CENTRO DE INOVAÇÃO
VILA NOVA ESPERANÇA

International Development
Innovation Network

PET BOTTLE CUTTER

Instructor's Guide

IDIN SKILL BUILDER: PET BOTTLE CUTTER

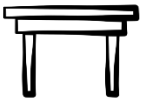
OVERVIEW

TIME NEEDED

4 hours

NUMBER OF PEOPLE NEEDED TO RUN THE SESSION

1 – 2 instructors per 8 participants



SPACE SET-UP

This activity requires a room with sufficient table space. Tables must be sturdy.

SKILLS INTRODUCED

Measuring / Cutting wood / Drilling / Fastening screws / Cutting PVC

INTRODUCTION

PHILOSOPHY

Many people around the world go through their lives rarely using their inherent creative instincts to make a useful object with their own hands. However, a belief in one's individual ability to create technology can lead to a sense of agency and a belief that one can create positive change in the world. This idea embodies the purpose of a Skill Builder. Those who participate in a Builder leave believing they can be creative, work with technology, and build tools to solve problems present in their own lives or in the lives of others. The experience provided is transformative; if they can successfully build this device, then by extension, they can build another. For example, creating light is a magical experience, endowing a person with the ability to replicate the power of the sun. As a person said in Zambia following a Builder, "I was a dull knife and you sharpened me." This kind of transformation is only achieved by having participants build on their own terms, exploring the use of tools with guidance from an instructor. It is important that their devices work so they are successful and feel a sense of accomplishment; but even more important is that they felt they did it themselves and believe they could do it again. Skill Builders are the building of a piece of technology as a means to acquiring fabrication skills, working with materials, and learning physical principles. This can range from using wire strippers and a soldering iron to create an LED light to using a hammer and chisel to shape wood into a spoon. The key to inspiring change in participants does not lie within the device created; it lies in the skills gained and the newfound sense of ability felt by participants. For those who have never used the tools before, the initial stages of the Builder will feel awkward. Participants may "fail" at steps in the process. They should be guided out of these stumbles, not have the 2 stumbles solved for them. Struggling with the process and resolving issues on one's own are important in building the feeling of agency that is necessary to use these skills to address problems in the world. Skill Builders are also a powerful experience for the instructors. When the participants have successful devices, the pride they have will be reflected in the pride instructors feel. The instructors are the first link in passing along the philosophy and skills transmitted. If the instructors are steeped in these principles, the participants will carry the philosophy and skills forward in their lives and will share with those around them.

INTRODUCTION

GUIDELINES

To be an effective instructor and create a valuable experience for the participants, keep the following ideas in mind while delivering the Skill Builder.

- Allow participants to work through the steps at their own pace. It is important that everyone gets to practice using each of the tools. Since this is the first time most people have used them, it will take longer than you might expect. The length or number of sessions should account for this. If you find you still go over, arrange for more time.
- Encourage participants to form pairs and help each other through the activity. Ensure there is not a dominant person in each pair who does all of the tooling and machining.
- If a participant is having trouble, encourage those around him or her to provide help so the participants can learn from each other. When a participant has solved a problem, have them demonstrate the solution to the group so they can take credit.
- If a participant makes a mistake, help them to diagnose the problem and fix it. This should be done by encouraging them to share their thoughts on the problem and the solution, before offering your own diagnosis and solution. Avoid correcting the mistake for the participant except in extreme situations.
- It is important to practice showing, instead of telling. A visual demonstration goes much farther than an oral description of the task. During the Skill Builder, be vigilant to ensure there is more showing than speaking.
- Encourage participants to use spare materials to practice the skills before using the tools to make the final product.
- Observe and advise the participants on their technique in using the tools so they have the opportunity to improve.
- Complement the participants as they successfully complete steps in the construction process, emphasizing that they are responsible for accomplishing the task.
- Promote a sense of camaraderie in the group. Ways to do this can include a group picture, having each person sign each other's device, or taking time for each person to demonstrate their functional device. Place emphasis on each participant's success in creating a working device to increase their confidence.
- Keep the guiding principles described in the philosophy section in mind as you deliver the curriculum.

INTRODUCTION

SAFETY

Below is a list of safety concerns relevant to this Skill Builder.

HOLE SAW

- Always wear eye protection
- Don’t use the hole saw without the pilot bit.
- Make sure the arbor is properly tightened, to ensure the circular blade does not slide while drilling.
- Make sure your wood is properly secured prevent it from spinning or slipping.
- Drill perpendicular to the surface.
- Feed the saw in and out while drilling to allow for shavings to clear out.
- Finish the hole from the opposite side to prevent wood from splintering and to prevent the piece from getting stuck inside the hole saw.

