# Engineering Adventures

## Engineering Journal

### A Slippery Slope:
### Engineering an Avalanche Protection System

Name:_____

| ← reply | ⇒ forward | 🖅 archive | ✗ delete |
|---|---|---|---|

| from: | engineeringadventures@mos.org | |
|---|---|---|
| to: | You | |
| subject: | Engineering a Tower | 10:36 AM |

Hi everyone,

We're so excited to meet you! Our names are India and Jacob. We do a lot of traveling all over the world. We meet interesting people and see some amazing countries. Each place is unique, but we've found one thing in common. Everywhere we go in the world, we find problems that can be solved by engineers.

Engineers are problem solvers. They're people who design things that make our lives better, easier, and more fun! We heard you might be able to help us engineer solutions to some of the problems we find. That means you'll be engineers, too!

Today, we came across an engineering challenge we think you can help us solve. In our town, there's a park ranger that keeps a lookout for bad weather in the surrounding mountains. The ranger needs to be high enough off the ground to see over the treetops. India and I thought we could build a tall tower that the ranger could stand on. Do you think you can *create* a model tower that's at least 10 inches high?
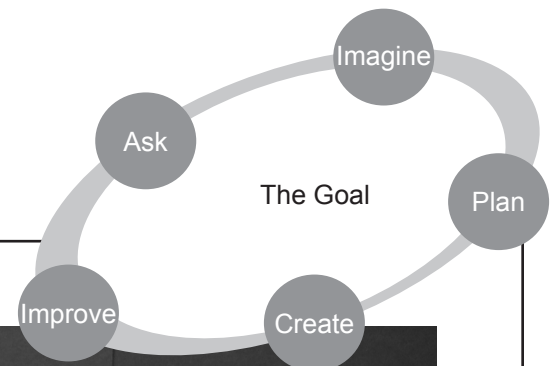
We sent you one tool that we usually find really helpful when we're trying to engineer a solution to a problem. It's called the Engineering Design Process. Take a look at it and see if it can help you!
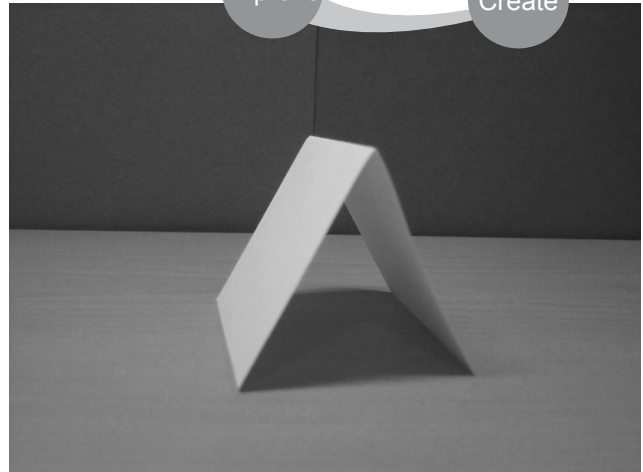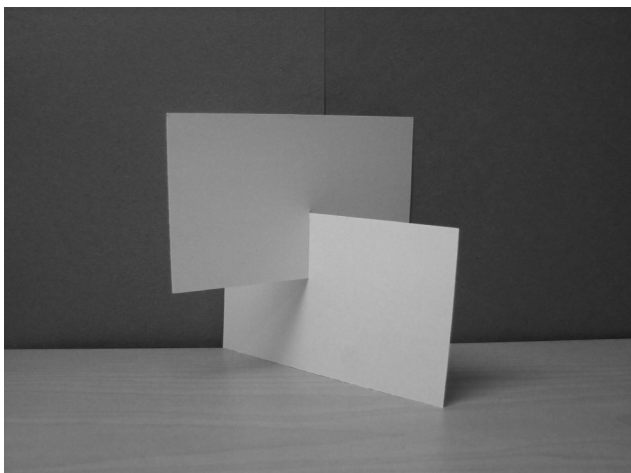
Good luck!
India and Jacob

Imagine
Ask
Plan
The Goal
Improve
Create
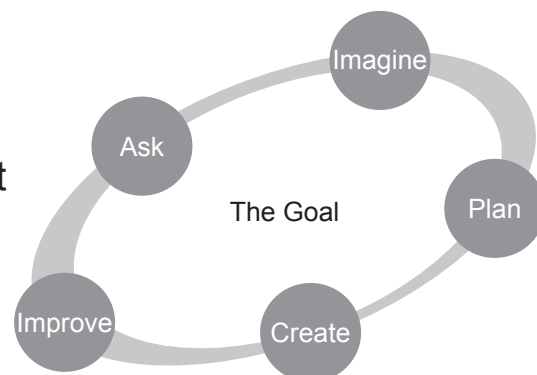
Here are three ways to build with index cards.

