# DISCOVER

## 4-H 3D PRINTING – TINKERCAD® CLUBS

EXTENSION
UtahStateUniversity

# DiSCOVER

## 4-H 3D PRINTING – TINKERCAD® CLUBS

Colby Carpenter | Stella Stowell | JoLene Bunnell | Stacey MacArthur
Utah State University Extension

## Description

The Discover 4-H Clubs series guides new 4-H volunteer leaders through the process of starting a 4-H club or provides a guideline for seasoned volunteer leaders to try a new project area. Each guide outlines everything needed to organize a club and hold the first six club meetings related to a specific project area.

## Purpose

The purpose is to create an environment for families to come together and participate in learning activities while spending time together as a multi-family club. Members will experiment with new 4-H project areas.

## What is 4-H?

4-H is one of the largest youth development organizations in the United States. 4-H is found in almost every county across the nation and enjoys a partnership between the U. S. Department of Agriculture (USDA), the state land-grant universities (e.g., Utah State University), and local county governments.

4-H is about youth and adults working together as partners in designing and implementing club and individual plans for activities and events. Positive youth development is the primary goal of 4-H. The project area serves as the vehicle for members to learn and master project-specific skills while developing basic life skills. All projects support the ultimate goal for the 4-H member to develop positive personal assets needed to live successfully in a diverse and changing world.

Participation in 4-H has shown many positive outcomes for youth. Specifically, 4-H participants have higher participation in civic contribution, higher grades, increased healthy habits, and higher participation in science than other youth (Lerner et al., 2005).

**Utah State University is committed to providing an environment free from harassment and other forms of illegal discrimination based on race, color, religion, sex, national origin, age (40 and older), disability, and veteran's status. USU's policy also prohibits discrimination on the basis of sexual orientation in employment and academic related practices and decisions. Utah State University employees and students cannot, because of race, color, religion, sex, national origin, age, disability, or veteran's status, refuse to hire; discharge; promote; demote; terminate; discriminate in compensation; or discriminate regarding terms, privileges, or conditions of employment, against any person otherwise qualified. Employees and students also cannot discriminate in the classroom, residence halls, or in on/off campus, USU-sponsored events and activities. This publication is issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth L. White, Vice President for Extension and Agriculture, Utah State University.**

Updated September 2017

## Utah 4-H

4-H is the youth development program of Utah State University Extension and has more than 90,000 youth participants and 8,600 adult volunteers. Each county (Daggett is covered by Uintah County) has a Utah State University Extension office that administers the 4-H program.

## The 4-H Motto

"To Make the Best Better!"

## The 4-H Pledge

I pledge: My HEAD to clearer thinking, my HEART to greater loyalty, my HANDS to larger service and my HEALTH to better living, for my club, my community, my country, and my world.

## 4-H Clubs

What is a 4-H Club? The club is the basic unit and foundation of 4-H. An organized club meets regularly (once a month, twice a month, weekly, etc.) under the guidance of one or more volunteer leaders, elects its own officers, plans its own program, and participates in a variety of activities. Clubs may choose to meet during the school year, only for the summer, or both.

## Club Enrollment

Enroll your club with your local Extension office. Each member will need to complete a Club/member Enrollment form, Medical History form, and a Code of Conduct/Photo Release form (print these from the www.utah4h.org website or get them from the county Extension office).

## Elect Club Officers

Elect club officers during one of your first club meetings. Depending on how many youth are in your club, you can decide how many officers you would like. This will typically include a president, vice president, pledge leader, and secretary. Other possible officers or committees are: song leader, activity facilitator, clean-up supervisor, recreation chair, scrapbook coordinator, contact committee (email, phone, etc.), field trip committee, club photographer, etc. Pairing older members with younger members as Sr. and Jr. officers may be an effective strategy to involve a greater number of youth in leadership roles and reinforce the leadership experience for both ages. Your club may decide the duration of officers–6 months, one year, etc.

## A Typical Club Meeting

Follow this outline for each club meeting:

- ☐ Call to order–president
- ☐ Pledge of Allegiance and 4-H Pledge–pledge leader (arranges for club members to give pledges)
- ☐ Song–song leader (leads or arranges for club member to lead)
- ☐ Roll call–secretary (may use an icebreaker or get acquainted type of roll call to get the meeting started)
- ☐ Minutes of the last meeting–secretary
- ☐ Business/Announcements–vice president
- ☐ Club Activity–arranged by activity facilitator and includes project, lesson, service, etc. These are outlined by project area in the following pages.
- ☐ Refreshments–arranged by refreshment coordinator
- ☐ Clean Up–led by clean-up supervisor

## Essential Elements of 4-H Youth Development

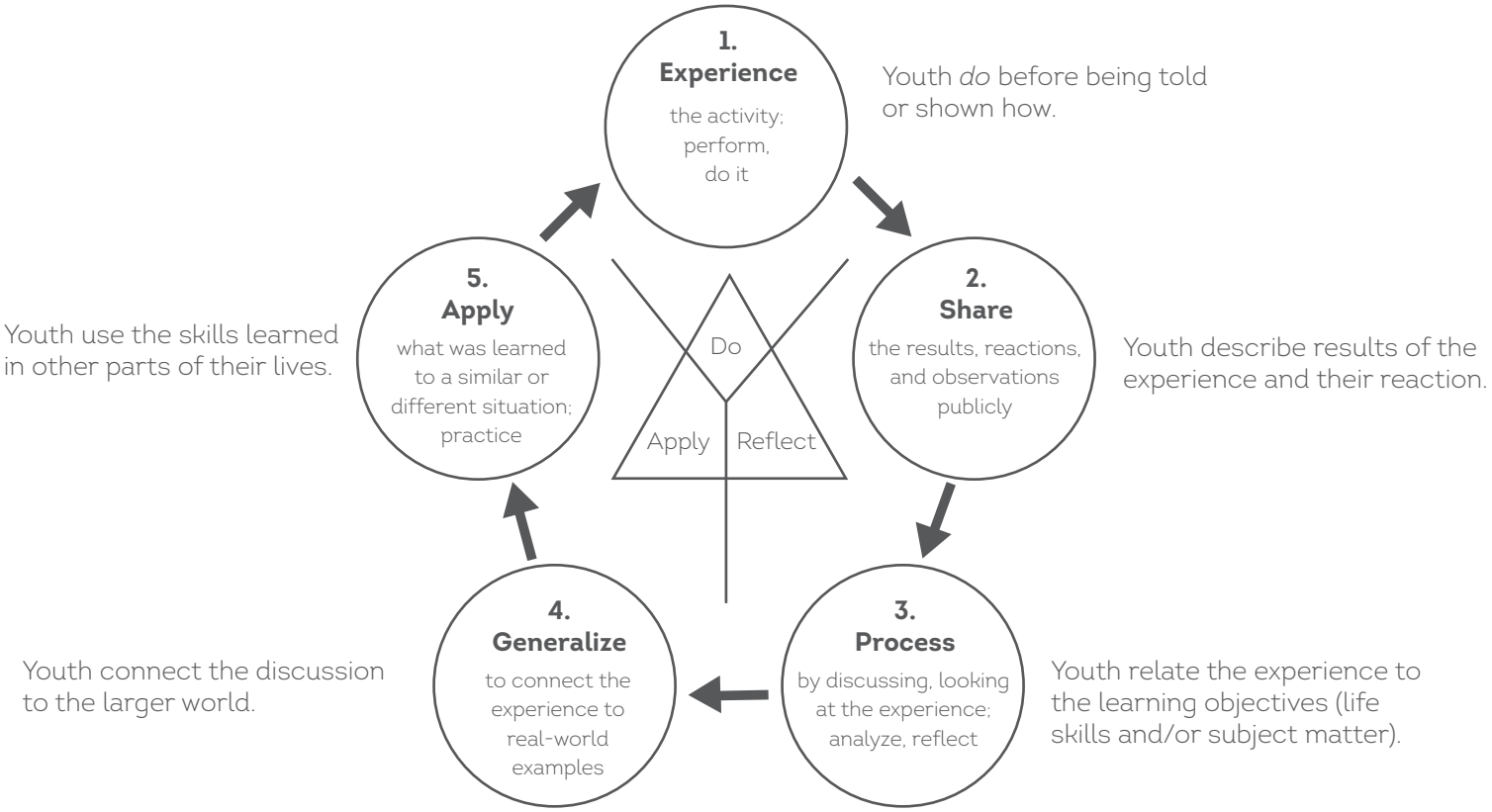
The essential elements are about healthy environments. Regardless of the project area, youth need to be in environments where the following elements are present in order to foster youth development.

1. **Belonging**: a positive relationship with a caring adult; an inclusive and safe environment.
2. **Mastery:** engagement in learning, opportunity for mastery.
3. **Independence:** opportunity to see oneself as an active participant in the future, opportunity to make choices.
4. **Generosity:** opportunity to value and practice service to others.

(Information retrieved from: http://www.4-h.org/resource-library/professional-development-learning/4-h-youth-development/youth-development/essential-elements/)

## 4-H "Learning by Doing" Learning Approach

The Do, Reflect, Apply learning approach allows youth to experience the learning process with minimal guidance from adults. This allows for discovery by youth that may not take place with exact instructions.




## 4-H Mission Mandates

The mission of 4-H is to provide meaningful opportunities for youth and adults to work together to create sustainable community change. This is accomplished within three primary content areas, or mission mandates, - citizenship, healthy living, and science. These mandates reiterate the founding purposes of Extension (e.g., community leadership, quality of life, and technology transfer) in the context of 21st century challenges and opportunities. (Information retrieved from: http://www.csrees.usda.gov/nea/family/res/pdfs/Mission_Mandates.pdf)

1. **Citizenship:** connecting youth to their community, community leaders, and their role in civic affairs. This may include: civic engagement, service, civic education, and leadership.
2. **Healthy Living:** promoting healthy living to youth and their families. This includes: nutrition, fitness, social-emotional health, injury prevention, and prevention of tobacco, alcohol, and other drug use.
3. **Science:** preparing youth for science, engineering, and technology education. The core areas include: animal science and agriculture, applied mathematics, consumer science, engineering, environmental science and natural resources, life science, and technology.

## Getting Started

1. Recruit one to three other families to form a club with you.
    a. Send 4-H registration form and medical/photo release form to each family (available at utah4h.org).
    b. Distribute the Discover 4-H Clubs curriculum to each family.
    c. Decide on a club name.
    d. Choose how often your club will meet (e.g., monthly, bi-monthly, etc.).
2. Enroll as a 4-H volunteer at the local county Extension office (invite other parents to do the same).
3. Enroll your club at the local county Extension office.
    a. Sign up to receive the county 4-H newsletter from your county Extension office to stay informed about 4-H-related opportunities.
4. Identify which family/adult leader will be in charge of the first club meeting.
    a. Set a date for your first club meeting and invite the other participants.
5. Hold the first club meeting (if this is a newly formed club).
    a. See *A Typical Club Meeting* section above for a general outline.
        i. Your activity for this first club meeting will be to elect club officers and to schedule the six project area club meetings outlined in the remainder of this guide. You may also complete a-d under #1 above.
    b. At the end of the first club meeting, make a calendar outlining the adult leader in charge (in partnership with the club president) of each club meeting along with the dates, locations, and times of the remaining club meetings.
6. Hold the six project-specific club meetings outlined in this guide.
7. Continue with the same project area with the 4-H curriculum of your choice (can be obtained from the County Extension Office) OR try another Discover 4-H Club project area.

## Other Resources

Utah 4-H website: www.Utah4-h.org
National 4-H website: www.4-h.org
4-H volunteer training:
To set up login:
http://utah4h.org/htm/volunteers/get-involved/new-volunteer-training
To start modules: http://4h.wsu.edu/volunteertraining/course.html
(password = volunteer)

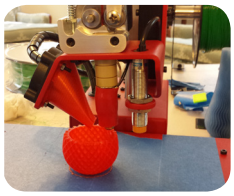
## References

Information was taken from the Utah 4-H website (utah4h.org), the National 4-H Website (4h.org), the Utah Volunteer Handbook, or as otherwise noted.

Lerner, R., M. et al., (2005). Positive youth development, participation in community youth development programs, and community contributions of fifth grade adolescents: Findings from the first wave of the 4-H Study of Positive Youth Development. Journal of Early Adolescence, 25(1), 17-71.