BLADE

- Wear eye protection and gloves while cutting the blade.
- Be careful while handling the blade, it is easy to cut oneself without noticing.

POWER DRILL

- Always wear eye protecting while operating.
- Avoid loose clothing or jewelry that could tangle. Be careful with the cord as well.
- Secure your work piece to avoid spinning.
- Make sure your bit is properly inserted and secured.
- Don’t apply too much pressure while operating to prevent slipping.

LESSON PLAN

LEARNING OBJECTIVES

Participants will learn:

- How to measure in SI units using a ruler and measuring tape.
- How to cut wood using a regular wood saw.
- How to use a power drill.
- Two different types of drill bits for wood, the hole saw and a spade bit.
- How to cut PVC pipe with a hacksaw.
- How to fasten wood screws.

AGENDA

1.	Introduction to the session	15 min
2.	Review of tools and materials	10 min
3.	Complete the pre-questions of the Skill Builder User Evaluation Sheet.	5 min
4.	Step 1: Making the base	10 min
5.	Step 2: Making the donut	35 min
6.	Step 3: Making the post	10 min
7.	Step 4: Making the holder	45 min
8.	Step 5: Set cut width	20 min
9.	Step 6: Blade Placement	5 min
10.	Step 7: Donut Placement	10 min
11.	Step 8: Holder Placement	20 min
12.	Step 9: PVC Placement	5 min
13.	Step 10: Cutting	15 min
14.	Reflection and Feedback	25 min
15.	Complete the post-questions of the Skill Builder User Evaluation Sheet	10 min

PREPARATION

TOOLS

QUANTITY per participant	TOOL	DESCRIPTION
1		Pair of safety glasses
1		Pencil for wood
1		Measuring tape
1		Ruler
1		Pair of Scissors
1		Pair of pliers
1		Philips Screwdriver
1		C-clamp
1		Hacksaw
1		Utility Knife
1		Wood saw
1		Power drill
1		Hole saw drill bit for wood, 45 mm diameter
1		Spade blade drill bit for wood, 10 mm

PREPARATION

MATERIALS

QUANTITY per participant	MATERIAL	DESCRIPTION
1		Plywood 20 mm thick, 12 cm x 20cm
1		Plywood 20 mm thick, 6.5 cm x 4.5 cm
1		30 cm of PVC pipe ½”
1		Ruler
2		Wood screws, Philips, 3cm length
1		2 – 3L Plastic Bottle

TEACHING NOTES

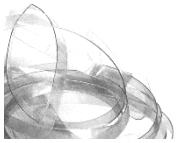
INTRODUCTION TO THE SESSION

15 MIN

WHY PET?

PET stands for polyethylene terephthalate, a common type of plastic used for bottle production. This is a highly abundant material, with a high volume in its bottle form, and low economic value. Every year millions of tons of PET are produced, and a good amount ends up in landfills for hundreds of years while it decomposes, if not contaminating the environment.

WHY TO CUT PET?



The PET plastic from discarded bottles can be reused to generate products of added value. This is made easier by cutting it into stripes of constant width. These stripes that can later be used for various purposes such as making boxes, tightening materials together, carrying loads, among others.

TOOLS AND MATERIALS REVIEW

10 MIN

Use this time to go over the names and characteristics of each tool and material, and also safety measures associated with the work that will be done.

PRE-QUESTIONS

10 MIN

During this time the participants can complete the pre-questions of the Skill Builder User Evaluation Sheet.

STEP 1

MAKING THE BASE

MATERIALS

Plywood 20mm thick

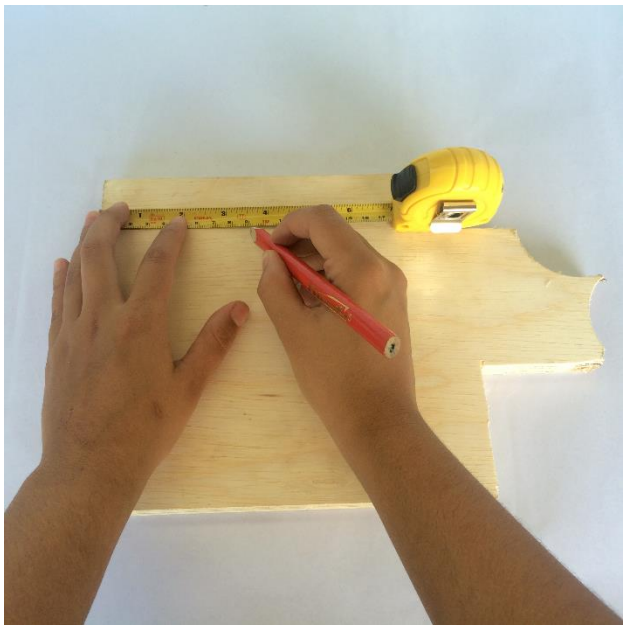
TOOLS

Pencil

Wood saw

Measuring Tape

INSTRUCTIONS



1.2 Mark and measure
a 12 cm x 20 cm rectangle in the piece of plywood.

Here you can explain how to measure properly using measuring tape or a ruler. Mention units as well.

