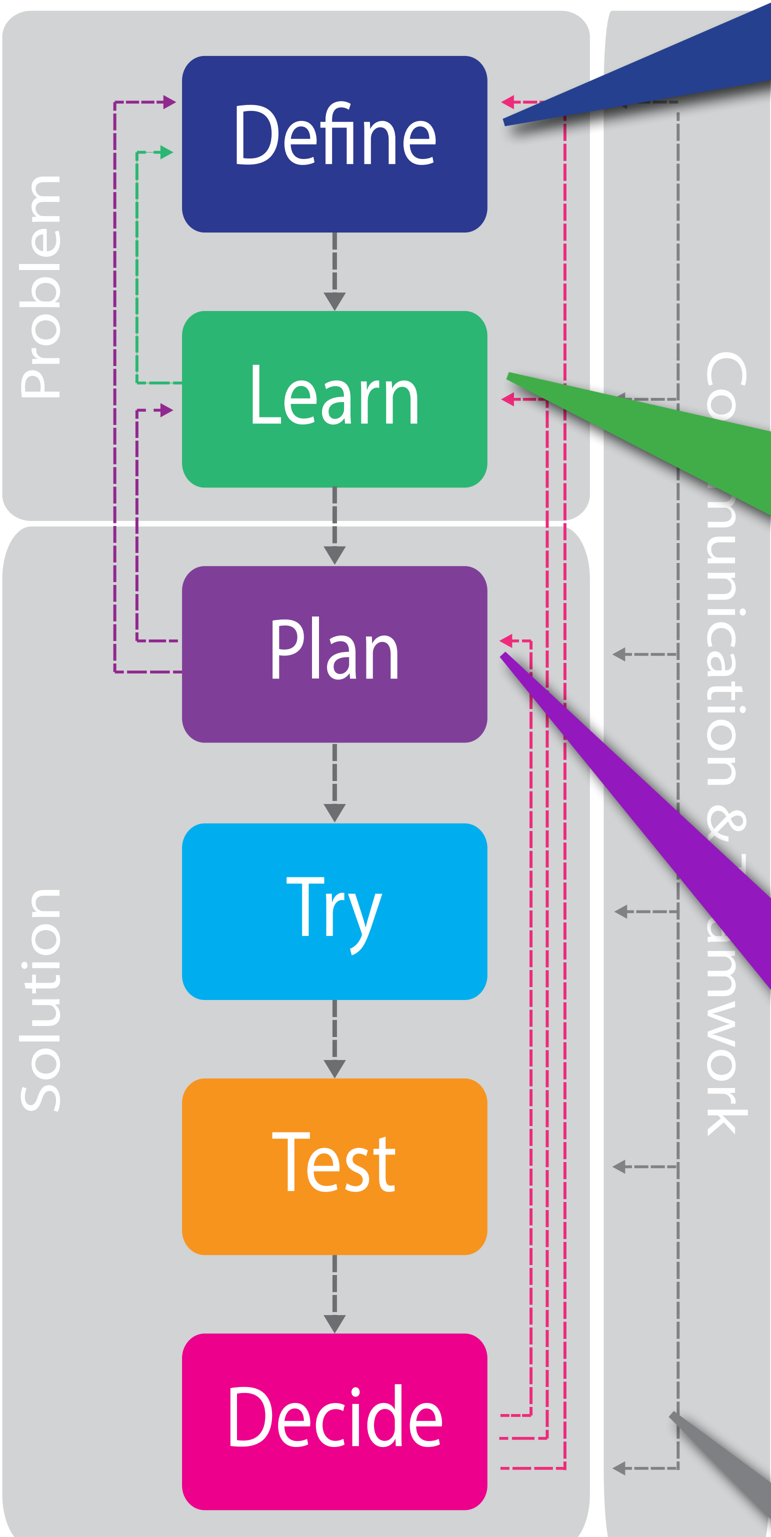
Authors
Melanie Gilbert
Kristen Van Laere
Fredrick Routson
Joseph Furman
Breejha Quezada

Mentors
Greg J Strimel
Selcen Guzey

Overview: Engineering Design Process

Engineering Design Process

A way to improve



DEFINE THE PROBLEM

- Who is the **client**?
- What does the client need?
- Why does the client need it?
- Who is the **end user**?
- Why might the end user want it?
- What are the **criteria** (requirements)and **constraints** (limits) of the solution?

Problem Scoping:
WHO needs **WHAT** because **WHY**

LEARN ABOUT THE PROBLEM

- What kind of background knowledge is needed?
  - What science/math knowledge will be needed?
  - What materials will be needed?
- What has already been done to solve the problem?
- What products fill a similar need?
- How should we measure success and improvement?

PLAN A SOLUTION

- Continue to specify the criteria/ constraints
- Generate ideas of possible solutions
- Develop multiple solution paths
- Consider **constraints, criteria**, and **trade-offs** (criteria that compete with one another)
- Choose a solution to try
- Develop plans (blueprints, schematics, cost sheets, storyboards, notebook pages, etc.)

COMMUNICATION

- Communicate the solution clearly and make sure it is easily understandable
- Use **evidence** to support why the client should use your solution

Overview: Engineering Design Process

TRY A SOLUTION

- Put the plan into action
- Consider risks and how to optimize work
- Use criteria/constraints and consider trade-offs from the problem/plan to build a **prototype** (a testable representation of a solution), **model**, or **product**

TEST A SOLUTION

- Consider testable questions or hypotheses
- Develop experiments or rubrics to determine if the solution is meeting the stated criteria, constraints, and needs
- Collect and analyze data

