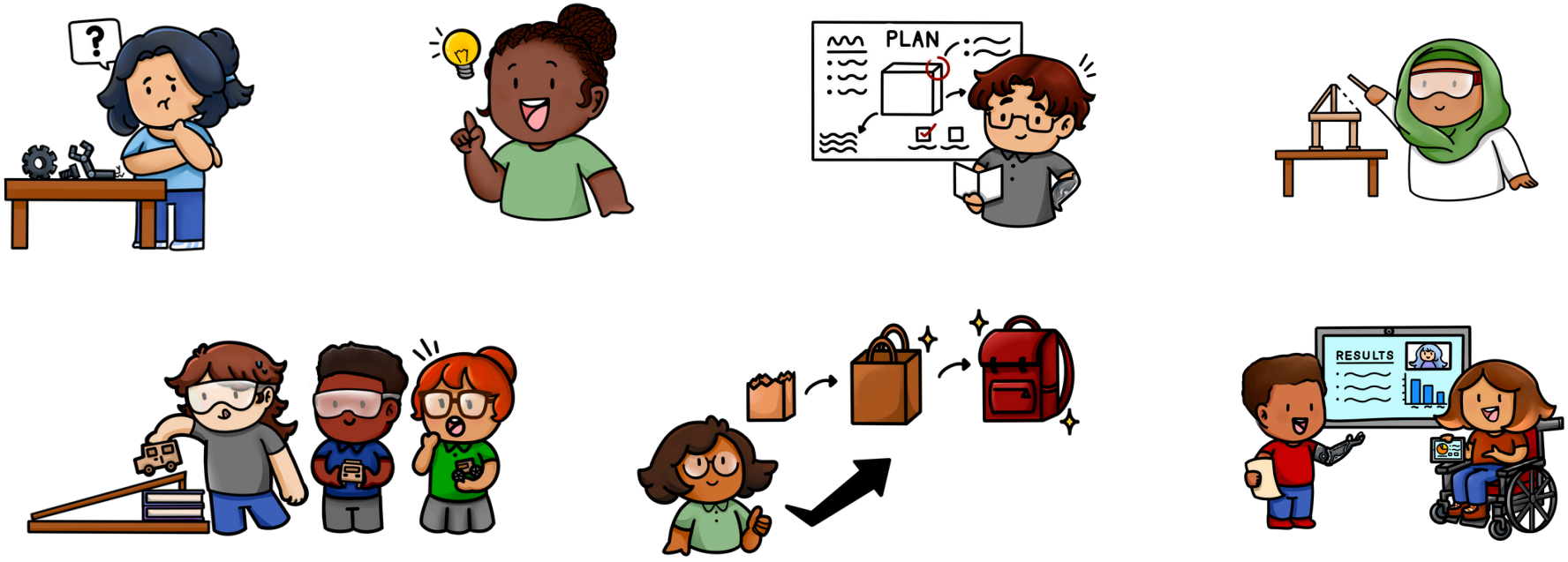
NASA eClips™

Primary
Engineering Design
Packet



This material is based upon work supported by the National Aeronautics and Space Administration (NASA) under award No. NNX16AB91A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of NASA.

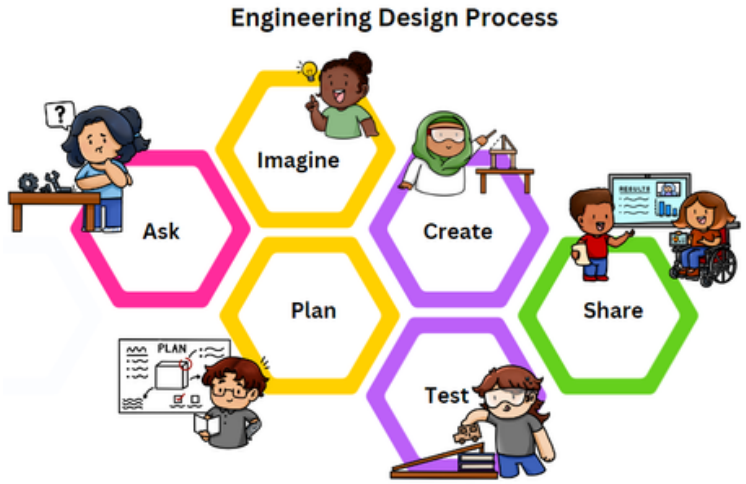
National Institute of Aerospace

NASA Partner

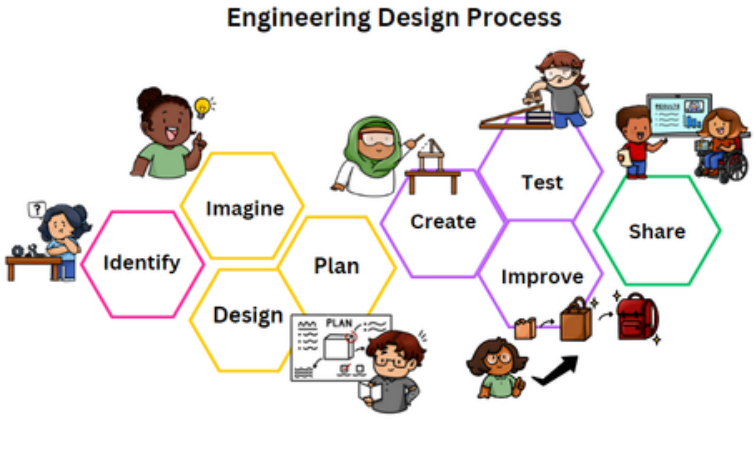
Using the NASA eClips Primary Engineering Design Packet

Young children are natural scientists and engineers. Through play-based exploration and learning, and design-based STEM learning experiences they can develop important skills, such as problem-solving, critical thinking, and creativity.

Engineering design provides an authentic context for learning. It engages students through hands-on learning and provides nontraditional ways to assess learners' skills and knowledge.



Early Primary Engineering Design Process



Upper Primary Engineering Design Process

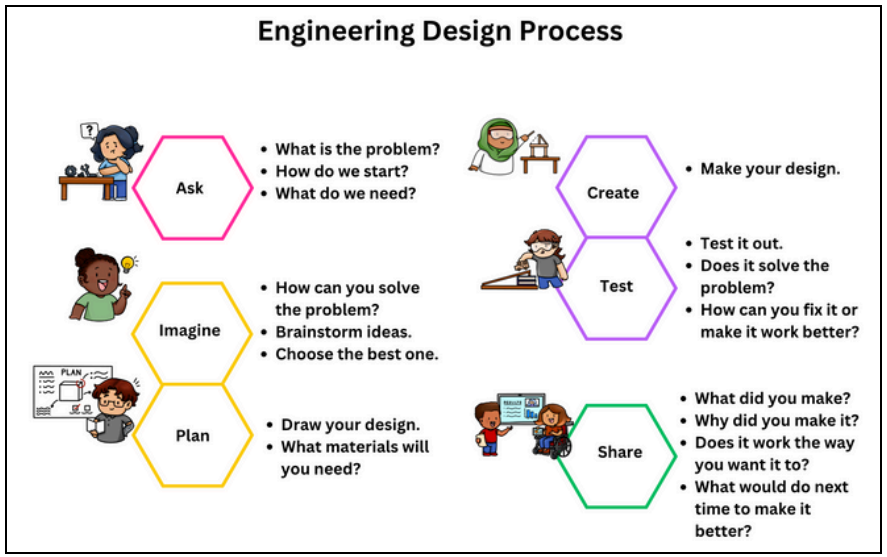
Simplified versions of the Engineering Design Process (EDP) are included in the following slides. One version is suggested as an early primary EDP; the other as an upper primary EDP. The difference is in the number of steps to the process.