**We would love feedback or suggestions on this guide; please go to the following link to take a short survey:**
http://tinyurl.com/lb9tnad

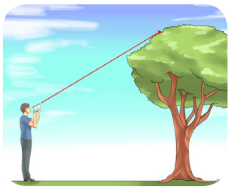
# 3D Printing - Tinkercad® CLUB *Meetings*



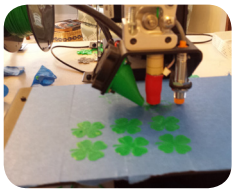

## Club Meeting 1
Tinkering with Tinkercad ---------- 7



## Club Meeting 2
Design Your Own 3D Rocket ---------- 21


## Club Meeting 3
Houston...We're Ready for Takeoff ---------- 27


## Club Meeting 4
Houston...We have a Problem ---------- 35



## Club Meeting 5
5, 4, 3..2...1...Blast Off! ---------- 38



## Club Meeting 6
Unleashing Creativity ---------- 40



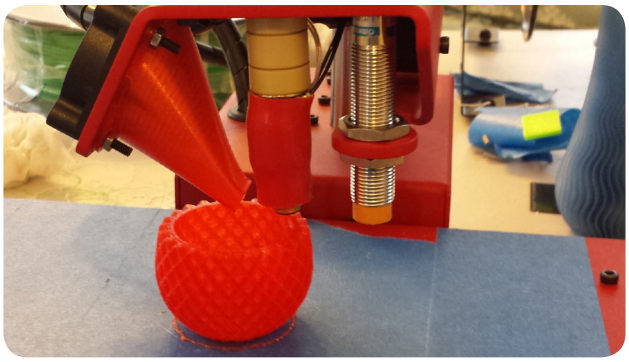
Colby Carpenter | Stella Stowell | JoLene Bunnell | Stacey MacArthur
Utah State University Extension


DISCOVER
4-H 3D PRINTING – TINKERCAD® CLUBS

# 4-H Club Meeting 1
## Tinkering with Tinkercad

### Supplies

- Broom - Use to demonstrate rocket stabilization (see Lesson 1: Rocket Basics).
- Clear tape/masking tape - This will be used for an activity in which club members make and test paper rockets.
- Computers - Every club member needs a computer with internet access. A mouse is optional, but the program is considerably easier to operate with a mouse.
- Drinking straws - 1 drinking straw per club member.
- Extension cords - Use to plug in the computers and printers.
- Internet access - The software that will be used is browser based; if the internet connection is really slow, it may be a struggle to effectively model in the program and save your 3D models.
- Masking or painter's tape - This will be placed on the floor to indicate where the club members start. Thus, masking or painter's tape is best suited for this purpose.
- Paper - 2 sheets per club member.
- Pencil - Use to demonstrate rocket stabilization (see Lesson 1: Rocket Basics).
- Power strips - Use to plug in the computers and printers.
- Projector - The projector will need to be connected to the club leader's computer so the club members will be able to see the Tinkercad demonstrations.
- Scissors - 1 pair per club member.



### PRIOR TO CLUB MEETING

1. Create your own Tinkercad account at Tinkercad.com. To familiarize yourself with the program, you can watch several of the basic skills videos, which provide a step-by-step guide of the fundamental tools in the program. These videos can be found by clicking on the "Learn" tab on the website homepage, located in the upper-left corner. In order to access all of the available videos, click on the blue bar labeled, "Browse all Basic Skills."
2. Visit Onshape.com, and create a free account. After you have created an account, practice sketching simple geometric shapes, constraining dimensions, and extruding a shape (making it three-dimensional). You will demonstrate the differences between sketch-based modeling, geometric shape-based modeling, and sculpt modeling in this club meeting. Onshape is an example of sketch-based modeling, so you do not need extensive knowledge of how the program works. However, learning the basics of the program will help you demonstrate the differences between the programs.
3. Visit https://stephaneginier.com/sculptgl/. You may also try typing "Sculpt GL" into Google search. The website is typically the first link on the first page. After you access the website, experiment with the different tools found

to the right (you can choose the various tools from the drop-down menu). For further instructions, read lesson 2 of this club meeting; Brief Overview of 3D Modeling.

4. Allow your club members the option of bringing their own laptops, as it can cut down on the number of supplies you will need to provide. This will also help them feel confident that they can use this program on their own computer at home after they have finished the club meeting.
5. Set up the projector in an area that allows you to project your computer screen onto a screen or large blank wall. This will enable the entire club meeting to see the Tinkercad demonstration.

## INTRODUCTION

In this meeting, club members will create and lauch their own paper rockets, learn basic rocket features, and then be introduced to Tinkercad.

# Activity #1

## LAUNCHING PAPER ROCKETS

### DESCRIPTION (15 MIN)

In this activity, club members will create their own rockets out of paper. Each club member will use a drinking straw to launch his or her rocket. The goal is for club members to try to design a rocket that will launch the farthest. This activity will demonstrate how the rocket's design determines how far and straight the rocket is launched.

### WHAT TO DO

1. Give each club member two pieces of paper and one pair of scissors. If there are not enough clear tape dispensers or masking tape rolls for each club member, they can share them in pairs or groups of three.
2. The club members will have 10 minutes to create a rocket using the supplies they have.
3. Club members must consider that their rockets will need a hole in the bottom that will fit onto the drinking straw.
4. After club members have completed their paper rockets in the 10-minute time allowance, they will stand at a designated place marked with masking or painter's tape and launch their rockets by blowing on their drinking straw.
5. The rocket that is launched farthest is the winner.

### REFLECT:

- What happened to your rocket after you launched it?
- What rockets laughed the farthest? Which rockets launched the straightest? Why do you think that is?
- Was there a specific design feature that helped it stay straight, or launch farther?

### APPLY:

- What can you change to help your rocket launch farther?
- How does the design of an object effect its motion in everyday life?

Explain that they will later learn how to design their own rockets in a 3D modeling program called Tinkercad, but first they will discuss rocket design specifications so they can make their rockets as effective as possible.

## DESCRIPTION (5 - 10 MIN)

After club members have launched their paper rockets, they will create rockets in the Tinkercad program; however, before club members begin working on 3D modeling a rocket, it is important to discuss basic rocket features so their rockets will be as functional as possible.

## WHAT TO DO

- What are features of a rocket?
  First, ask the club members the following question: What are some of the essential components and design features of rockets? Allow them to respond, and then discuss as a group the main parts of a rocket. Here are some essential features to discuss:

  A. **Boosters/engines**
  What is the purpose of rocket boosters and engines?
  We are going to use the release of compressed air as our engine.

  B. **Fins**
  Why do rockets have fins?
  - Fins are aesthetically appealing.
  - Fins help stabilize the flight. Fins' thin design produces very little drag when the rocket is launched in a vertical direction; however, the large surface area of the side of a fin prevents the rocket from rotating or traveling in a sideways direction.
  - If the rocket is spinning out of control or flipping when you launch it, it may be because your rocket needs to be stabilized. Fins may fix your problem, but there are other ways to stabilize flight. Bullets are stabilized by spinning really fast.
  - They are also used to control direction.

  C. **Fuel**
  - We are going to use compressed air for our fuel.

  D. **Pilot**
  Club members will essentially be acting as the pilots when launching their rockets. During the straw activity, club members were able to determine how hard they blew on the straw, which consequently affected how far their rocket was launched. During the final rocket competition, the air pressure of the air compressor will determine how high the rocket is launched.

  E. **Shape**
  Ask the club members to describe the shape of a rocket.
  - A rocket is skinny, long, and has a point at the top.
  - Ask the club members how the shape contributes to the rocket's function.
  - Explain the principle of air resistance or drag and how the shape of an object can determine how much drag is exerted on an object: If you put your hand out while you're running, you can feel air pressure against your hand. If you put your hand out the window while driving, it is much more noticeable. If you put your hand out while driving down the freeway, you will notice how much more intense the air pressure is against your hand. The difficulty of moving your hand through the air increases as your hand is traveling faster. This phenomenon is called drag. Drag is the longitudinal retarding force exerted by air or fluid surrounding a moving object. The sharper the knife, the better it can cut through something. The sharper and skinnier your rocket, the better it can cut through the air. This is also why competitive swimmers wear tight and sleek materials when they swim, such as swim caps and swim shorts. They may also shave their arms and legs to reduce the amount of drag created by their arm and leg hair.

- Ask the club members if they can think of any other examples of drag.

- What are ways to make your rocket go higher?
  - Make it light - Different materials are lighter than others - the more material used and the heavier the material is, the heavier the rocket will be.
  - Make it have less drag - Shape affects drag. If the rocket is skinnier and the top is pointier, drag will be reduced.
  - Stabilize it - If the rocket is not stabilized, then the kinetic energy of the rocket will be wasted. The pointed top of the rocket is designed to cut through the drag produced by air; however, if the rocket is not stable, then it may start traveling in a manner that retards its speed - it may begin flipping or angling in a different direction. To maximize the kinetic energy of a rocket, the rocket needs to travel in a straight direction, which is achieved by stabilizing it. Fins are very effective rocket features, which help to stabilize the rocket when it is in flight. Another key to stabilizing a rocket is length. It is much easier to stabilize something that is long than something that is short. Check for club members' understanding of this concept by having them guess whether it would be easier to balance a broom or a pencil on your finger. After everyone has responded, have each club member try balancing a pencil on their finger. Then have them try balancing a broom on their finger. Which object was easier to balance? Why? As the club members discover, it is much easier to balance the broom. The length of the broom allows for more correctional time to balance its weight while the pencil's length provides very little correctional time before it falls. Another explanation for the broom's better balance is its weight. There is more weight at each end of the broom than there is at each end of the pencil. The weight at each end of the broom helps to stabilize it, causing it to tip sideways more slowly.

### APPLY:

Club members will recognize which design features provide a successful launch using the paper rockets. They will be able use the same design principles when they create their own rockets using the Tinkercad program.

## Activity #3

### BRIEF OVERVIEW OF 3D MODELING

### DESCRIPTION (15 MIN)

In this lesson, participants will learn about some of the most common types of 3D modeling available today. After learning about the different types of programs and their respective uses, participants will learn how to use an online geometric shape-based modeling program called Tinkercad. Ultimately, club members will be able to develop their creativity and innovation as they work with their individual 3D models in Tinkercad. As club members familiarize themselves with the program, they will discover that their creativity is their only limitation: if they can think it, they can create it.

### WHAT TO DO

First, ask the club members what they know about 3D modeling, and allow them to respond. After the club members have explained what they know, discuss the history of 3D modeling and the types of 3D modeling available today. The following link provides a brief overview describing 3D printing and its history:
https://www.3dhubs.com/what-is-3d-printing

**The following are main points from this online overview:**

- 3D printing is an additive manufacturing process, which creates a physical object from a digital design. After a digital design has been created, the design is sliced into small layers in a 3D printing program and is sent to the 3D printer.
- After the file is sent to the 3D printer, the printer will melt the filament that is selected for the project and begin to lay down the melted filament layer by layer. Explain how this method is similar to using a hot glue gun - if you heat up a glue gun and melt the glue onto a flat surface, layer by layer, then you can eventually build the glue layers into a three-dimensional object. The 3D printer is much more precise than a glue gun and is programmed to know exactly how much and where to melt the plastic filament. Depending on the type of printer used and the type of filament used, the method for bonding filament will vary. It typically takes hours to print a design; however, the time required for the printing process varies depending on the size of the design and the type of printer used.
- Though 3D printing may seem somewhat futuristic, the technology for 3D printing has been around for 30 years. The first 3D printing process was invented in 1983 by Chuck Hull and was called "stereolithography." In his patent, he described stereolithography as "a method and apparatus for making solid objects by successively 'printing' thin layers of the ultraviolet curable material one on top of another."
- It was not until 2009 that the patent for fused deposition modeling (FDM) expired, and the technology became available for anyone to capitalize on it. As manufacturers capitalized upon this opportunity, the technology for 3D printing continued to develop, and now printers are available at a reasonable price, making 3D printing more accessible.

**Pros of 3D Printing:**

- Create complex designs
- No need for tools and molds – lower fixed costs
- Speed and ease of prototyping, faster and less risky to market
- Less waste

**Cons of 3D Printing:**

- Higher cost for large production runs
- Less material choices, colors, finishes
- Limited strength and endurance
- Lower precision

**What is 3D printing used for?**

Ask club members if they can consider ways 3D modeling may be used. If they could design anything they wanted, what would it be? Explain that through 3D printing, you can create anything imaginable. Your creativity is your only limit. After you have given club members a few minutes to respond to the question, show them some pictures of the following 3D printing uses:
(It is easiest if you Google search the following 3D modeling uses and project the images onto a screen or blank wall using an overhead projector. It may be risky to do a live search in class, as some images may not be appropriate in your search, so you may want to find several images to use prior to class.)

**Car Manufacturers -** 3D printing is used to develop prototypes for car parts, as well as finished car parts. Formula 1 has been using 3D printing to develop custom car parts, which are used in competitive racing.

**Doctors -** Hearing aids are now produced through 3D printing. Each hearing aid is custom shaped for the user through 3D printing rather than manual labor, therefore helping to reduce the cost and production time for hearing aids.

**Dentists -** Braces and retainers are now tailored specifically to the needs of the user through 3D printing.

Today, orthodontists and dental surgeons can 3D scan a patient's jaw and teeth and digitally construct custom braces. The dental industry has embraced this innovative technology, and there are now 3D printer models designed specifically for dental use.

**Prop Makers -** Cinema props were formerly produced by hand, which was an expensive and time-consuming process. However, through the advent of 3D printing, all prop designers now have the ability to create movie props in an affordable and timely manner.

**Prosthetic Designers -** 3D printing has been revolutionary in prosthetics production and has improved many lives, as it has allowed prosthetic devices to be produced at more affordable prices. Children quickly outgrow their prosthetic devices, making prosthetics extremely costly and inaccessible; however, 3D printing has allowed companies to customize prosthetics and produce them at a more affordable price.