If available, you can explain how to use a square to create rectangular shapes.

1.1 Cut
it to size using the wood saw.

Here you can explain how to cut wood: follow the mark, make a starting cut by sawing backwards, find a good standing position, relax your grip, let the elbow swing freely, use the full length of the blade.

STEP 2

MAKING THE DONUT

MATERIALS

Plywood 20mm thick

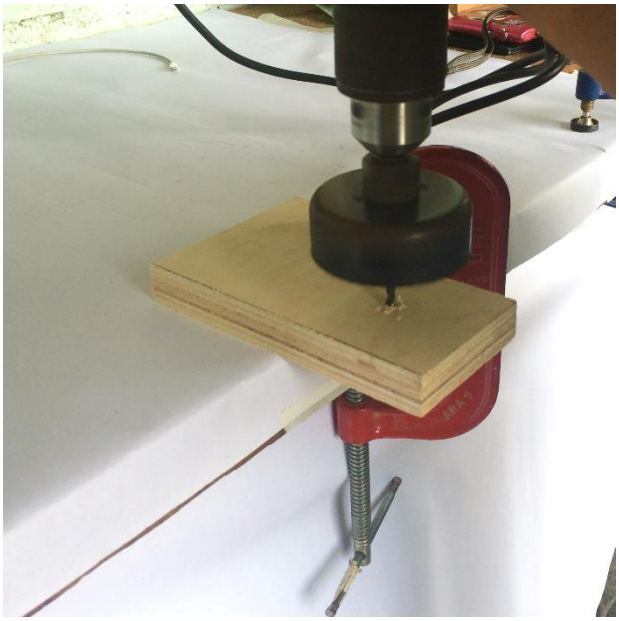
TOOLS

Power drill

Hole saw bit

Spade bit

INSTRUCTIONS



2.1 Drill
a circular piece out of plywood using the hole saw and the power drill.

2.2 Drill
A hole in the middle of the circular piece you just made using a spade bit and the power drill.

Be careful while operating the drill, and re-visit the safety measures in this document on how to use a power drill, and a hole saw.

STEP 3

MAKING THE POST

MATERIALS

PVC pipe ½”

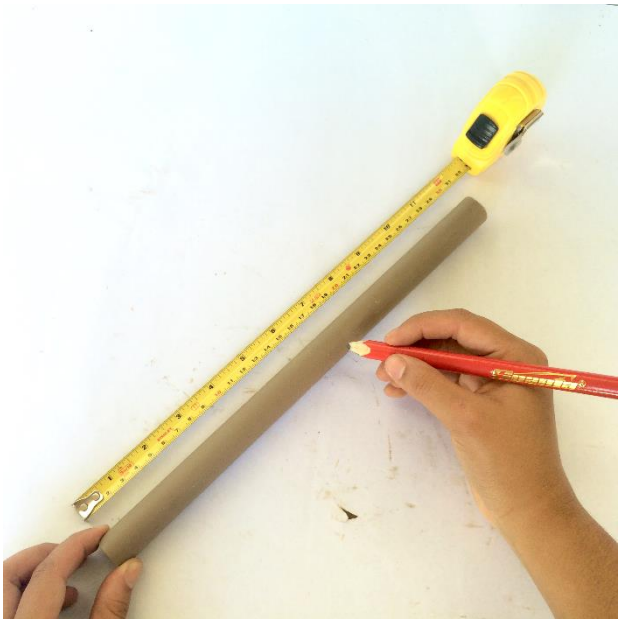
TOOLS

Pencil

Hacksaw

Measuring tape

INSTRUCTIONS



3.1 Measure and mark
a 30 cm piece of ½” PVC tube.

3.2 Cut
it to size using a hacksaw.

STEP 4

MAKING THE HOLDER

This step could also be done with a jigsaw. It is also possible to teach how to make straight and curved cuts with the different blades if the circular cut left from the donut is not used.

