

The Complex Problem Solving Project: A Guide to Improving Our Own Community (Student Workbook)

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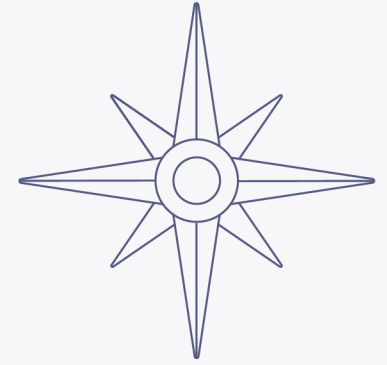
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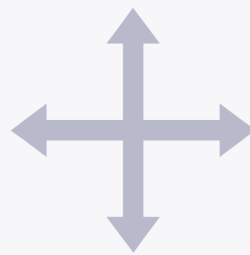


The Complex Problem Solving Project

A GUIDE TO IMPROVING
OUR OWN COMMUNITY

Enhancing Critical Thinking and Creativity Skills

Solving
**REAL-WORLD
PROBLEMS**
with ideas!



The Complex
Problem Solving Project

A Guide to Improving Our Own Community
Teaching and Learning Lab, Kyushu University Faculty of Design

The Complex
Problem Solving Project

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Teaching and Learning Lab, Kyushu University Faculty of Design
<https://life-green-peace.org>

This resource package is an educational prototype produced by the Teaching and Learning Lab. We are hoping to understand the usefulness of these materials and how we can improve them to make them better for educators and learners. At the same time, through the feedback, we also hope to create new resources for educators and learning through research and development. If you have used these materials, please share your feedback with us in this survey.



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Acknowledgement

Leading towards the creation of these resources, our lab has visited secondary and high schools in Oceania and Asia to understand the common approaches teachers use in their teaching subjects to teach students to solve complex problems. At the same time, through the sharing by the teachers, we were able to catch a glimpse of the challenges faced by the teachers when facilitating and teaching complex problem solving. The generous insights from the teachers have contributed to the motivation and ideas for these resources.

We would like to express our appreciation to all the staff, teachers, and professors for their help in coordinating the school visits in their countries.

In addition, we would like to thank the following faculty members at Kyushu University for their valuable insights and advice in this project.

Dr. Melanie SARANTOU Professor

Dr. Yanfang ZHANG Associate Professor

Dr. Moe SHIMOMURA Associate Professor

Dr. Noriko TAKANO Researcher

Preface

There is no doubt that complex problem solving is one of the most important competencies that our students should possess to navigate the rapidly changing and uncertain future. Why is it so? Doing a search on the World Wide Web, we will be able to find many books, resources, and information that explain what complex problem solving is, its importance, and how to develop complex problem solving skills. National curricula in many countries have also been designed to systematically develop complex problem solving skills in students. Through solving complex problems, students develop important attributes necessary for the 21st century.

Complex problems can be associated with ill-defined problems. Ill-defined problems are like the real-world problems that we face daily. During my research journey, I often found students learning how to solve complex problems in subjects such as Design and Technology; in some countries, the subject is called Technology. In Design and Technology, students are taught how to use the design process to solve real-world problems. Besides Design and Technology, school curricula in some countries consist of a dedicated subject for students to be engaged in project work. During project work, also known as complex problem solving projects, students are often taught to use design-based approaches to solving real-world problems. While some teachers are trained to facilitate complex problem solving projects using design-based approaches, many are not. Some teachers may be trained in teaching a specific subject area; some are beginning teachers with less experience than others. For this reason, our team in the Teaching and Learning Lab at Kyushu University started to conceptualize this project that aims to develop a set of resources as a “starter kit” for teachers to embark on facilitating and teaching complex problem solving in their classrooms.

Our set of resources is designed to enable teachers to initiate a complex problem solving project in their classrooms. In this project, students will explore real-world problems within their communities, with the overarching goal of contributing to a sustainable world by achieving the Sustainable Development Goals (SDGs) through their creative solutions. The general approach to solving real-world problems in this project is adapted from the design process used by design practitioners and academics. While the design process can be defined in various ways, our team has attempted to articulate it through a story, providing teachers and students with a more general approach to solving real-world problems.

Through solving real-world problems in this project, students will develop various competencies. Firstly, students will need to integrate knowledge and skills learned in different subjects to understand the problem and create suitable solutions to solve the problem. Through understanding the problem, students may better

understand their communities and connect with their cultures, history, societies, etc. Secondly, through solving real-world problems, students will also need to exercise critical thinking to make good decisions, creativity to create original ideas, social-emotional learning to empathize with the issues faced by others, communication skills to connect with stakeholders, and many more.

This set of resources is mainly written with the following users and learners in mind.