Please modify the number of steps as needed to scaffold for the needs of your learners.

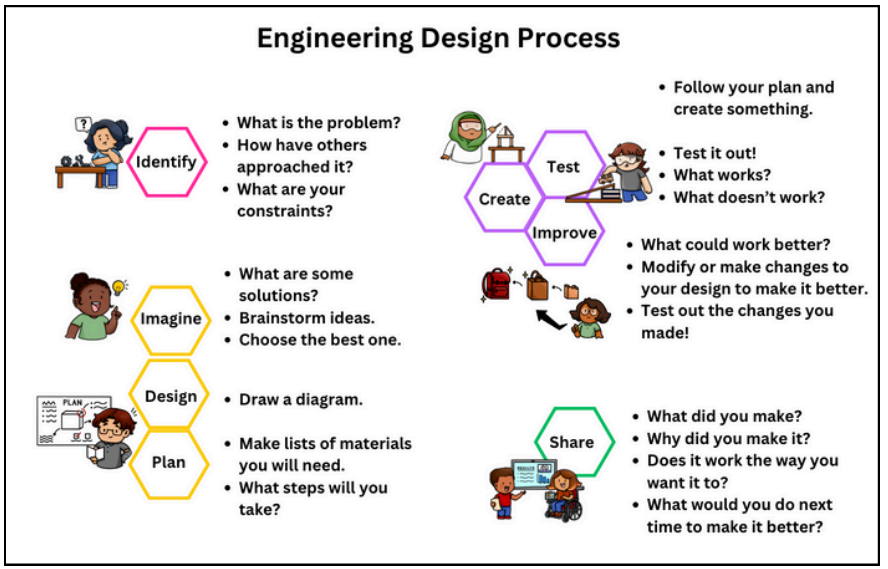
Using the NASA eClips Primary Engineering Design Packet

The early and upper primary engineering design processes both include expanded graphics and guiding questions that could be used as anchor charts.

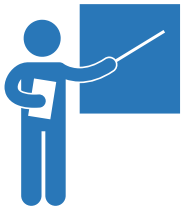
Early Primary Engineering Design Process



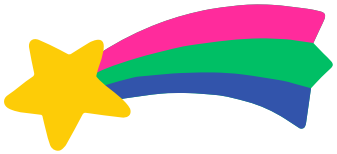
Upper Primary Engineering Design Process



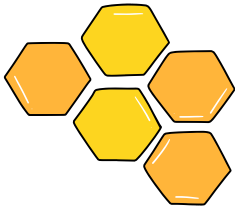
Icon Key



Pages for Educators



Pages for Early Primary Learners



Pages for Upper Primary Learners

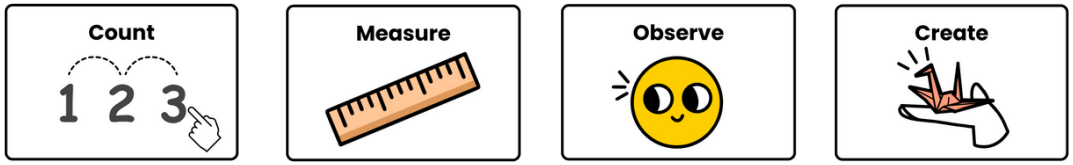
Using the NASA eClips Primary Engineering Design Packet

Collaboration

Working with others, in small groups, is an important component of EDP. Young learners will need help learning how to share, compromise, and work with teammates. The self-reflection wheel helps define behaviors that support collaboration. Learners may use this tool to self-assess their role in a group.

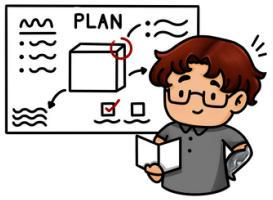
Self-Reflection Wheel

Graphics Farm



Images that visualize tasks and activities within EDP are included as a Graphics Farm. The graphics may be used to differentiate learners' experiences to scaffold their understanding of engineering design.

Using the NASA eClips Primary Engineering Design Packet



Pick the items you will use.

Exploring Materials

Young learners need time to explore materials BEFORE they are asked to use them to solve a problem. Provide time for learners to observe and describe available materials BEFORE they select items for their planning. Use this time to introduce them to descriptive language such as texture, size, color, weight.

The pages within this packet are editable to provide maximum flexibility as you plan the engineering challenge.

Integrating Disciplines

Early science and engineering experiences leverage young learners' curiosity about the natural and designed world. The EDP engages learners in authentic science and engineering practices while building their oral and written communication skills.

After learners explore and experience science and engineering, domain specific vocabulary may be introduced and reinforced. A word bank is included in the packet.

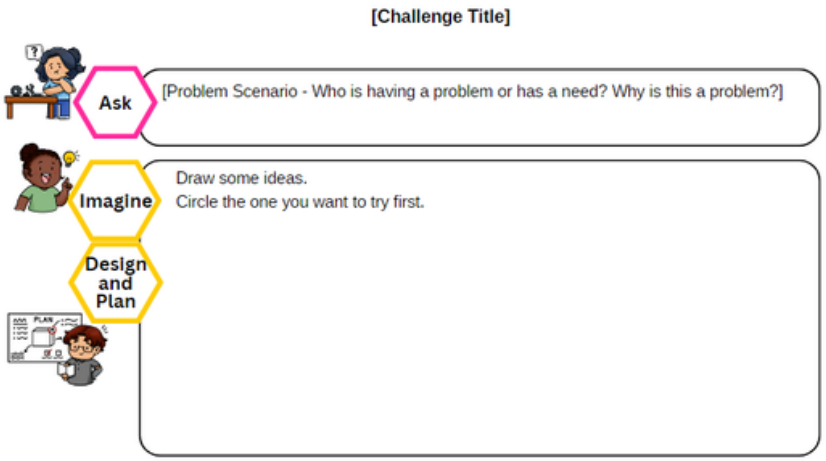
Word Bank

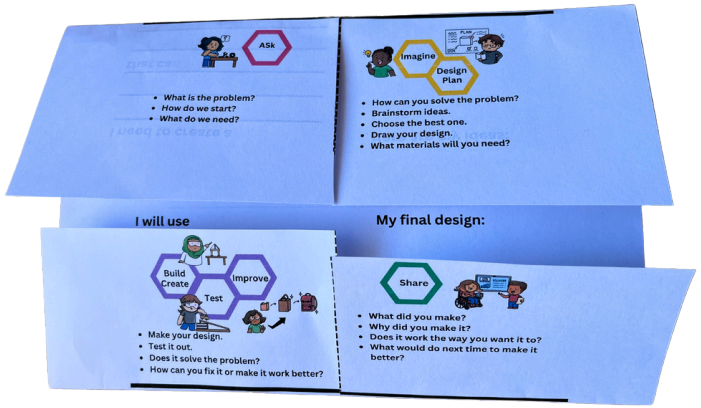
Using the NASA eClips Primary Engineering Design Packet

Written and Oral Communication

The Primary Engineering Design Packet provides scaffolded opportunities for integrating science, engineering, and communication skills.

Learners are encouraged to sketch and record ideas within the packet. Graph paper is included for this step. A one-page engineering sheet is also included to simplify recording the process.





Self-Assessment

Learners are encouraged to self-reflect about the design process and their final innovations. The concept of improvement and iteration is an important step within the EDP.

Which face shows how you feel about your design?

😐 🙂 😍

Why did you choose this face?