**Architects -** Creating scale models used to be an extremely laborious process; however, the use of 3D printing has made it easy for architects to quickly print their designs directly from their Computer-Aided Design (CAD) data, which is used for developing blueprints.

**Shoe Manufacturers -** Adidas is one of the first shoe companies that has capitalized on 3D printing technology. Through 3D printing, Adidas offers a customizable shoe midsole that is tailored to the specific needs of the individual and is manufactured on demand, thus eliminating the need for shipping, factories, and excessive raw materials.

**Reflect:**

- As you can see, 3D printing has transformed many industries. What are some other examples of ways 3D printing can be used?
- How could you use 3D printing in your own life?
- Chuck Hull revolutionized the way we produce countless items due to his innovative idea for 3D printing. Many lives were also changed as 3D printing helped to make customized prosthetics, braces, and even shoe designs more affordable. What ways can your ideas help to improve the lives of others? (Their ideas do not have to be directly related to 3D printing . . . this question simply encourages them to think of how they may use their ideas and creations to help others.)
- Why is it important to consider how our innovations can affect other people?

**Explain and Demonstrate the Three Main Types of 3D Modeling Available Today:**

- Sketch-Based Modeling:

  Some of the programs that utilize sketch-based modeling are Solidworks, Onshape, Fusion 360, and Sketchup.

  Sketch-based modeling is a go-to favorite for mechanical engineers. This type of modeling is particularly helpful for engineering projects, because the shapes can be manipulated according to exact mathematical and geometrical constraints, allowing engineers to produce the exact shape they want.

  Though the ability to manipulate the mathematical and geometrical constraints in sketch-based modeling is a considerable advantage, sketch-based modeling is not effective when trying to produce shapes with curvature. For example, if you are trying to model the human face, which possesses many curves, it would be nearly impossible, as it would take someone with extensive experience and countless hours to be able to model all the curvature of a human face. Rather than spend unreasonable amounts of time trying to shape an object with a lot of curvature, it would be easier and more efficient to use sculpting modeling for this type of project.

  Visit www.onshape.com, and quickly demonstrate the features of sketch-based modeling in Onshape by drawing a circle and transforming it into a cylinder, then drawing a square and transforming it into a cube.

*Sculpting Modeling:*

Here are some programs that use sculpting: Z-brush, Sculptris, Blender, and various browser-based sculpting.

It is easy to produce items with curvature through this program. With sculpting modeling, you can sculpt a human face in as little as 30 seconds.

Another great feature with high-end sculpting software is the ability to add texture to objects, such as texturing a blob to make it look like a rock. Although the texturing feature can be particularly useful, it is difficult to size the object to specific dimensions using 3D sculpting. It may be easy to pull, stretch, or scale objects using sculpting modeling, but tying a specific part of the model to a dimension can be difficult.

Quickly demonstrate how the online sculpting program, Sculpt GL, is similar to working with shaping dough as you shape an alien face. Sculpt GL is accessible online, and you can immediately begin using the program without creating an account. Simply visit https://stephaneginier.com/sculptgl/. The website will typically appear as the first link.

Sculpt GL is an extremely basic sculpting program, which allows you to sculpt the sphere that appears on the workplane. To sculpt the object, you may select any tool available in the tool drop-down menu. The drag tool allows you to stretch the object in different directions. If you select the paint tool, you can select the color you would like to paint your object. The color palette will appear as you hover your cursor over the preselected yellow color.

Provide your club members a few minutes to experiment with Sculpt GL. It may be easier for club members to type "Sculpt GL" into the Google search bar.

*It is possible to reconcile the pros and cons between these two types of modeling, achieving the best of both worlds. This would require you to devise and produce your object in a sketch-based program, and then load it into a sculpting program. You could then sculpt the section that you want to revise or change, while retaining the original form of all the other shapes you want. Some high-end sculpting programs like Z-Brush will allow you to make dimensionally accurate parts, yet it can be very difficult and is often used specifically for animation purposes.

*Geometric Shaped-based Modeling:*

Here are some examples of geometric shape-based modeling: Tinkercad, Minecraft, and various Autodesk 123D software. Geometric shape-based modeling provides the user with a library of shapes, which he/she can use and manipulate to create a unique three-dimensional design. These programs can be extremely beneficial for those learning how to 3D model, as it provides the foundation to understanding how 3D modeling functions. While beginning 3D modeling users might find this helpful, geometric shape-based modeling has many limitations when trying to design more advanced objects. For example, models in Tinkercad can only be created by adding or removing spheres, cubes, and other geometric shapes from each other. Although sketch-based modeling requires more skill, it offers more versatility once the user understands how to operate the program.

This club meeting does not have enough time to teach the sculpting, modeling and sketch-based modeling programs, so we are going to use a simple 3D modeling program that combines the best aspects of both programs. This is a geometric modeling program called Tinkercad.

## WHAT TO DO (30 MIN)

Connect your computer screen to the projector, so the club meeting can follow along as you demonstrate how to set up a Tinkercad account and use the program.

Go to tinkercad.com

1. Sign in or create a new account in the top right corner. Once everyone has successfully created their own Tinkercad account, the club members may begin experimenting with the fundamentals of Tinkercad together.
2. To begin using the program, click on the multicolored Tinkercad box in the upper-left corner, which will take participants to their account home page.
3. Participants will then select the blue box entitled, "Create New Design." This box is located directly underneath the area entitled, "All Designs." If club members do not click on the "Create New Design" box, but rather start 3D modeling in the tutorial, their design will not be properly saved.
4. The program will automatically provide the new design with a title. To change the name of the title, click on the name the program automatically generated for the participant. The title is located in the upper-left corner next to the "My Designs" tool.

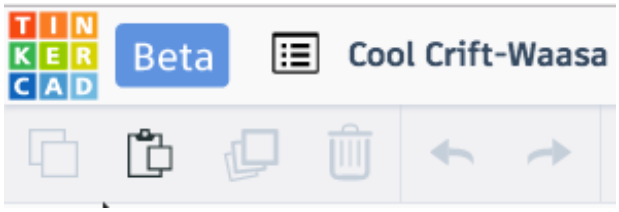
For example, the name automatically generated for this project is "Cool Crift-Waasa."
Simply click on this name to change the title, then type in the preferred title. It is recommended that club members change the name of their title to their name and what they are creating. For example, "John Smith's Rocket." This will help to avoid confusion when printing all of the club members' projects.

## DEMONSTRATE THE BASIC TOOLS OF TINKERCAD THROUGH BUILDING A HOUSE

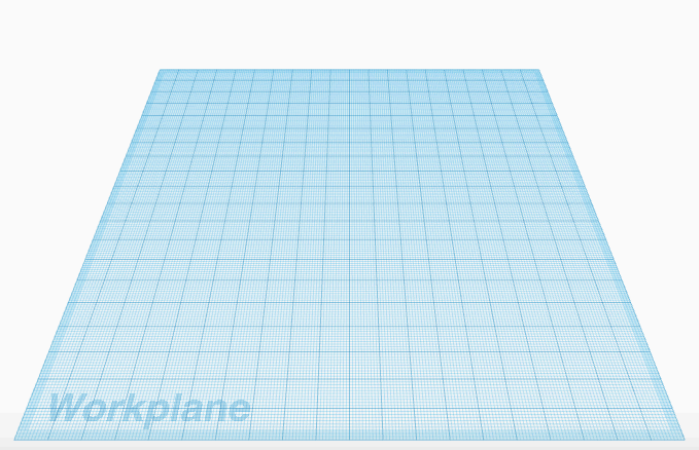
### DESCRIPTION (30 MIN)

Club members can familiarize themselves with the basic Tinkercad tools as they build a simple house as a club. Demonstrate how to do each of the following steps below. It is beneficial when you demonstrate each step two times. If some club members still struggle to understand how to complete a step or how to use one of the tools, encourage them to ask their neighbors for help. As club members rely on their fellow club members for support, their club members will have the opportunity to teach, thereby helping them become more familiar with the program themselves.

### WHAT TO DO

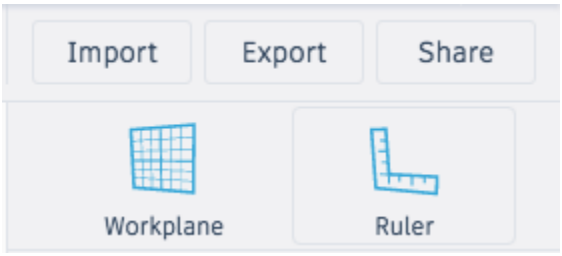



1. **Identify the work plane:** This is the light blue gridded square with the word "Workplane" in the lower-left corner. Demonstrate how to manipulate the work plane, which is done by right-clicking and dragging the mouse (if you have a mouse attached to the computer), or through pressing ctrl and clicking and dragging your finger on your touchpad when using a laptop. Zooming in and out on the workplane is achieved by using the scroll on the mouse or through moving two fingers apart or together on the touchpad, if using a laptop. The workplane can also be moved from side-to-side through clicking on the scroll button of the mouse and dragging from side-to-side. Provide club members with a couple minutes to practice manipulating the workplane: moving above and below the plane, zooming in and out of the plane, and moving the plane side-to-side.
2. **Select an Object:** There is a library of basic shapes to the right of the workplane. You may select any one of these objects by simply clicking on the desired object, then clicking on the workplane. The object will then be placed in the location you clicked on the workplane. For the purpose of this demonstration, club members will select the "Box" and the "Roof" from the library of shapes, and they will place both of these shapes on their workplane.

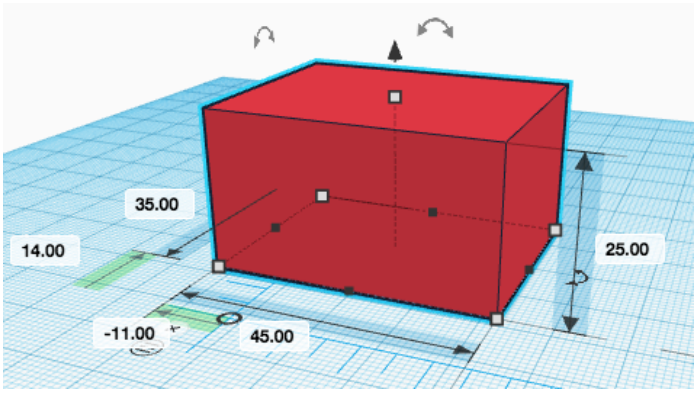



3. **Moving your object:** Simply click on either object, and drag it to the new location. Club members can practice moving both the "Box" and the "Roof" shape around on the workplane.
4. **Measuring tool:** For this demonstration, club members will select the "Box" shape. After clicking on the box, several white and black squares will appear around the box. These indicate that the box has been selected. Measure the height and width of the box by clicking on the ruler tool in the upper-right corner, directly underneath the "Import," "Export," and "Share" buttons. After clicking on the ruler tool, click to the left of the object on the work plane. If the numbers indicating the measurements do not show up, click on the object once again. Measurements for the shape will be pro-

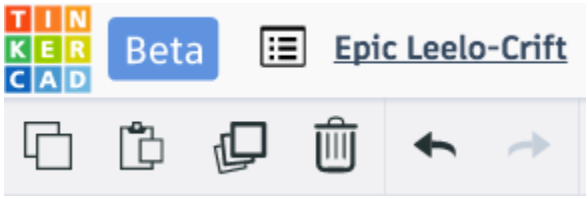
vided in millimeters.




5. **Modify shapes:** Shapes are easily modified using the black squares, white squares, black triangle, and rotational arrows. The white squares adjust width from the corner and height from the center, the black squares adjust width from the center, and the black triangle above the shape raises the shape above or below the work plane, without changing the dimensions. In order to maintain uniform dimensions while changing the size of an object, press the shift key while dragging one of the white corner squares in or out, depending on whether you want to make your shape larger or smaller. Allow club members time to practice modifying these shapes until they feel comfortable with their ability to manipulate the height, width, and rotational direction. It is easy to control the measurements of the shape using the ruler measurements as well. Using the ruler measurements, have the club members adjust the length of their box to 45 mm, the height to 25 mm, and the depth to 35 mm. These numbers can be adjusted by simply clicking on number and typing the desired measurement into the white box. It may be difficult for some of the club members to identify which number represents the width, length, height, etc. Encourage the club members to zoom in on the object and look at it from different angles, as it will help them identify which number indicates width, length, height, etc.