- a. Beginning teachers (secondary/high school teachers)
- b. Teachers unfamiliar with facilitating and conducting complex problem solving project
- c. Secondary and high school students

While we admit that there are many strategies to conduct and facilitate complex problem solving projects, our team hopes these resources will serve as a starting point for some teachers and be useful for them and their students. Teachers may also adapt the content of the resources to implement the project in a way that suits their classroom and students best.

Leon LOH

The Complex Problem Solving
Project Package

This package consists of four items designed to be used hand in hand with each other. Main items in this package:

- Lesson Plans
- Guidebook
- Workbook
- Worksheets

This project is planned as a short curriculum for teaching complex problem solving. The curriculum is planned for 18 Lessons. Each lesson is suggested to be 100 minutes. Activities planned in each lesson include individual and group work.

This complex problem solving project is designed for upper secondary/high school students. Students in the class are suggested to work in groups. The recommended size of each group is about four.

How to use the resources?

1. The lesson plans consist of the following content to suggest how teachers can conduct each lesson in the project.
 - Learning objectives
 - Detailed plans, including the purpose of the content/activities, teaching strategies, materials needed and time allocation
 - Facilitation notes which pre-empt teachers of possible issues that may happen, suggestions of what they can do, what they can prepare beforehand, etc.
 - Suggested references and resources for further reading
2. The guidebook provides concise content information, examples, and references for further reading that students will need for the project.
3. The workbook provides activities to facilitate students' learning, and it serves as a journal in which students record all their learning, research, and thoughts during the project.
4. The worksheets are designed in A3 size for individual work and group discussion.
5. Teachers can use the resources in the following ways.
 - Use as it is
 - Extract relevant activities and materials to adapt to your curriculum
 - References to design your curriculum and materials

Introduction

PROJECT TASK

In this project, you will identify a **real-world problem** related to achieving the **Sustainable Development Goals (SDGs)** within your community and solve it creatively and feasibly through a **real-world problem solving process**.

Why is this project task important?

Guidebook p.11

It is important to discuss the significance of this project and who and why it matters. The impact that you can make with this project on your community and how your effort can contribute to the country and inspire many to join you and, in turn, these will impact the world.

Answer the **3 Whys** thinking routine questions developed by Project Zero, a research center at the Harvard Graduate School of Education. Then, share your answers with your group and note down interesting and different points from your group mates.

QUESTIONS

1 Why might this project matter to me?

Notes

GROUP WORK

2 Why might this project matter to the people around me?

Notes

GROUP WORK

3 Why might this project matter to the world?

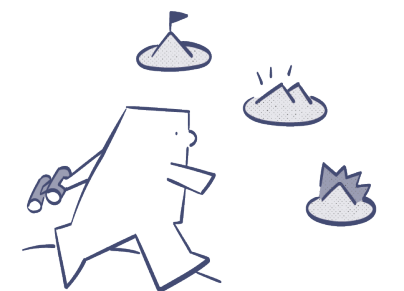
Notes

GROUP WORK

1

Exploration of Problems

The explorer is curious and wonders about what's happening on all the islands. Are you curious about your surroundings? Do you know what is going on with the people and environment around you? As an explorer, stay curious, as it is the driving force to move forward. Do you know how to achieve a sustainable society?



1

Exploration of Problems

What have been done for SDGs?

Guidebook p.20

Explore the given resources through the link in the guidebook and understand the **SDGs efforts** done by different people, communities, and organizations.

As you explore different resources, reflect on the given questions for each resource and note the issues that seem relevant to your community.

What can I do for SDGs?

After viewing the resources on the different issues and efforts done by others, think about the areas that you are interested in. Which **goals, sub-goals** can you play a part in contributing to the community?

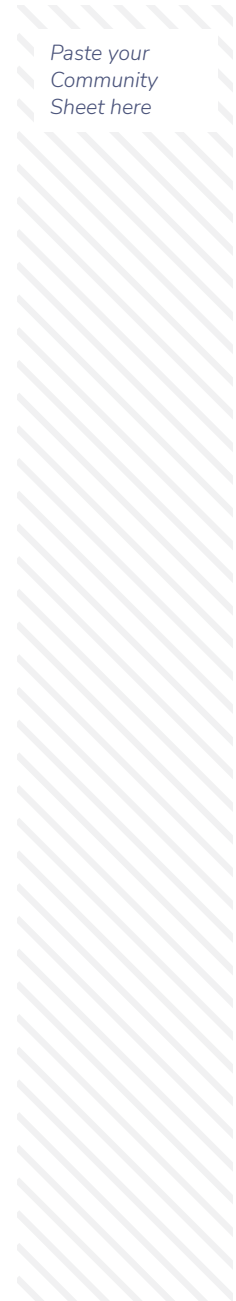
Start small,
think big

Guidebook p.20

There are many ways to achieve the SDGs in our community. For starters, we can start small and think big. We can start by solving small problems within our community to make it a better place for everyone to live and then expand this effort to reach out to bigger groups or address deeper problems.