_____

_____

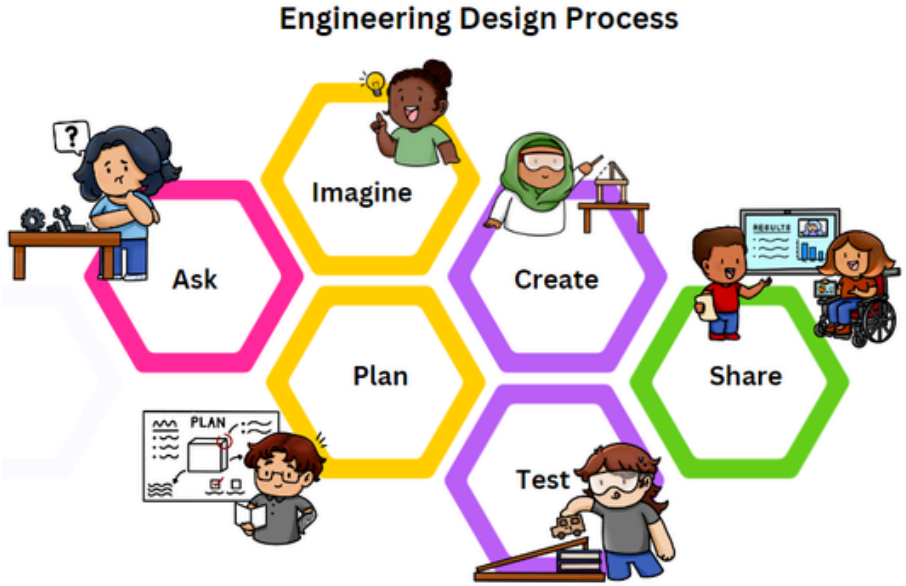
_____

_____

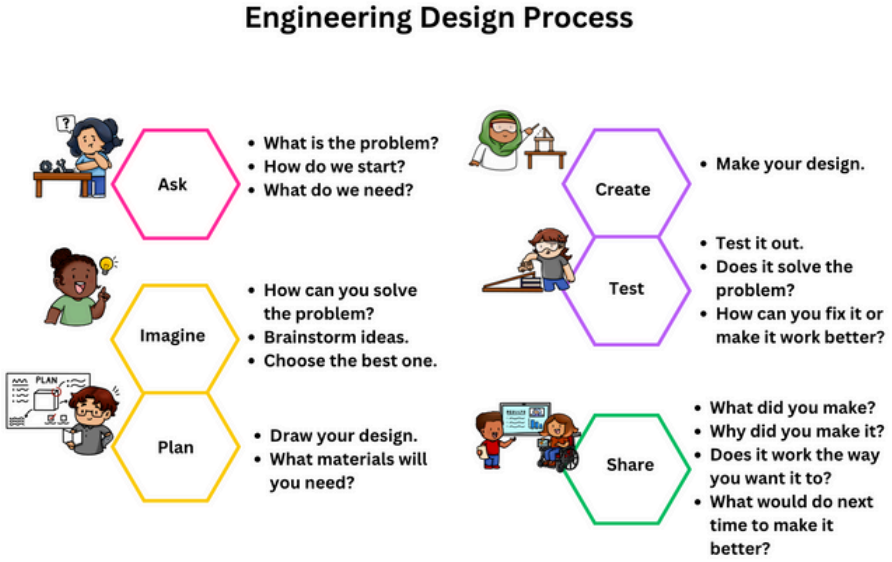
_____

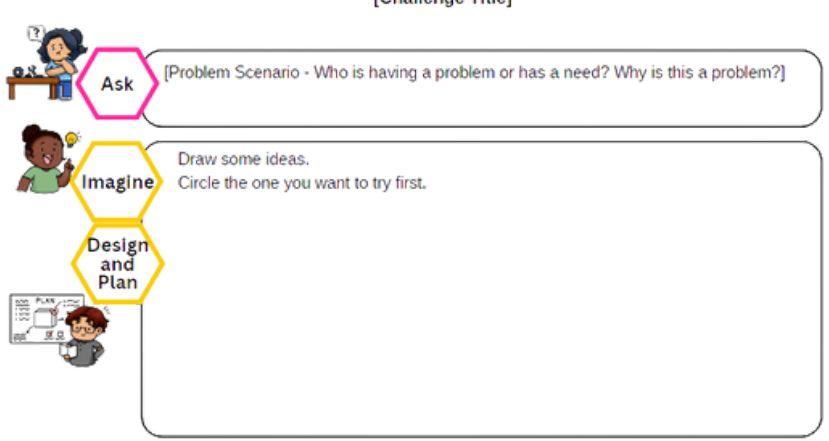
Using the NASA eClips Primary Engineering Design Packet For Early Primary Learners

The next section includes learner-facing images and guides appropriate for early primary-aged learners. Based upon the needs of your learners, you may want to use these as anchor charts or guide sheets.

