

The Perfect Present

Program Type: Classroom Program

Audience Type: Grades 3–8

Description: Students will design and improve a gift for their class partner based on their individual needs and unique interests.

This activity is adapted from Stanford Design School's "Gift Giving Project." See https://dschool-old.stanford.edu/groups/designresources/wiki/ed894/The_GiftGiving_Project.html

LEARNING OBJECTIVES

For Next Generation Science Standards alignment, see end of outline.

- Students will use the engineering design process to design, test, and improve upon an object that will be a perfect present for a unique individual.
- Students will interview their partner and actively listen to their partner's specific needs and wants.

TIME REQUIRED

Advance Prep



20 minutes

Set Up



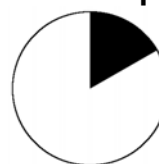
10 minutes

Activity



60-120 minutes

Clean Up



10 minutes

SITE REQUIREMENTS

- Table space for partner groups.

PROGRAM FORMAT

<u>Segment</u>	<u>Format</u>	<u>Time</u>
Introduction	Large group discussion	5 min
Design, Test, Improve	Partner activity	50-85 min
Wrap-Up	Large group discussion	5-30 min

*This class can be altered to fit many different schedules. A minimum of 90 minutes is recommended for the full experience. For a shorter class, you may eliminate the showcase at the end, use drawings instead of physical prototypes, and only have one round of designing. For a longer class, you may include more rounds of iteration on the designs, or even have students go through the same process with different partners.

SUPPLIES

Supplies	Amount	Notes
Booklet: <i>Engineering the Perfect Gift for your Friend</i>	1/student	Found in the <i>Appendix</i>
Colored pencils, crayons, or markers	1 set/group	
Object cards	3–4 cards/group	Found in the <i>Appendix</i>
Suggested Building Materials	Amount	Notes
K'NEX® rods and connectors	Amounts may vary, but distribute enough for each student to build his or her own design.	If building materials are not available, you may choose to let students draw their designs instead.
Rubber bands		
Cotton balls		
Foam sheets		
Wooden craft sticks		
Paper clips		
Binder clips		
Metal washers		
Straws		

ADVANCE PREPARATION

- Print or photocopy one *Engineering the Perfect Gift for your Friend* booklet per student. The booklet can be found in the *Appendix*. Fold and staple the booklets, ensuring the page numbers are in order.
- Print and cut out the object cards found in the *Appendix*. You may also choose to write your own prompts for objects on index cards or slips of paper.

SET UP

- Place one set of colored pencils, crayons, or markers on each table.
- Distribute a variety of building materials to each group.

INTRODUCTION

5 minutes

Let students speculate before offering answers. The answers given are primarily for the instructor's benefit.

Suggested script is **shaded**. Important points or questions are in **bold**. Possible answers are shown in *italics*.

Engineers create many wonderful things for all kinds of people! Different groups of people, or audiences, have different needs and wants.

Can you think of things that were designed for a certain person or group of people? *A bridge, handicap ramps, aerial trams, science equipment, heavy machinery, etc. There will be many acceptable answers here.*

The smaller the audience, the more an engineer can focus on making something even more personalized. It is also helpful to the engineer when the audience can give their opinions, or feedback, about the design.

Today you are going to design a gift just for your partner. And they will design a special present for you too! The gift you design will be an object that your partner needs or wants. When asking them questions to help plan your design, make sure you listen carefully to what they have to say.



PARTNER ACTIVITY




Design, Test, Improve

50-85 minutes




Assign one person in each pair the number 1 and the other person number 2. Make sure the students remember their numbers. Person #1 will interview their partner first.



Follow the suggested script below as the students work through the booklet. Let students know that when you give the signal, it will be time to stop and listen for the next instruction. They should wait for instructions before moving forward in their booklet. It is recommended to use a timer with an alarm to keep on track and allow both participants an equal amount of time to speak.