MATERIALS

Wood left from donut

TOOLS

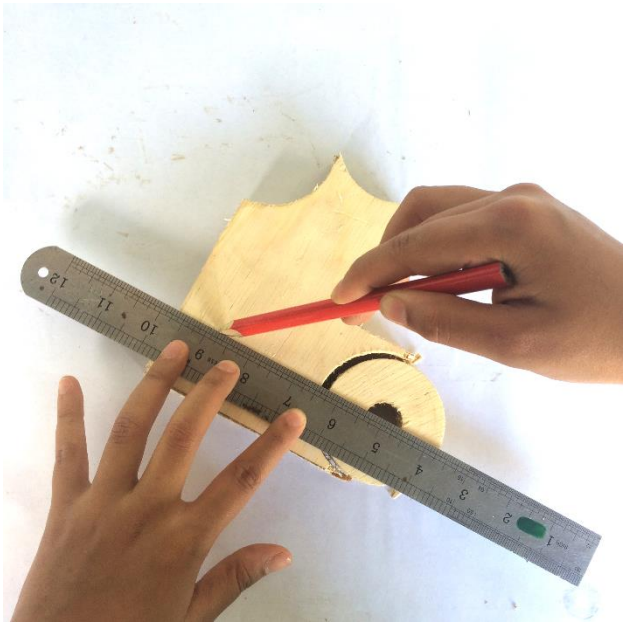
Pencil

Ruler

Wood Saw

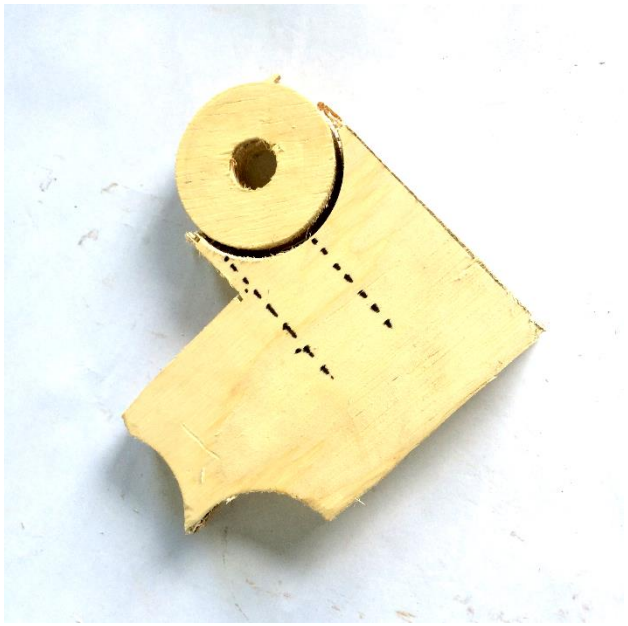
C-clamp

INSTRUCTIONS

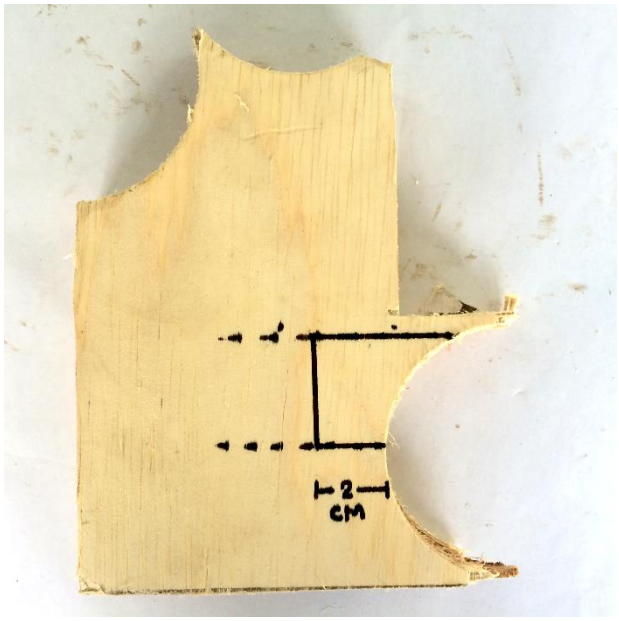


4.1 Trace
a line across the center of the circle made by the previously cut donut.

4.2 Trace
a line tangent to the circle and parallel to the previous line.



4.3 Checkpoint!
your piece should look like this.



4.4 Trace
a line 2 cm away from the center of the circle.

4.5 Cut
The piece using a wood saw.

4.6 Checkpoint!
Your piece should now look like this.

STEP 5

SET CUT WIDTH

MATERIALS

Donut

Holder

TOOLS

Pencil

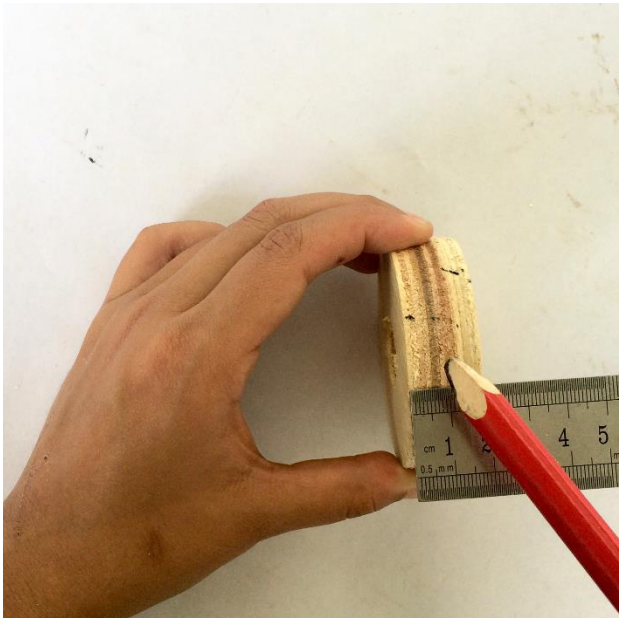
Ruler

Hacksaw

INSTRUCTIONS