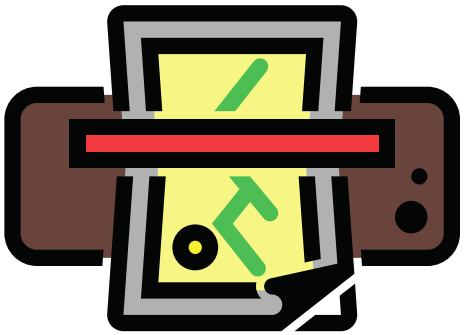


Early Primary Engineering Design Process

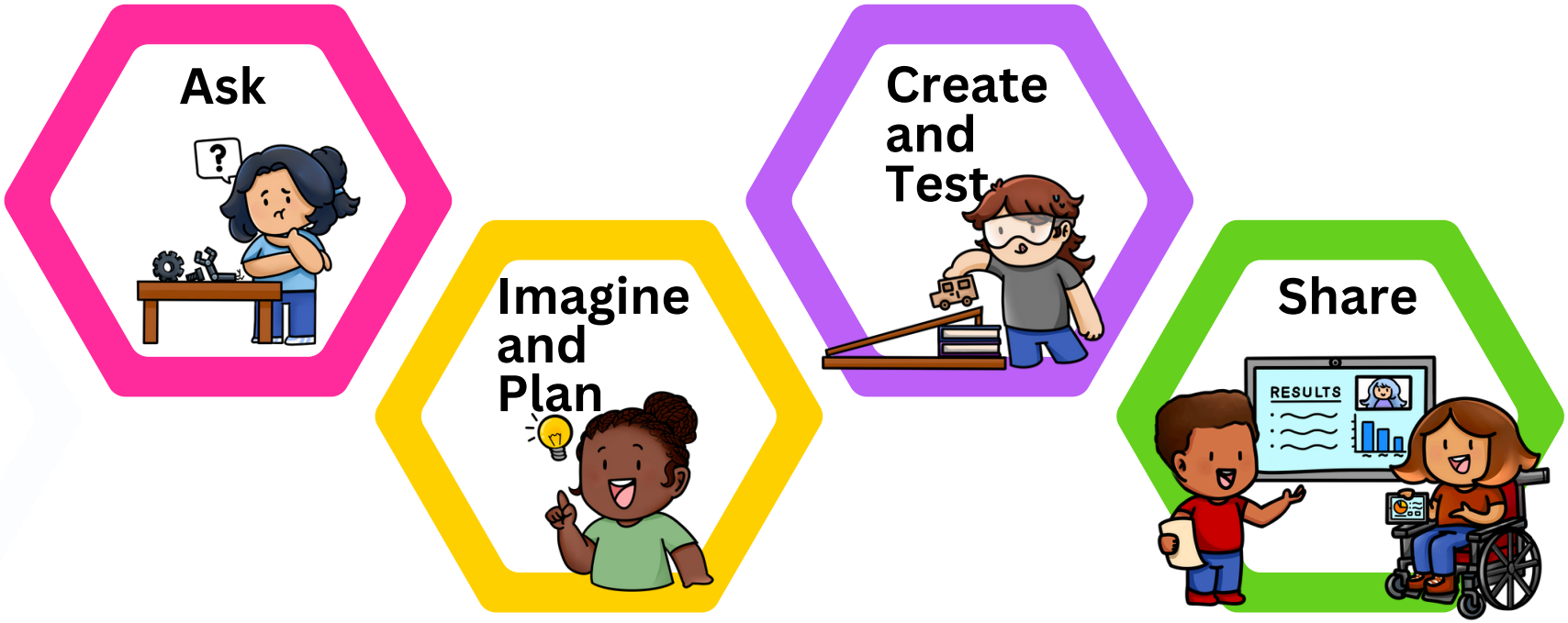




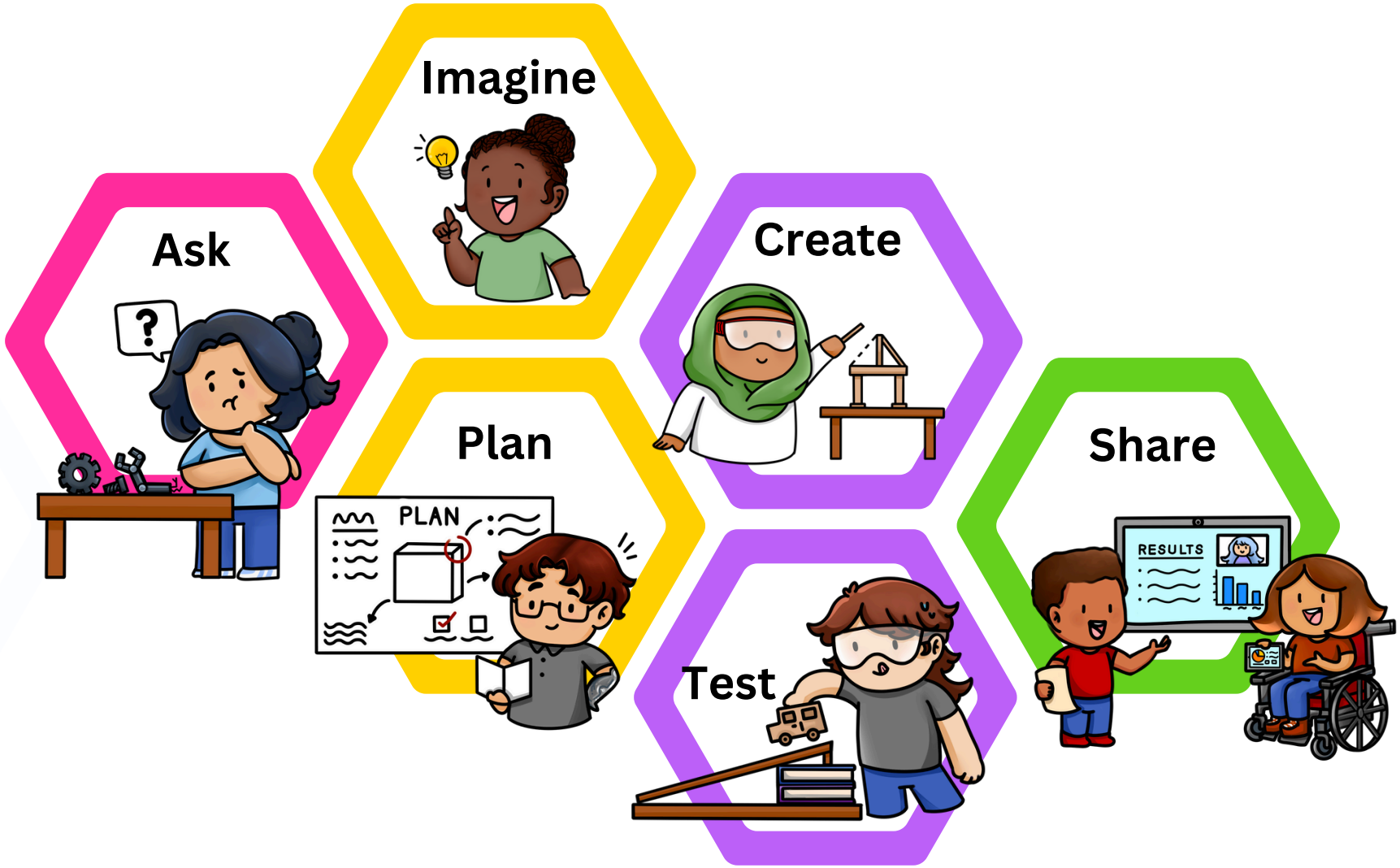
TIP: Print a class set of the EDP printed and laminated on cardstock to be used as table mats. Use the mats to introduce the steps of the process and guide self-reflection.



Four-Step Engineering Design Process



Six-Step Engineering Design Process



TIP: Enlarge the next set of pages to create anchor charts. Use the charts to introduce the steps and for self-reflection.

Engineering Design Process

Ask

- What is the problem?
- How do we start?
- What do we need?

Imagine

- How can you solve the problem?
- Brainstorm ideas.
- Choose the best one.

Plan

- Draw your design.
- What materials will you need?

Create

- Make your design.

Test

- Test it out.
- Does it solve the problem?
- How can you fix it or make it work better?

Share

- What did you make?
- Why did you make it?
- Does it work the way you want it to?
- What would do next time to make it better?

Engineering Design Process

Ask

- What is the problem?
- How do we start?
- What do we need?

Imagine

- How can you solve the problem?
- Brainstorm ideas.
- Choose the best one.

Plan

- Draw your design.
- What materials will you need?

Engineering Design Process

Create

- Make your design.

Test

- Test it out.
- Does it solve the problem?
- How can you fix it or make it work better?

Share

- What did you make?
- Why did you make it?
- Does it work the way you want it to?
- What would do next time to make it better?

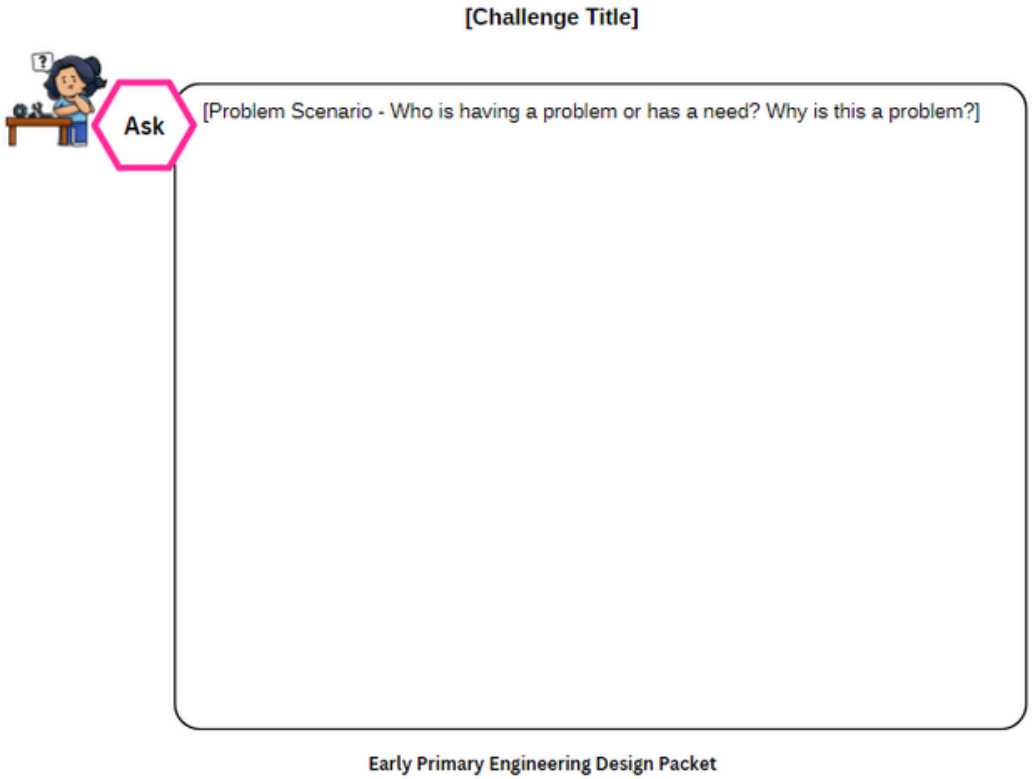
Using the NASA eClips Primary Engineering Design Packet

Challenge Title

Choose a title that is interesting to your learners. Add an image that engages the learners.