Page in Book	Suggested Script	Time
 <p>Step #1: Pick your gift</p> <p>What object do you need? Is there an object you would like to improve?</p> <p>Choose your card and give it to your partner.</p>	<p>Pass out 3–4 object cards to each pair of students. Allow one minute for everyone to choose a card that represents the object they would like their partner to design for them. Students can also just think of something on their own.</p> <p>Look through the cards and pick what object you'd like your friend to design for you. Maybe choose something that you think could be improved in your life, something that you want to change the appearance of and make work better for you.</p> <p>Think about the questions on the page. What did you envision the gift to look like when you picked the object card? How can you improve an existing version of that object? Your idea doesn't have to make complete sense or even be technologically possible right now. Dream big!</p> <p>Once each student chooses an object, have them give their card to their partner so the partner knows what they will be designing.</p>	5 min
 <p>Step #2: Interview your partner</p> <p>What does he/she need? Read the questions on the back of your partner's card and take notes on their answers.</p>	<p>Time to interview your partner so you can start designing their gift! Use the questions on the back of the object card to get you started, or come up with your own.</p> <p>Be sure to ask "why" often. Try to uncover stories, feelings, and emotions from your partner. Figure out what he or she will be using the object for and when. Is it for sharing, playing with, or using at home? Take notes about what your partner says</p> <p>Partner #1 will start interviewing partner #2. You each get 4 minutes, and I will let you know when it's time to switch.</p> <p>Keep a timer to let students know when to switch.</p>	9 min

Page in Book	Suggested Script	Time
	<p>Circle some of the words your partner used to describe the object. Write down any other words they said that seemed important to them.</p> <p>Check with your partner to see if there are any other words they would like to add.</p>	3 min
	<p>Make a plan about what your partner needs! Fill in the blanks to make a statement about what the gift will be.</p> <p>This statement will explain the reason your gift is unique to your partner and addresses his or her wants and needs.</p> <p>*At this point, partners can return to Step # 1: Pick Your Gift, this time switching roles. Once both students have had a chance to interview their partner about their perfect gift, both students can proceed to Step #3.</p>	3 min
	<p>Sketch at least five different ideas that could be the perfect present for your partner! Don't worry about the quality of the idea or the drawings. Just come up with as many different "wild" ideas as you can!</p> <p>Remember to try changing all parts of the object for each design sketch: color, shape, size, how it's used, etc. Give your partner lots of options to choose from!</p> <p>Both partners can work on this step at the same time.</p>	8 min

Activities

Page in Book	Suggested Script	Time
 <p>Step #4: Share your ideas</p> <p>Share your ideas with your partner and capture his or her feedback on your designs.</p>	<p>Show your sketches to your partner and listen to his or her feedback! As you give feedback, focus on what you like about each idea, and what parts you think could be improved.</p> <p>Try not to defend your ideas, but instead listen to what your partner likes and doesn't like as much. Take notes on his or her feedback.</p> <p>This time partner #2 will start. You have 4 minutes discuss the ideas before switching.</p> <p>Give the signal to switch after 4 minutes.</p>	8 min
 <p>Step #5: Sketch your new idea based on the feedback you received.</p>	<p>Consider what you learned about your partner and sketch a new idea. It might be a variation of one of your first ideas, or it might be something completely new. Don't be afraid of starting over if you don't think any of your ideas are working, but keep in mind what your partner wanted from the gift in the first place, and what parts of your original ideas they liked.</p> <p>Both partners can work on this step at the same time.</p>	8 min
 <p>Step #6: Build your gift!</p> <p>Use the materials at your table and make something your partner can interact with.</p>	<p>Build your idea! It doesn't have to be realistic, but it will give your partner a design to interact with. You can build the whole item or just focus on one part of it.</p> <p>Both partners can work on this step at the same time.</p>	15 min

Page in Book	Suggested Script	Time
 <p>Step #7: Share and get feedback</p> <p>Share your creation with your partner and get feedback about the gift you made for them.</p>	<p>Present your perfect present! Let your partner interact with the prototype, or model, you built for them. Watch how they use it or misuse it. Capture their feedback on the next page.</p> <p>Starting with partner #1, take 5 minutes to share and get feedback and then switch.</p> <p>Give the signal to switch after 5 minutes.</p>	10 min
 <p>Step #8: Improve!</p> <p>Improve your design even more based on the last bit of feedback your partner provided.</p>	<p>Continue improving your designs!</p> <p>If time allows, you may want to have students continue the improving, redesigning, and testing steps –all part of the Engineering Design Process!</p>	(Time will vary)

WRAP-UP

5-30 minutes

If time allows, host a final showcase to share all of the gifts. Encourage students to share one part of the design that they changed based on their partner's feedback and one thing that they created to make their gift even unique for their partner.