My cut width is:

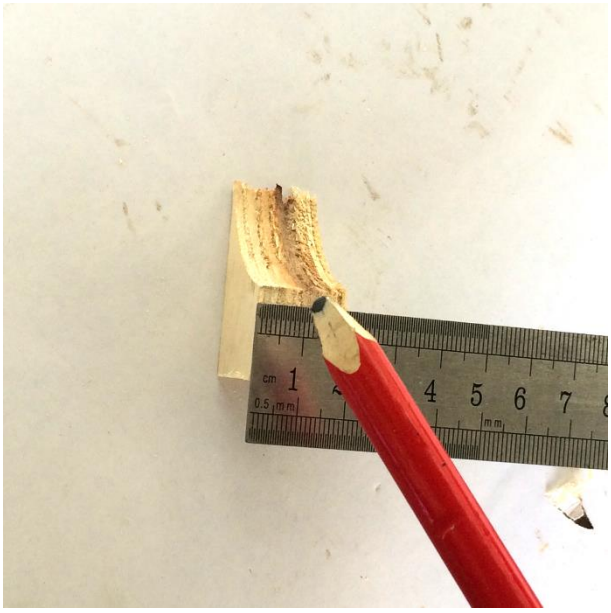
_____ cm



5.1 Choose
What you want your stripe thickness to be. This will be the cut width. Recommended range is 0.5 cm – 1 cm.

5.2 Measure and mark
your chosen cutting width on the donut's height.

5.3 Cut
a straight groove at the marked cut width until you can see the hacksaw through the donut hole.



5.4 Measure and mark
the cut width on the shortest flat side of the holder that is adjacent to the round face.

5.5 Cut
with the hacksaw a 1cm deep groove at the mark previously made, and then make a cut perpendicular to it through the bottom of the piece.

5.6 Checkpoint!
Your piece should now look like this.

The mirror image of this piece won't work.