Problem Scenario

The problem scenario should be a real-world problem that is important to learners. Use language that is developmentally appropriate for your learners. The title and scenario should be written FOR learners.



[Challenge Title]

Ask

[Problem Scenario - Who is having a problem or has a need? Why is this a problem?]

[Challenge Title]

Imagine

Plan

Draw some ideas.
Circle the one you want to try first.

Pick the items you will use.

Add a picture of your design.

Word Bank

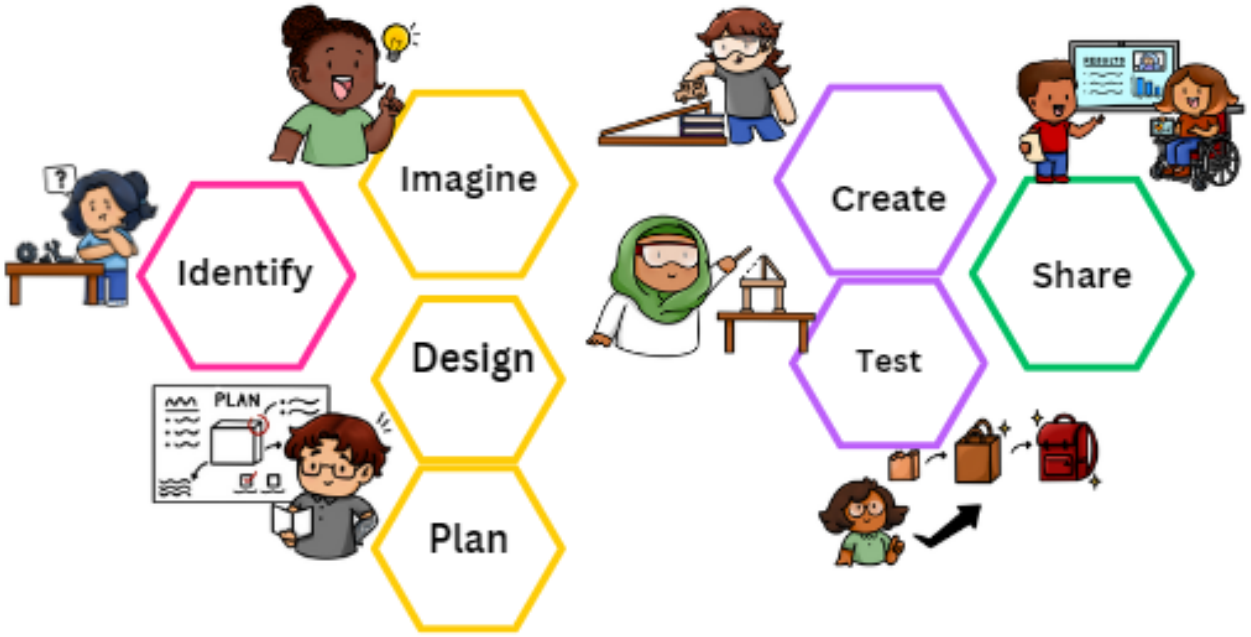
How did you do? What is the best feature of your design?

The best part of my design is

Share

Word Bank

Color in each step you finished.



What did you learn or discover?

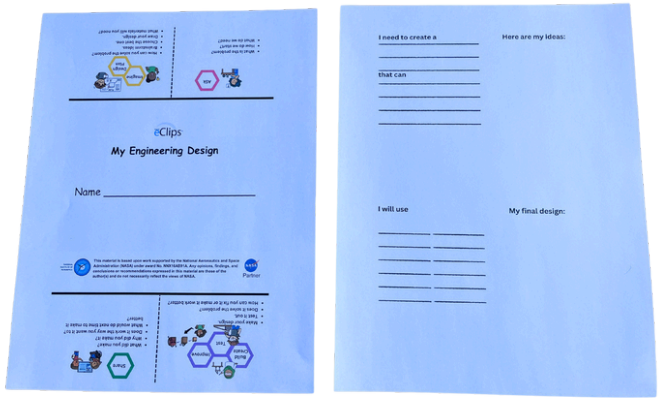
I learned or discovered

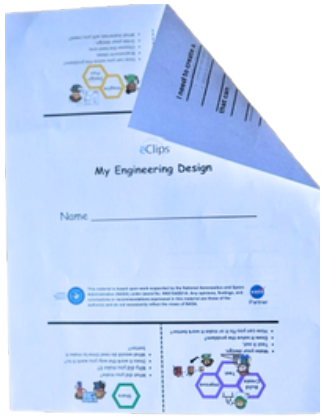
Using the NASA eClips Primary Engineering Design Packet

It is important for young engineers to learn how to record their work. The 2-sided Engineering Guide is a simple template to help build this skill.

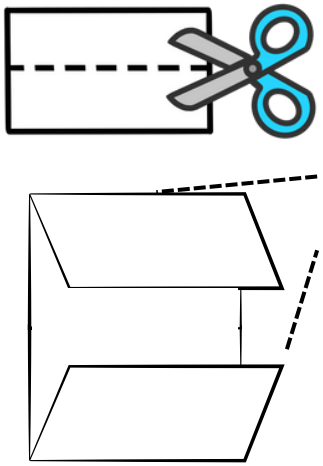
Directions for “My Engineering Design” are included here. The learner-facing template follows this section.

1. Print the next 2 pages front to back.

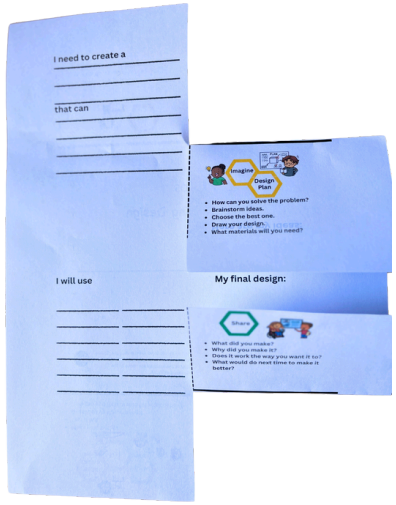




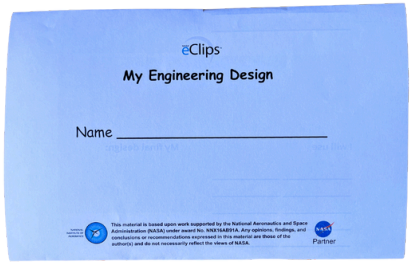
2. Cut at the dotted lines.

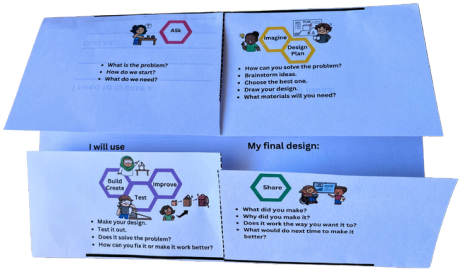


3. Fold on the solid lines.



4. Lift the flaps to answer the questions.





Ask

- What is the problem?
- How do we start?
- What do we need?

Imagine · Design Plan

- How can you solve the problem?
- Brainstorm ideas.
- Choose the best one.
- Draw your design.
- What materials will you need?

