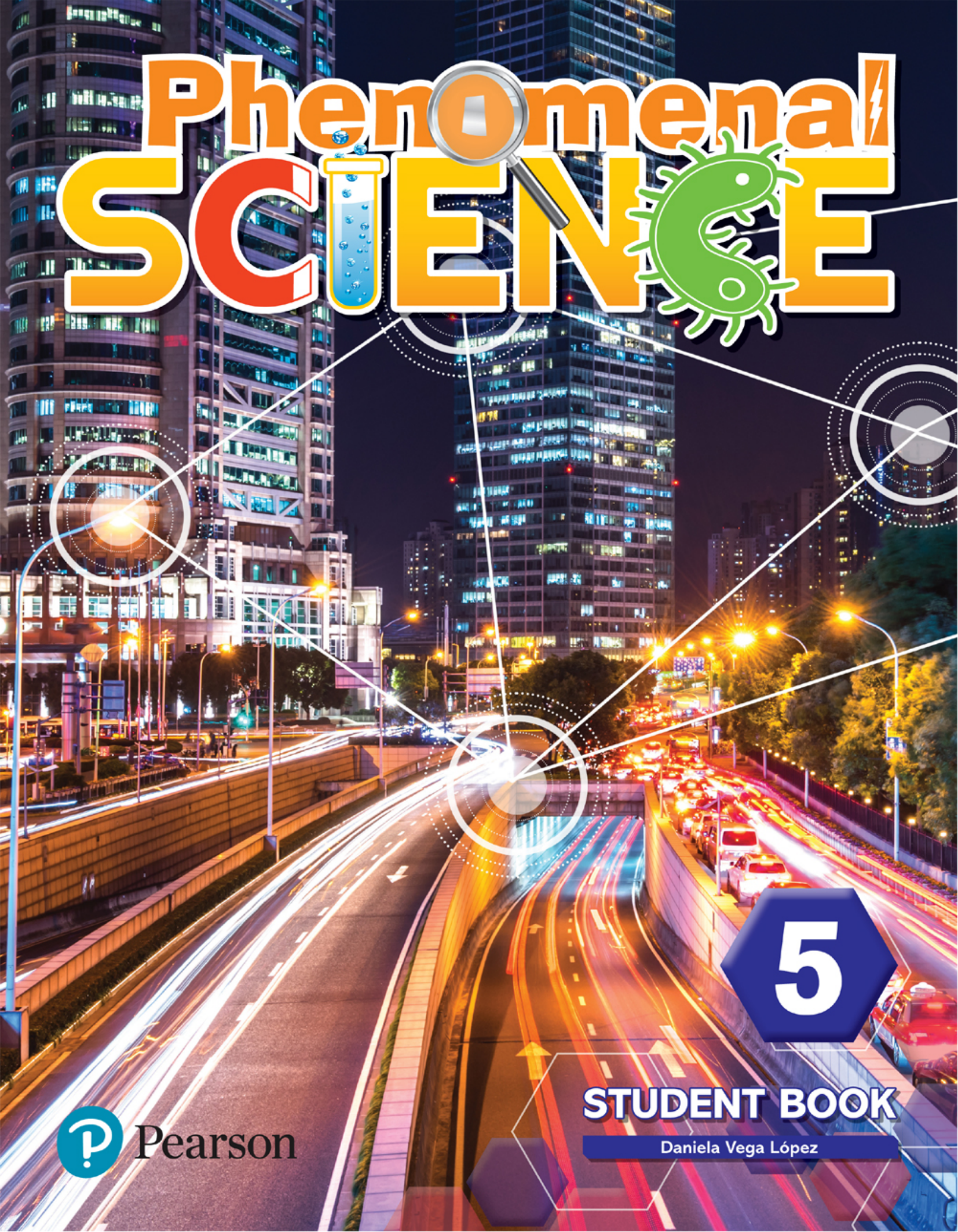
Phenomenal
SCIENCE
5
STUDENT BOOK
Daniela Vega López
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Phenomenal SCIENCE

5

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Unit 1

What is the design process?

Technology

Word Box

technology
machines
research
prototypes
engineers
design process

When we think of **technology**, we often think of computers, laptops, and **machines** full of circuits and buttons, but technology is everywhere: in our homes, schools, offices, parks, cars, and supermarkets. Technology is the use of knowledge in a specific way. It applies science in a practical way and can be used to develop something as simple as a pencil or as sophisticated as a computer. Technology helps improve communications, makes doing everyday tasks more efficient, protects us from danger, helps us entertain or relax, and more.

New technologies are being created all the time in all different fields of science. The development process requires a lot of **research** and testing of **prototypes** in order to come up with a final product or process. **Engineers** help design new technologies by following a **design process**. They identify problems and use science and math to find solutions to improve the design.

1. **Circle the objects that are a type of technology. Then, in pairs, discuss your reasons.**

leaf | sheet of paper | hammer | nail | tree | apple

2. **In pairs, list 10 items of technology that you use in daily life. Then discuss how each item helps you.**

Lesson 1

What are the first steps of the design process?

Engineering Design Process

Word Box
devices
iterative

In order to develop new technologies, engineers have to understand the needs people have and the problems they face, then design programs, processes, machines, or **devices** that solve these problems. Thanks to these scientists, people can use the latest-generation smartphones, play a variety of video games, have access to vaccines and powerful prosthetics (artificial devices that replace a lost body part), cook a hot meal, and enjoy a warm shower in the morning.