Imagine

Ask

The Goal

Plan

Improve

Create

Roll it!

Fold it!

Cut it!

Will any of these ideas help
your group build a tower?
What other ideas do you have?

Talk with your group to
figure it out!

The taller the tower you engineer, the better view of the mountains the park ranger will have!

## 10 inches and up



## 7-10 inches



## 5-7 inches



## 3-5 inches



## 0-3 inches

**Draw Your Tower**

*Use the space below to draw a picture of your tower.*

The Goal

Ask · Imagine · Plan · Improve · Create
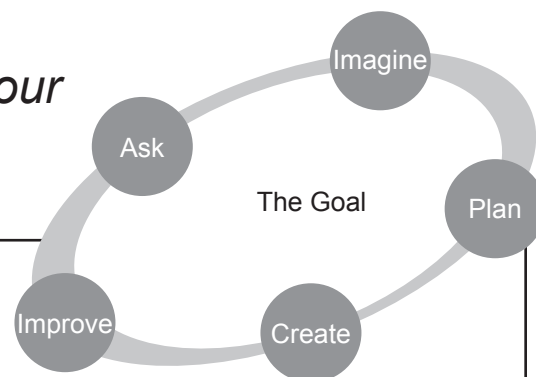
Which parts of your tower design would you change if you could do it again?

# For the Record

I think engineering is:

☐     Fun

☐     Exciting

☐     Difficult

☐     _____

| | reply | | forward | | archive | | delete |
|---|---|---|---|---|---|---|---|

| from: | engineeringadventures@mos.org | |
|---|---|---|
| to: | You | |
| subject: | What is Technology? | 11:23 AM |

Hi Engineers,

You did a great job engineering a tower to help the ranger see over the treetops! Now, you can help us engineer more technologies.

Do you know that the things engineers *create* to solve problems are called technologies? Most people think technologies have to be electronic, but this isn't true. A technology is actually anything engineered by a person that solves a problem.

Think about an airplane as an example. An airplane is a technology because people engineered it and it solves the problem of traveling long distances quickly. But something as simple as a paper cup is also a technology. A person engineered it, and it helps people hold drinks without spilling them everywhere.

We have some more challenges for you today. Can you use the Engineering Design Process to engineer technologies to solve the problems we sent?

Talk to you soon,

India and Jacob

Ask
Imagine
Plan
The Goal
Create
Improve
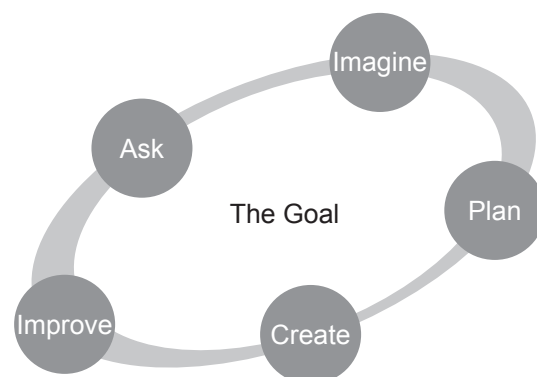
## Which Problem Will You Solve?

☐ Communicate across the length of the room
☐ Move water from one container to another
☐ Carry pens and scissors
☐ Protect a stuffed animal from water from a spray bottle

## You are an engineer!
## What can you engineer to solve this problem?

## Think about what you designed . . .

Did a person engineer it?
    ☐ Yes          ☐ No

Does it help you solve a problem?
    ☐ Yes          ☐ No

If you answered YES to both questions, it is a technology!

| ← reply | → forward | 🗃 archive | ✕ delete |
|---------|-----------|-----------|----------|

| from: | engineeringadventures@mos.org |
|-------|-------------------------------|
| to: | You |
| subject: | Look Out Below! |

8:55 AM

*Hola* (pronounced *oh-la*)! That's "hello" in Spanish.

We are in Peru, a country in South America. We sent you a map to show you where we are. We are here to explore the Andes Mountains, the longest mountain range in the world! There are so many cool things to explore in the Andes, but we have to be careful. We've learned that the mountains can be really dangerous.

Right now we are in a small village in southern Peru that is located right at the bottom of a big mountain. The villagers are worried because there is supposed to be a lot of snow this year, and they are concerned that an avalanche might occur and cause damage to their town.

Have you ever heard of an avalanche? Avalanches happen when a huge amount of snow slides down the side of a mountain. As it falls, the snow can pick up rocks and trees, bury roads and damage buildings. We have been talking to a local avalanche engineer, José Pablo, who designs technologies to prevent or protect people from avalanches. He said we can help him engineer a way to protect the town we are visiting in case an avalanche happens.

