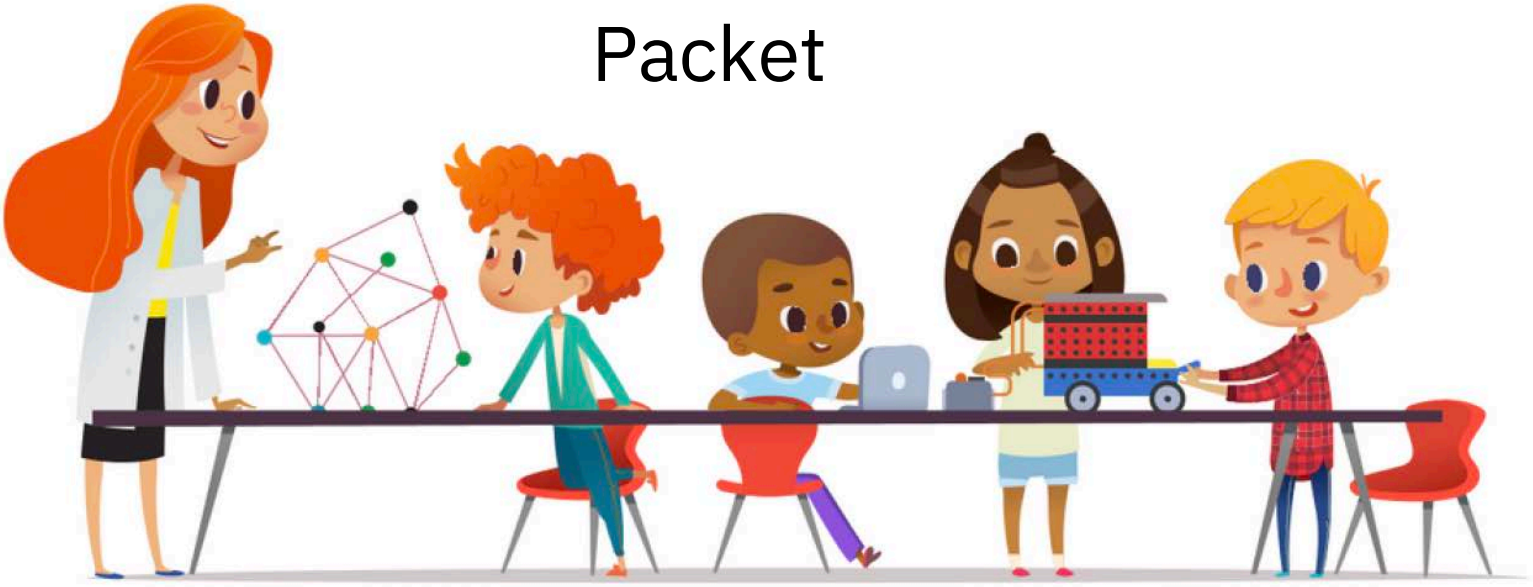
Elementary

Engineering Design

Packet



Student Packet (Grades 3-5)

https://nasaeclips.arc.nasa.gov/

Engineering Design Process*

ASK

- What is the problem?
- What solution is needed?
- What have others done?
- What are the limits?

IMAGINE

- What are some solutions?
- Brainstorm ideas.
- Choose one to try first.

PLAN

- Draw a diagram.
- Make a list of materials and tools you will need.

CRE ATE

Build

- Follow your plan and build it.

Test

- Record your results.
- Identify weaknesses in the design.

Refine

- Make changes to improve the design.

SHARE

- Explain your ideas to others.
- Present your model to others.

*An accompanying teacher implementation guide is available on the NASA eClips website.

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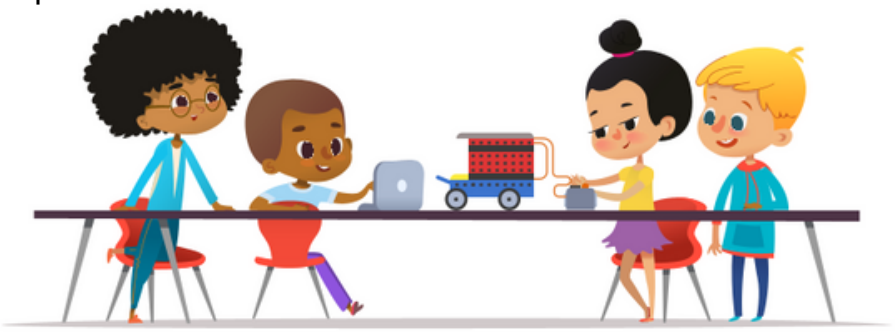
Engineers use the engineering design process (EDP) to solve problems. Math and science are important in this process, too. It's time for you to be an engineer and use this EDP to solve a problem.