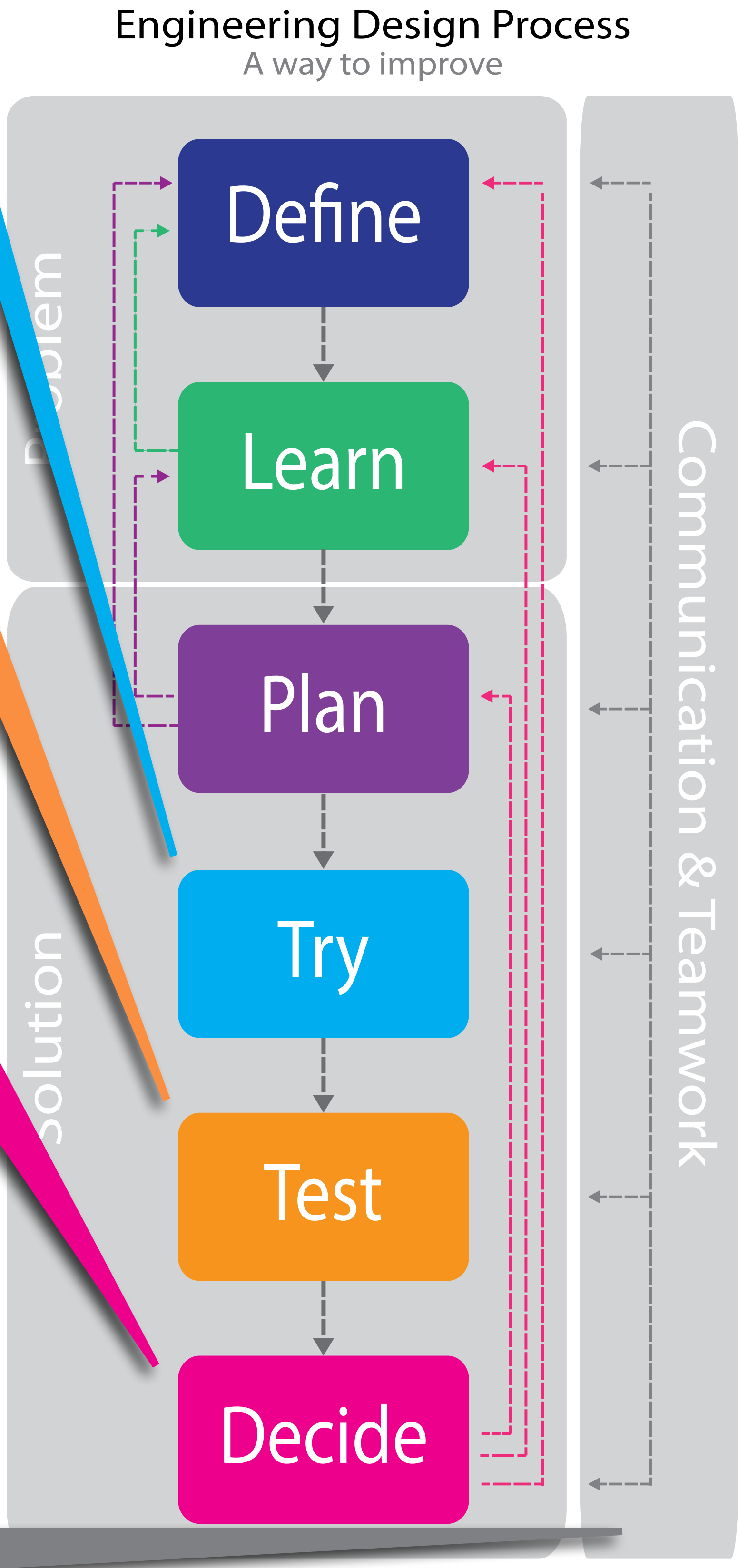
DECIDE IF THE SOLUTION IS GOOD ENOUGH

- Are users able to use the design to help with the problem?
- Does the design meet the criteria and constraints?
- How could the design be improved based on test results and feedback from the client/user?

Iterative nature of design: Always consider which step should be next!

TEAMWORK

- Discuss in teams how the solution meets the criteria and needs of the client
- Consider different viewpoints from each teammate



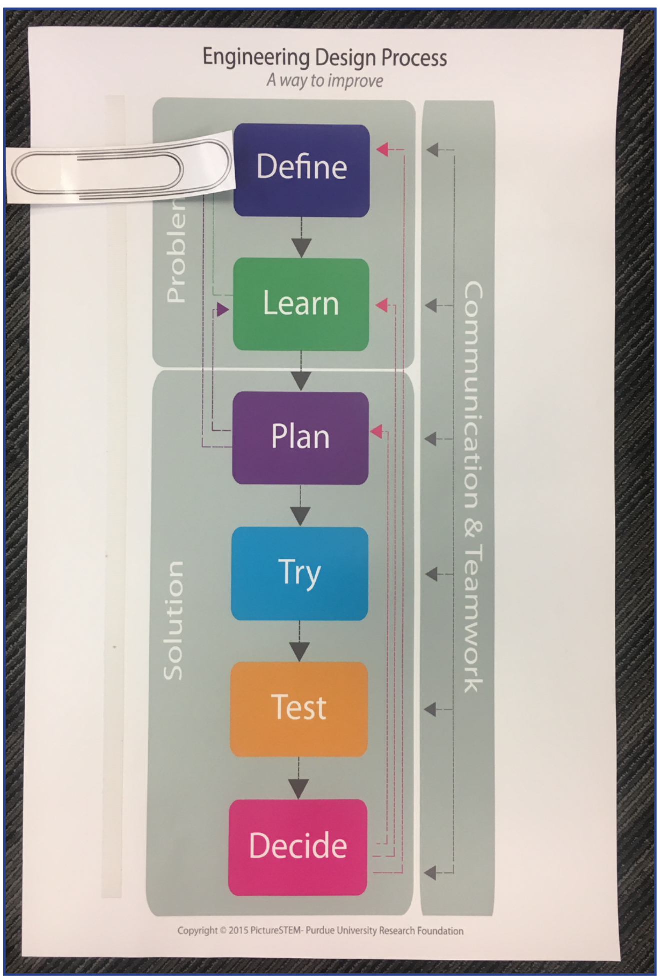
Overview: How to make EDP sliders

How to create the poster

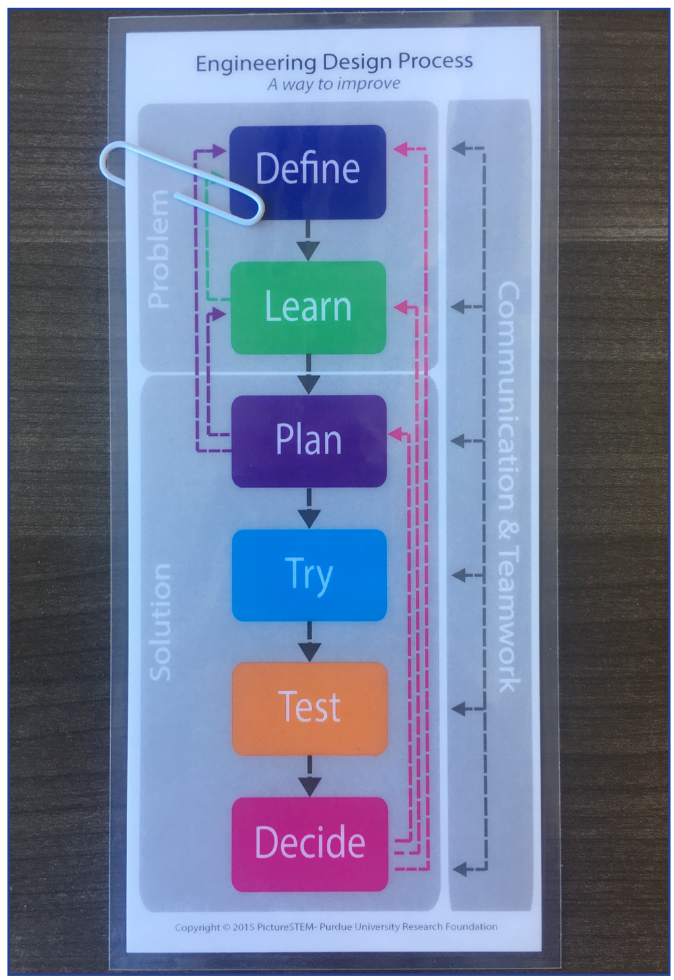
1. Download the high-quality PictureSTEM Slider Poster and the paper clip images from PictureSTEM.org.
2. Print the poster and the paper clip on poster-sized paper and cut to size. High-gloss or semi-gloss paper is the best choice.
3. Use self-sticking Velcro on the back of the paper clip and down the side of the poster so that the paper clip can be placed to point at all 6 sections of the slider.