STEP 6

BLADE PLACEMENT

MATERIALS

Donut

Blade

TOOLS

Pliers

Safety Glasses

INSTRUCTIONS

6.1 Break
the blade in half using the pliers.
Make sure to wear safety glasses while you do this!

6.2 Place
the blade in the donut's groove until the sharp side hits the end of the groove.

STEP 7

DONUT PLACEMENT

MATERIALS

Base

Donut

2 screws

Blade

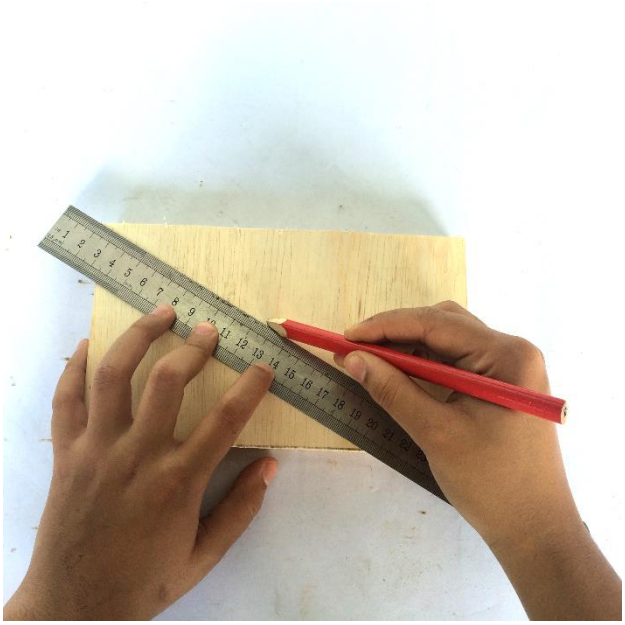
TOOLS

Pencil

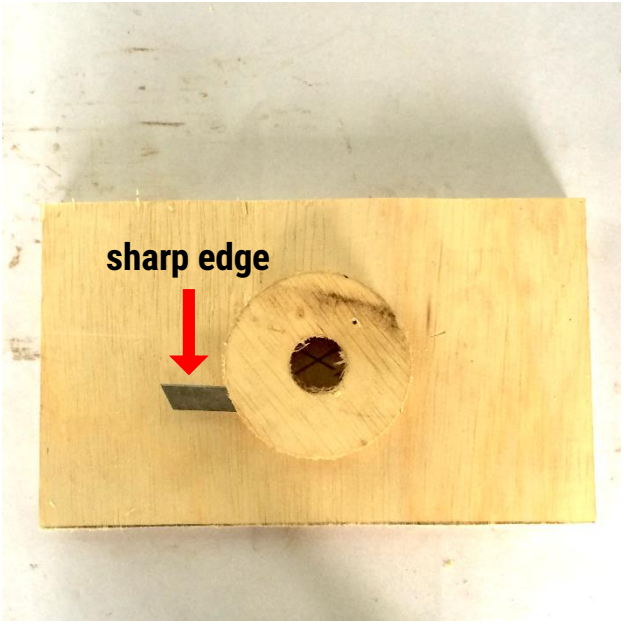
Ruler

Screwdriver

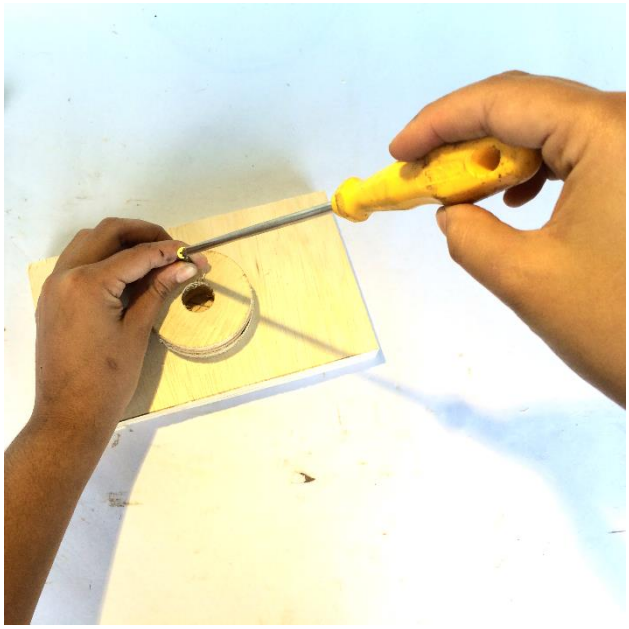
INSTRUCTIONS



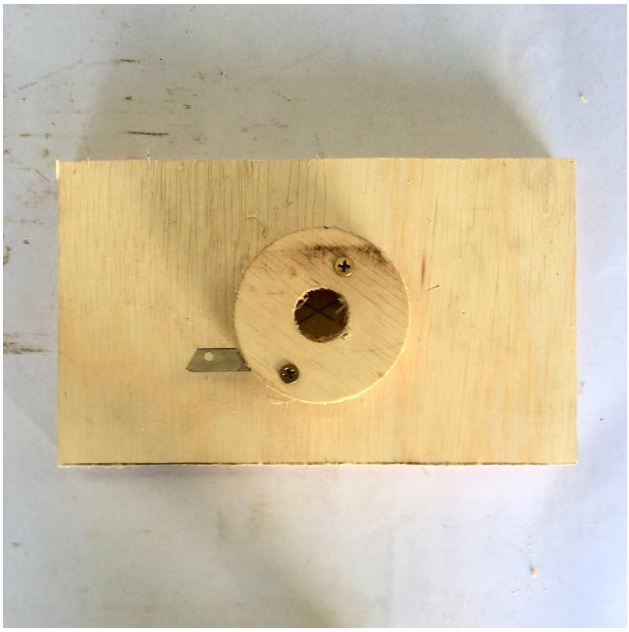
7.1 **Mark**
the center of the base.



7.2 **Place**
the donut such that the blade is parallel to the larger side of the rectangle, and the sharp edge of the blade is facing inwards.



7.3 **Secure**
the donut to the base with a screw at 1 o'clock and another one at 7 o'clock (this screw should prevent the blade from moving towards the inside of the donut). ***Make sure you remove the blade from the donut before this step.***



7.4 **Checkpoint!**
Your piece should now look like this.

In this section, you can talk about the different types of screws, and how to use screws of the appropriate length and size.