From this activity, we learned how important it is to listen to the ideas and feedback of the person who will be using something we design. You also problem-solved to make your design better and used your partner's feedback to work with your own vision. Engineers do these same steps all of the time since the people who hire them don't always have the exact same ideas or understand the project at the same level. Engineers usually work in teams to create the best designs possible for the problem they are trying to solve.

What were some good questions you asked your partner that helped you make a design plan?

Which answers were most helpful with inspiring your design?

Were there times when you realized that your partner's ideas wouldn't work with your design ideas? What did you do?

CLEAN UP

5 minutes

- If there are enough materials, let students keep the gifts. If not, have students disassemble the gifts and separate the materials back into separate bins.

BACKGROUND INFORMATION

The process used in this activity is based on human-centered design, a way of developing solutions to problems that involves the human perspective in all steps of the problem-solving process. One interesting application of human-centered design is 3D-printed prosthetics. Companies have managed to design and put together kits for prosthetic limbs at a much lower cost than traditional prosthetics. Of course, this process took longer than the one in this activity, but the idea is similar: People were able to create an object that was customized to solve their unique problem.

Many people need prosthetic limbs, and people need different fits depending on their size. Using 3-D printers results in designs for prosthetics for people of various sizes and needs. Just like our gifts, the idea started because of a need to create something for someone. Engineers then worked on a design until it met the needs of their target audience.



Figure 1: A 3D-printed leg is designed based on a user's needs and preferences (Photo: art-vibes.com)

GLOSSARY

Prototype	An early sample or model product built to test a concept or process or to act as a thing to be replicated or learned from.
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NEXT GENERATION
SCIENCE STANDARDS

	Practices
✓	Asking questions and defining problems
✓	Developing and using models
	Planning and carrying out investigations
	Analyzing and interpreting data
	Using mathematics and computational thinking
✓	Constructing explanations and designing solutions
	Engaging in argument from evidence
✓	Obtaining, evaluating, and communicating information

	Crosscutting Concepts
	Patterns
	Cause and effect
	Scale, proportion, and quantity
	Systems and system models
	Energy and matter
✓	Structure and function
	Stability and change

	Disciplinary Core Idea	3	4	5	MS
Physical Science					
PS1	Matter and Its Interaction	n/a	n/a		
PS2	Motion and Stability: Forces and Interactions		n/a		
PS3	Energy	n/a			
PS4	Waves and Their Applications in Technologies for Information Transfer	n/a		n/a	
Life Science					
LS1	From molecules to organisms: Structures and processes				
LS2	Ecosystems: Interactions, Energy, and Dynamics		n/a		
LS3	Heredity: Inheritance and Variation of Traits		n/a	n/a	
LS4	Biological Evolution: Unity and Diversity		n/a	n/a	

Earth & Space Science					
ESS1	Earth's Place in the Universe	n/a			
ESS2	Earth's Systems				
ESS3	Earth and Human Activity				
Engineering, Technology, and Applications of Science					
ETS1	Engineering Design	✓	✓	✓	✓

DCI Grade Band Endpoints

3-5 ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (By the end of Grade 5)

3-5 ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (By the end of Grade 5)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (By the end of Grade 5)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (By the end of Grade 5)

3-5 ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (By the end of Grade 5)

MS ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (By the end of Grade 8)

MS ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (By the end of Grade 8)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (By the end of Grade 8)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (By the end of Grade 8)
- Models of all kinds are important for testing solutions. (By the end of Grade 8)

MS ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (By the end of Grade 8)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (By the end of Grade 8)

3-5 ESS3.C: Human Impacts on Earth Systems

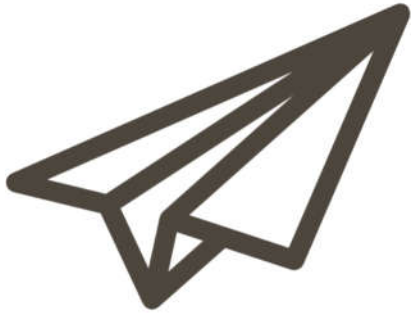
- Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. For example, they are treating sewage, reducing the amounts of materials they use, and regulating sources of pollution such as emissions from factories and power plants or the runoff from agricultural activities. (By the end of Grade 5)

Performance Expectations

3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
5-ESS3-1	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

The Perfect Present

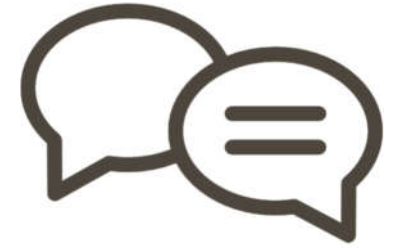
Appendix



**A Form of
Transport**



**Something
to Carry
Things In**



**A Communi-
cation Device**



**Something
to Sit On**



Shoes



**Something
to Wear**

- Where and with whom would you need to communicate?
- How could you improve existing communication devices?
- What else would it do?
- How does it help you?
- How is it powered?