José Pablo said the first thing we need to do is *ask* questions to learn more about snow and avalanches.

What kind of snow causes avalanches? What makes avalanches dangerous to the villages below? We sent you some materials so you can experiment with model snow and avalanches. We can't wait to hear what you learn!

India & Jacob

Ask — Imagine — Plan — Create — Improve — The Goal
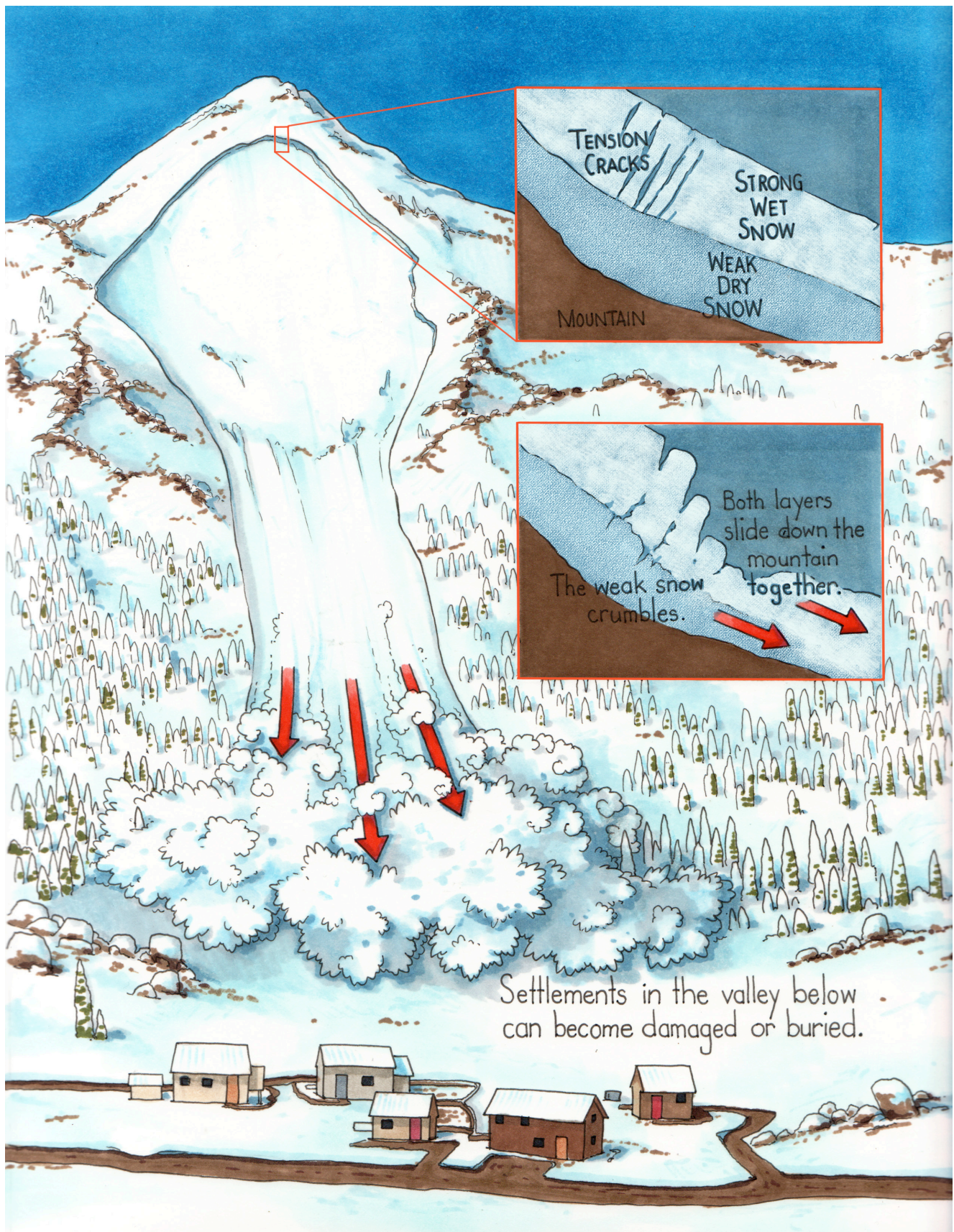
This is
Peru!
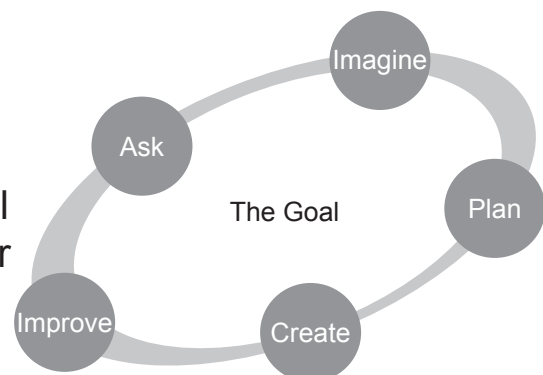
Different types of weather can cause snowflakes with very different properties to form.