It is recommended to make pilot and countersink holes before fastening the screws.

STEP 8

HOLDER PLACEMENT

MATERIALS

Base

Holder

2 screws

Blade

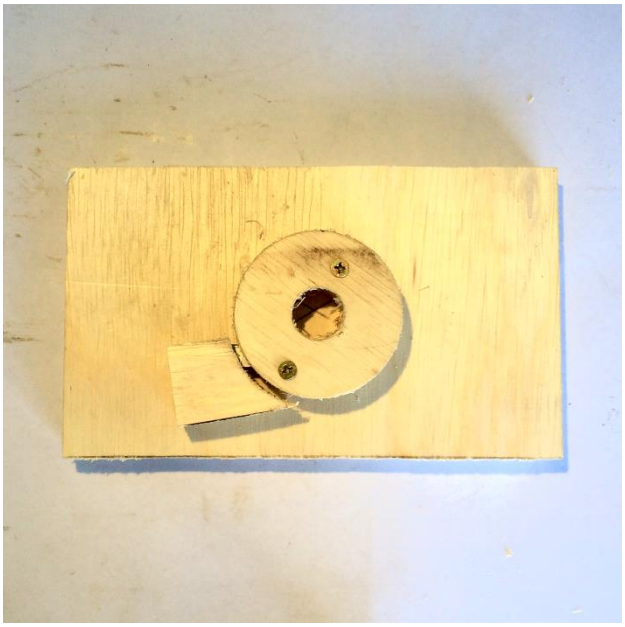
TOOLS

Pencil

Ruler

Screwdriver

INSTRUCTIONS



8.1 **Place**
the holder so that it covers the blade as shown above.

8.2 **Secure**
the holder to the base with 2 screws, one through the center of the holder, and the other one to the right of the blade (this screw should prevent the blade from moving to the right).

STEP 9

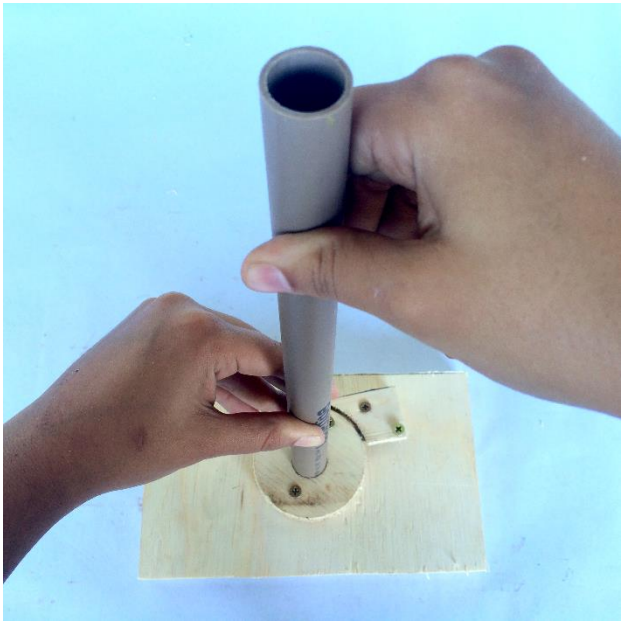
PVC PLACEMENT

MATERIALS

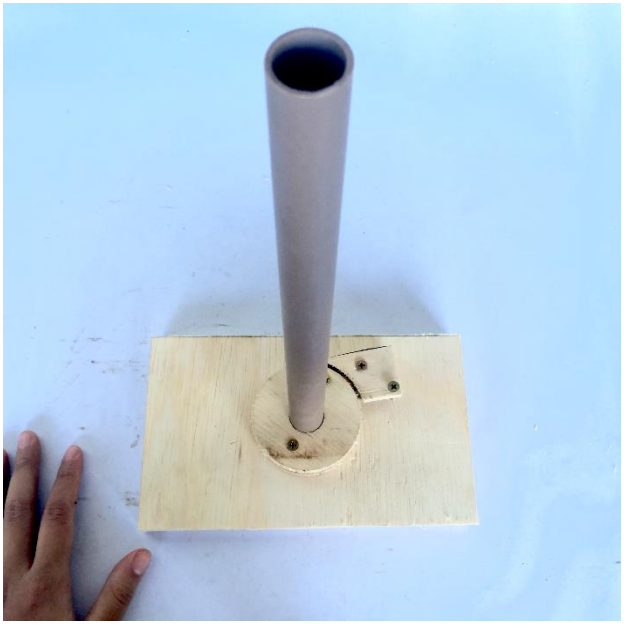
Base

PVC

INSTRUCTIONS



9.1 **Place** the PVC in the



9.2 **Ready to cut!** Your PET Bottle cutter should now be ready to cut!