NASA eClips™

My Engineering Design

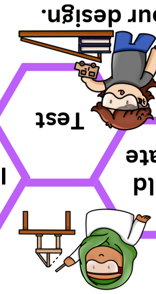
Name ______________________________

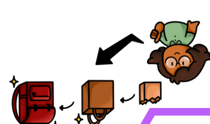
National Institute of Aerospace

This material is based upon work supported by the National Aeronautics and Space Administration (NASA) under award No. NNX16AB91A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of NASA.

NASA Partner

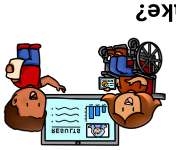
Build Create · Test · Improve





- Make your design.
- Test it out.
- Does it solve the problem?
- How can you fix it or make it work better?

Share



- What did you make?
- Why did you make it?
- Does it work the way you want it to?
- What would do next time to make it better?

I need to create a

that can

I will use

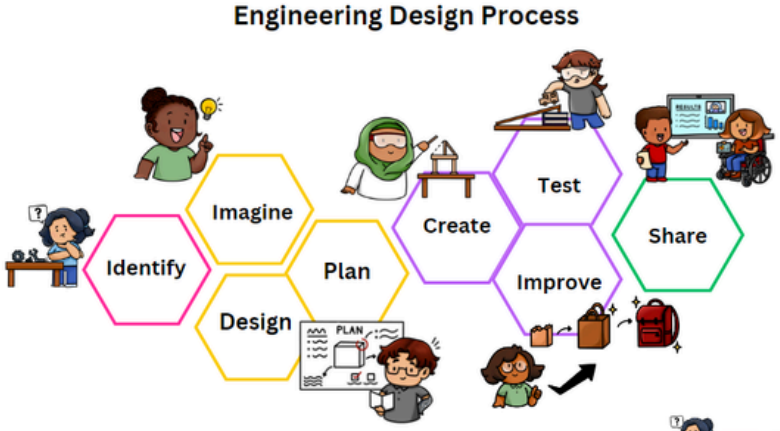
Here are my ideas:

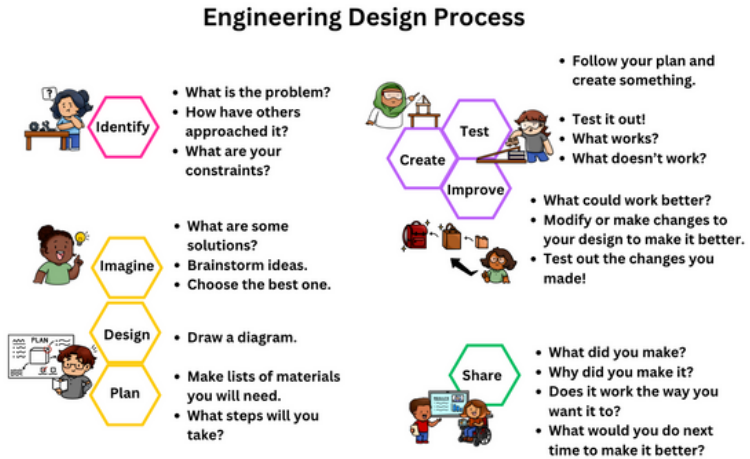
My final design:

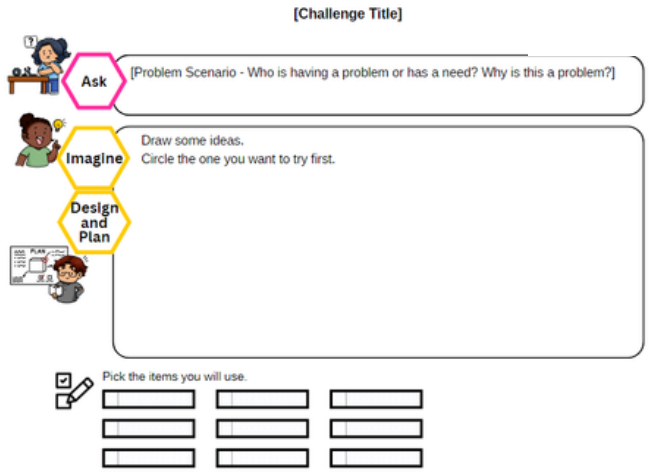
Using the NASA eClips Primary Engineering Design Packet For Upper Primary Learners

A few more steps to the EDP are included in the next section. These learner-facing pages add more complexity to the process and are suggested for upper primary learners.

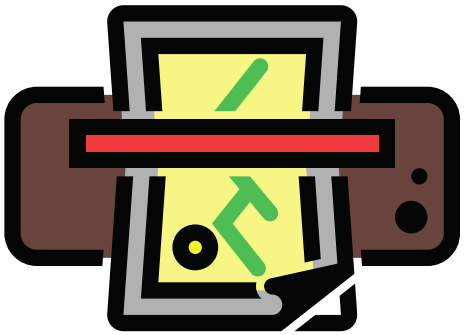
TIP: Print a class set of the EDP printed and laminated on card stock to be used as table mats. Use the mats to introduce the steps of the process and guide self-reflection.