Observe the different types of model snowflakes. What do you notice? How are the textures different? How do they move? Do they stick to each other or slide around easily? Record your observations in the spaces below.

| Snow Type | Observations |
|---|---|
| **Dry** | |
| **Wet** | |

TENSION CRACKS

STRONG WET SNOW

WEAK DRY SNOW

MOUNTAIN

Both layers slide down the mountain together.

The weak snow crumbles.

Settlements in the valley below can become damaged or buried.

reply | forward | archive | delete

from: engineeringadventures@mos.org

to: You

subject: Caution: Falling Objects!

6:09 PM

Hi Engineers,

José Pablo says when an avalanche occurs, heavy snow can carry trees, boulders, and other large objects down the mountain. These objects can move quickly and become extremely dangerous for the people and structures in the valley below. José Pablo showed us a type of technology, called a catch, that engineers use to contain the falling objects in avalanches. Take a look at the pictures we sent along. What do you notice about the shapes and materials these catches are made of?

José Pablo helped us make a model of a mountain so we can test all of the technologies we engineer. He told us it can be helpful to focus on one part of an avalanche before taking on the full avalanche. José Pablo wants us to start by trying to stop one boulder from causing damage at the base of the model mountain, even if it falls from the very top!

Can you use the Engineering Design Process to help you *imagine* ways to catch objects, like a large boulder? Then, *create* and test some different ideas using the materials we sent you. For an extra challenge, try to use as few materials as possible or catch a larger boulder.

Good luck!

Jacob
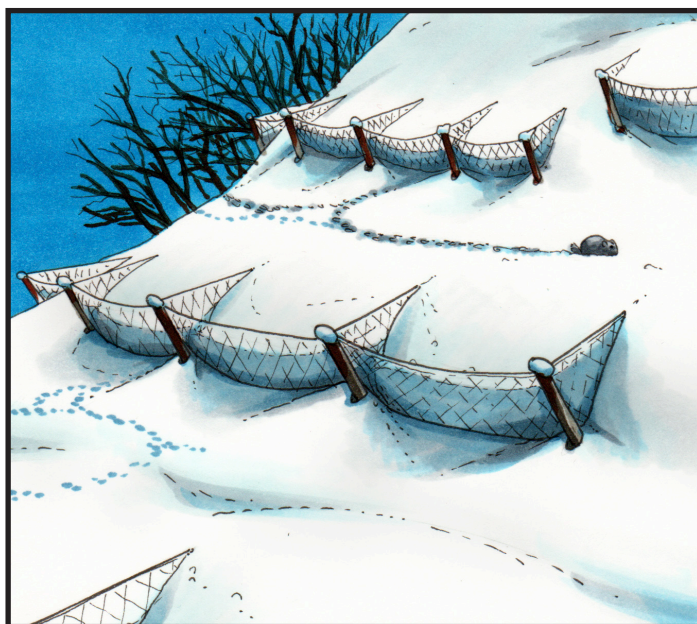
**Draw your catch design below.** *Label the materials you used.*

**Notes for Next Time:**

*Which parts of all of the designs worked well? What do you want to remember when engineering a catch?*

| ⬅ reply | ➡ forward | 🗄 archive | ✖ delete |
|---|---|---|---|

| from: | engineeringadventures@mos.org | |
|---|---|---|
| to: | You | |
| subject: | Changing Direction | 10:41 AM |

Hi Engineers,

You did a great job engineering catches to stop debris from falling down a mountainside! Today, José Pablo told us that sometimes avalanches are so powerful you can't use just catches to stop them. He showed us a different type of technology, called barriers, that are used to change the direction of an avalanche. José Pablo said that if you can't stop an avalanche, directing the falling snow and debris to a different area can protect the towns and roads below.

We sent you some pictures of the barriers that José Pablo showed us. Some of the barriers were engineered from wood or concrete, but others were made of natural objects like trees and stones.

We are hoping that you engineers can design barriers to direct falling objects to different areas. Can you direct falling objects, like small boulders, to two different areas on a slope? Try to figure out what materials make good barriers. Does the placement of your barriers matter?