The **Community Sheet** provides an example of what is in your community and questions to think deeply about what you see.



STEP 1
Explore problems,
think wide

Guidebook p.20

You can create a mind map on the mind map sheet to help you recall what you see in your community and think deeper about what you have seen with questions to identify possible problems. If you are unfamiliar with mind maps, you can [refer to the examples in the guidebook.](#)



STEP 2
Explore problems,
think deep

Guidebook p.21

As you create the mind map and explore the different places, facilities, people, objects, etc., in your community, use the considerations and questions in the guidebook to help you uncover problems, inconveniences, and improvements that can be made and draw connections to similar situations. Then, note these down in the mind map. You can [refer to the examples in the guidebook.](#)

Methods

Guidebook p.20

STEP 1

A mind map is a tool that captures the thinking that goes on inside our heads. It helps us think, collect knowledge, remember, explore options and create ideas. Most importantly, it will likely help us be better thinkers.

A diagram of a mind map with a central circle connected to three outer circles.
Mind Map

STEP 2

Questions can arouse curiositiy, develop observational skills, and provoke responses that allow thinking to be deepened, extended or challenged. It can help you discover many interesting and new insights and issues that need to be resolved to improve your daily lives.

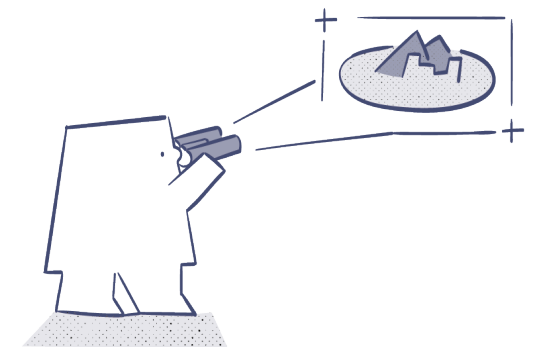
A large, stylized question mark.
Questions

Paste your
Mind Map
Sheet here

2

Selecting a Problem

Looking far through a telescope, the explorer discovers an island with villagers in need of help. To get to the island, the first challenge is to cross over the vast sea. Among the different problems that you have discovered in your community, which problem should you first choose to work on?



2

Selecting a Problem

STEP 1

Write problems with detail

Guidebook p.27

Select 5 problems and write them clearly so that other group members can understand. When did the problem take place? Who were involved, what happened, and why did it happen? [Refer to the examples in the guidebook.](#)

1

2

3

4

5

STEP 2

Share problems in groups

GROUP WORK

Write 5 problems with keywords or short phrases on the Post-it. Write down 1 problem on 1 Post-it. Share them with your group members.

Problem 1
Write with
keywords,
short phrases

STEP 3

Evaluate different problems

GROUP WORK

To decide on one problem, you will need to evaluate all the problems shared by the group.

Decision
Axis Sheet

Decision
Matrix Sheet

STEP 3 - 1

Before you can evaluate the problems, you need to consider the criteria used to evaluate all the problems. Look through the **list of criteria** [on the guidebook.](#)

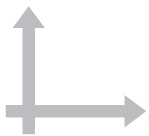
Guidebook p.27

Methods

Guidebook p.28

STEP 3 - 2

Choose two criteria from the list that are most important to your group. Using the Decision Axis, shift out problems that don't meet the criteria.



Decision Axis

STEP 3 - 3

Using the Decision Matrix, evaluate further based on all the remaining criteria and decide which problem to work on.



Decision Matrix

STEP 4

Choose one problem to work on

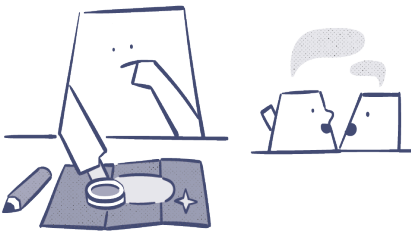
The problem that our group will try to solve is,

Which of the **SDGs** are related to this problem?

3

Understanding the Problem

The explorer is unfamiliar with the island and the sea. To find accurate information, the explorer talks to the people who know the sea and studies the current and wind patterns surrounding the island. Do you really understand the problem that you have selected? What do you need to find out and who should you talk to?



3

Understanding the Problem

Verify the problem

Guidebook p.31

If you see it and hear it, does it mean that it is real? How do you make judgement in everyday life?

Understanding the problem is a very important process and the key to achieving good solutions. Hence, you will need to examine if the problem you have chosen is **accurate**.