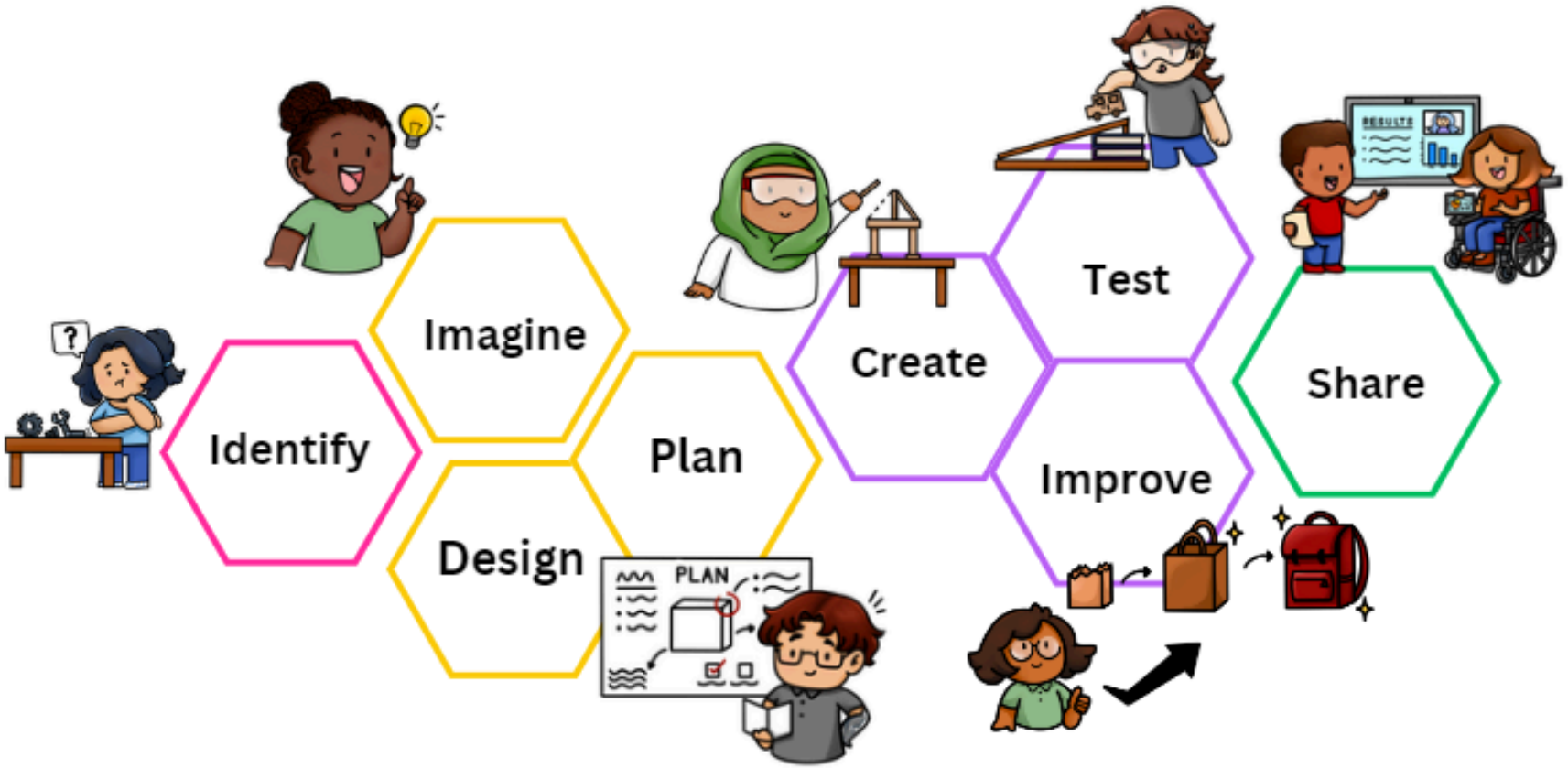




TIP: Print a class set of the EDP printed and laminated on cardstock to be used as table mats. Use the mats to introduce the steps of the process and guide self-reflection.



Eight-Step Engineering Design Process



Upper Primary Engineering Design Process

TIP: Enlarge the next set of pages to create anchor charts. Use the charts to introduce the steps and for self-reflection.

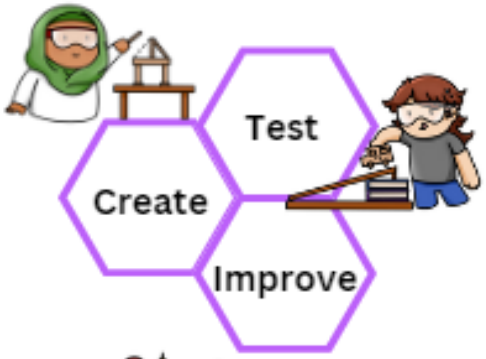
Eight-Step Engineering Design Process

- What is the problem?
- How have others approached it?
- What are your constraints?

- What are some solutions?
- Brainstorm ideas.
- Choose the best one.

- Draw a diagram.

- Make lists of materials you will need.
- What steps will you take?



- Follow your plan and create something.

- Test it out!
- What works?
- What doesn't work?

- What could work better?
- Modify or make changes to your design to make it better.
- Test out the changes you made!

- What did you make?
- Why did you make it?
- Does it work the way you want it to?
- What would you do next time to make it better?

Engineering Design Process

Identify

- What is the problem?
- How have others approached it?
- What are your constraints?

Imagine

- What are some solutions?
- Brainstorm ideas.
- Choose the best one.

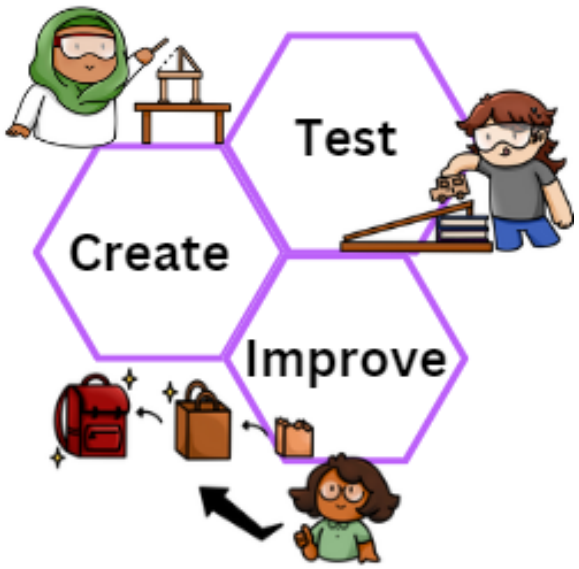
Design

- Draw a diagram.

Plan

- Make lists of materials you will need.
- What steps you will take?

Engineering Design Process



- Follow your plan and create something.

- Test it out!
- What works?
- What doesn't work?

- What could work better?
- Modify or make changes to your design to make it better.
- Test out the changes you made!

- What did you make?
- Why did you make it?
- Does it work the way you want it to?
- What would you do next time to make it better?

[Challenge Title]

Identify

[Problem Scenario - Who is having a problem or has a need?
Why is this a problem?]

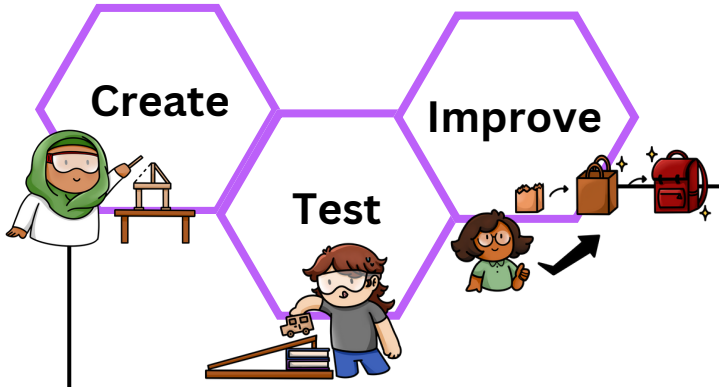
[Challenge Title]

Imagine

Draw some ideas.
Circle the one you want to try first.

Design

Pick the items you will use.



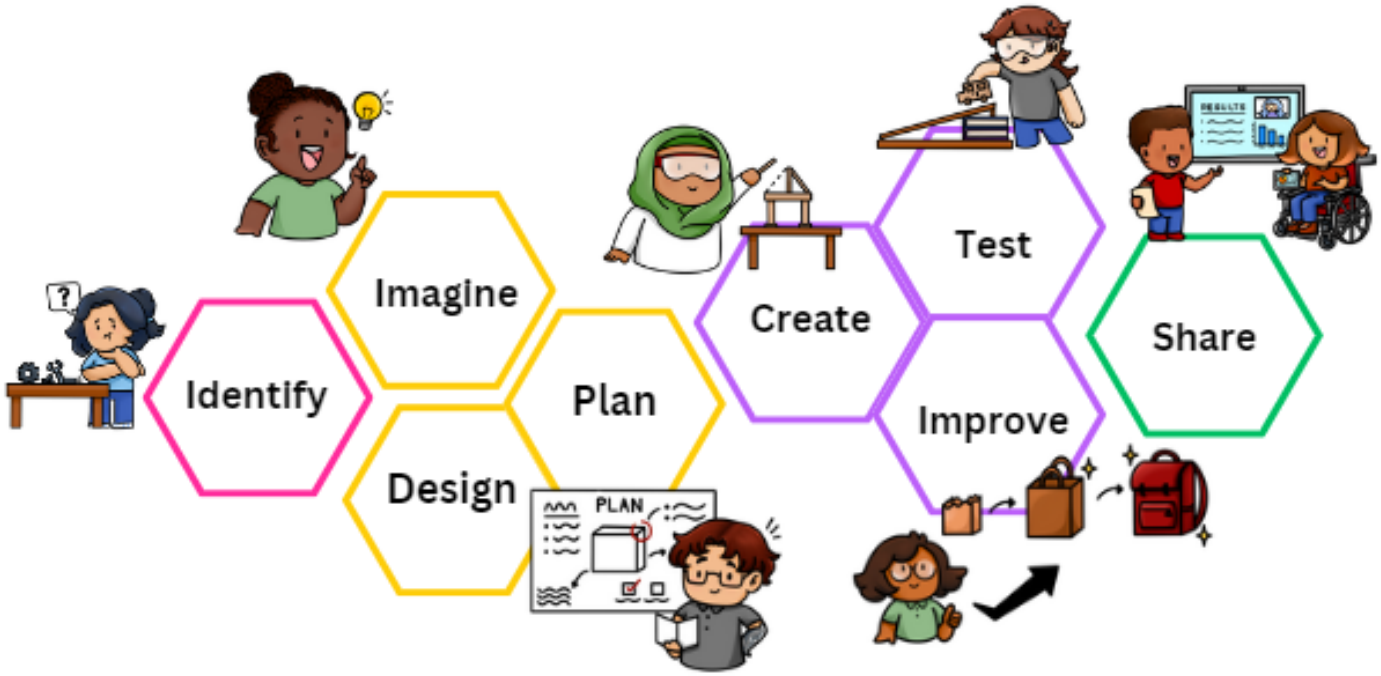
Add a picture of your design.