José Pablo said once you finish investigating different ways of making barriers, you'll be ready to engineer an avalanche protection system for the town!
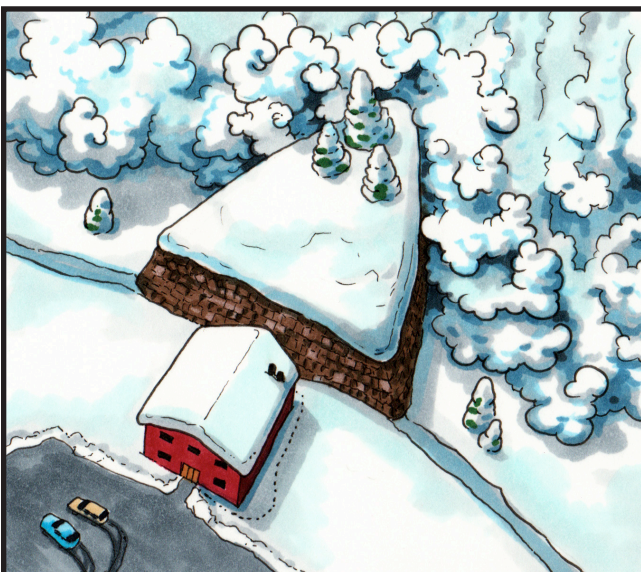
Talk to you soon,
India

Imagine
Ask
Plan
The Goal
Improve
Create
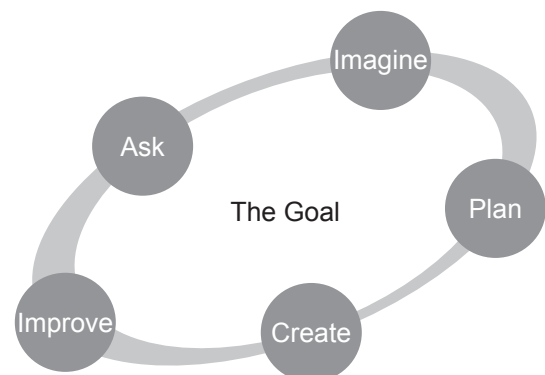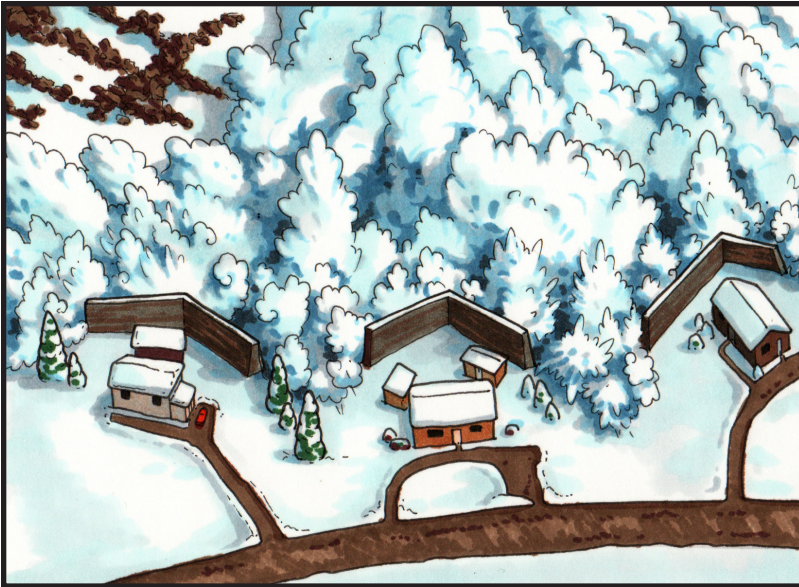
Deflecting structures keep avalanches from directly impacting these homes.



This wall made of earth guides the avalanche flow away from areas where people live.