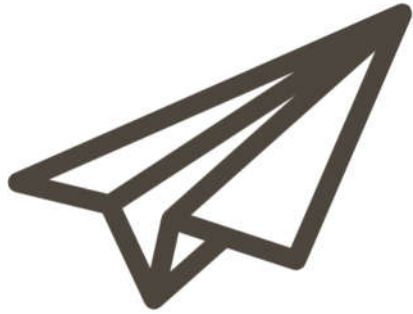
- Why do you need it?
- What is your favorite thing to wear?
- What else would it do?
- How does it make you feel?
- How does it help you?

- What type of things would it carry?
- What else would it do?
- How does it help you?
- How would you carry it?

- Why do you need them?
- When would you wear them?
- What else would they do?
- Describe your favorite shoes.

- How could you improve existing modes of transportation?
- What else would it do?
- How does it help you?
- What is your favorite and least favorite mode of transportation?
- Where would you go?
- How would it be powered?

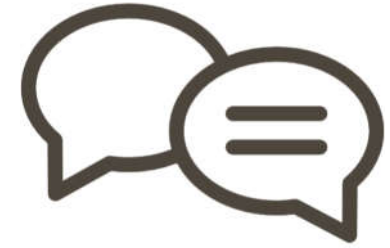
- Where would you use it?
- Where is your favorite place to sit?
- What else would it do?
- How does it help you?



**Un modo de
transporte**



**Algo para
llevar cosas**



**Un dispositivo
de
comunicación**



**Algo en donde
sentarse**



Zapatos



**Algo para
ponerse**

- ¿Dónde y con quién necesitas comunicarte?
- ¿Cómo podrías mejorar dispositivos de comunicación que ya existen?
- ¿Qué más haría?
- ¿Cómo te ayudaría?
- ¿Cómo se activa?

- ¿Para qué lo necesitas?
- ¿Cuál es tu prenda favorita para ponerla?
- ¿Qué más haría?
- ¿Cómo te hace sentir?
- ¿Cómo te ayudaría?

- ¿Qué tipo de cosas llevaría?
- ¿Qué más haría?
- ¿Cómo te ayudaría?
- ¿Cómo lo llevarías?

- ¿Por qué los necesitas?
- ¿Cuándo lo usarías?
- ¿Qué más harían?
- Describe tus zapatos favoritos.

- ¿Cómo podrías mejorar modos de transporte que ya existen?
- ¿Qué más haría?
- ¿Cómo te ayudaría?
- ¿Cuál es tu modo de transporte favorito y menos favorito?
- ¿Adónde irías?
- ¿Qué tipo de energía usaría?

- ¿Dónde lo usarías?
- ¿Cuál es tu lugar favorito para sentarte?
- ¿Qué más haría?
- ¿Cómo te ayudaría?

Note: To correctly print the Perfect Present booklet, use the following printer settings:

- Only print pages 23-32 (English version) or 33-42 (Spanish version)
- Select “Duplex” or “Print on both sides” and “flip on SHORT edge.”

Once printed, the entire stack of pages can be placed together, folded in half to form a booklet, and the pages will be in the correct order.

Engineer the
Perfect Gift!



↑
Pair up

↑
Interview

↑
Design a gift
for your partner



Depending on time, these steps
can be done over and over and
over again...

It's all part of the Engineering
Design Process!



Step #1: Pick your gift

What object do you need?
Is there an object you would
like to improve?

Choose your card and give it to:
your partner.



Step #8: Improve!

Improve your design even
more based on the last
bit of feedback your
partner provided.



Step #2: Interview your partner

What does he/she need?

Read the questions on the
back of your partner's card
and take notes on their
answers.



Feedback

What worked well:

What could be improved/changed:

Questions:

New ideas:



Step #7: Share and get feedback

Share your creation with
your partner and get
feedback about the gift you
made for them.