How did you do? What is the best feature?

The best part of my design is

Word Bank

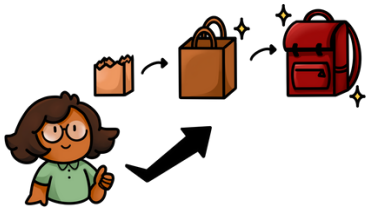
Color in each step you finished.



What did you learn or discover?

I discovered

Using the NASA eClips Primary Engineering Design Packet



Testing, refinement, and self-reflection are important components of the Engineering Design Process. Several self-reflection instruments are included in the next few learner-facing pages.

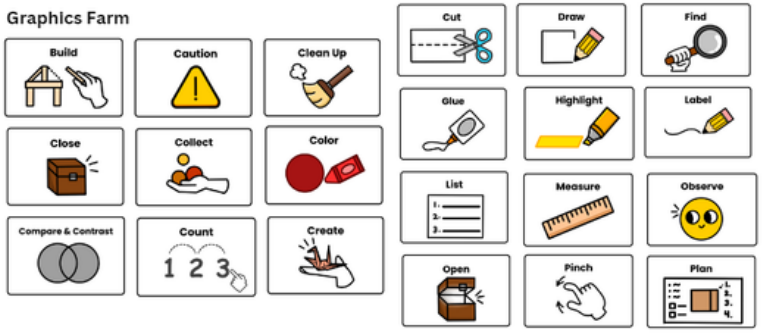
Color in each piece that is true for you.

Which face shows how you feel about your design?

Why did you choose this face?

Images from the Graphic Farm may be used to modify these instruments.

Primary Engineering Design Packet



Color in each piece that is true for you.

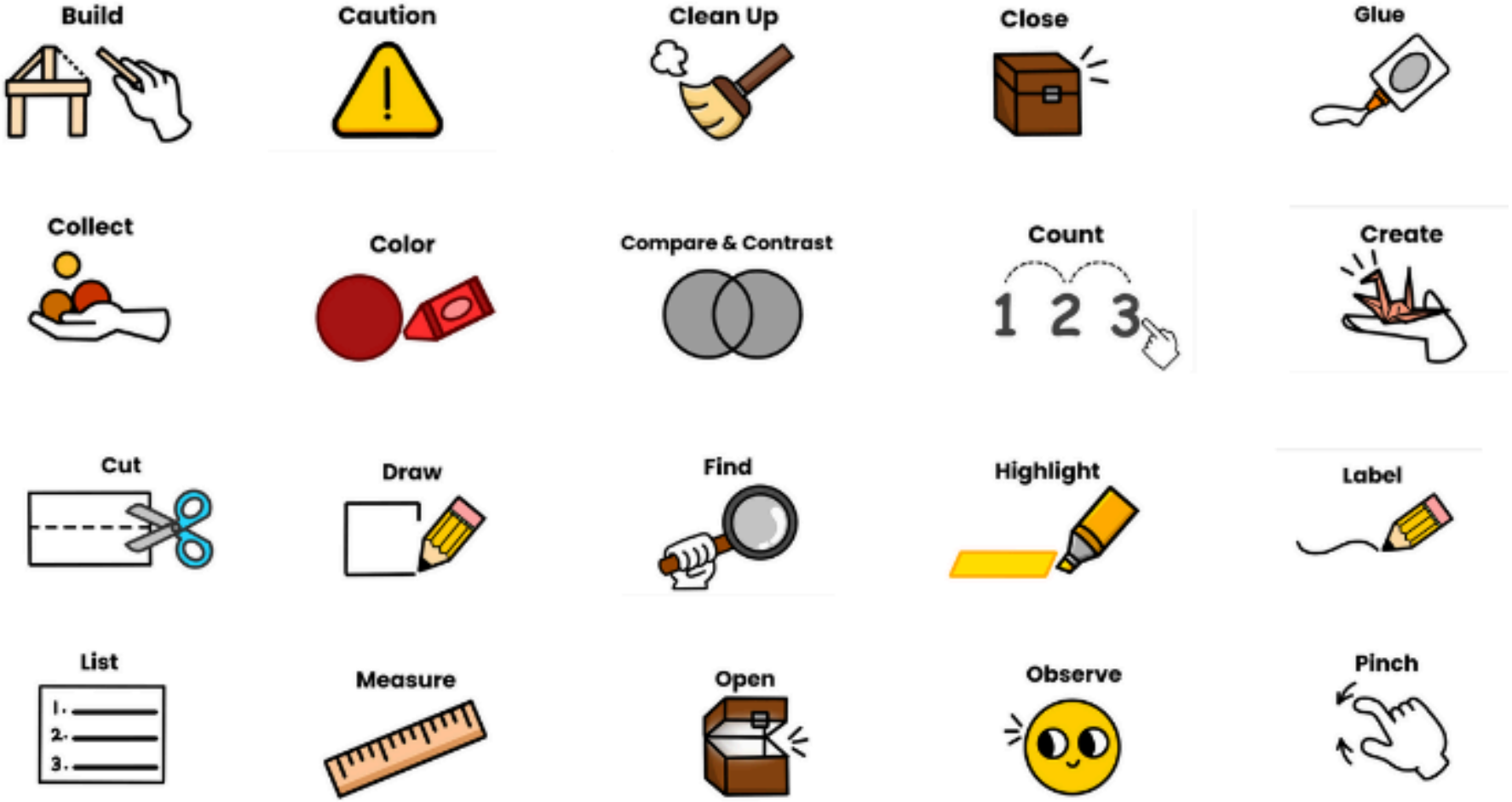
Which face shows how you feel about your design?

Why did you choose this face?

Using the NASA eClips Primary Engineering Design Packet

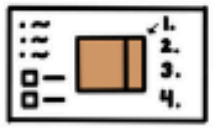
Graphics may be integrated into the Primary Engineering Design Packet to customize the tool.

Graphics Farm



Graphics Farm

Plan



Pour

Put Away

Respect

Share

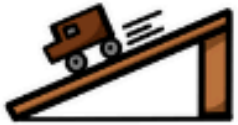
Stamp

Start

Stop

Tape

Test



Trace

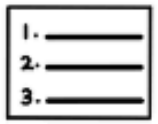
Wait

Weigh

Write Date

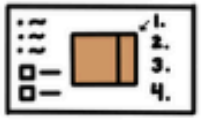
Write Name

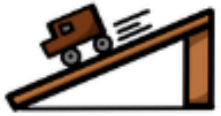
Graphics Farm







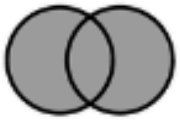


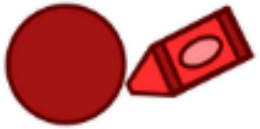

Graphics Farm











Primary Engineering Design Packet