Write down your problem in the space provided. Discuss and answer the questions below with your group members.

The **problem** that our group agreed upon is,

GROUP WORK

GROUP ASSESSMENT

QUESTIONS	YES	NO
Q. Is the problem based on our own assumption?	☐	☐
Q. Do we have evidence to support that the problem is accurate?	☐	☐
Q. Is the problem only from our perspective?	☐	☐
Q. Have we asked anyone else for their opinion?	☐	☐
Q. Did we ask relevant people for their opinions?	☐	☐
Q. Did we ask many of the people involved?	☐	☐

Research

Now, you need to research for accurate information as evidence to justify the problem. What evidence do you need to collect and who do you need to seek opinion from to make a fair judgement and the current available situation? [Refer to the examples in the guidebook.](#)

STEP 1 Plan research

GROUP WORK

Guidebook p.31

Based on your learnings, discuss in the group on the evidence that you need to collect, how you are going to collect, who you need to seek opinion from and how to do it. **Fill out the Research Plan Sheet** as a group. Below, note down the finalized evidence to collect.

Research Plan Sheet

Group Research Plan

What evidence should we collect?	How?	Where? Who?
1		
2		
3		
4		
5		

STEP 3 Documenting research findings

Cite the source and write down key findings.

*Print and staple
the documents
on the top-
left corner,
then paste the
documents here.*

Analyze the findings

Based on the information that you have collected, you can organize, collate, analyze the information and data to draw conclusion of the findings.

STEP 1

Organize and collate findings

Organize and collate the information and data of your individual research by categorizing them.

Analyze and draw conclusions

Guidebook p.38

The next step is to analyze the information gathered from various sources in your group. Draw conclusions and summarize your findings clearly and accurately.

Share your findings
with the group

**GROUP
WORK**

STEP 2

Summarize the group findings

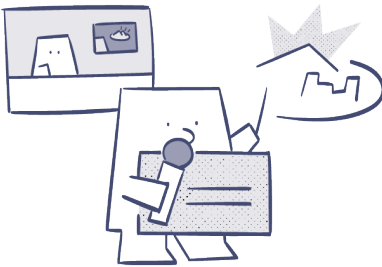
Summarize the group findings. Explain in sentences and paragraphs to express your findings in a logical manner.

Lined area for summarizing group findings.

4

Defining the Problem

After the investigation, the explorer gained a deeper understanding of the unknown island and felt more confident about reaching it. Do you have a deeper understanding of the problem? If yes, go on to make a final announcement about your problem statement!



4

Defining the Problem

Define the problem

GROUP
WORK

Guidebook p.39

Discuss how to rewrite your problem clearly and accurately based on your findings. You need to include the place where it happened, the people involved, what happened, how and why it happened.

Write the problem on the big paper provided. Note the statement down below. *Refer to the examples in the guidebook.*

The **final problem statement** that our group agreed upon is,

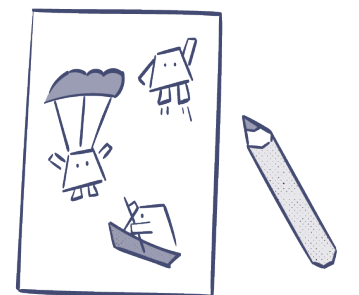
Problem
Statement
Sheet

Which of the SDGs are related to this problem?

5

Generating Ideas

The explorer considers all possible ways to cross the ocean and get to the destination. How about you? How might you generate innovative and feasible ideas to solve the problem? Ride the wind, throw yourself into the waves!



5

Generating Ideas

STEP 1

How-Might-We

Guidebook p.41

GROUP WORK

Ideation can be a daunting task. “How-Might-We (HMW)” questions can be helpful as a structure to guide you to think and ideate. These questions can turn the problems into opportunities for design. *Refer to the examples in the guidebook.*

Methods

Guidebook p.41

How-Might-We

The “How-Might-We” questions can turn problems into opportunities for design. It will help you break down your problem into smaller parts to generate solutions. Creating different How-Might-We questions will help you generate ideas based on each question.



STEP 1 - 1

In groups, generate “How-Might-We” questions based on your group’s problem statement and summarized research findings. Discuss in groups and take notes *on the big paper provided*.

There is no limit to the number of questions. The more questions, the more ideas you can have. However, if there are too many, your group should examine if there are overlapping questions and see if they can be combined.



STEP 1 - 2

After the discussion, note down your group’s final How-Might-We questions on the right page.