How to create individual sliders

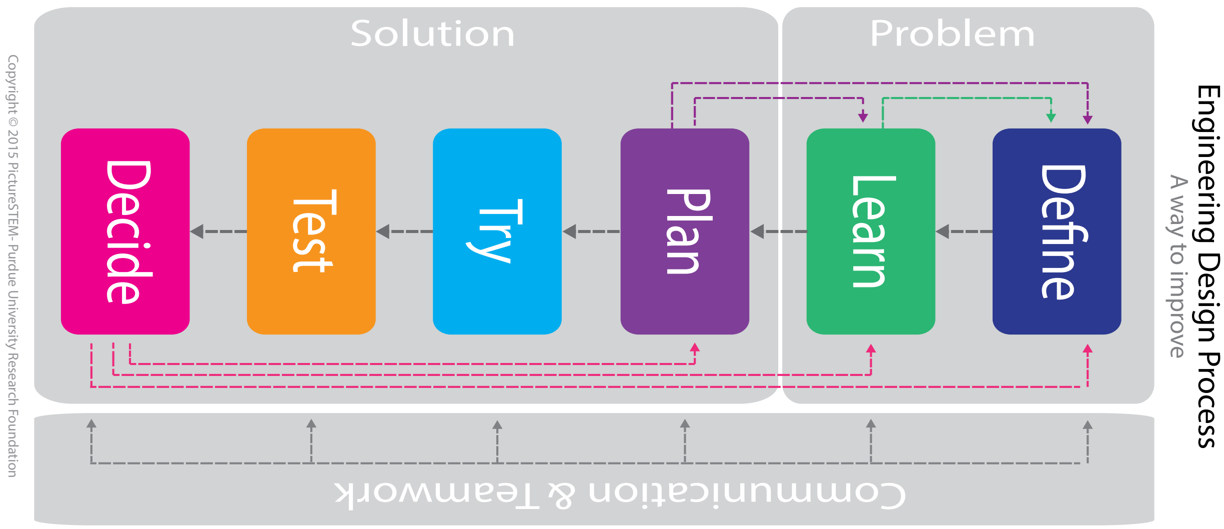
1. Print the sliders on the opposite page - enough for one slider per student in your class.
2. Cut the sliders apart.
3. Laminate the sliders individually.
4. Use a jumbo paper clip as the pointer for each slider.



Poster



Individual slider


Engineering Design Process
A way to improve
Problem
Solution
Define
Learn
Plan
Try
Test
Decide
Communication & Teamwork
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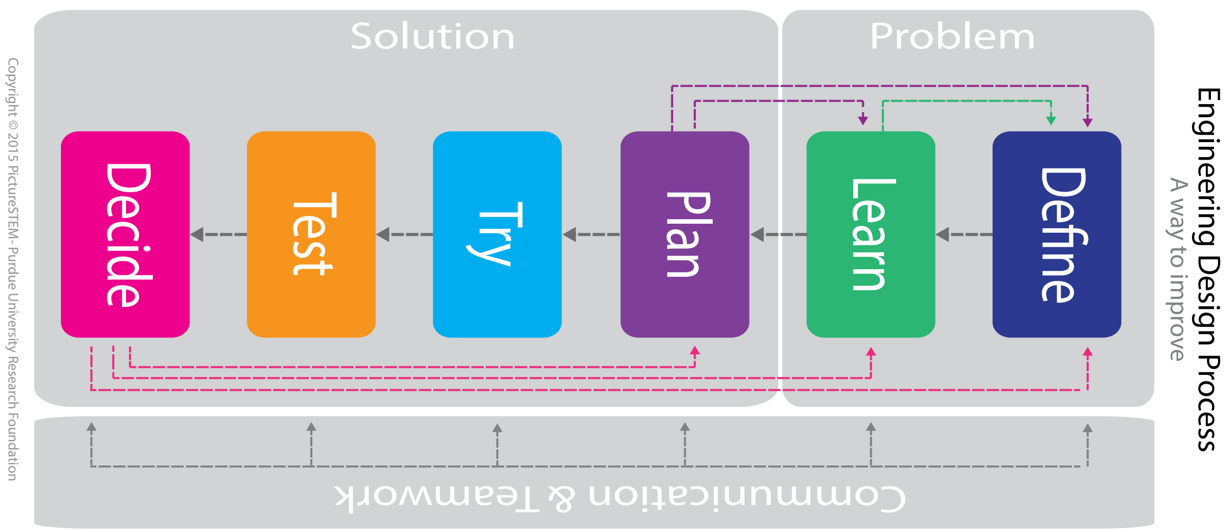
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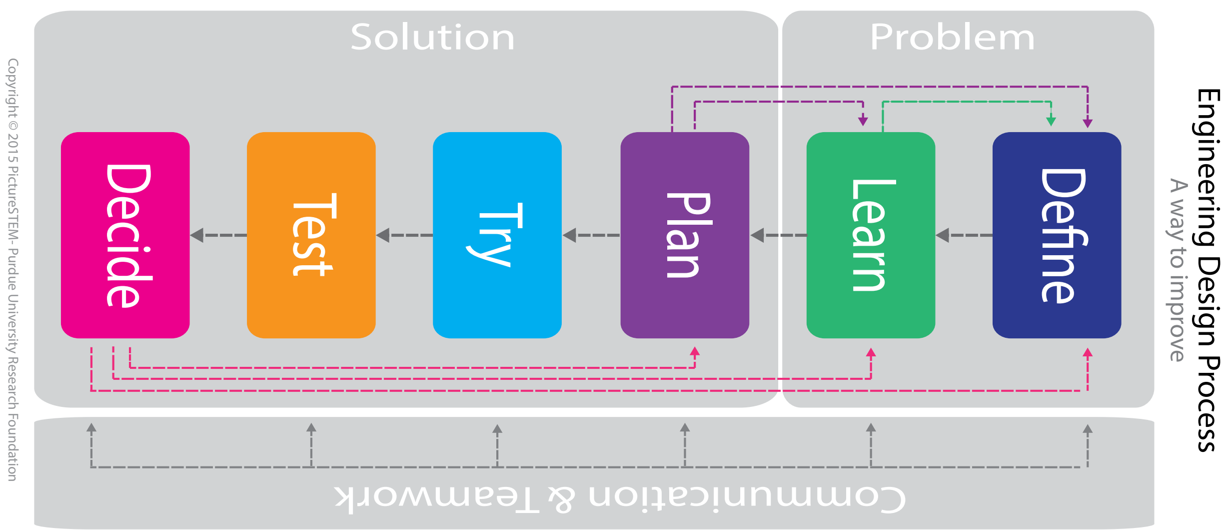
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Unit Overview

Grade Levels: **9th-12th**

Approximate Time Needed to Complete Unit: **10-12 Class periods ~ 2 Weeks**

Unit Summary:

This unit will detail the chip shortage and the effects that the pandemic and other factors had on the supply chain. This will also set up the need to produce chips locally rather than rely exclusively on chips from overseas. There are cybersecurity connections, buisness connections, and engineering design project connections.