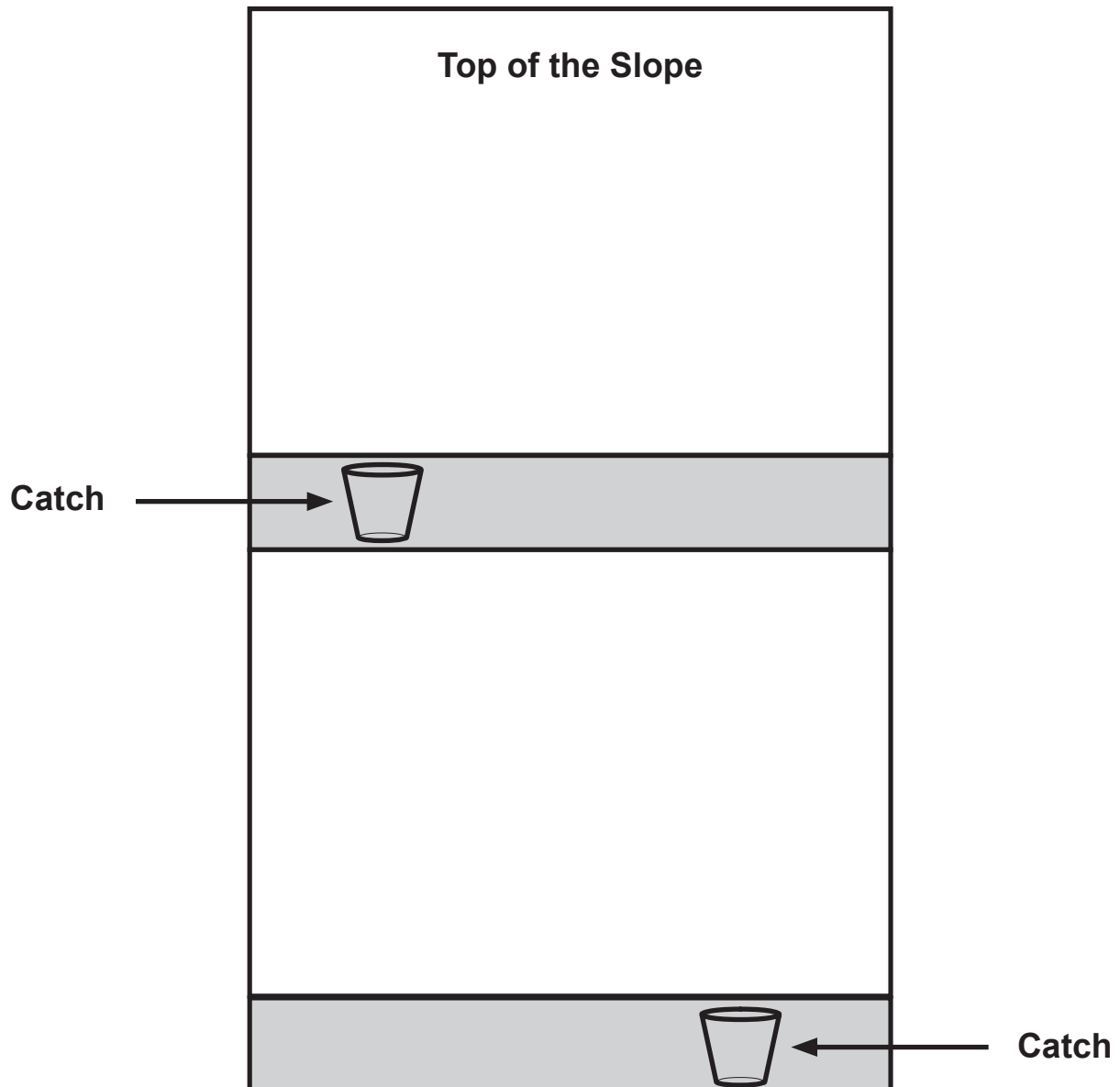A wedge shape made of earth and rocks breaks the avalanche around this building.

## Draw your barrier design below.
*Label the materials you used.*

**Top of the Slope**

**Catch** →

← **Catch**

## Notes for Next Time
*Which parts of all of the designs worked well? What do you want to remember when engineering an avalanche barrier?*

| reply | forward | archive | delete |

**from:** engineeringadventures@mos.org

**to:** You

**subject:** Snowverload!

8:55 AM

Hi everyone,

You have *asked* great questions about avalanches, and *imagined, planned,* and *created* creative catch and barrier designs. Now it's time to use what you learned to make an avalanche protection system that can protect the village!

José Pablo and his team want to try many different designs on a model before they decide what to use on the mountain. Can you come up with a design for an avalanche protection system? José Pablo told us there are some trees on the mountain, which act as natural barriers to help stop some of the snow. We also need to keep our budget in mind. The town has a certain amount of money they can spend on an avalanche protection system. We have sent you a list for how much the materials cost. The town does not want the protection system to be too high because they still want to enjoy the beautiful view.

Can you design an avalanche protection system that can protect the town, is under budget, and is less than five inches tall on the model mountain?

We can't wait to see what you come up with!

Jacob

**BUDGET: $1,000**

## Draw Your Plan

*Use the space below to draw a plan for your avalanche protection system. Which materials will you use? Where will you place them?*

Section 1

Section 2

| Material | Amount for 1 | Number Needed | Total Price |
| --- | --- | --- | --- |
| Cheesecloth (12 in.) | $ 500 | _____ | _____ |
| Construction Paper (1/2 sheet) | $ 250 | _____ | _____ |
| String (12 in.) | $ 50 | _____ | _____ |
| Rubber Bands | $ 30 | _____ | _____ |
| Pipe Cleaners | $ 30 | _____ | _____ |
| Coffee Stirrers | $ 20 | _____ | _____ |
| Craft Sticks | $ 20 | _____ | _____ |
| Tape (12 in.) | $ 20 | _____ | _____ |
| Toothpicks | $ 10 | _____ | _____ |

Total Cost  =  _____

## Testing Results

*What happened to your avalanche protection system during the model avalanche? Where did the model snow end up? What worked well to protect the village and the road?*

## Sharing Ideas

*Which parts of other groups' designs worked well? Which parts would you want to add to your design?*

reply  forward  archive  delete

from: engineeringadventures@mos.org

to: You

subject: Always Room for Improvement!