Take notes here:



What words describe the object they want? Circle the ones that matter most, and write some of your own.

Heavy	Small	Light
Useful	Big	Simple
Colorful	Short	Long
	Complicated	



Building Time.
Have fun!



Pa 14

A vertical stack of five colorful gift boxes with various patterns (polka dots, stripes, floral) and bows, decorated with a string of dots at the top and bottom.

Step #3: Design your gift!

Sketch at least 5 wild new
ways to meet your partner's
needs (they don't have to be
good sketches!)



Sketch Here!



Sketch Here!



Step #5:
Sketch your new idea
based on the feedback
you received.



Step #4: Share your ideas

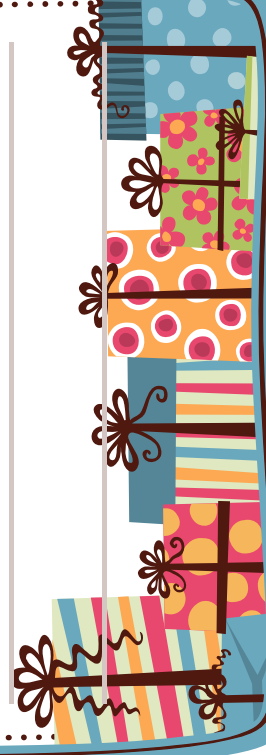
Share your ideas with
your partner and
capture his or her
feedback on your
designs.



Feedback

What parts my partner liked:

What parts they didn't like:



¡Crea el regalo
perfecto!



↑ Encuentra un/a

compañero/a

↑ Entrevístalo/a

↑ Diseña un regalo



Dependiendo de cuánto tiempo
tengan, estos pasos se pueden
repetir una y otra y otra vez...

¡Todo es parte del proceso de
diseño de ingeniería!



Paso #8: ¡Mejora!

Mejora tu diseño aún
más de acuerdo a las
sugerencias que tu
compañero/a te acaba
de dar.



Paso #1: Escoge tu regalo

¿Qué necesitas?
¿Tienes un objeto que
quisieras mejorar?

Escoge tu tarjeta y dásela a tu
compañero/a



Paso #2:

Realiza tu entrevista

¿Qué necesita tu
compañero/a?

Lee las preguntas en la
parte de atrás de su tarjeta.
Y escribe sus respuestas.



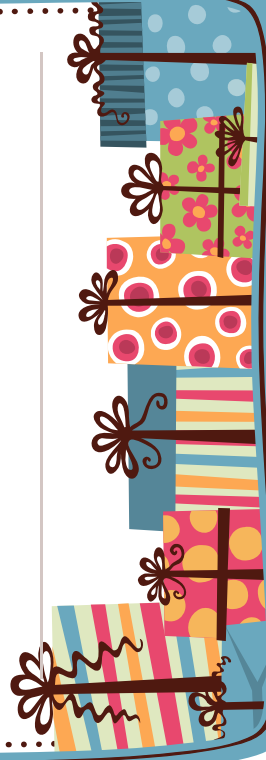
Sugerencias

Qué funcionó:

Qué puede mejorar/cambiar:

Preguntas:

Nuevas ideas:



Paso #7: Comparte y escucha sugerencias

Comparte la creación con
tu compañero/a y escucha
sus sugerencias.



Toma apuntes aquí:



¿Qué palabras describen el objeto que
quiere? Marca las más importantes, y
escribe otras que se te ocurran.

Pesado

Liviano

Pequeño

Útil

Simple

Grande

Corto

Colorido

Complicado

Largo



Hora de construir.

¡Diviértete!



Paso #6: ¡Construye tu regalo!

Usa los materiales en la
mesa para crear algo que
tu compañero/a pueda
usar.



Mi compañero/a _____ (nombre)
necesita _____ (objeto)
que _____ (¿qué hace el regalo?)
porque/pero/y _____
_____ (razón o limitación)



Paso #3: ¡Diseña tu regalo!