Subject Connections:

Science Connections	Technology and Engineering Connections	Mathematics Connections
Brief mentions of electricity, insulators and conductors	Microelectronics, cybersecurity, microchips, digital electronics	Cost Comparisons

Lesson Summaries

Lesson 1: Defining the Problem

Students will learn about engineering, the engineering design process, and criteria and constraints. The students will read and interpret a letter from the client that asks them to participate in an engineering design challenge. Microchips are all around us in cars, phones, computers, gaming consoles, and even electronic toothbrushes. Students will engage with this context and prepare questions for how to move forward in the engineering design process.

Lesson 2: Supply Chain

Examine the chip supply chain, potentials for disruptions, environmental, security, price, and time concerns

Microchips, like any other product are subject to the laws of supply and demand. Disruptions like natural disasters, trade disagreements, or wars are just a few of the examples that can tip a delicate balance and send prices and wait times skyrocketing. Even when the system works as intended, where these microchips come from and who is in charge of making them can cause concerns in security, safety, and environmental sustainability.

Lesson 3: Plan a Solution

Specifically examine the effect that Covid had on the supply chain, and why the chip shortage brought many industries to a halt. Why are we so dependent on them? And What can be Done?
The pandemic really forced industries to reckon with their dependence on international chip supply, and the lack of an industry within the US to be able to compensate. We will be examining the manufacturing process of these chips, ways that we could create a national system to support this process, and pros and cons of the United States doing so.

Lesson 4: Try Some Safe Chips Out

This lesson introduces students to microchip technology and basic block coding using a micro:bit as a pedometer. Students will code the micro:bit, take a walk to test their pedometers, and compare the data with their smartphones. The lesson aims to blend physical activity with technological learning and data analysis. Understanding the versatility of microelectronics and a practical use for them help establish how important the microelectronics supply chain is and why the client problem is important to solve.

Lesson 5: The Case for Safe Chips

In this lesson, students showcase their research and creative solutions through poster presentations or demonstrations. Building on previous lessons where they delved into the complexities of the microelectronics supply chain and explored potential solutions, students now have the opportunity to share their insights and proposed strategies. This culminating activity reinforces the importance of addressing issues in the microelectronics supply chain and highlights the students' problem-solving and presentation skills honed throughout the curriculum.

Unit Overview

Unit Planner

Lesson	Time Needed	Objectives	Materials	Duplication Master
1. Defining the Problem	2 Days	Students will be able to: • Identify the problem from a client. • Identify background knowledge needed to develop a solution. • Explain the criteria and constraints of the provided design brief.		
2. Supply Chain	2 Days	Students will be able to: • Explain key links of the supply chain • Identify the relationship between the supply chain, consumers, pricing, and product availability • Describe influential factors that impact the supply chain when given a specific phase of the supply chain to examine.		
3. Plan a Solution	2 Days	Students will be able to: • Identify supply chain issues within a specific industry context such as microelectronics • Compare and contrast the United States manufacturing supply chain with other countries • Develop a clear and concise project proposal for a given client.		

Lesson	Time Needed	Objectives	Materials	Duplication Master
4. Try Some Safe Chips Out	3 Days	Students will be able to: • Identify where examples of microchips are in the real world • Interact with microelectronics to understand components		
5. The Case for Safe Chips	1-2 Days	Students will be able to: • Develop an economical argument related relocating an industry, such as microchip production, to the United States. • Evaluate the economical pros and cons of relocating industries to different countries.		

Master Material List

	Unit Materials	Lessons Where Material is Used
Per Classroom		
Per Group		
Per Student		

LESSON ONE:

Lesson Objectives
Students will be able to:
- Identify the problem from a client.
- Identify background knowledge needed to develop a solution.
- Explain the criteria and constraints of the provided design brief.

Time Required
One 50-minute lesson

Standards Addressed
NGSS HS ETS1-1

Key Terms
Client, engineering design process, criteria, constraints, microelectronics

Lesson Materials
Per classroom
- EDP Poster
- Chart paper

Per student
- EDP slider and paperclip
- Laptop/Chromebook/ Tablet
- Engineering notebook

Lesson Summary
Students will learn about engineering, the engineering design process, and criteria and constraints. The students will read and interpret a letter from the client that asks them to participate in an engineering design challenge. Microchips are all around us in cars, phones, computers, gaming consoles, and even electronic toothbrushes. Students will engage with this context and prepare questions for how to move forward in the engineering design process.

Teacher Background

Teamwork
Students should be teamed strategically and may or may not be assigned jobs within their team. When forming student teams, consider academic, language, and social needs. In place of strategic teaming, a random teaming can be substituted. Students will work in these teams of 3 or 4 throughout the unit. Effective teamwork is essential in this unit as well as in engineering in general. The teams will operate as consulting engineers with each team specializing in a specific measuring device eventually working together as a class to address the client's problem.

Engineering Design Process
NOTE: If students are familiar with the engineering design process (EDP) before beginning the unit, the teacher can skip this (EDP) introduction.

The engineering design process (EDP) is an iterative, systematic process used to guide the development of solutions to engineering problems. There is no single engineering design process, just like there is no one scientific method. However, the various engineering design processes have similar components. The engineering design process (EDP) involves understanding the problem, learning background information necessary to solve the problem, planning, trying, testing the solution, making changes based on the tests, and communicating their ideas. Students will use an engineering design process slider throughout the unit to help them understand where they are in the design process. For more information about the steps of the engineering design process presented in this unit, see the front matter section about it.

Some common misconceptions about engineering

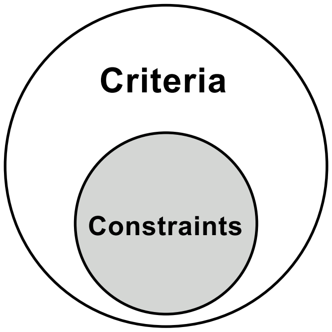
- Engineers do not have to learn anything new when they are working on a project. **In reality:** Engineers need to continually learn throughout their lives.
- Engineers come up with solutions that are just "good enough" and do not take risks. **In reality:** Engineers strive to create the best solution possible through optimization. It is normal to experience failure when solving engineering problems.
- Engineers work alone to solve a design problem. **In reality:** Engineers collaborate with people in different disciplines and fields to best solve a problem. Engineering problems often require a wide range of content knowledge.