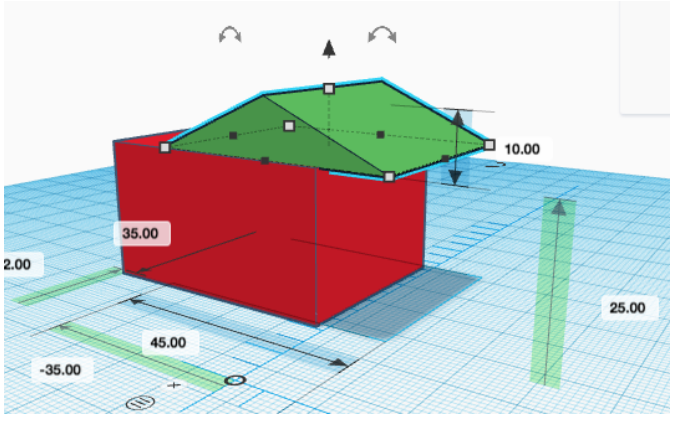



6. **How to duplicate, copy, paste, and delete shapes:** Shapes can be duplicated by using the keyboard shortcut on your computer (Ctrl + D). After using the keyboard shortcut, simply click on the shape, and drag out the duplicate shape. Shapes can also be copied and pasted using shortcuts (Ctrl + C) and (Ctrl + V). If you decide you want to remove a shape after adding, select the shape and click the trash bin in the upper-left corner, or use the delete or backspace key on your keyboard. The duplicate, copy, paste, and delete tools are all available in the upper-left corner as well, directly under the multi-colored Tinkercad box. All homes need windows, so club members can practice duplicating a window through selecting another box from the shape library and adjusting its size, so it is smaller than their first box. After they have adjusted the box to the size of the window they want, they can duplicate the box so they will have two matching windows. These smaller boxes will be inserted into the main box as windows in step 9; however, they will remain separate on the workplane until then.

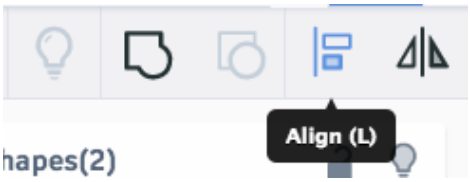



7. **How to align shapes:** The align tool is used when arranging two separate shapes in direct proportion to

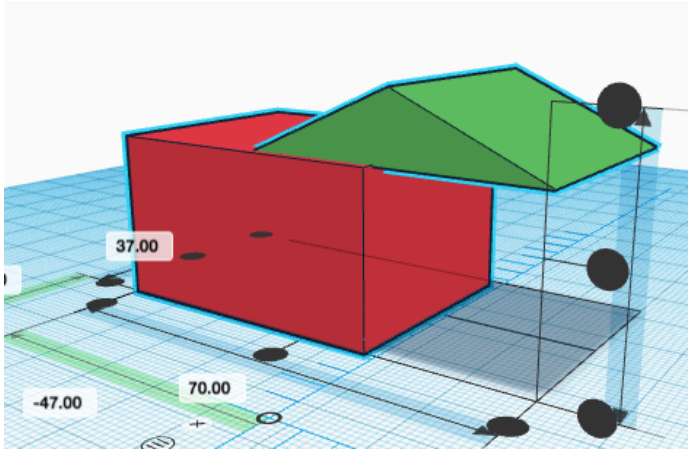
each other. For this demonstration, club members will need to place their "Roof" shape onto their main box in order to add a roof to their house. If the club member is trying to place the "Roof" shape on top of the "Box" shape, then he/she will first modify the dimensions of the roof so it will match the dimensions of the box. Try modifying the dimensions of the roof through using the ruler tool and typing in dimensions that correspond with the box. The roof can be raised by clicking and dragging the black triangle above it upward; however, to ensure that there is no gap between the roof and the box, type the box height (25 mm) in the box that determines how high the roof is raised (see the figure below). The green arrow to the far right of the roof shape will appear after slightly raising the object using the black triangle above the object. The green arrow determines how high the roof is raised, so typing in the height of the box in the white box to the right of the arrow will ensure that the bottom of the roof is the same distance from the workplane as the top of the Box. Therefore, there will be no gap between the roof and the box. This is important, as the printer will be unable to print a design as a solid object when there are gaps between objects.




Aligning the roof on the box so that their dimensions correspond evenly is done by using the align tool. Once the club member has successfully placed the roof on the box, he or she will select both objects by drawing a box around both objects or through the keyboard shortcut (command or Ctrl + A). The club member can use the align tool through the keyboard shortcut "L" or by clicking on the align tool, located above the shapes box.



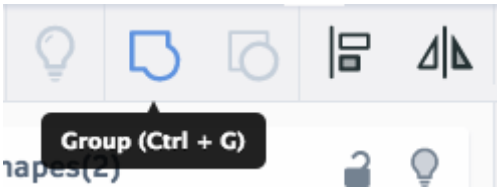

After the align tool has been selected, several handles (several lines with circles attached to the ends) will be visible around both objects (along each axis). Clicking on the circles will align the two shapes according to the different axis. It is helpful to hover over the circle, as it will provide a preview of what clicking that circle will do to the objects. In this case, clicking on the front middle handle will match the box and roof exactly.



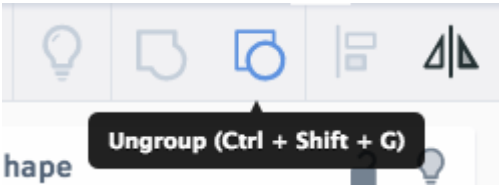

For a quick tutorial demonstrating the various ways to align objects, click on the following link: https://youtu.be/zVVL_mIUTbE?list=PLV6cmKvnKRs5Qjz0GY_NO4pmTwDjKhnzT

8. **How to group shapes:** To combine two or more separate shapes into one object, such as the roof and

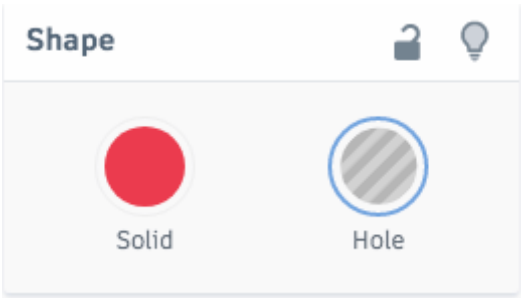
the box shape, which were aligned in step 7, select all of the desired shapes (both the box and the roof shape). After all the shapes have been selected, use the keyboard shortcut (Ctrl + G), or click on the "Group" icon, located above the shapes box. This tool will consolidate both objects into one single unit.



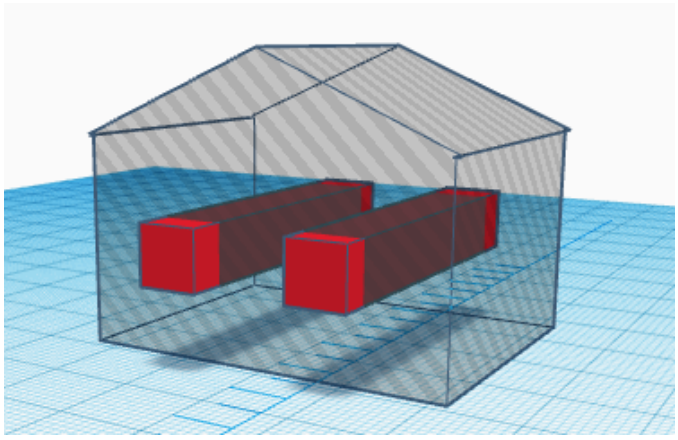

Objects can be ungrouped through the keyboard shortcut (Ctrl + Shift + G) or through clicking the "Ungroup" icon.




9. **How to put holes in shapes:** Holes can easily be placed within any of the shapes, through the use of other shapes. For example, if club members want to create a couple of square holes in their home to look like windows, then they will use the two small boxes they created earlier. Club members should try creating windows in their house, so they feel comfortable with how to place holes in their objects. Their box and roof should be one solid object after they have grouped the two together in step 8. After selecting their house, they will click the "Hole" tool in the "Shape" box.

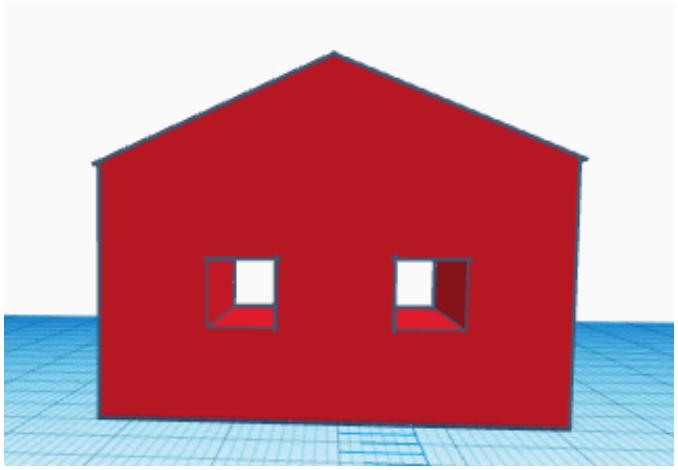



This will make the house transparent so you can work to create a hole in the object more easily. After the club members have used the hole tool to make their house transparent, they will select one of the small boxes they previously created and they will raise it to the height they would like for their windows. To ensure that both windows are an equal height, they will need to type in the same height for both boxes, as was previously done for the roof in step 7. Before placing the small boxes in the house, they will need to elongate the boxes, changing them into long rectangles that will protrude from either end (see figure below). They can then place the windows in the house.



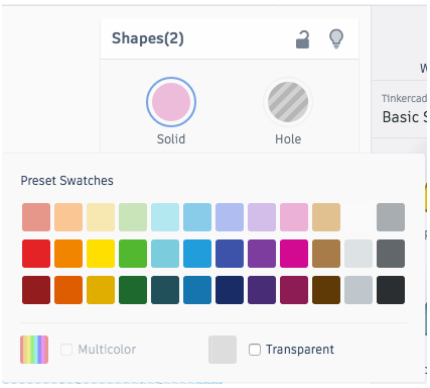
Next, transform each rectangle into a hole by selecting both rectangles and clicking on the "Hole" tool. After the rectangles have been transformed into holes, select the house, and make the house solid once again. This is done by clicking the "Solid" tool next to the "Hole" tool. After the house has been transformed back into a solid object, select the whole house and group all the objects, using the "Group" tool. Their houses will now have windows. Club members can use any of the objects from their library of objects to place holes within objects. For example, if they want to make a circular hole, they may use the cylinder shape from the library. There

are infinite possibilities for club members using this program, and the best way is to become familiar with the different possibilities is to use their creativity and just create!

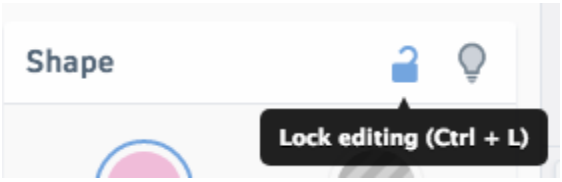


* The following video tutorial may help you to further understand how to create a hole in your object: https://youtu.be/KAW_ZIzmoCI?list=PLV6cm-KvnKRs5Qjz0GY_NO4pmTwDjKhnzT

10. **How to change color:** To change the color of an object, click on the "Solid" circle in the "Shape" box. Various colored swatches will appear from which to select a different color for the desired shape. *Remember, the finished printed product will be one solid color, as the product will be printed in the color of the filament used, so club members may experiment with changing the color of their object, yet their finished object may not be the color they have selected if the filament is a different color.

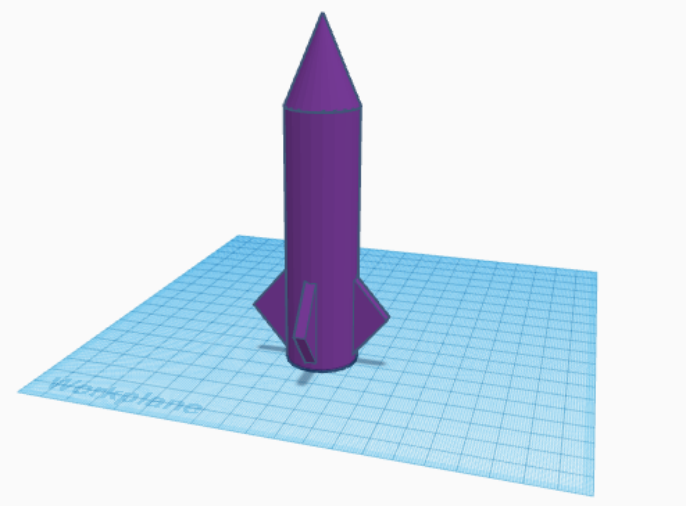



11. **How to lock shapes into position:** Shapes can be easily locked into position using the locked tool. This tool can be found in the right corner of the shape box, or it can be selected through the keyboard shortcut (Ctrl + L). If club members have difficulty moving their objects, they may have unintentionally clicked on the "Lock" button, which locked their shape into its position. They can undo this by clicking on the "Lock" icon, which will unlock their shape, allowing them to move it around once again.




Explain that they will be using Tinkercad to create their own rockets, which they will later launch, but first you will discuss rocket design specifications.

***Important Note:** The program will automatically save the club members' designs as they are working in Tinkercad. If club members accidentally exit out of the browser, they will still be able to find their design in Tinkercad. Once club members finish their designs, they simply need to logout and exit out of their browser.



## Reflect

- What Tinkercad tools were the hardest to use? Why?
- What tools will help you when you build your own rocket?
- How did working together as a group to build a house in Tinkercad help you develop basic skills to work with Tinkercad?