To develop these solutions, engineers use the design process—a step-by-step method to create and test products and processes for possible solutions. This process is repetitive, or **iterative**.

1. **Look at the steps of the design process in the picture below. In pairs, discuss why engineers follow these steps to create new technologies.**

2. **Do you think imagination and creativity are important in the design process? In pairs, discuss your answers.**

Identify the Problem

Word Box
scientific journals
surveying
simple machine
complex machine

The first step in the design process is to identify a need or a problem. It is important to know who will benefit from the new technology and how. If you think about how someone came up with the idea of making wheeled backpacks for students, you could infer that students had trouble carrying too many books and materials to school. Students needed an easier way to do this.

Do Research

The next step is to research information and technology related to the problem by using a variety of sources such as books, **scientific journals**, or the internet; by **surveying** people; or by talking to experts. Research helps engineers to explore what technologies already exist, if any, and to make a plan for possible new solutions. As they research technology for wheeled backpacks, for example, engineers might ask the following questions: *How sturdy should it be? What type of machine does it need? Does it need wheels? Is it a* ***simple machine*** *or a* ***complex machine****? How heavy or light should it be? What materials are available? Is there a need to develop new ones?*

3. **In pairs, discuss what machines and materials you need to make a wheeled backpack.**

4. **Answer the following questions. Then share your answers in a small group.**

1 What type of information do you need to research the problem of heavy backpacks?

_____

2 Where can you find this information?

_____

3 Who can you ask about this information?

_____

Develop Possible Solutions

Once engineers have gathered all the information they need about the problem and the technology needed to fix it, they start to develop possible solutions. They might improve an existing technology or design a new one. In the case of a wheeled backpack, there are lots of possible models depending on the specific needs students have. Engineers might ask the following questions: *What type of wheels will make it easier to pull or push the backpack? How big should the backpack be? Does the material need to be water repellent? What designs will appeal to students? Do students need many pockets or compartments in the backpack? What will it cost to make the backpack? At what price will customers buy it?*

Choose a Solution

After developing different options and solutions, engineers need to choose the best one to build and test. In the case of a wheeled backpack, engineers will make a list of pros and cons of the different possible solutions. This will help them decide the size and weight of the wheeled backpack, the material and shape of the frame, the type of wheels and materials, and the overall design they think will best suit the needs of the product.

5. **In your notebook, draw a design for a wheeled backpack suited for fifth graders who carry 5 kg of books and materials every day.**

6. **In small groups, share your wheeled backpack designs and choose the best design option based on the questions below.**
   1. Which design appears to be the most durable? Why?
   2. Which design will appeal the most to a fifth grader? Why?
   3. Which design looks like it will carry the most books and supplies? Why?

Lesson 2

How do you design, construct, and test your solution?

Design and Construct a Prototype

After choosing a solution, engineers design and construct a prototype, or a model, to test its efficacy. The prototype takes into consideration all the choices engineers made. For the wheeled backpack, for example, engineers choose the best material for it to be sturdy and durable, the best wheels for it to roll easily on different surfaces, and the best handle for it to provide a firm grip.

Test the Prototype

Now it is time to test whether the prototype meets the requirements and expectations. In order to test whether the wheeled backpack will solve the students' needs, for example, engineers need to measure the capacity and weight the backpack can hold; estimate the friction the wheels create on the ground; and consider the appropriate size and material, the sturdiness of the material, and the firmness of the handle.

1. **Correct the sentences.**

   1 You have to build a prototype before choosing the solution.

   _____

   2 The prototype is a plan of the solution.

   _____

   3 To test whether the prototype works, you should make several models.

   _____

2. **In small groups, discuss how you would test the efficacy of the wheels of your wheeled backpack.**

Communicate Results

Word Box

document
feedback
graphs
tables
graphic organizers
labeled diagrams

As engineers test the prototype, they **document**, or record, the results. Then they communicate the results to other people, who will give **feedback** on how well the prototype accomplished its purpose.

Engineers can record and present their information in different forms.

Graphs: diagrams used to show the relation between different quantities or variables. Graphs use lines, points, curves, or areas. Some examples include histograms, bar graphs, pie graphs, and line graphs.

Tables: rows and columns used to arrange information or data so that a single piece of data can be easily identified and interpreted.

Graphic organizers: visual representations used to show how some elements relate to one another. They help illustrate difficult concepts or organize ideas in a visual way. Some examples are spider maps, Venn diagrams, charts, and mind maps.

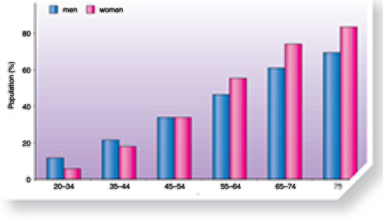
Labeled diagrams: drawings accompanied by words used to help identify the parts or components of something.

Sharing the prototype with others is a way of repeating the tests to verify the results. It can help engineers identify any problems they may not have noticed before. For example, engineers might ask a group of students to test the wheeled backpacks and give feedback. Feedback has to be honest and relevant so that the prototype can be improved if necessary.

3. Label the pictures with the correct name of the type of data displayed.

pie chart | line graph | labeled diagram | table | histogram | mind map

1 _____



2 _____

3 _____

4 _____

5 _____