Some common misconceptions about the EDP

- The engineering design process is linear, and you never need to go back to previous phases. **In reality:** The EDP is a cyclical process that requires many iterations.
- Once the project is done, it is considered complete and not revisited. **In reality:** The engineering design process is never really "done" and it is revisited so engineers can improve projects and make changes.

Criteria and Constraints:

One difficulty that students might experience is distinguishing between criteria and constraints. Criteria are the things required for a successful design, or goals of the designed solutions. They help engineers decide whether the solution has solved the problem. Another way of thinking about criteria are that they are anything that the client and the engineers will use to judge the quality of a solution. Constraints are a specific type of criteria; they are those criteria that limit design possibilities, or the ways that that problem can be solved. If constraints are not met, the design solution is by default not a viable solution to the problem. The relationship between criteria and constraints is represented in the figure. It may be helpful to post the definitions with the figure somewhere in the classroom for future reference.



Duplication Masters
1.A Content Pre-Assessment
1.B Problem Scoping Prompts
1.C Client Letter
- 1.C1 for business classes
- 1.C2 for engineering classes

Educator Resources
1.D Problem Scoping Section 3 Key
- 1.D1 for business classes
- 1.D2 for engineering classes

LESSON ONE:

Assessment

Pre-Activity Assessment

Assess students' prior knowledge by listening to their responses to 1.B Problem Scoping Prompts. Use students' answers to 1.A Content Pre-Assessment as baseline data about the students' current level of understanding and background knowledge.

Activity Embedded Assessment

Observe students' discussions and written responses to 1.B Problem Scoping Prompts. Check students' brainstorming lists to see if they can identify the content they will be expected to master by the end of the unit.

Post-Activity Assessment

Use the 1.E Problem Scoping Section 3 Key to evaluate students' answers to the notebook prompts.

Problem Scoping

In this lesson, students will be in the Problem Scoping section of the engineering design process, specifically on the define the problem step. Define the problem and learn about the problem combine to make Problem Scoping. In this stage, students will be first introduced to the engineering problem through a client letter and then be given a chance to ask questions to the client to receive more information about the problem. The problem statements given in the client memos purposefully do not provide all the information necessary to solve the problem. Students are tasked with generating questions about the problem to try to fill in this missing information. Based on all information from the client, students will then define the problem in terms of: what the problem is and why it is important, who are the client and end users, what are the criteria and constraints, and what other information they may need to learn about in order to solve the problem. This process of generating ideas and questions for the client is an important skill on its own both in engineering and in other fields, but it also helps to ensure that the students fully understand the problem and their task in the engineering design challenge.

Solution Generation

The Solution Generation section of the engineering design process includes plan the solution, try out the plan of the solution, test the solution, and decide whether the solution is good enough. When engineers are generating solutions, they will use iteration as a means to continually improve their solution, reflect back on the problem definition and what they have learned about the problem, and consider criteria, constraints, and trade-offs. Trade-offs involve having to make compromises about which criteria to emphasize because they compete with one another in terms of making the solution effective. For example, cost could be a trade-off for durability.

Engineering Notebook

Throughout the unit students will be recording information in an engineering notebook, and they will need the notebook immediately in Lesson 1. The engineering notebook is a digital set of documents which includes writing prompts, black space to take notes or upload pictures of work, and digital copies of the duplication masters that are listed in each lesson. The engineering notebook is offered as a google doc but can be adapted to your classroom needs. Students' engineering notebooks will support their communication of ideas and should be used consistently throughout the unit.

Vocabulary
Students will be introduced to many new science and engineering vocabulary terms throughout the unit. It may be helpful to create a vocabulary section in their notebook with term definition and memory clue. Additionally, the class could maintain a word wall.

Before the Activity
- Assemble the Engineering Design Process Sliders and post the EDP poster in the classroom (see the front matter for how to assemble them). If your students do not want to use the sliders, simply hanging the poster achieves the same result. Make sure you and your students can refer to the EDP sliders and/or poster throughout the unit.
- Determine student teams of three or four. These teams should be their teams throughout the rest of the unit.
- Print and make copies of the following worksheets in the labeled amounts:
  - (1 per student) 1.A Content Pre-Assessment, 1.D Client Letter

Classroom Instruction
Introduction
1. **Complete the pre-assessment activity.** The students will participate in a more formal pre-assessment to assess their current level of knowledge and understanding regarding the topics of supply chain, microelectronics, and the engineering design process. Using the questions on the 1.A Content Pre-Assessment, distribute hard copies of the survey. Make sure to tell students that this is just to assess any prior knowledge, so it is okay to not know the answers.
2. **Review prior knowledge.** Lead a discussion with the class in which students are able to share their prior knowledge on the topics of engineering, supply chain, microchips. *Prompts may include the following: What do engineers do? What kinds of industries do engineers work in? What is a microchip? What might be some reasons why there is a microchip shortage?*
3. **Set up engineering notebooks. Say:** *Engineers use notebooks to document their design process and keep notes. We will also be using Engineering Notebooks throughout our engineering challenge. Each day, you'll use the digital notebooks to take notes and record what you are learning. In addition, there are*

questions that you'll be asked to answer. NOTE: You can have your students type in their notebooks in two different colors – one for thoughts and prompts that are individual and one for thoughts and prompts that they discuss in their teams. This will help both you assess, and the students recognize, where ideas came from. You also may want to have students start a Table of Contents page.

4. **Complete problem scoping section 1.** Direct students to the 1.B Problem Scoping Prompts in their engineering notebooks. Have students individually answer the prompts from section 1. Make sure to let them know that it is okay if they do not know very much about engineers or engineering – just have them answer these questions to the best of their ability.
5. **Form teams.** After students have finished the prompts, explain that for the rest of the unit they will start the day with a review of the engineering design process, and then look at a specific problem that will require the use of that process. Explain that students will be working in small teams to solve a problem being brought to them by the client. Divide students into teams of 3 or 4.

Activity

6. **Discuss engineers and engineering.** Allow students to share their answers from 1.B Problem Scoping Prompts section 1. Define engineers and engineering and take some notes for students to type in their notebooks. As a class create a list of the different types of engineering and have students brainstorm careers that may fall within each type of engineering in their notebooks. Explain that the problem they will be solving falls under the category of environmental engineering and draws on biology and electronics to understand the context and generate a solution.
7. **Introduce the Engineering Design Process.** Display the Engineering Design Process poster and pass out individual EDP Sliders and a paper clip to each student. **Say:** *Engineers use an engineering design process, along with mathematics, science, and creativity, to understand a problem and come up with a solution. Since we are working as engineers during this unit, we will be using this engineering design process as a guide while we come up with a solution for our engineering problem.* Go through the EDP Slider and ask the students what they think each stage involves. Be sure to clarify any misconceptions and elaborate where needed. There is a detailed description of the EDP Slider in the front matter of the unit. **Ask:** *Based on what*

we have discussed so far, where do you think we are in the engineering design process? **(Define).**