## Apply

- When might it be beneficial to learn how to do something as a group? Why is it beneficial?
- Although it may seem like a lot of new information was covered, experimenting with Tinkercad is one of the best ways to become comfortable working with the program. Have you had other experiences where the information felt a little daunting initially, but with practice you were able to feel comfortable with it?

## 4-H MISSION MANDATES

### Science

Club members will understand the fundamentals of rocket design and how the design contributes to the rocket's function. This knowledge will aid them as they design their own rockets in Tinkercad.

## ESSENTIAL ELEMENTS

### Independence

Club members will be able to use all of the basic tools in Tinkercad, which will help them build their own rockets during the next club meeting.

### Belonging

As club members learn how to use various tools in Tinkercad, they will be able to rely on each other for information when they have forgotten how to do something or do not understand how to use a tool. This will create a community of learning, as they teach and learn from each other.

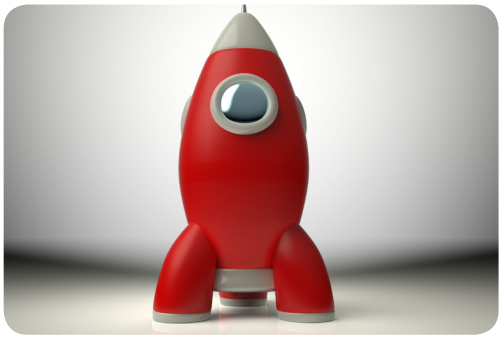
### REFERENCES

3D Hubs. (2017). What is 3D Printing? The Definitive Guide to Additive Manufacturing. Retrieved from https://www.3dhubs.com/what-is-3d-printing.

# 4-H Club Meeting 2
## Design Your Own 3D Rocket

### Supplies

- 3D Printer - Have as many as possible to maximize printing efficiency.
- 3D Printing Filament - Using a different filament color for every printer can add more variety and diversity to the club members' projects, but if you are using one printer, it is important to ensure that you have a 1 kg roll for every four club members.
- 3D Printing Software - Have at least one computer with 3D printing slicing software on it because most 3D printing slicing software is not browser based.
- Blue Painters Tape - Placing blue painter's tape on the build plate helps the 3D printed parts adhere to the build plate and also allows easy removal, as the objects can be difficult to remove otherwise. Important note: The wider the tape, the better.
- Computers - Every club member needs a computer with internet access. A mouse is optional. However, the program is considerably easier to operate with a mouse.
- Digital Calipers - Use to measure the dimensions of the rockets.
- Extension cords - Use to plug in the computers and printers.
- Internet access - The software that will be used is browser based; if the internet connection is really slow, it may be a struggle to effectively model and save your 3D models in the program.
- Poster or Whiteboard - Use to display design specifications for the rocket. The specifications need to be written large enough so the club members can easily see them as they work at their computers.
- Power strips - Use to plug in the computers and printers.
- Projector - The projector will need to be connected to the club leader's computer, so the club members will be able to see the Tinkercad demonstrations.
- Rocket launcher - This must be air-powered. The following link provides instructions for one possible method to create a rocket launcher. There are numerous ways to create a rocket launcher. http://makezine.com/2010/07/11/how-to-building-the-compressed-air/
- SD Card - Printers usually have a SD card slot for the g-code (the g-code is the code the printer will read in order to print the exact specifications of the design). Having multiple SD cards makes the printing process more efficient, as it enables club members to prepare their file on the SD card if the printer is already in use. Once the printer completes its current file, the club members can immediately begin printing their pre-prepared file.
- SD Card Reader - Some computers may have an SD card reader built into it, however, if the computer does not have an SD card reader, you will need to purchase one.
- Sharpened putty knife - This allows you to remove the 3D printed parts from the build plate.



## PRIOR TO CLUB MEETING:

1. Confirm that all the printers are working properly and the build plate is level before meeting.
2. Write the rocket design specifications on a whiteboard/poster and display the poster in a visually accessible place so the club members may refer to it as they work at their computers.
3. Create an air-powered rocket launcher, so that students may use it to measure for their rocket's bottom hole.

## INTRODUCTION

Club members will use Tinkercad tools to creat their own rockets, and then they will 3-D Print their rockets.

# Activity #1

### TINKERCAD ROCKET DESIGN

## DESCRIPTION (25 MIN)

Now that the participants have familiarized themselves with the Tinkercad tools, they will use these tools to create their own rocket. It is important that they use their own creativity and innovation, as there is not one established method to create a rocket. After club members have finished designing their rockets, they will print them out using a 3D printer. Each completed rocket will be a reflection of individual creativity, though it is important that the participants consider the dimensions of their rockets.

## WHAT TO DO

Calculating their rocket's dimensions will ensure several things:

- The rocket will fit on the launcher
- The rocket will fit on the printer
- The participant will not be disqualified
- The rocket will be able to fit inside a 150mm x 150mm x 150mm box

Write the following specifications for the rockets' dimensions on a poster/whiteboard, and display it in a visually accessible area, so that club members will be able to refer to the board as they design, making sure their rocket meets the required dimensions.

**Specifications will include:**

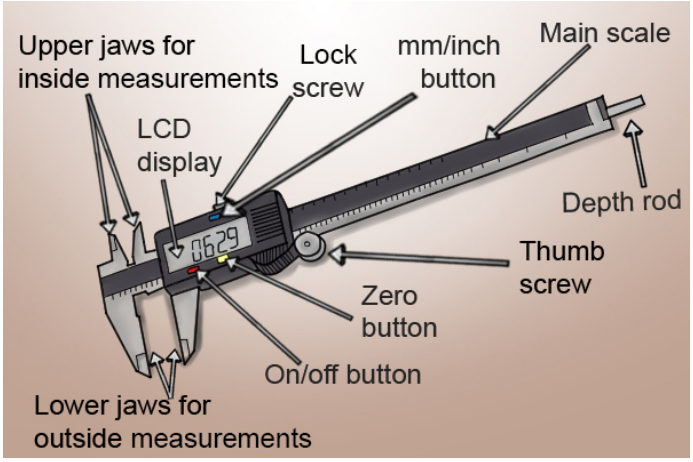
- 150mm x 150mm x 150mm dimensions (this includes the rocket fins). Not all 3D printers are capable of printing objects that are larger than 150mm x 150mm x 150mm, and if the printer is capable of printing an object larger than that size, it will still require too much time to print. Printing large objects also makes it difficult to print several objects at once, as there is not enough room on the build plate. To save time, make sure club members design rockets that meet the 150mm x 150mm x 150mm specifications.
- The size of the hole they will need to create in the bottom of their rocket will also need to be accurately dimensioned. Using calipers, measure the dimensions of the pipe from which the club members' rockets will be launched. A hole should be 0.5 mm larger than the pipe, as 0.3mm is too snug and 0.8mm is too loose. This will ensure that the rocket is properly fitted to the pipe when it is launched.

Club members will use calipers to generate a mental image of what the dimensions of the rocket will look like. A caliper is a highly sensitive piece of equipment that delivers an extremely accurate measurement of the dimensions of an object.

- First, demonstrate the different ways a caliper can be used on a small marker cap. To measure the width

of the marker, you need to place the width of the marker between the lower jaws of the caliper. The lower jaws are slid apart through scrolling the thumb screw (also known as the fine adjustment knob) to the right. You can also slide the lower jaws together when scrolling to the left. The thumb screw can be helpful when trying to slide the jaws slowly and precisely into position; however, the black, ridged protrusion on the battery cover can be helpful when trying to slide the jaws apart quickly. After sliding the jaws securely into place around the width of the marker, you can tighten the lock screw, which will lock the jaws into place. Next, look at the display screen to see what the measurement reads. The mode of measurement on some calipers can be changed from inches to millimeters.

- To measure the depth of the inside of the marker cap, place the marker cap on the end of the main scale where the depth rod protrudes. If the depth rod does not protrude on the caliper, try sliding the thumb screw to the right, which should cause the depth rod to emerge. Place the inside of the marker cap on the depth rod and extend the depth rod to the end of the marker cap. This will produce a measurement for the depth of the marker cap on the display screen.
- Club members can practice using calipers to measure even the smallest objects. Allow them to experiment measuring a piece of paper, or even a strand of hair. A standard sheet of white printer paper is typically 0.004, which is generally read by engineers in the thousands place.




**Reflect:**

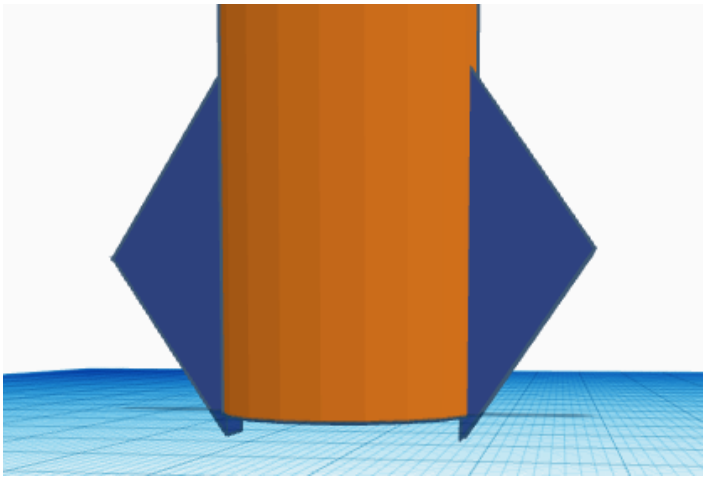
When would you use calipers rather than a ruler? What are the limitations of calipers? (They cannot measure large objects; their accuracy is limited by 0.0005".) Fun Facts: Many measuring devices have been engineered to produce extremely accurate readings. The micrometer is a measuring device that is similar to a caliper, but it can measure to 0.0002". There is another innovative measuring device that is so accurate that it can measure the object, despite the minor temperature changes an object undergoes. These minor temperature changes can cause an object to shrink or expand, yet the micrometer can still obtain an accurate measurement. If that does not succeed in blowing your mind, then try imagining a device so accurate that it can detect gravitational waves. Gravitational waves cause objects to shrink or expand, depending on how much force gravity has on an object. For example, when gravity has a strong force on an object, the object shrinks; however, when gravity has a weak force on an object, the object expands. Despite the fluctuation of gravity's force, this measuring device can still obtain an accurate measurement of the object.

How will you use calipers to measure the dimensions of your rocket?

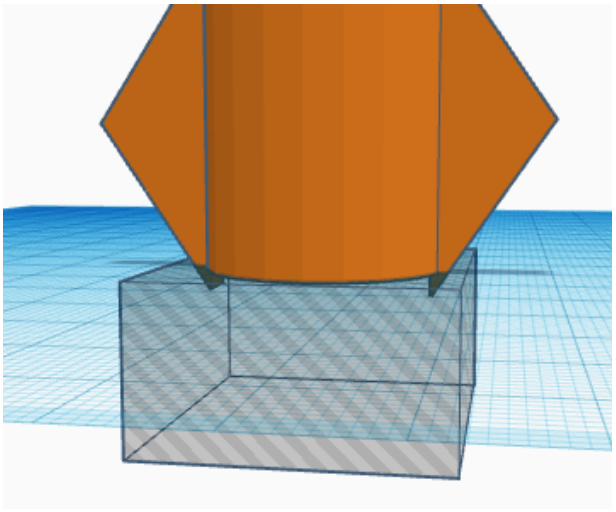
## WHAT TO DO (25 MIN)

It is recommended that the club leader prints the rockets after class, as the rockets can take between 3 to 6 hours to print, depending on how many printers are available for use.

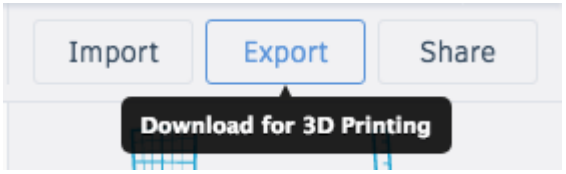
1. First, club members will need to make sure that elements of their object are grouped together before printing. The printer will not be able to properly print their design if they have inadvertently left a gap between shapes. They also need to make sure there are not any separate objects left on the workplane or even to the side of the workplane. These extraneous designs can simply be deleted if the club members do not want them. If club members have created something to the side of their rocket that they would like to keep, the rocket can be selected as the only object reserved for printing. This prevents the club members from unnecessarily deleting an object they would like to keep.
2. Club members will often create rockets with fins that extend off the bottom of the body (see image below). Although this may look "cool," this design presents a problem when printing, as the points of the fin extending from the rocket will not be properly supported when printing.



To quickly fix this problem, draw a box, and place it directly underneath the rocket, below the workplane. Cut off the extended points of the rocket by simply making a hole in the box and then grouping the transparent box to the rest of the rocket. This will automatically cut off the points that extend past the base of the rocket.



3. Export rocket design for printing. The export tool is found in the top right corner.




If there are no extraneous objects on or to the side of the workplane, you may opt to download everything in the design; however, if there are other objects on the workplane that a club member would like to keep, it's important to select the design through highlighting a box around it, and they will need to choose to include selected shapes only when downloading. They should choose to download it as a .STL file from the options available. This is the most common file type for 3D printing.