How-Might-We Questions

How might we *encourage people to buy near-expiry raw food?*

1

2

3

4

5

6

7

8

9

10

11

12

13

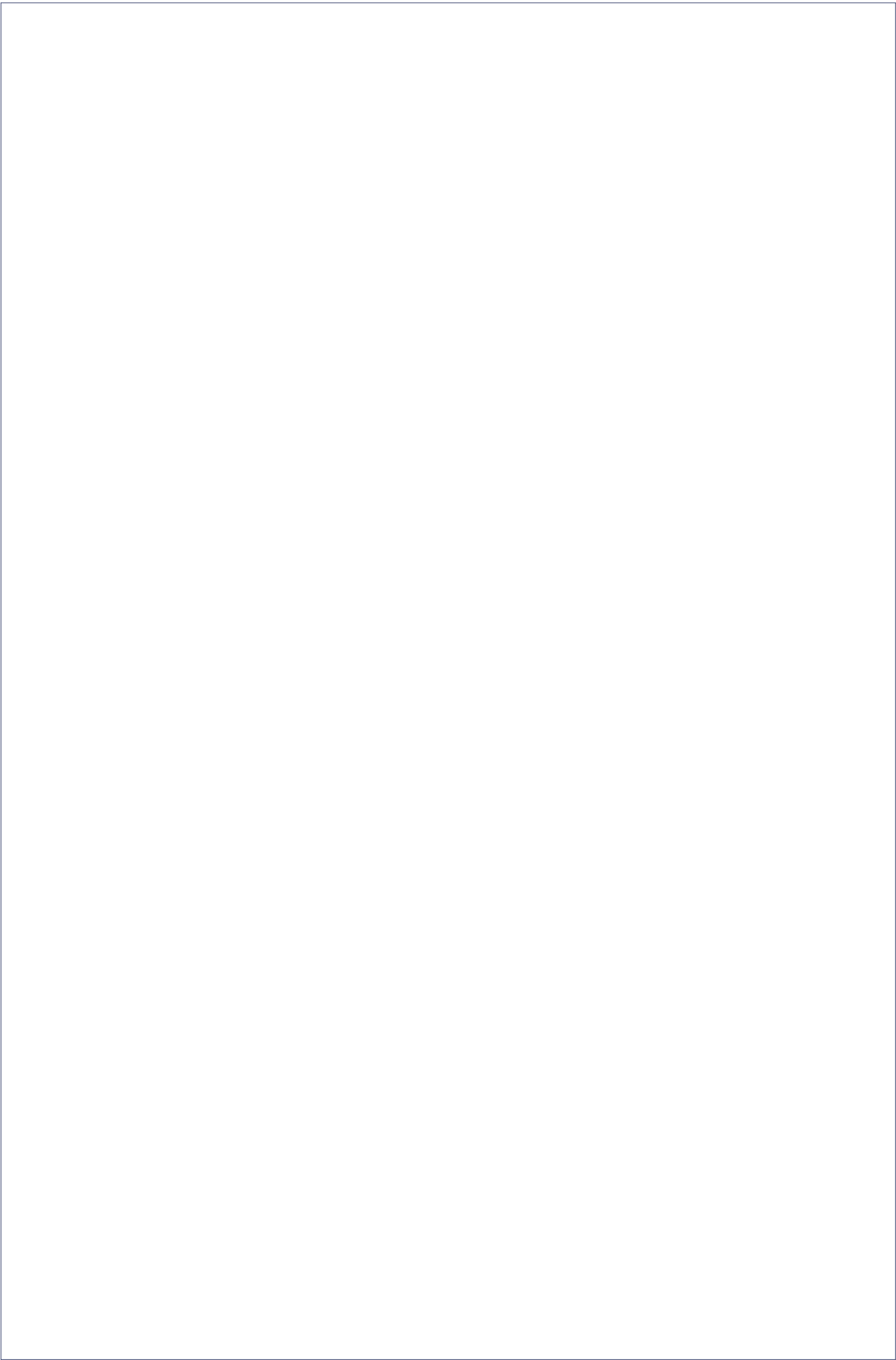
14

15

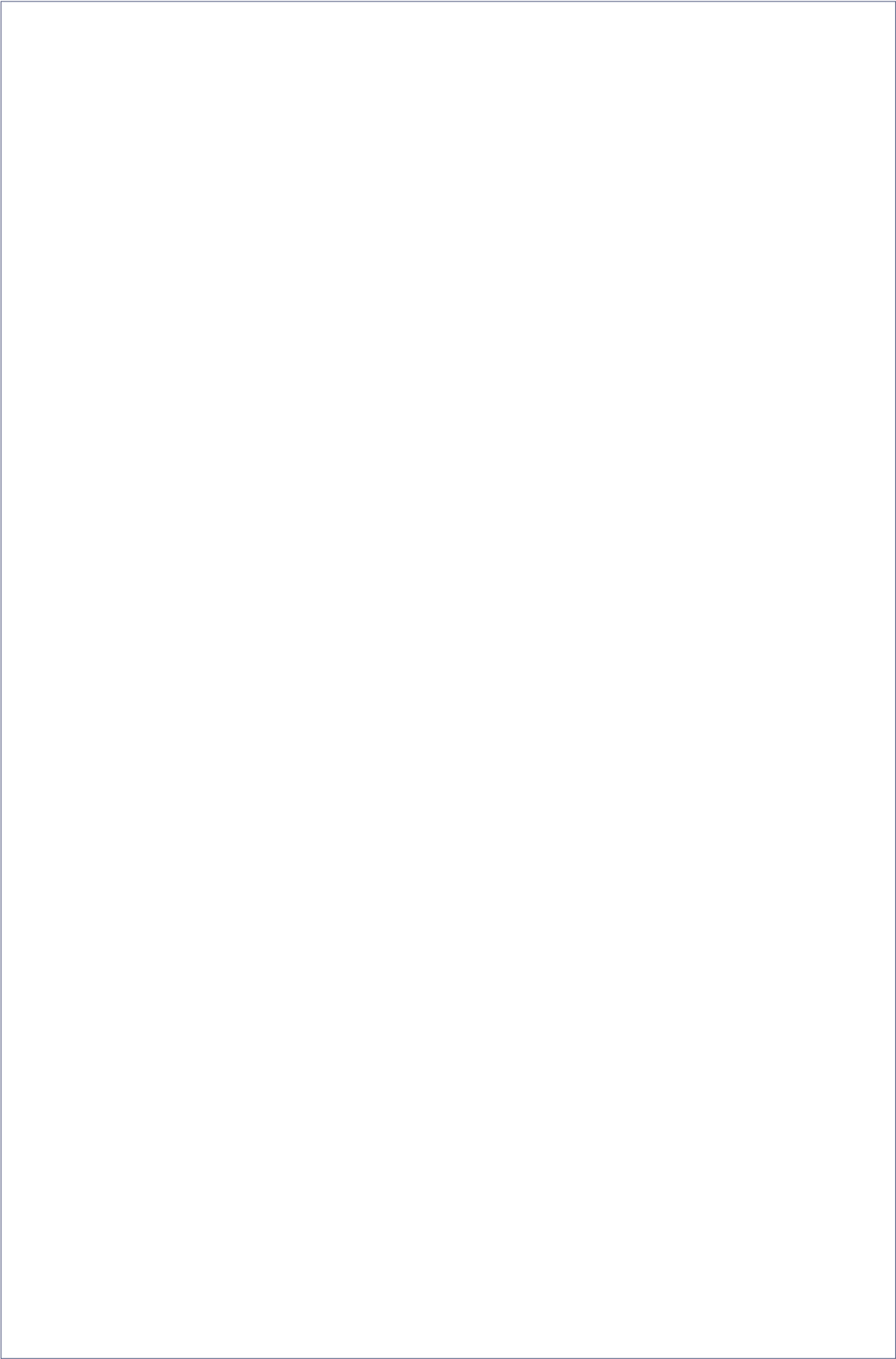
STEP 2
Generate ideas

Brainstorm as many ideas as possible based on the questions. Come up with wild ideas, but provide evidence that the idea is feasible. Alternatively, improve existing ideas that you have researched.