8. Introduce the problem. Discuss with students about the chip shortage. Watch https://youtu.be/IUfobGJVszs?si=q7TMonZcbKY4P5j7 (about 5 mins) OR https://youtu.be/sfAyXjRFUJk?si=3Pwaa6DqI5w-rj51 (about 10 mins) depending on the time allotted. Allow students time to read copies of the 1.D Client Letter. Encourage them to type in their notebooks as they read to keep track of important information. Give students time to discuss in small teams what information they read in the letter. **Ask:** *What is the challenge? What are some possible constraints and criteria?*
9. **Identify the problem from the client.** Have the students reread the letter, if necessary, to identify the problem and type it in their notebooks.
10. **Identify required information.** Have students work together to brainstorm a list of "required information" in order to help the client with their request. Encourage them to highlight/underline the things on their list they already know. Then as a class create an anchor chart that will be revisited throughout the unit. As students learn information you can check content off of the anchor chart or add to it if they think of some other information that they will need to help the client.
11. **Complete problem scoping section 2.** After reading the letter, direct students to respond to section 2 of the 1.B Problem Scoping Prompts in their notebooks. They can do this individually or in teams.
12. **Complete problem scoping section 3.** After students have completed the section 2 prompt, direct students to section 3 of 1.B Problem Scoping Prompts. They can do this individually or in teams.

Closure

13. **Revisit the problem.** Give the students a chance to revise their list of questions or required information they composed for the engineering challenge.
14. **Discuss the engineering design process. Ask:** *Which phase of the engineering design process did we focus on related to our challenge today? Why is this important?* Ex: Students need to understand the root problem from the perspective of the client and other stakeholders before attempting a solution.

Name_______________________________________ Date_______________ Period __________

1.A Content Pre-Assessment

Name____ Date_______________ Period __________

1.A Content Pre-Assessment

Name____ Date_______________ Period __________

1.B Problem Scoping Prompts

Section 1:

Directions: Please answer the following questions.

1. What do engineers do?

2. How do engineers solve problems?

Section 2:

Directions: Please answer the question after hearing about the engineering design challenge.

3. What questions do you want to ask the client?

Section 3:

Directions: Please answer these questions after you have been able to ask questions about the challenge. First, complete each prompt on your own. Then write your revised answer (if different) to the prompt, based on the discussion with your team. You may use a different color writing utensil to distinguish your answer and how it changed after talking with teammates.

4. The client is:

5. The client's problem is:

6. The problem is important to solve because:

7. The end-users are:

8. An effective solution for the client will meet the following criteria:

Name_______________________________________ Date_______________ Period __________

1.B Problem Scoping Prompts

9. The constraints (or the limits) of the solution are:

10. Think about the problem of carbon emissions. In terms of designing a method to combat this issue, what are at least 2 things you need to learn in order to make an evidence-based recommendation? Make sure to consider all important aspects of the problem. Be specific.

1.C1 Client Letter – Business Class

Dear Engineers,

The world is currently facing a shortage of microchips that has impacted essentially every industry. These microchips are used in agriculture, science, medicine, engineering, and even throughout your own classroom. The chip shortage that began in 2020 led to an increase in prices and requires reuse of products. As global participation in technology continues to increase, so does the need for increased production of microchips.

My company works to increase US participation in the microelectronics industry. This is important so that we remain competitive among the global push to engage with this industry. I would like you to examine the business side of the microchip shortage and determine the economic viability of producing microchips in the United States and develop a proposal for relocating the manufacturing of microelectronics to the U.S. in order to solve current/future global supply chain issues.

Please use the engineering design process, the business and supply chain knowledge that you will acquire, and your ingenuity to make an evidence-based recommendation for us. Please include this recommendation in your final report so we know why you have come to your conclusion. Note that this recommendation must be reliable, cost-effective, ethical, and demonstrate the use of scientific reasoning. We look forward to reading your report and implementing your result.

Sincerely,

Charlie “Chip” Campbell
Engineer
SAFE Chips

1.D1 Problem Scoping Section 3 Key – Business Class

Section 3:

4. The client is:

   Charlie "Chip" Campbell at SAFE Chips.

5. The client's problem is:

   There is a global microchip shortage.

6. The problem is important to solve because:

   Microchips are used in essentially every industry.

7. The end-users are:

   Everyone that uses microchips.

8. An effective solution for the client will meet the following criteria:

   The recommendation should be reliable, cost effective, ethical, and demonstrate the use of scientific reasoning.

9. The constraints (or the limits) of the solution are:

   The solution needs to be implemented within the next calendar year.

10. Think about the problem of carbon emissions. In terms of designing a method to combat this issue, what are at least 2 things you need to learn in order to make an evidence-based recommendation? Make sure to consider all important aspects of the problem. Be specific.

    Answers will vary. Potential ideas include learning what a microchip is, how to make a microchip, what type of facility makes microchips, how quickly they can be produced, what facilities currently exist in the US, etc.

LESSON TWO:

Lesson Objectives
Students will be able to:
- Explain key links of the supply chain
- Identify the relationship between the supply chain, consumers, pricing, and product availability
- Describe influential factors that impact the supply chain when given a specific phase of the supply chain to examine.

Time Required
One 50-minute lesson

Standards Addressed
PMK 1.6 Explain the Nature of Global Trade

Key Terms
Supply chain, consumers, demand, production

Lesson Summary
Examine the chip supply chain, potentials for disruptions, environmental, security, price, and time concerns

Microchips, like any other product are subject to the laws of supply and demand. Disruptions like natural disasters, trade disagreements, or wars are just a few of the examples that can tip a delicate balance and send prices and wait times skyrocketing. Even when the system works as intended, where these microchips come from and who is in charge of making them can cause concerns in security, safety, and environmental sustainability.

Objective: By the end of this lesson, students will be able to understand the intricacies of the microchip supply chain, recognize potentials for disruptions, and discuss the environmental, security, price, and time concerns associated with the microchip industry.

Teacher Background

Background Information on Lesson Content
Teachers may find watching the video and reading the article provided to the students helpful in providing an introduction to the microelectronics supply chain

Before the Activity
Make sure students have access to the article and/or the YouTube video on their individual devices, otherwise it might have to be accessed by the instructor and gone through as a class.

Classroom Instruction

Introduction (10 minutes)
1. **Identify where students are in the Engineering Design Process. Say** *So we have been introduced to a problem by the client, and now we get to learn more about it.*
2. **Introduction to Supply Chain: Say** *Who here has heard of the term 'supply chain'? And who thinks they have a definition for it?* Have students share their definitions. Encourage them to write these in their engineering notebooks. **Say** *A supply chain is the entire process of making and selling commercial goods. It starts with raw materials and ends with the final product in the hands of consumers. Each step in this chain, from design and manufacturing to distribution and sales, is interconnected and essential. In the microelectronics industry, the supply chain is especially complex and fascinating, impacting everything from*

smartphones to satellites. Today, we are going to learn all about it, and it will help us solve the client problem.