4. Club members will then select where they want to

save their downloaded file and save it on their computer. They will then email their downloaded files to their club leader, who will create a separate file for their club's files.

5. One of the easiest 3D printing programs to use is Cura. Cura is simple, free, and does well at slicing files. There are two Cura versions. If you are adept at using the older version, it will only take a little critical thinking to figure out how to use the newer version.
6. After club members have downloaded their file, they will need to email to you. To avoid any confusion, it is best if you create a specific file for the club members' projects, such as "Tinkercad Rockets," so that they can all be accessed in one place.
7. Once you have received the files, you can upload each file to the Cura program by either dragging and dropping the file into the program, or by clicking on "file," then "load model." The most efficient method is to simply drag and drop the file directly from the Google Chrome download bar. You can then search through your folders to find the file you want to upload. You will then insert one of the SD cards into the SD card reader in the computer. The Cura program displays a floppy disk icon at the top of the screen, yet when the SD card is placed in the reader, this icon transforms into an SD card icon.
8. When the rocket has been properly uploaded to the Cura program, it will show up in the cube. If the rocket is not inside the parameters of the cube, the design will turn gray, indicating it cannot print the rocket in its current location. The rocket will need to be moved onto the platform of the cube. This is not typically an issue, unless the object has been moved off the cube's platform.
9. After the rocket has been uploaded to the Cura 3D printing program, then some printing specifications will need to be checked and/or changed. The following are the basic specifications for printing the rockets:

   Support Type: None
   Platform Adhesion Type: None
   Printing Temperature: 190 Degrees
   Layer Height: 0.3 mm (This is the biggest you can go without incurring delamination problems. Delamination occurs when the layers are not properly bonded together and can be easily pulled apart.)
   Shell Thickness: 0.8 mm (The printer will print two solid walls on the outside of the part while the inside of the part will be a honeycomb structure. Each line will be 0.4 mm, because the nozzle diameter is 0.4 mm.)
   Bottom/Top Thickness: 0.6 mm
   Fill Density: 20 mm
   Diameter: most common is 1.75 mm
   Flow: Always 100%

10. Print! If the printer is plugged directly into the computer, you can just click the image of an hourglass, and it will immediately begin printing. If the printer is not plugged directly into the computer, use the SD card, and insert it into the 3D printer. Depending on the type of printer you use, the manner of printing will vary: some may have a scroll interface, some operate through WIFI, and others operate through a USB cord.

***Important Note:** Write a checklist of common design flaws in a visible area in the room. Here are some common design flaws: rocket parts are not grouped together, rocket is too big, rocket contains inadequate hole size, rocket fins not attached to the body, and rocket fins are embedded too deeply into the body (interfering with the rocket hole). Before club members email the club leader their rocket file, they should refer to the checklist to make sure they have avoided these common design

flaws. Some of the club members may still make some design errors; however, the checklist will help reduce the number of errors. Although some rockets may have design flaws, print all of the rockets so the club members can see what errors they made and correct those errors when they redesign their rockets.

## Reflect

- What shapes did you use to design your rocket?
- How did you modify the shapes you used to make them accommodate your rocket?
- What other shapes might be fun to work with when designing a rocket?
- Everyone used different shapes and methods when creating their 3D rocket. Why is it important to recognize that there is more than one way to do something?

## Apply

- Considering the skills you have acquired through using Tinkercad so far, what other objects do you want to design in the future? Think of things you can use every day.
- Sometimes it is difficult to recognize how a shape can be useful unless we modify its dimensions, or rotate it. You might want to share an example of how looking at a problem from a different perspective has helped you, or share a story you have heard that helps to get club members thinking before you ask them the following question: "How can looking at a difficult problem from a different perspective provide us with potential solutions?"
- Is there a problem in your life that might be solved by looking at it from another perspective?

## 4-H MISSION MANDATES

### Science

Youth will discover how manipulating basic shapes can help them create an object in Tinkercad. The objects that surround us are composed of different geometric shapes, which they can identify and recreate with the library of geometric shapes available in Tinkercad. 3D modeling requires that youth think critically and creatively to make an object with the shapes provided.

## ESSENTIAL ELEMENTS

### Mastery

Youth will learn the basic tools and features of Tinkercad to create a rocket, and they will be able to use these same tools and features to create other designs independently in the future.

### Generosity

As club members master basic functions of Tinkercad, they can help those who are struggling to understand how to use the tools. Teaching others how to use the program will help the club members further master the Tinkercad tools.

### REFERENCES

3D Hubs. (2017). What is 3D Printing? The Definitive Guide to Additive Manufacturing. Retrieved from https://www.3dhubs.com/what-is-3d-printing.

# Houston...We're Ready for Takeoff!

## Supplies

- Air Compressor - Choose any type of air compressor that is large enough to have its own tank. It is possible to use a bicycle pump; however, it will require more time and labor, stifling the fun and excitement in this project.
- Air Compressor Regulator - Some air compressors have regulators, but if your air compressor does not, you may want to purchase one so you can determine the air pressure.
- Clear Tape or a Hot Glue Gun - Use to create the clinometer.
- Drinking Straw - Include 1 drinking straw per club member.
- Exacto Knife - Use to cut out the protractors from the foam board. Foam board can be difficult to cut out, so exacto knives help to reduce strain on you and the scissors! If you allow the club members to cut out their own protractors with the exacto knife, make sure you carefully supervise. They can be dangerous when they are not used properly.
- Extension cords - Use this to plug in computers, printers, and air compressor.
- Foam Board/ Cardboard - Include one square piece of sturdy foam board or cardboard per club member (foam board can be purchased at a dollar store).
- Measuring tape - Use for the "calculating height" activity.
- Printed Protractor - Include one printed protractor per club member. Club members will use this to make a clinometer. The link below provides the correct protractor for this activity, as a clinometer protractor is different than your typical protractor, for the middle is zero degrees and it increases to ninety degrees to the left and right. http://moodle2.rockyview.ab.ca/mod/book/tool/print/index.php?id=51529&chapterid=23909
- Rocket launcher - This must be air-powered. The following link provides instructions for one possible method to create a rocket launcher. There are numerous ways to create a rocket launcher. http://makezine.com/2010/07/11/how-to-building-the-compressed-air/
- Scientific Calculator - Use to calculate the height of various tall objects, as well as the club members' rockets. One scientific calculator is sufficient, but it if you have more available, the club members will not have to take turns.
- Scissors - Use to cut out the protractors.
- String - Use to create the clinometer. 1 piece of string about 30 cm or 1 foot long
- Washer - Use one small hardware washer per club member. These will be used as a weight to create a clinometer.

## PRIOR TO CLUB MEETING

1. Make sure everyone's rockets are printed.
2. Locate a wide, flat area with a nearby electrical outlet. This area will be used for launching the rockets, and the outlet will be used to plug in the air compressor and rocket launcher.
3. Create a free Onshape "Education" account at www.onshape.com, and learn how to make a basic triangular sketch. There are step-by-step instructions for creating a basic triangular sketch in the lesson directions. Practice using Onshape so there will not be any problems the day you meet with the club.

## INTRODUCTION

In this meetings, participants will learn some basic math principles, which they will use to calculate the height of their rockets. They will understand how essential right triangles are in calculating the height of objects that are difficult to calculate using a measuring tape.

You should have Onshape set up on the computer so the club members can demonstrate how the program will calculate height, using the data they collected outside. This will take 2 minutes to demonstrate.

# Activity #1

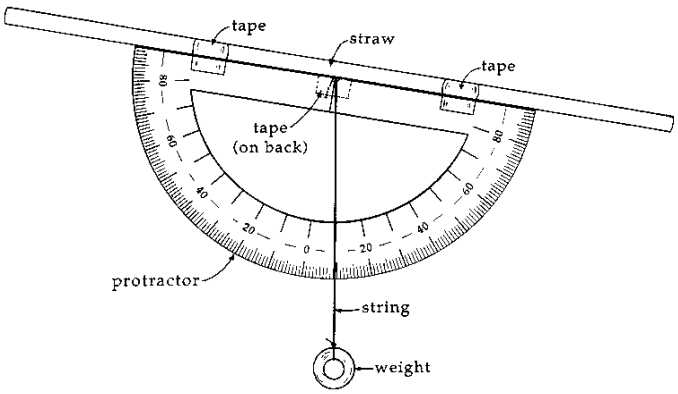
## CREATE YOUR OWN CLINOMETER

## DESCRIPTION **(10 MIN)**

Club members will create their own clinometers, which they will use to calculate the maximum height of their rockets when they are launched.

## WHAT TO DO

1. Each club member will receive a printed protractor, which they will carefully cut out and glue to sturdy foam board. After they have glued the printed protractor to the styrofoam board, they will once again cut out the protractor.
2. Cut a central hole in the bottom (the flat edge) of the protractor. This hole needs to be placed exactly in the center of the protractor.
3. Next, tie the string to the central hole of the protractor. Tie the opposite end of the string to the washer.
4. Attach the drinking straw to the flat end of the protractor. You can tape the straw to the bottom of the protractor, or use a hot glue gun to attach the straw to the protractor.

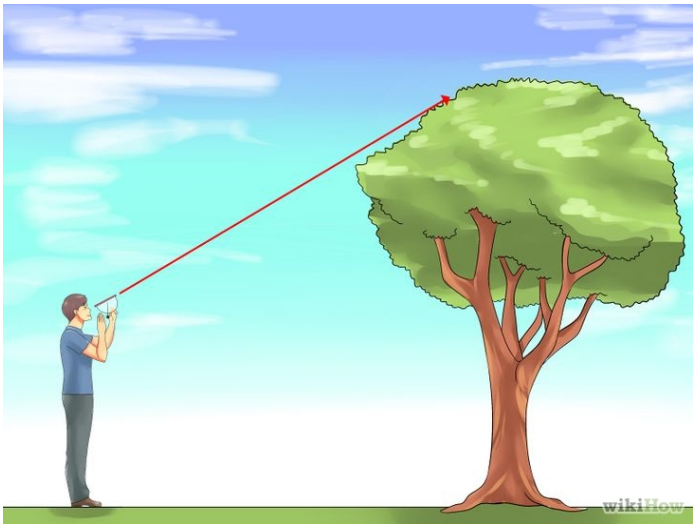



*The finished clinometer should look similar to the image to the right (the numbers do not reflect the correct numbers):

If you need additional help to create your own clinometer, watch the following YouTube video: https://youtu.be/gWMgf0XpGF4

## WHAT TO DO (15 MIN)

1. As a group, participants will first locate an object that is difficult to measure with a measuring tape: flag pole, tall tree, light pole, etc. These objects are all too tall to reasonably measure with a measuring tape; thus, we need another tool or formula in order to calculate their height.
2. Once the club members have selected the tall object they would like to measure, they will all stand 15-25 feet away from it. They will use a measuring tape to measure the exact distance from themselves to the object.
3. Next, club members will use their clinometers to measure the height of the tall object. First, they need to make sure they are holding the clinometer properly. The flat bottom of the clinometer needs to be on top so that the washer dangles to the side of the protractor. The washer needs to hang from the side of the protractor on which the numbers can be read. The club member will then look through the drinking straw to locate the top of the object.

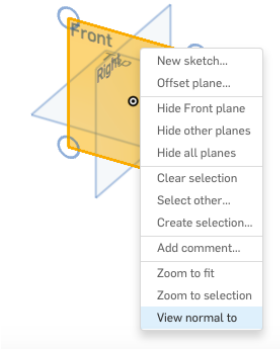



4. Once the top of the object is visible through the straw, the youth will hold the string to the protractor to measure the angle of the object. If the string is held down at the 45 mark, this indicates that the angle is 45 degrees.

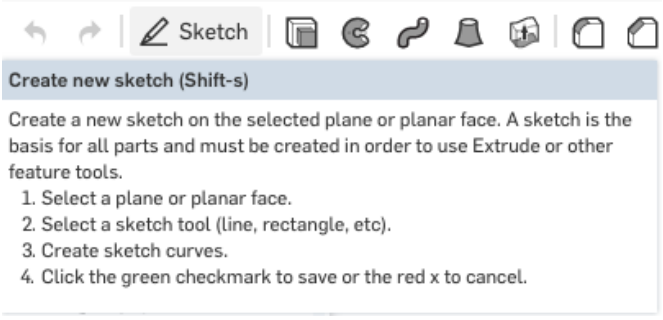
*For step-by-step instructions for this activity with accompanying pictures, use the following link: https://www.mathsisfun.com/activity/how-high.html

Once club members have collected both the measurement for the distance from themselves to the object, and the angle, you will use the Onshape program to calculate the height of the object.