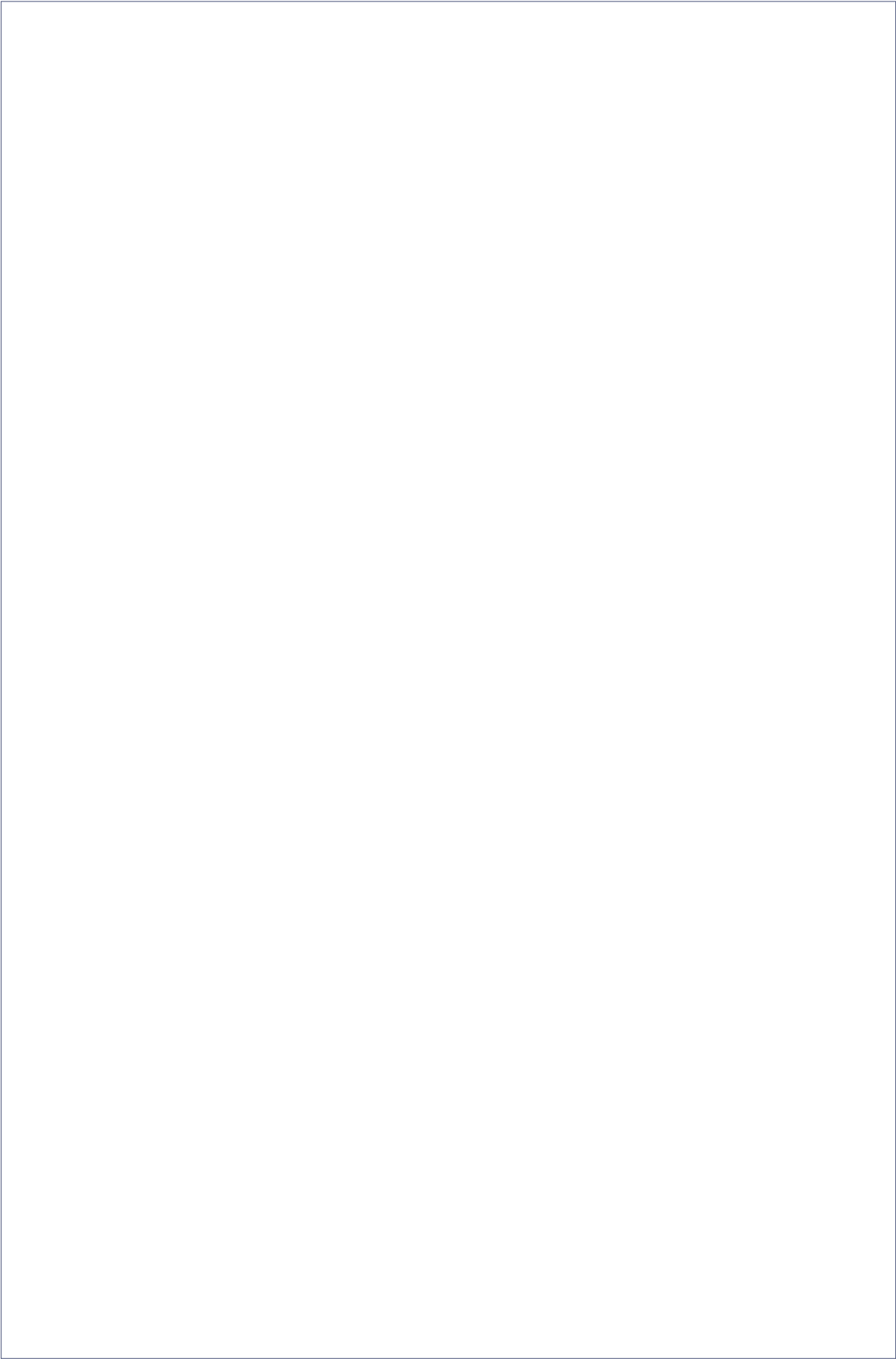
Record your ideas with some details to explain how the idea works in words and/or sketches. You can research on the internet to draw inspiration.



“There’s a way to do it better, find it.” –Thomas Edison



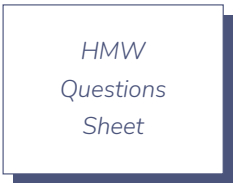
“Ideas are like rabbits. You get a couple and learn how to handle them, and pretty soon you have a dozen.” –John Steinbeck



STEP 3

Share ideas

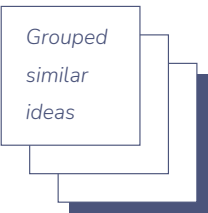
GROUP WORK



- ① Note down the keywords of your ideas on Post-it. Write down 1 idea on 1 Post-it. Share your ideas with your group members. Start by indicating which idea is associated with which “How-Might-We” question.
- ② Organize the Post-it according to the “How-Might-We” questions and *paste on the previous lesson's big sheet*. If the idea is a solution to a few questions, paste on the table or somewhere else.
- ③ Build on each other's ideas to strengthen the idea or to give constructive feedback on the ideas. Evaluate the advantages and disadvantages of ideas.

Suggestions or Feedback

- What do you think of this idea?
- Do you have any suggestions for improving this idea?
- How can we make this part better?



- ④ After your group has finished sharing, you can group similar ideas for each question together. If ideas are similar across the questions, you can group them together by pasting the Post-it together. Discuss the advantages and disadvantages of each idea and note them down on Post-it.

STEP 4

Select an idea

GROUP WORK

To choose an idea, you need to decide on the criteria. You can use the decision axis, or if you have many criteria, you can use the decision matrix. However, in this project, you can evaluate the ideas based on two criteria: **originality** and **feasibility**.

Method

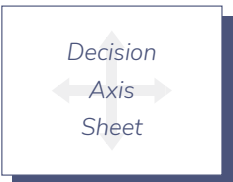
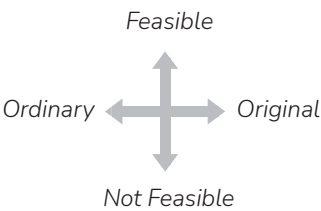
Guidebook p.43

Decision Axis

Using the Decision Axis, place the 2 criteria (originality, feasibility) on the axis. Evaluate each idea and decide an idea that are high on both criteria.