Main Activity (30 minutes)

3. **Create the Chain** Assign a small group of students to each phase of the supply chain:
(1) Research, design, and development, (2) Material Procurement and Manufacturing, (3) Testing, Quality Control, and Packaging, (4) Distribution and Market Integration, (5) Recycling and Sustainability.

   Research, Design, and Development: This is the initial phase where engineers and designers work on creating new microelectronic products or improving existing ones. It involves research into new technologies, designing the electronic components, and developing the blueprint for manufacturing.

   Material Procurement and Manufacturing: In this step, the necessary materials and components are sourced and procured. This includes semiconductor materials, substrates, and other essential elements. The manufacturing process involves the fabrication of microchips and other electronic components using specialized machinery and techniques.

   Testing, Quality Control, and Packaging: After manufacturing, rigorous testing is conducted to ensure the electronic components meet the required specifications and quality standards. Faulty components are identified and discarded. Once validated, the components are packaged to protect them from external factors and handling during transportation.

   Distribution and Market Integration: This step involves the distribution of microelectronics to various markets and customers. Manufacturers may work with distributors and retailers to make their products available to end-users. Integration into various applications, such as consumer electronics, automotive, or industrial systems, occurs during this phase.

   Recycling and Sustainability: As electronics reach the end of their lifecycle, the recycling and sustainability phase becomes crucial. This step involves proper disposal and recycling of electronic waste (e-waste) to minimize environmental impact. Sustainable practices, such as reusing components or materials, are promoted to reduce waste and conserve resources.

Lesson Materials

Per classroom

- EDP Poster

Per student

- EDP slider and paperclip
- Laptop/Chromebook/ Tablet
- Engineering notebook

Duplication Masters

2.A Microchip Supply Chain Worksheet

Have Students put together a few slides of a PowerPoint presentation, to combine at the end of class into a discussion of the supply chain. See Duplication Masters 2.A for an optional worksheet to help students find what information is important to the supply chain.

A. Students Can Read this Article: https://www.investopedia.com/semiconductors-supply-chain-7367716
B. Or Watch this Video https://youtu.be/z9RDXd2xeks?si=oKQWa10YfDUGkfB1

To start learning about the semiconductor (microelectronics) supply chain

Conclusion (10 minutes)

4. **Group Sharing:** Have students share their slides in order that a microchip would go through to get from the beginning of the chain to a consumer product of instructor choice. Share that in the real world, presentations sometimes have to be generated to quickly summarize an industry and propose a problem to be solved.
5. **Have students reflect on how this exercise could help them solve the problem in the client letter.**

Name______________________________________ Date______________ Period __________

2.A Microchip Supply Chain Worksheet

Microchip Supply Chain Worksheet

Objective: By completing this worksheet, you will gain an understanding of your assigned phase in the microchip supply chain, recognize potential disruptions, and explore environmental, security, price, and time concerns associated with the industry.

Your Name: ______________________________

Assigned Phase: ______________________________

Instructions:

1. Review the introductory information (i.e., article and videos) provided by your teacher.

2. Define the term “supply chain” in your own words:

____

____

Main Activity (30 minutes):

Phase Overview:
- Briefly describe your assigned phase in the microchip supply chain. What is its primary purpose and role within the supply chain?

____

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Disruptions:
- Identify and describe various types of disruptions that can affect your assigned phase within the supply chain. Consider natural disasters, trade disagreements, and other potential challenges.

____

____

Name____ Date_______________ Period __________

2.A Microchip Supply Chain Worksheet

Real-World Experience:
- Reflect on any personal or observed experiences related to supply chain disruptions, especially during the COVID-19 pandemic. How did disruptions affect the availability of products?

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Concerns:
- Discuss any environmental, security, price, or time concerns associated with your assigned phase. How do these concerns impact the overall supply chain?

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____

LESSON THREE:

Lesson Objectives
Students will be able to:
- Identify supply chain issues within a specific industry context such as microelectronics
- Compare and contrast the United States manufacturing supply chain with other countries
- Develop a clear and concise project proposal for a given client.

Time Required
Two 50-minute lessons

Key Terms
Supply Chain, microelectronics, business proposal

Teacher Background

If students don't have a lot of experience with brainstorming, this video may be helpful to them https://youtu.be/mtn31hh6kU4?si=RgLKzHSRYMAokp88

Classroom Instruction

Introduction (5 minutes)

1. **Identify where Students are in the Engineering Design Process. Say** *Now that we know a little about the problem and how the supply chain exists right now, we are going to plan for a solution. We are going to create a proposal for why and how relocating the microelectronics supply chain to the U.S. could solve current industry problems.*

Main Activity (2 days)

2. **Problem Identification and Research** (25 minutes): Group Formation: Organize students into groups, with each group focusing on a specific problem in the current global supply chain. Research Areas: Assign topics such as geopolitical risks, trade conflicts, environmental concerns, labor issues, logistical challenges, or technological limitations. Problem Analysis: Instruct each group to research their assigned problem, exploring its causes, impacts, and how relocation to the U.S. might offer solutions.
3. **Solution Formulation** (15 minutes): Based on their research, each group proposes solutions and strategies for how relocating to the U.S. could address their identified problem. Encourage innovative thinking, considering economic, technological, and policy-related solutions. Groups prepare a brief outline of their problem and proposed solution.

Conclusion (5 minutes)

4. **Group Insights Sharing:** Allow each group to share a key insight from their problem-solution analysis.
5. **Preparing for Consolidation:** Inform students that the next lesson will involve combining these sections into a comprehensive relocation proposal.

Lesson Materials

Per classroom

- EDP Poster

Per student

- EDP slider and paperclip
- Laptop/Chromebook/ Tablet
- Engineering notebook

Duplication Masters

3.A, 3.B

Name_______________________________________ Date_______________ Period __________

3.A Brainstorming Worksheet

Brainstorming

When brainstorming with your teammate(s), you get to ask the questions! Try to figure out what they are thinking about and how it will help our client with the challenge.

Idea #1:

Idea #2:

Idea #3:

Idea #4:

Idea #5

Name____ Date_______________ Period __________

3.B Design Sketching

Now choose one idea from your group (you can also look for ways to combine ideas) this can be a concept map, a presentation outline/plan or any other graphic that can help you plan your next steps

LESSON FOUR:

Lesson Objectives
Students will be able to:

- Identify where examples of microchips are in the real world
- Interact with microelectronics to understand components

Time Required
One 50-minute lesson

Standards Addressed
HS-ETS1-3.

Key Terms
Microcontroller

Lesson Summary

This lesson introduces students to microchip technology and basic block coding using a micro:bit as a pedometer. Students will code the micro:bit, take a walk to test their pedometers, and compare the data with their smartphones. The lesson aims to blend physical activity with technological learning and data analysis. Understanding the versatility of microelectronics and a practical use for them help establish how important the microelectronics supply chain is and why the client problem is important to solve.