10:41 AM

Hi Engineers,

It was so great to see your avalanche protection systems! The technologies you have designed are so creative.

We just found out that experts are predicting even more snow than they originally thought this winter! This could lead to a more intense avalanche. There might be bigger slabs of snow that fall, or it could be strong enough to pick up trees or boulders along the way. We want the village to stay safe!

Can you *imagine* ways to make sure your avalanche protection system is strong enough to withstand a more powerful avalanche? You may have to change your *plan* and *improve* your current system. José Pablo and his team have to do this all the time.

*Buena suerte* (*bwe-nah swer-te*) — that's good luck in Spanish!

India

Imagine

Ask

The Goal

Plan

Improve

Create
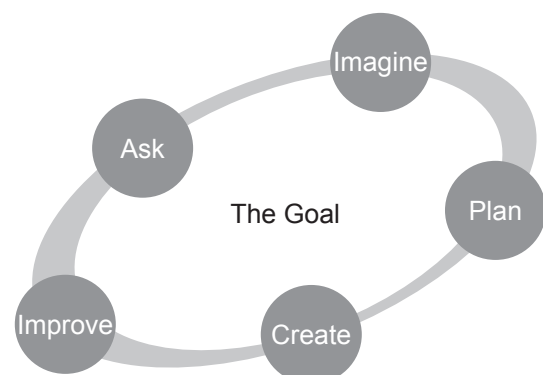
## ADDITIONAL BUDGET: $1,000

### Improvements

*What improvements will you make to your avalanche protection system? Which materials do you need? Make sure to stay under budget and remember the 5 inch height limit!*

Section 1

Section 2

| Material | Amount for 1 | Number Needed | Total Price |
|---|---|---|---|
| Cheesecloth (12 in.) | $ 500 | _____ | _____ |
| Construction Paper (1/2 sheet) | $ 250 | _____ | _____ |
| String (12 in.) | $ 50 | _____ | _____ |
| Rubber Bands | $ 30 | _____ | _____ |
| Pipe Cleaners | $ 30 | _____ | _____ |
| Coffee Stirrers | $ 20 | _____ | _____ |
| Craft Sticks | $ 20 | _____ | _____ |
| Tape (12 in.) | $ 20 | _____ | _____ |
| Toothpicks | $ 10 | _____ | _____ |

Total Cost　=　_____

reply

forward

archive

**X** delete

from: engineeringadventures@mos.org

to: You

subject: Share Your Designs!

11:11 AM

*Hola* Engineers!

You have worked hard to engineer an avalanche protection system to protect the village and road. Are you ready for the final avalanche test? José Pablo told us that it is important to share your designs with others. We will be helping José Pablo and his team present their final design to the village before they can start building.

This is also your chance to explain how you used the Engineering Design Process to *create* your technologies. Remember all those questions you *asked* about avalanches and what has already been done to lessen the damage of an avalanche? Don't forget the catches and barriers you *imagined, planned,* and *created.* What improvements did you make to your barrier systems? Did your improvements protect the model homes and road in the village?

We can't wait to hear about your designs! You have been great avalanche engineers. There are so many more challenges waiting to be solved. What will you engineer next?

*Hasta luego* (*ahs-ta loo-ay-go*)—that's see you later in Spanish!

India and Jacob
engineeringadventures@mos.org

Imagine

Ask

The Goal

Plan

Improve

Create
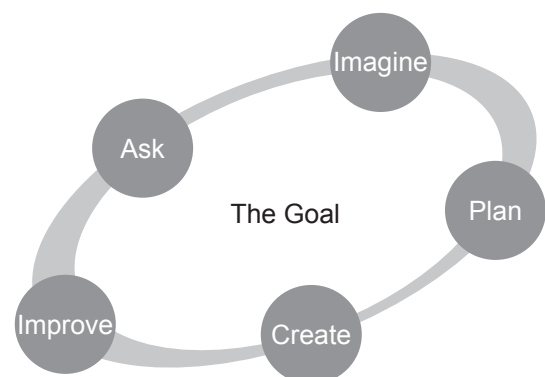
Plan *how you will present your avalanche protection system with your group.*

How does your avalanche protection system work?

Which materials did you choose? Why?

What improvements did you make?

How did the Engineering Design Process help you design your avalanche protection system?

# For the Record

I would like to be an avalanche engineer.          ☐ Yes     ☐ No     ☐ Maybe

Why or why not?