- ① Draw two axes, like a cross, on the big paper provided. Label the horizontal axis with “Ordinary” on the left and “Original” on the right. Then, label the vertical axis with “Feasible” on top and “Not Feasible” on bottom.
- ② Evaluate each idea based on these two criteria and *place the Post-it on the big paper*.
- ③ Review the ideas pasted on the quadrant of “Original” and “Feasible” that are high on both criteria to decide which idea to choose. It is possible to combine two or more of the ideas and choose the idea.

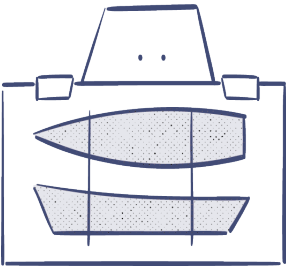


④ The **selected idea** that our group agreed upon is,

6

Creating a Concept

Now it is time to turn the idea into a reality! The explorer decides to build a boat and starts questioning. What material should be used to make the boat? How many people can it carry? What basic supplies should be taken to the island? Start listing down questions and go on making your idea into a concept!



Creating a Concept

GROUP WORK

Consideration

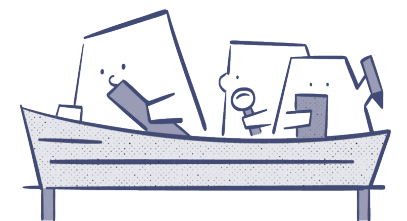
GROUP WORK

Design
Concept
Sheet

7

Prototyping and Evaluation

The explorer decides on the dimensions and creates a small model to see what the boat looks like. Seeking an opinion from a friend, a discussion is held on how to finalize the making. Is the boat spacious and sturdy enough to load the supplies and sail across the ocean? How do you want to test and improve your idea?



STEP 1

Plan prototypes

Guidebook p.47

GROUP WORK

Making prototypes is necessary to test the concept’s workability and ensure the solution works smoothly and effectively. *Refer to the guidebook* to understand different types of prototypes. Think about what type of prototype to make for your concept and its purpose. Discuss and note down the plan, including the allocation of work.

Prototype Plan

Prototype type

Poster, Sketches of App pages/ interface, Cardboard model, etc.

Purpose of your prototype

Materials or equipment

How to make the prototype

Work allocation

STEP 2

Create prototypes

You may have to make more than one to test the concept. Test your design concepts with the prototypes.

Guidebook p.47

**GROUP
WORK**

STEP 3

Evaluate prototypes

Invite appropriate people to test your prototypes and give feedback on how to improve them. If you are invited by others to test their prototypes, remember to provide constructive feedback. [Refer to the guidebook](#) and learn more about giving constructive feedback.

Guidebook p.48

[illegible]

STEP 4

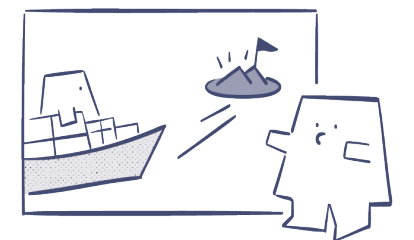
Improve prototypes

Note down what and how to improve the prototypes.

8

Presentation

The explorer introduces the strategies to reach the island in need. The boat, supplies, and the route are presented to the people, and some join them on the journey. A one-time journey crossing the sea might not be enough to help the island villagers. That is why continuous effort and action are crucial! To encourage ongoing interest, present your ideas and persuade others to join in. How might you present your outcomes and convince people of your bright ideas?



8

Presentation

Prepare for presentation

GROUP WORK

Based on the presentation requirement, discuss the presentation and work allocation, including the improvement of the prototype, and note them down. You must be able to present the concept clearly with **visuals, descriptions** and **prototypes**.

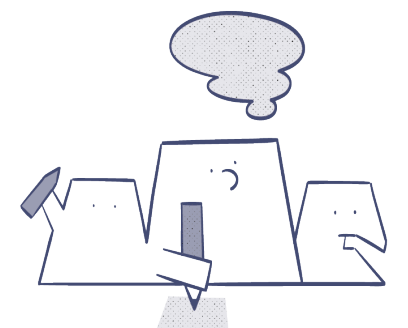
Record feedback and comments

Note down all valuable feedback and comments from the judges, stakeholders, audiences, etc., to review your concept proposal.

9

Reflection

The explorer reflects on the whole journey. What has been learned through the investigation, challenges, and failures? Then, when arriving safely on the island, the explorer will begin a new challenge to help and rescue the islanders with the lesson learned earlier. What stories might await after completing your first journey?



Reflection

Guidebook p.49

QUESTION



THE END

Everyone can be a changemaker.
You can start by taking a baby step.