Classroom Instruction

Introduction

1. **Introduction to Micro:bits (10 minutes)** Briefly explain what microchips are and their significance in everyday devices. Introduce the micro:bit and its capabilities. Discuss the concept of a pedometer and its practical uses.

Activity

2. **Block Coding Tutorial (15 minutes)**
   Guide students through the process of programming their micro:bits to count steps. Use a block coding platform suitable for micro:bits: https://microbit.org/projects/make-it-code-it/step-counter/. Demonstrate how to transfer the code to the micro:bit.
3. **Pedometer Walk (10 minutes)** Have students attach their micro:bits to themselves (e.g., on their wrist or shoe) Students should also activate the pedometer app on their smartphones. Take a supervised walk around the school, ensuring each student walks the same distance.
4. **Data Collection and Comparison (10 minutes)** After the walk, students will note the number of steps counted by both the micro:bit and their smartphone. Encourage them to observe any discrepancies and ponder the reasons.

Conclusion (10 minutes)

5. **Analysis and Reflection (5 minutes)** Discuss the accuracy and reliability of micro:bit vs. smartphone pedometers. Reflect on the challenges and advantages of using micro:bits, and how the microchips industry is critical to daily life.

Lesson Materials

Per classroom

- EDP Poster
- Chart paper

Per Student

- EDP slider and paperclip
- Laptop/Chromebook/ Tablet
- Engineering notebook

Duplication Masters

4.A

Name____ Date_______________ Period __________

4.A

Data Analysis Questions:

1. **Did the micro:bit and your smartphone record the same number of steps? If not, why do you think there were differences?**

2. **What factors might affect the accuracy of a pedometer?**

3. **How could the micro:bit pedometer be improved for better accuracy?**

4. **What did you learn about block coding and its applications in real-world scenarios?**

5. **How do microchips in devices like the micro:bit and smartphones impact our daily lives?**

Name____ Date________________ Period ___________

LESSON FIVE:

Lesson Objectives
Students will be able to:
- Develop an economical argument related relocating an industry, such as microchip production, to the United States.
- Evaluate the economical pros and cons of relocating industries to different countries.

Time Required
One 50-minute lesson

Standards Addressed
HS-ETS1-3.

Key Terms
Microcontroller

Lesson Summary

In this lesson, students showcase their research and creative solutions through poster presentations or demonstrations. Building on previous lessons where they delved into the complexities of the microelectronics supply chain and explored potential solutions, students now have the opportunity to share their insights and proposed strategies. This culminating activity reinforces the importance of addressing issues in the microelectronics supply chain and highlights the students' problem-solving and presentation skills honed throughout the curriculum.

Classroom Instruction

Introduction (First 5 minutes)

1. Welcome the students and remind them of the purpose of today's class, which is to present their proposals about relocating the microelectronics supply chain.
2. Briefly introduce the rubric for evaluating their presentations.
3. Explain the order of presentations and any logistical details, such as time limits for each group.

Main Activity

4. Group 1 Presentation (4 minutes): Allow Group 1 to present their proposals
5. Group 1 Q&A and Feedback (2 minutes): Open the floor for questions and comments from the audience and provide feedback based on the rubric.
6. Repeat steps 4 and 5 for Groups 2, 3, 4, and 5, ensuring that each group gets their allotted time for presentation and feedback.
7. Facilitate a brief class discussion (5 minutes) after all presentations are completed. Encourage students to share their observations, insights, and what they learned from the presentations.
8. Ask students to discuss which solution they found most innovative and feasible (5 minutes).
9. Provide any additional comments or insights based on the overall quality of the presentations.

Conclusion (Last 5 minutes)

10. Summarize the key takeaways from the presentations and the class discussion.
11. Emphasize the importance of presentations as a skill and how constructive feedback can help students improve.
12. Remind students that the goal is not just to earn points but also to develop valuable skills in researching, presenting, and problem-solving.
13. Conclude the class by thanking the students for their hard work and participation.

Lesson Materials

Per Classroom

- EDP Poster
- Chart paper

Per Student

- EDP slider and paperclip
- Laptop/Chromebook/ Tablet
- Engineering notebook

Duplication Masters

5.A

5.A

Comprehensive Rubric for Evaluating Student Presentations on Relocating the Microelectronics Supply Chain

1. Content (40 Points Total)
   Accuracy (10 Points):
      10: Information is factually correct, detailed, and well researched.
      7: Mostly accurate with minor inaccuracies or omissions.
      4: Several inaccuracies or lacks depth in research.
      0: Information is mostly inaccurate or very poorly researched.

   Relevance (10 Points):
      10: Directly addresses the assigned problem and solution with high relevance.
      7: Generally relevant but with some areas lacking direct connection.
      4: Only partially relevant to the topic.
      0: Off topic or fails to address the assigned problem/solution.

   Integration (10 Points):
      10: Proposal integrates different aspects seamlessly, showing a holistic understanding.
      7: Good integration with minor disjointed areas.
      4: Some integration, but many areas are disconnected.
      0: Lack of integration, very fragmented.

   Scope (10 Points):
      10: Covers all necessary aspects of the supply chain and solutions comprehensively.
      7: Covers most aspects, but misses some important details.
      4: Covers only a few aspects, missing significant details.
      0: Very narrow or superficial coverage of the topic.

2. Creativity and Innovation (20 Points Total)
   Originality (10 Points):
      10: Highly original and innovative, showing unique problem solving.
      7: Some original ideas, but also relies on conventional concepts.
      4: Limited originality, mostly conventional ideas.
      0: Lacks originality, completely conventional.

   Feasibility (10 Points):
      10: Solutions are practical, realistic, and well considered.
      7: Mostly practical, with minor unrealistic elements.
      4: Some practical ideas, but many unrealistic elements.
      0: Solutions are impractical or unrealistic.

3. Presentation (20 Points Total)
   Clarity and Organization (10 Points):
      10: Exceptionally clear and well organized.
      7: Generally clear with minor organizational issues.
      4: Somewhat disorganized or unclear.
      0: Very disorganized or difficult to understand.

   Engagement (10 Points):
      10: Highly engaging, maintains audience interest throughout.
      7: Moderately engaging, with some lapses in interest.
      4: Limited engagement, struggles to maintain interest.
      0: Not engaging, fails to capture interest.

4. Collaboration and Teamwork (20 Points Total)
   Participation (10 Points):
      10: All team members actively and equally participate.
      7: Most members participate, but some unevenness in contribution.
      4: Uneven participation, with some members minimally involved.
      0: Poor participation, one or more members not contributing.

   Cohesion and Communication (10 Points):
      10: Excellent teamwork, with clear communication and coordination.
      7: Good teamwork, minor issues in communication or coordination.
      4: Some teamwork, but noticeable issues in communication.
      0: Poor teamwork, significant communication issues.

Total Points: 100

Notes for Teachers:
Use this rubric as a guide, adjusting as necessary. Encourage students to review the rubric beforehand to understand the expectations. Offer feedback along with the scores to help students understand their strengths and areas for improvement.