What do you want to engineer next?

_____

Draw your technology here!

## My engineering checklist:

☐     Find friends to work with.
☐     *Ask* questions about how to start.
☐     *Imagine* lots of ideas.
☐     Make a *plan*.
☐     *Create* and test the plan.
☐     *Improve* until you think it is ready.

What materials will you use?

_____

_____

_____

_____

_____

The Goal

Plan

Imagine

Create

Ask

Improve

STAMP HERE
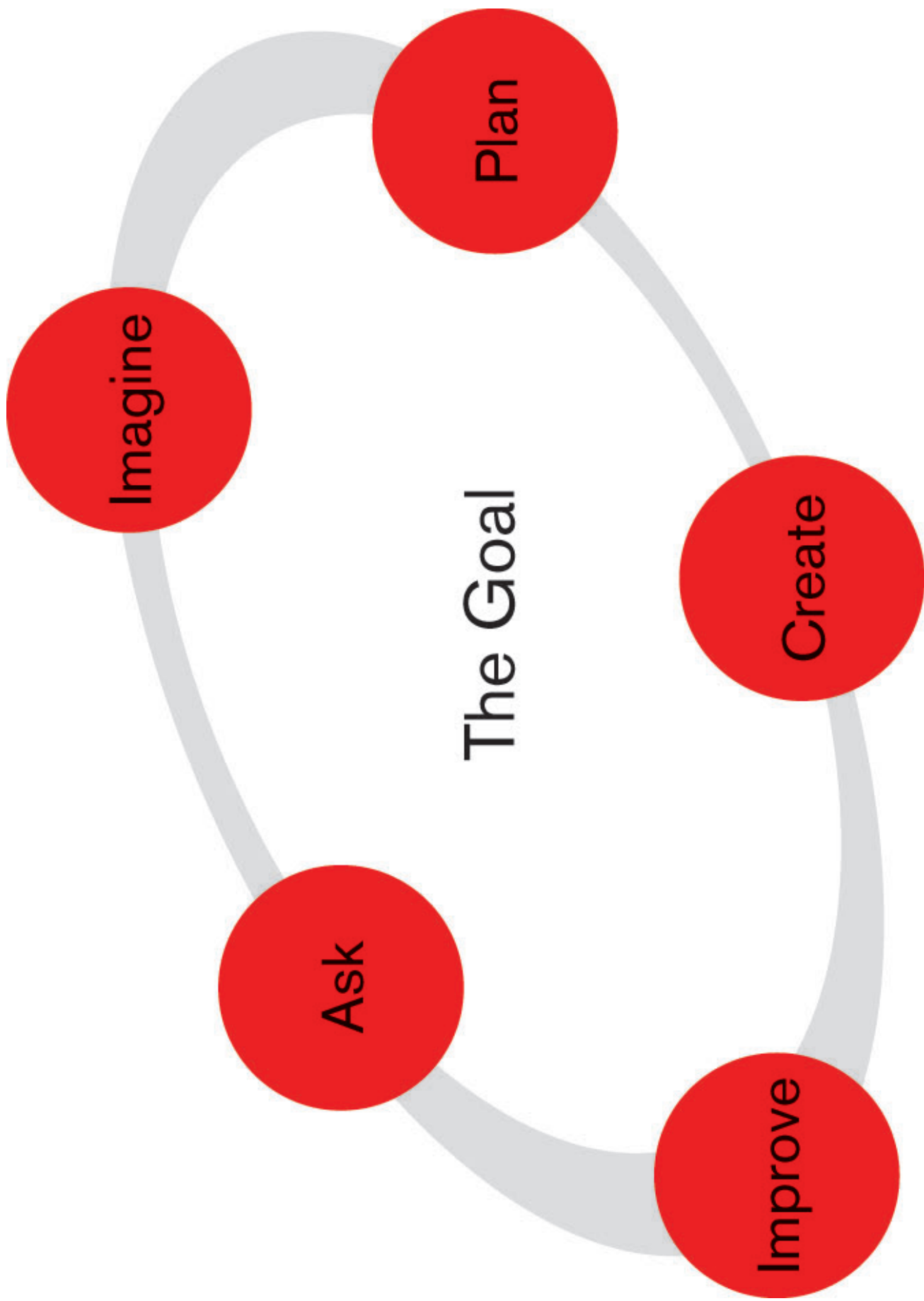
MACHU PICCHU is a ruined city of the INCA EMPIRE built on a mountaintop.

QUECHUA WOMAN

QUECHUA MAN playing the flute.

QUECHUA WOMAN

THE AMAZON RIVER has its source in the eastern PERUVIAN RAINFOREST.

LLAMAS and ALPACAS are used for their wool and for carrying goods.

PERU