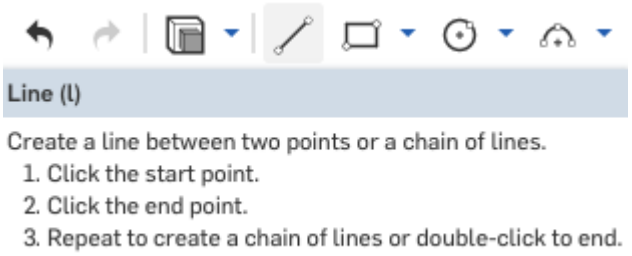
1. Go to onshape.com, and enter your account information.
2. Next, click on the blue box in the upper-left corner labeled "Create." This will provide a drop-down menu. Click "Document," then you will be prompted to provide a name for your document. Name it "Calculating Height Activity."
3. After you have created a new document, you will see several different planes labeled, "Front," "Top," and "Right." For the purpose of this activity, select the "Front" plane, and right-click on it. This will provide you with a drop-down menu from which you will select, "View Normal To."



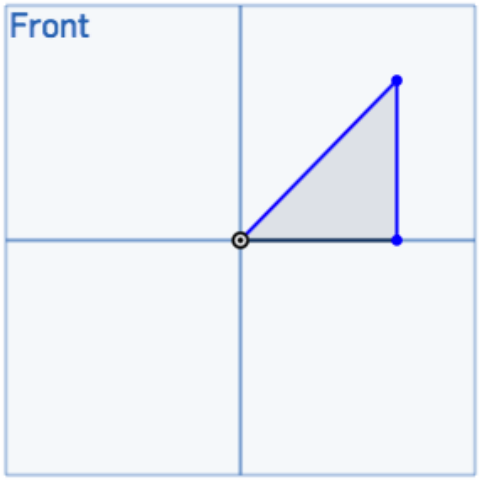

4. To begin sketching, click the "Sketch" tool located in the upper-left corner, and clip on the "Front" plane once again.



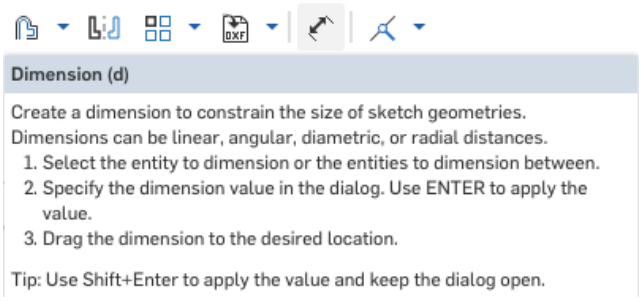
5. After you have selected the "Sketch" tool, you need to select the tool with which you would like to sketch. To draw a simple triangle, select the "Line" tool.



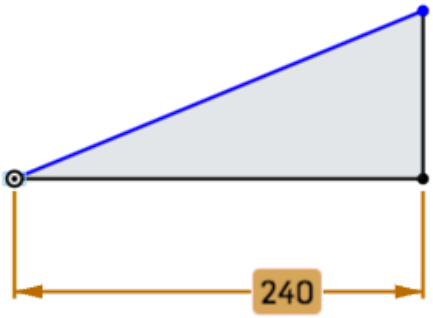

6. Starting from the center of origin in the center of the plane, sketch an outline of a triangle. The origin will act as the point from which you stood when measuring the tall object.



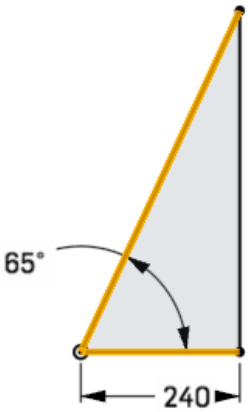

7. Next you will use the dimension tool to change the dimensions of the triangle. The "Dimensions" tool is located on the same toolbar the "Line" tool was found on.




8. After selecting the "Dimensions" tool, click on the bottom line of the triangle, and drag downward. You will see a box with the measurement of the line you can double-click to change the measurement. Change this measurement to the distance you measured with the tape measure (the distance from yourself to the object). For example, if the distance was 20 feet, type 20 feet into the box. Make sure to include feet, as the program will automatically assign its value in inches if you do not specify. The program will then translate 20 feet into inches. After you are done typing in the new value, press "Enter" on the keyboard. The entire triangle will probably be too big to see, so you will need to zoom out on the plane using the scroll dial on the computer mouse. Your triangle should look similar to the triangle in the image below:




9. Next, you will dimension the triangle according to the angle you measured with the clinometer. Select the dimension tool again, and then select the hypotenuse of the triangle and the base leg, which you already measured. Clicking on both lines will provide you with the angle of the triangle. To change the angle, click on the box, and type in the desired value. For example, if the angle you measured with the clinometer was

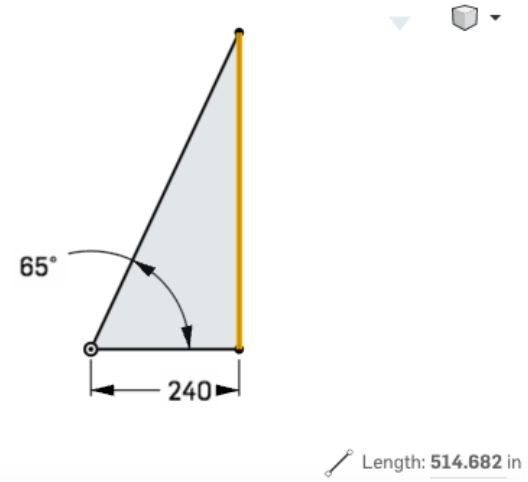


65 degrees, double-click on the pre-assigned value, and type in 65. The following image can act as a model for your own triangle.

10. Now that you have specified the measurements for the angle and the base of the triangle, you can calculate the height of the opposite leg. Reimagine the center of origin as the place where you were standing. Now, the point that is across from the point of origin would be the base of the object you are measuring. If that point is the base, then the tallest point of the triangle is the highest point of the object you are measuring. Therefore, the line extending between the base point and the tall point would be the height of the object. Onshape will automatically provide you with a measurement of this line if you select this line. Make sure no other lines are selected. If there are other lines selected, click on the white space outside of the triangle.

    The measurement of the line you selected will appear in the bottom-right corner of the screen. For this triangle, which had a 240 in. base and a 65 degree angle, the height of the object is 514 in. This measurement would be accurate if you were measuring with the clinometer from the ground, yet it is most likely that you are standing up while measuring. Measure the height from the ground to the clinometer as you use it, and add that value to the value of the height. For example, if the clinometer was 4 ft. from the ground as we were measuring the height of an object, and we calculated the height of the object as 42 ft., then the final height calculation would be 42 ft + 4 ft = 46 ft.

After club members have calculated the height of the selected object as a group, they will do the same activity individually. They will walk around and practice calculating the height of different objects, using their clinometers.




Once club members have collected the data (the measurement from the base of the object to the place in which they are standing, and the angle) for various objects, the club leader may show them how to use Onshape to calculate the height of the objects they measured.

## Reflect

- Were the objects you measured taller than you had anticipated?
- What was the tallest object you measured?
- What other objects could you measure in the future using your clinometers?
- How do your measurements compare to others that measured the same thing? Why might your measurements be different? (Their protractors may be slightly different, or they might have rounded down or up a degree.)

## Apply

- Show the club members a picture of a Theodolite. This instrument is much more advanced than the clinometers we used today, but the same principle still applies. Theodolites are used to precisely measure the angles of tall objects. Theodolites are primarily used by surveyors and builders, yet they have also been adapted to measure rocket launches.
- It might have seemed impossible to measure the objects we measured today, due to their height; however, through the application of right triangles, we could measure these objects. What other things in your life might have appeared impossible initially? What did you do to make the seemingly impossible, possible?

# Activity #3
### LAUNCHING THE ROCKETS

**DESCRIPTION (30 MIN)**

Now that club members have practiced measuring the height of tall objects with their clinometers, they will be able to measure the maximum height of their rockets when they launch them. This activity will allow club members to see how their individual rocket designs affect rocket flight. They will be able to observe which designs contributed to the highest rocket launches.

***Important Note:** Some of the club members might not be able to launch their rockets during the rocket launch activity due to design flaws. Common design flaws are listed under the print activity in the second club meeting. Assure the club members that it is okay if their rockets are not perfect for the first launch, because they will be able to learn from their mistakes and redesign their rockets during the next club meeting.

**WHAT TO DO**

1. Select a wide open area with an electrical outlet where the rockets can be launched. You may need to use an extension cord so the air compressor will meet the outlet. It is also advisable to select an area with few trees, as the rockets can get stuck in the trees.
2. Plug the air compressor in, and set the PSI between 70 and 100. You may decide to increase the PSI depending on how well the rockets are launched.
3. Ask for a volunteer who would be willing to use his or her clinometer to calculate the maximum height of the first rocket launched. Encourage every club member to try calculating the height of a rocket launched, so they all have a chance to use their clinometers. You may even provide club members with the opportunity

to calculate the height on a scientific calculator. They only need to plug their variables into the following equation: Height = (Distance) * tan(Angle), so if you used a scientific calculator to determine the height of the same object you calculated using Onshape, then it would look similar to this: Height = 20*tan(65). *It is important to make sure that the calculator is set to degrees and not radians.

4. Allow the club members to place their rockets on the pipe and press the button/switch that will release the air. Every club member should have a chance to launch his or her rocket. Once everyone has had a chance launching their rocket, the club members may continue to take turns launching their rockets.

## Reflect

- Did your rockets go as high as you had anticipated?
- What were the design features of the rockets that were launched highest?
- What could you do to improve your rocket when we redesign our rockets next club meeting?

## Apply

- Scientists will often build prototypes to test their designs. Testing their prototypes allows them to identify what they can do to improve their designs. Each of you have now tested your prototypes so you can now determine what you need to do to redesign your rockets for a more successful launch.

## 4-H MISSION MANDATES

### Science

Club members will understand how right triangles can be used to calculate the height of tall objects, as basic geometry can be applied to the observable world.

## ESSENTIAL ELEMENTS

### Belonging

Club members will work together as a group to determine the height of various tall objects. As they work together in groups, they will be able to provide help to one another, thereby developing a better understanding of the principles they are learning.

### Mastery

Through launching the rockets they have designed, the club members will be able to observe and identify the rocket features that provide for a more successful launch. This process will allow them to improve their rockets when they redesign them.

### Independence

After club members have mastered usage of their clinometers, they will use them independently when they launch their rockets.

### REFERENCES


Activity: How High? (2016) Math is Fun. Retrieved from https://www.mathsisfun.com/activity/how-high.html

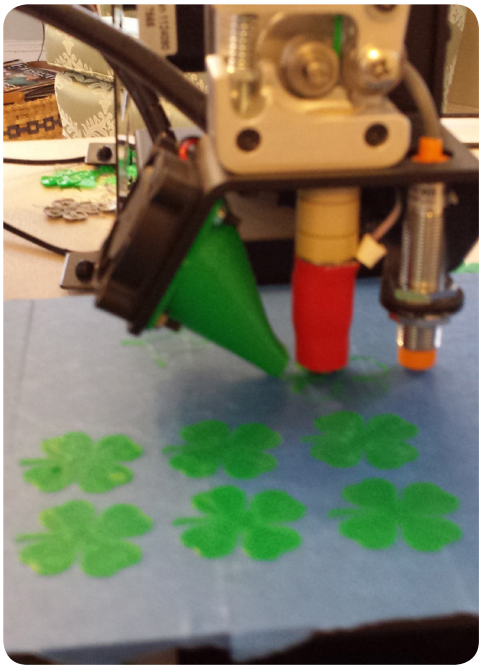
Raza, Sikander. (2012, April). How to Use/Make a Clinometer [Video File]. Retrieved from https://youtu.be/gWMg-f0XpGF4

Vinck, Marc. (2010, July) How-to: Building a compressed air rocket launcher. Make: Retrieved from http://makezine.com/2010/07/11/how-to-building-the-compressed-air/

# 4-H Club Meeting 4
## Houston...We Have a Problem

### Supplies

- 3D Printer - Have as many as possible to maximize printing efficiency. (It is possible to run up to 15 or more 3D Printers simultaneously on one circuit; however, if you are using heated build plates, then heat them up one at a time).
- 3D Printing Filament - Using a different filament color for every printer can add more variety and diversity to the club members' projects, but if you are using one printer, it is important to ensure that you have a 1 kg roll for every four club members.
- 3D Printing Software - Have at least one computer with 3D printing slicing software on it because most 3D printing slicing software is not browser based.
- Blue Painters Tape - Placing blue painter's tape on the build plate helps the 3D printed parts adhere to the build plate and also allows for easy removal, as the objects can be difficult to remove otherwise. Important note: The wider the tape, the better.
- Digital Calipers - Use to measure the dimensions of the rockets.
- Computers - Every club member needs a computer with internet access. A mouse is optional. However, the program is considerably easier to operate with a mouse.
- Extension cords - Use to plug in the computers and printers.
- Internet access - The software that will be used is browser based; if the internet connection is slow, it may be a struggle to effectively model and save your 3D models in the program.
- Power strips - Use to plug in the computers and printers.
- Projector - The projector will need to be connected to the club leader's computer so the club members will be able to see the Tinkercad demonstrations.
- SD Card - Printers usually have an SD card slot for the g-code (the g-code is the code which the printer will read in order to print the exact specifications of the design). Having multiple SD cards makes the printing process more efficient, as it enables club members to be able to prepare their file on the SD card if the printer is already in use. Once the printer completes its current file, the club members can immediately begin printing their prepared file.
- SD Card Reader - Some computers may have an SD card reader built into the computer itself; however, if the computer does not have an SD card reader, you will need to purchase one.
- Sharpened putty knife - This is used to remove the 3D printed parts from the build plate.