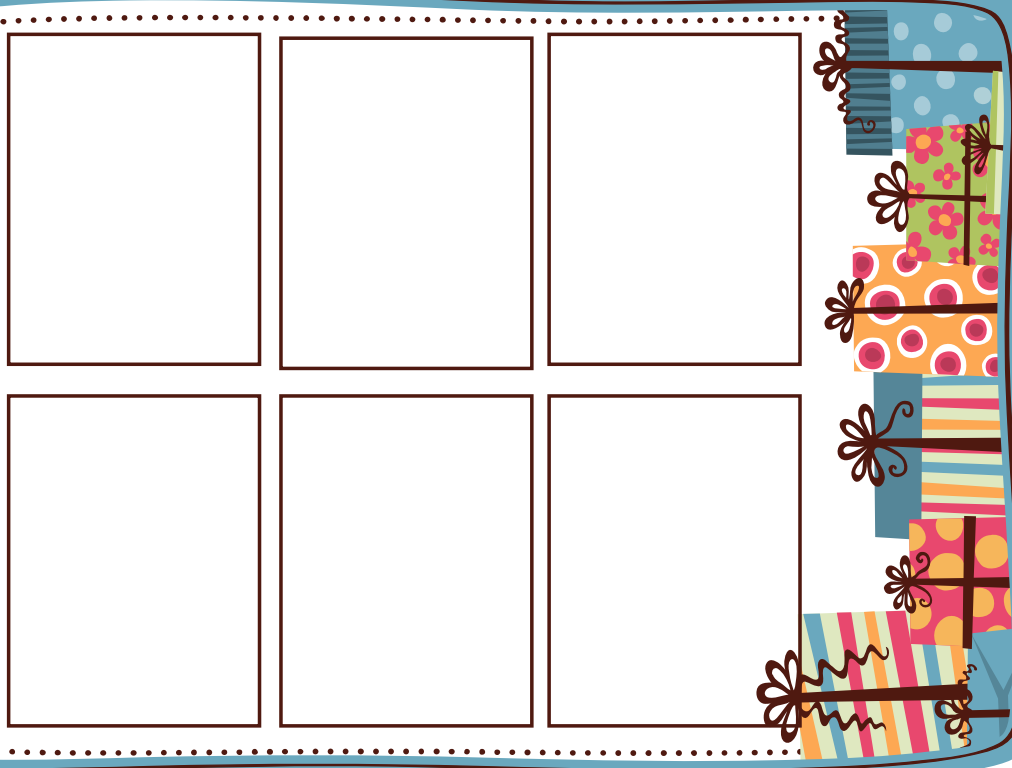
Dibuja al menos 5 ideas diferentes
que pudieran satisfacer las
necesidades de tu compañero/a (¡los
dibujos no tienen que ser perfectos!)



¡Dibuja aquí!



¡Dibuja aquí!



Paso #5:
Dibuja tu nueva idea
de acuerdo a las
sugerencias que
recibiste.



Paso #4: Comparte tus ideas

Comparte tus ideas con tu
compañero/a, y captura
sus sugerencias en tus
diseños.



Sugerencias

Qué le gustó a mi compañera:

Qué no le gustó a mi compañera:



The Perfect Present

Description: Students will design and improve a gift for their partner based on their individual needs and unique interests.

Promoting collaboration and organization

- Encourage students to provide kind but honest feedback to their partner. Their perfect present depends on this input!
- Remind students that criticism on their design is not meant to be taken personally. Rather, it's to help them improve their design. Try giving one compliment along with each suggestion.
- Make sure both students in the partner team get time to speak.

Encouraging iteration

- Motivate students to think outside the box with their design. Dream big! Wild ideas are encouraged!
 - Is this object design too similar to something you have seen before? Try making it more unique. If you can buy it online, redesign it to be more original.
 - Can you change the function, material, or size?
 - What other problems does your partner want their gift to solve?

Helping those who are stuck

- Use object cards to inspire ideas, but the design does not have to be one of the objects on the cards.
- If partners are having difficulty compromising, then remind the engineer (i.e., the person designing) that their partner is their customer. Engineers want to make their customers happy.
- Ideas for an object don't have to be similar. A fork and chopsticks look nothing alike, but you can eat with either one.
- Have the designer go back to the object card and determine the function of the object. Then have the engineer visualize how it can work and what it may look like based on the preferences of their partner.

Real-world applications

- A popular way to make custom human-centered designs is using 3D printing. This process, also known as additive manufacturing, uses computer controls to create a 3D object in which layers of material are formed to make a specific object.
- Custom-designed gifts are gaining popularity. Many companies let you design your own custom products from phone cases to bath mats to clothes.