STEP 10

CUTTING

To make more regular stripes, it is recommended to hold the base to a table using a clamp, and push the neck of the bottle that is being cut slightly downwards with a wooden donut, or an inverted bottle neck.

MATERIALS

Plastic Bottle

PET Bottle Cutter

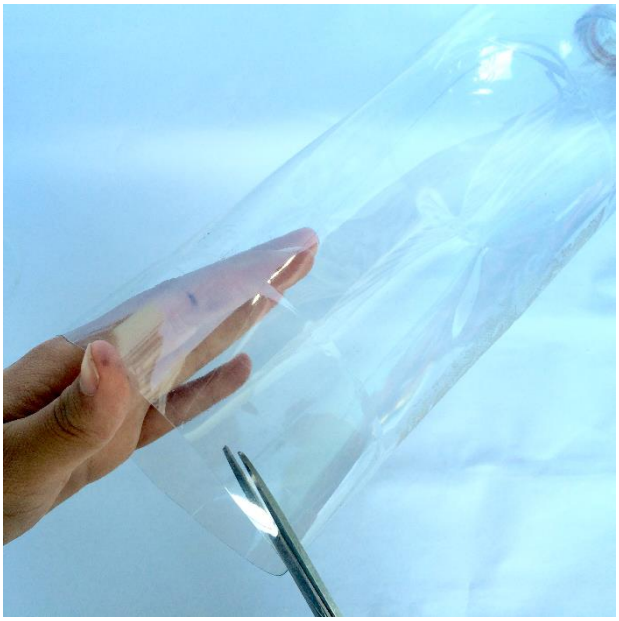
TOOLS

Utility knife

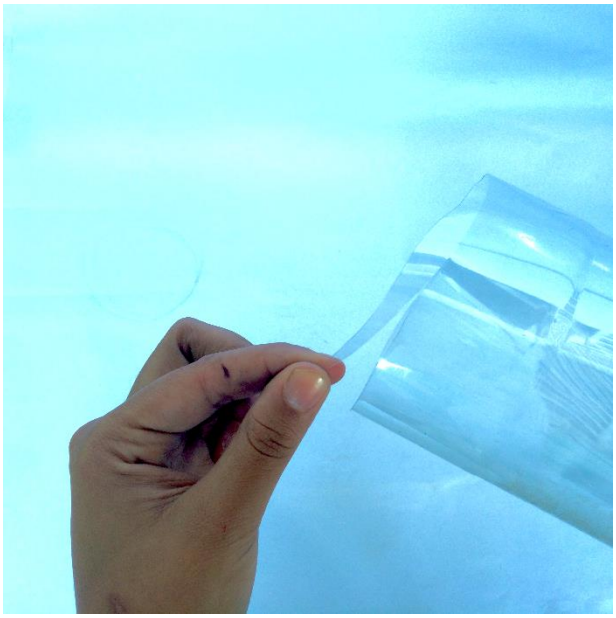
Scissors

INSTRUCTIONS

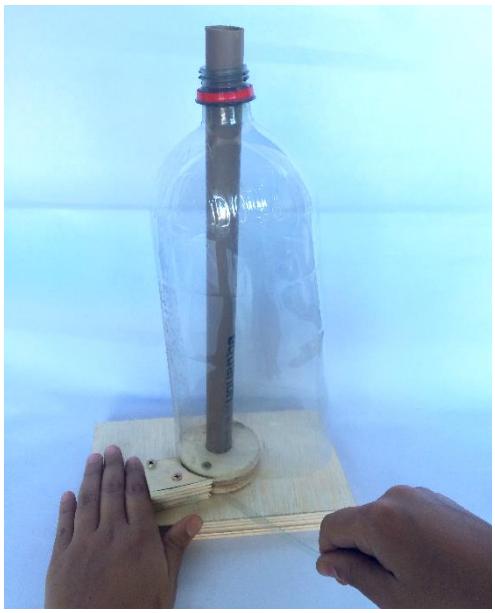
10.1 Cut
out the bottom of the plastic bottle using a utility knife.



10.2 Cut
a stripe at the edge of the bottle for starting.



10.3 Checkpoint!
The starter stripe should look like this.



10.4 Pull
the starting stripe towards you while holding the base of the PET bottle cutter to cut.

REFLECTION AND FEEDBACK

25 MIN

During this time the participants can offer their feedback on the activity. You can promote a discussion by asking what they learned, what worked, what can be improved, etc. Make sure you congratulate everyone for their great work.

POST-QUESTIONS

10 MIN

During this time the participants can complete the post-questions of the Skill Builder User Evaluation Sheet.