Problem Scenario

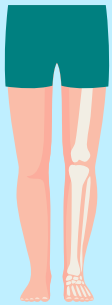
Being physically fit is important for everyone in our world, but it is especially important for astronauts living and traveling in space. Being in space can cause bones and muscles to become weaker. It is important for astronauts exercise a lot to stay physically fit.

Biomechanics is the science of how our body moves. It is the study of how our muscles, bones, tendons, and ligaments work together. When all of these body parts work together, we can perform different tasks. Some examples are using our hands and arms to lift a fork to eat, swinging our feet to kick a ball, and bending our knees to jump.

You are going to work as a biomedical engineer. Design and build a Biomechanical Jumping Machine to show the importance of muscles in movement. Your machine must jump up, or vertically, more than 3 feet or 91.44 centimeters.

Activities and Resources to Build Knowledge

Jumping Demo



1. Stand up tall with your legs straight and jump as high as possible without bending your knees.

How does it feel?

2. Bend your knees and jump.

Was the straight leg or bended knee jump higher?

Rubber Band Testing

1. Collect rubber bands of different sizes and thickness.

2. Put on safety goggles.

3. Stand behind the line.

4. Shoot the rubber bands at the target on the wall.

In what ways did the types of rubber bands respond differently?

What is the problem?

What solution is needed?

Research what others have done to solve this problem.

Person/Group	Their Solution	How did it work?

What are the limits? These may include such things as cost or time.

What are some solutions? Brainstorm ideas and list them. You can include drawings.

Choose the idea to try first and explain why you think it will work.

Draw a diagram of your design. On the drawing, label all parts clearly.

Make a list of materials you will need. Describe why you have chosen these materials.

Material/Object	Quantity	Reason for Selection

Build

Follow your plan and build the model.

- How did your drawing help you build your model?
- How would your drawings and notes help others?

If there are any differences between your drawing and your model, explain why you made these changes.

Test

Test your model. Describe the test you used.

Record your results.

Refine Design

Make changes to improve your model.

Did your model do what was expected? Describe what you observed.

- Did the materials you used work?
- What other materials might be better?

What changes would you make to improve your model?

- Why would you make each change?
- Are there any reasons you cannot make the changes you would like to make?

Go back and mark any changes you made on your original drawing.

Explain your ideas to others. You might:

- Make a poster.
- Give a presentation.
  - Make a short video.
- Write a letter to NASA convincing them to build your model.

You may include sketches, pictures, data, or graphs.

What did you learn or discover? Why does your design solve the problem?

How did you work as a team? What was each person's valuable contribution?

Elementary Engineering Design Student Checklist

Engineering Design Process

My work shows evidence of all parts of the engineering design process.

- [ ] I stated the problem and challenge in my own words. I identified the solution needed.
- [ ] I brainstormed more than one possible solution.
- [ ] I developed a diagram of the solution that explains the parts and their purpose. The plan contains a list of materials and tools needed.
- [ ] I used the plan to create the model or prototype. I tested my solution and recorded the results. I identified the weaknesses in the design of my model or prototype.
- [ ] I made changes to improve the design.
- [ ] I presented my model to others and explained how it solves the problem. I shared what I discovered and learned.

Collaboration / Teamwork

I shared responsibilities for completing the work. I showed an appreciation for the contributions of each team member.

- [ ] I voluntarily engaged in all steps of the project.
- [ ] I completed the tasks required by my team role.
- [ ] I offered ideas and encouragement to my team.
- [ ] I listened to the ideas and feedback of team members.
- [ ] I offered solutions and compromises to solve conflicts that came up.

Content Knowledge and Skills

I can thoughtfully discuss and apply specific content knowledge related to the design challenge.

- [ ] I explained how bones and muscles work together.
- [ ] I used the ruler correctly.
- [ ] I measured to the nearest half-inch and nearest centimeter.
- [ ] I used the rubberbands and cups to show and identify kinetic and potential energy.