### INTRODUCTION

Following the previous rocket launch, club members will redesign their rockets in preparation for a rocket launching competition. Now that they have seen which rockets were most successful, they will have the opportunity to redesign their rockets to launch them higher. This lesson will give club members the opportunity to evaluate what characteristics on their previous rockets were and were not effective.

*If several club members made the same design flaws when designing their rockets, this is a good indicator that you should demonstrate how to do it again. They may need help dimensioning their hole, embedding their fins, aligning objects, or grouping objects together. Demonstrate how to fix common problems in front of the club meeting, then write the common mistakes in a location where everyone can refer to the list. If club members still struggle to fix their rocket, they should refer to their club members who understand how to do it.

## Activity #1
### REDESIGNING ROCKETS

### WHAT TO DO

Club members will use this club meeting time to redesign their rockets. They should be encouraged to use their creativity to make their rockets unique as well as functional. After club members have finished redesigning, they will print them. If club members have finished redesigning their rockets before the club meeting has ended, they can use the remainder of the hour for free time, designing whatever they desire in Tinkercad.

## Reflect

- Was it easier to design your rocket now that you are more familiar with how to use Tinkercad?
- What aspects of your rocket did you change when you designed your rocket this time?
- Why did you change those aspects of your rocket?
- Do you think your redesigned rocket will perform better in the competition than your first rocket? Why?

## Apply

- Why is it often important to revise something you have created? When might it be necessary to revise something you have worked on in school?
- "Practice makes perfect" is a common phrase often heard when trying to develop a new skill. Many of you saw improvement from the first rocket you designed to the second rocket as you practiced working with the Tinkercad tools. How might this apply to your future endeavors?

## 4-H MISSION MANDATES

### Science

Club members will continue to work with geometric shapes to create three-dimensional objects.

## ESSENTIAL ELEMENTS

### Mastery

Club members will identify what was and was not effective about their last rocket design and will redesign accordingly.

### REFERENCES


Activity: How High? (2016) Math is Fun. Retrieved from https://www.mathsisfun.com/activity/how-high.html

Raza, Sikander. (2012, April). How to Use/Make a Clinometer [Video File]. Retrieved from https://youtu.be/gWMg-f0XpGF4

Vinck, Marc. (2010, July) How-to: Building a compressed air rocket launcher. Make: Retrieved from http://makezine.com/2010/07/11/how-to-building-the-compressed-air/

# 4-H Club Meeting 5
# 5, 4, 3...2...1...BLAST OFF!

## Supplies

- Air Compressor - Choose any type of air compressor that is large enough to have its own tank. It is possible to use a bicycle pump; however, it will require more time and labor, stifling the fun and excitement of this project.
- Air Compressor Regulator - Some air compressors have regulators, but if your air compressor does not, you may want to purchase one, to help determine the air pressure.
- Candy Bar Prize - The winner of the competition will receive the candy bar. (Ask club members prior to the club meeting if they have food allergies of any kind, as some candy bars can induce allergic reactions.)
- Clinometer - Club members will continue to use the clinometers they made to calculate the height of the rockets they launch
- Rocket launcher - This must be air-powered. The following link provides instructions for one possible method to create a rocket launcher. There are numerous ways to create a rocket launcher. http://makezine.com/2010/07/11/how-to-building-the-compressed-air/

### PRIOR TO CLUB MEETING

Confirm that everyone's redesigned rocket has printed and is ready to be launched.

### INTRODUCTION

Club members will be able to see how their redesigned rockets perform as they participate in the launching competition. The club member who designs the rocket that is launched highest will receive the prize. You may choose to use your own clinometer to gauge how high the rockets are launched, or you may have the club members use their clinometers to gauge their own rockets in the final competition.

### RULES:

- Everyone should have the same PSI when they launch their rocket.
- The four rockets that are launched the highest will be relaunched so everyone can measure their height with their clinometers. The angle readings that are the closest together will be averaged, to produce the most fair and accurate height calculation.

## Reflect

- Did these rockets perform better than your first rockets? Why?

## Apply

- How did testing the prototype help you with your redesigned rocket? When might it be helpful to design and test a prototype?
- Prototypes are crucial when scientists and engineers are testing their ideas. What would happen if car manufacturers did not test car prototypes before they sold their cars to the public? What would happen if vaccines and other drugs were not tested before they were distributed to the public? The same principle applies to rockets. When NASA was trying to launch the first person into space during the space race of the 1960s, they had to test their theories and designs before launching the first American into space - Alan B. Shepard. If they had not tested all of their theories and designs, the launch would likely have been fatal.

## 4-H MISSION MANDATES

### Science

Club members will continue to work with geometric shapes to create three-dimensional objects.

## ESSENTIAL ELEMENTS

### Mastery

Club members identified what was and was not effective about their last rocket design and redesigned their rockets accordingly.

### REFERENCES


Activity: How High? (2016) Math is Fun. Retrieved from https://www.mathsisfun.com/activity/how-high.html

Raza, Sikander. (2012, April). How to Use/Make a Clinometer [Video File]. Retrieved from https://youtu.be/gWMg-f0XpGF4

Vinck, Marc. (2010, July) How-to: Building a compressed air rocket launcher. Make: Retrieved from http://makezine.com/2010/07/11/how-to-building-the-compressed-air/

## Supplies

- 3D Printer - Have as many as possible to maximize printing efficiency. (It is possible to run up to 15 or more 3D Printers simultaneously on one circuit; however, if you are using heated build plates, heat them up one at a time).
- 3D Printing Filament - Using a different filament color for every printer can add more variety and diversity to the club members' projects, but if you are using one printer, ensure that you have a 1 kg roll for every four club members.
- 3D Printing Software - Have at least one computer with 3D printing slicing software on it because most 3D printing slicing software is not browser based.
- Blue Painters Tape - Placing blue painter's tape on the build plate helps the 3D printed parts adhere to the build plate and also allows for easy removal, as the objects can be difficult to remove otherwise. Important note: The wider the tape, the better.
- Computers - Every club member needs a computer with internet access. A mouse is optional. However, the program is considerably easier to operate with a mouse.
- Extension cords - Use to plug in the computers and printers.
- Internet access - The software that will be used is browser based; if the internet connection is slow, it may be a struggle to effectively model and save your 3D models in the program.
- Power strips - Use to plug in the computers and printers.
- Projector - The projector will need to be connected to the club leader's computer so the club members will be able to see the Tinkercad demonstrations.
- SD Card - Printers usually have an SD card slot for the g-code (the g-code is the code which the printer will read in order to print the exact specifications of the design). Having multiple SD cards makes the printing process more efficient, as it enables club members to be able to prepare their file on the SD card if the printer is already in use. Once the printer completes its current file, the club members can immediately begin printing their prepared file.
- SD Card Reader - Some computers may have an SD card reader built into the computer itself; however, if the computer does not have an SD card reader, you will need to purchase one.
- Sharpened putty knife - This is used to remove the 3D printed parts from the build plate.

### INTRODUCTION

Using skills acquired through the course, club members will use their creativity to design anything they want in Tinkercad. This may require more critical thinking as club members consider how they can manipulate the shapes provided in the library to make the objects they wish to make. If club members struggle to think of ideas, you can show them the different objects people have made in the gallery. At the top of the Tinkercad website, you will find a link labeled, "Gallery." You can click on any object in the gallery and view it on the workplace, which can help you see how the object was made. Ask the club members if they can think of some of the tools the creator would have used in order to make his or her 3D design.


## WHAT TO DO

Club members will have the entire hour to create anything they want using Tinkercad. If club members want help thinking of things to create, encourage them to visit www.thingiverse.com, which offers thousands of interesting 3D designs. Club members may browse the website as they try to think of something they would like to create, but they will not be able to print anything they did not design themselves. The purpose of this club meeting is for club members to develop their 3D modeling skills and use their creativity to make their own unique designs. Explain this to the club members, so they do not send you design files that are not their own.

At the end of the hour, allow club members to choose which design they would like to email to the club leader to be printed.

## Reflect

- What have you learned about 3D printing after taking this club?
- How would you explain 3D printing to someone who has never heard of it?
- Which aspect of this club meeting was your favorite? Why?
- Which aspect of this club meeting was your least favorite? Why?

## Apply

- How will you continue to use the 3D modeling skills you have acquired?
- Now that you have had experience working with one of the basic 3D modeling programs, you can try to learn how to work with more advanced programs, such as the sketch-based modeling program, Onshape. (If time permits, give a brief overview of Onshape and how to use it.)
- Sometimes learning about something you know nothing about can be daunting. When many of you started this club, you were unfamiliar with how to 3D model. Everyone in this club has made progress as you have learned to work with the various tools and print your designs. How does this give you confidence to learn new things and try new things in the future?

## 4-H MISSION MANDATES

### Science:

Club members will understand the fundamentals of 3D modeling and will be able to use the Tinkercad program to create new designs and print them.

## ESSENTIAL ELEMENTS

### Mastery:

As club members continue to use the skills they acquired in this club, they will be able to create more complex designs and be prepared for more advanced 3D modeling programs.

### REFERENCES


Activity: How High? (2016) Math is Fun. Retrieved from https://www.mathsisfun.com/activity/how-high.html

Raza, Sikander. (2012, April). How to Use/Make a Clinometer [Video File]. Retrieved from https://youtu.be/gWMg-f0XpGF4

Vinck, Marc. (2010, July) How-to: Building a compressed air rocket launcher. Make: Retrieved from http://makezine.com/2010/07/11/how-to-building-the-compressed-air/

# Continue Discovering

## More to Discover

Congratulations on completing your Discover 4-H club meetings! Continue with additional curriculum in your current project area, or discover other 4-H project areas. Check out the following links for additional 4-H curriculum.

1. http://utah4h.org/htm/discover4hclubs
2. http://www.4-h.org/resource-library/curriculum/
3. http://utah4h.org/htm/resource-library/view-all-curriculum

### Become a 4-H Member or Volunteer

To **register** your Utah club or individuals in your club visit:

http://www.utah-4.org/htm/staff-resources/4-h-online-support

http://utah4h.org/htm/about-4-h/newto4h/

Non-Utah residents please contact your local 4-H office:

http://www.4-h.org/get-involved/find-4-h-clubs-camps-programs/

## Stay Connected

### Visit Your County Extension Office

Stay connected with 4-H activities and news through your county Extension office. Ask about volunteer opportunities and don't forget to register for your county newsletter. Find contact information for counties in Utah here:

http://extension.usu.edu/htm/counties

### Enjoy the Fair!

Enter your project or create a new project for the county fair. Learn about your county fair and fair judging here:

http://utah4h.org/htm/events-registration/county-fairs

## Participate in Local or State 4-H Activities, Programs, Contests or Camps

For Utah state events and programs visit:

http://utah4h.org/htm/events-registration

http://www.utah4h.org/htm/featured-programs

For local Utah 4-H events and programs, visit your county Extension office.

http://extension.usu.edu/htm/counties

Non-Utah residents, please contact your local 4-H office.

http://www.4-h.org/get-involved/find-4-h-clubs-camps-programs/

# Discover *Service*

## Become a 4-H Volunteer!

http://www.youtube.com/watch?v=UBemO5VSyK0

http://www.youtube.com/watch?v=U8n4o9gHvAA

To become a 4-H volunteer in Utah, visit us at:

http://utah4h.org/htm/about-4-h/newto4h/

## Serve Together as a 4-H Club or as an Individual 4-H Member

Use your skills, passions, and 4-H to better your community and world. You are needed! Look for opportunities to help in your area or participate in service programs that reach places throughout the world (religious groups, Red Cross, etc.).

## Hold a Club Service Project

USU Collegiate 4-H Club hosted "The Gift of Giving" as a club activity. Club members assembled Christmas stockings filled with needed items for CAPSA (Community Abuse Prevention Services Agency).

http://tinyurl.com/lu5n2nc

## Donate 4-H Projects

Look for hospitals, nursing homes, or other nonprofit organizations that will benefit from 4-H projects. Such projects include making quilts for CAPSA or Primary Children's Hospital, or making beanies for newborns. During Utah 4-H State Contests, 40 "smile bags" were sewn and donated to Operation Smile.

## Partner with Local Businesses

92,000 pounds of processed lamb, beef, and pork were donated to the Utah Food Bank in 2013 by multiple companies.

http://tinyurl.com/pu7lxyw

## Donate Money

Clubs or individuals can donate money gained from a 4-H project to a worthy cause. A nine-year-old 4-H member from Davis County donated her project money to help a three-year-old battle cancer.

http://tinyurl.com/mqtfwxo

# Give Us Your *Feedback*

Help us improve Discover 4-H curriculum. We would love feedback or suggestions on this guide; please go to the following link to take a short survey:

http://tinyurl.com/lb9tnad