The background of the slide features a close-up, angled view of a 3D printer's nozzle and the extruder assembly. The nozzle is positioned to deposit a thin layer of material onto a surface, with a bright light reflecting off the point of contact. The overall color palette is dominated by deep blues and purples, with a bright white highlight where the filament meets the print bed.

# 3D PRINTING

Project Ideas, Ultimaker Printer &  
Lessons Learned

*Jackie Derr*

*Perrysburg Jr. High School  
Perrysburg, Ohio*

# A Little Bit About Me...



Jackie Derr  
[jderr@perrysburgschools.net](mailto:jderr@perrysburgschools.net)

- **Teach STEM at Perrysburg Jr. High in Perrysburg, Ohio**
- **22nd year teaching**
- **Presented at National Conferences on 3D Printing**
- **MatterHackers Education Ambassador**
- **Former Member of Pitsco's TAG (Teacher Advisory Group)**
- **Member of the Civil Air Patrol**
- **Coach basketball, Play softball, Enjoy being on the water**
- **Lots of nieces and nephews**



Ultimaker

MatterHackers

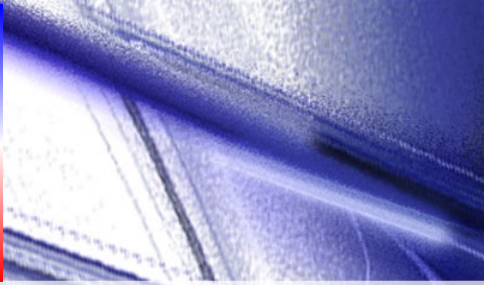
fppt.com

# My 3D Printing Journey...

- » **First year - Started out with one printer that had a 5"x5" bed...**
  - » **Used for group projects**
- » **2nd year - a couple new printers (small)**
  - » **Started printing student designs**
- » **Over last couple of years - been able to get bigger printers and expand my class challenge projects**
- » **Last Spring - bought a printer for my home**
  - » **Rescued 9 duck eggs**
  - » **Hatched from incubator**
    - » **Used 3D printer to print adapters for water bottles**
  - » **Printed ear savers and visors for face shields**



# My Classroom



Hands Off - DO NOT TOUCH

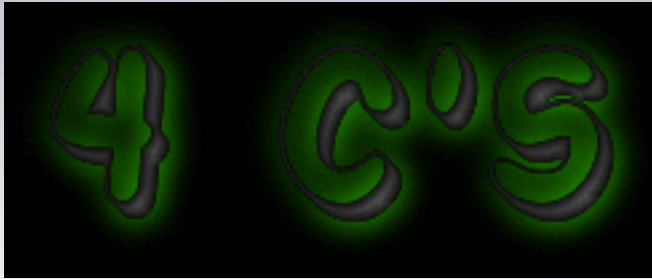
Ultimaker



BOX OF TOUCHABLES

MatterHackers

# 4 C's That Happen With 3D Printing...



- » **Communication**
- » **Creativity**
- » **Collaboration**
- » **Critical Thinking**

# Every Project Can Include...

## Engineering Design Loop



### 1. What is the problem?

- Restate it in your own words.
- Research as needed.



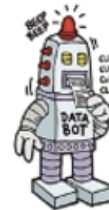
### 2. Brainstorm solutions.

- Use your productive thinking to list many, varied, and unusual ideas.
- Remember that your first idea is not usually your best idea.
- Can you combine two or more of your ideas to come up with a better idea?



### 3. Create the solution you think is best.

- Make sure that you have a plan for how you will create your solution. Document the process. Use a guided portfolio if your teacher provides one.
- What things will you need to create your solution?
  - How will you build it? A sketch might help.
  - Think about the problems that might keep you from creating your solution so that you can avoid them.



### 5. Evaluate your solution.

- Was it your best solution/idea? Go back and check your brainstorming notes.
- What would you have done differently if you had more time?
- What would you add to your idea to make it better if you had a chance to start over?



### 4. Test your solution.

- Informally test as you build your solution.
- Formally test your solution when you share it with your classmates.



**\*\*Poster available from Pitsco**

# Designing Lessons...

- **ASK** your students what they are interested in!
- Remember you will have a wide range of abilities
- Always have students draw a sketch of what they want to design
- Have another student look at design - will it work? Any changes needed?
- Do some lessons in groups and others individually
- Don't have to print every project



# What Do I Use?

- » I use Tinkercad
  - » Students set up accounts so work gets saved
- » 7th and 8th grade students complete same lessons in Tinkercad
- » Day 1 and 2 could be used as H.W. if short on time

# What Do I Use?

## » 7th Grade

- » Design an object of their choice according to rubric

## » 8th Grade

- » Assignment 1: Design object of choice
- » Assignment 2: Download design and modify
  - » Choose which project gets printed

# Tinkercad Lesson

## DAY ONE

1. Go to [www.tinkercad.com](http://www.tinkercad.com)
2. Sign into your account
3. Click on the “Learn” tab (top left)
4. Scroll down to “Tinkercad Lessons” and complete the following lessons:  
Do the lessons in order - I can tell if you’ve completed the lesson or not!!
  - Learning the Moves
  - Camera Controls
  - Creating Holes
  - Scale, Copy & Paste
  - Die on the Workplane
5. Start creating your own 3D item.
  - You **MUST** create something!!
  - Your creation **MUST** include some of the things taught during the above lessons.
  - You may look at the “Gallery” tab (top left) for sample ideas

# Tinkercad Lesson

## DAY TWO

1. Go to [www.tinkercad.com](http://www.tinkercad.com)
2. Sign into your account
3. Click on the “Learn” tab (top left)
4. Scroll down to “Tinkercad Lessons” and complete the following lessons:  
Do the lessons in order - I can tell if you’ve completed the lesson or not!!
  - Cufflinks
  - Saw Shaped Wrench
  - Money Clip
  - One Lesson from the “Jewelry” group
5. Continue creating your own 3D item.
  - Go to the top right area of the screen and you’ll find your login icon.
  - Click on it and you’ll see where you can then click on “My designs” to retrieve your design you already started.

# Tinkercad Lesson

## Tinkercad 3D Project

### Assignment Requirements:

1. You will be creating a 3D object of your choice using the Tinkercad website.
2. Must be school appropriate! No weapons, violence of any kind (not even video game characters, comic book violence, evil, etc.) will be acceptable. \*\*If in doubt – pick something else!!
  - If you choose to create an inappropriate item – you will receive ZERO credit and a discipline referral will be issued.
3. Maximum size is 3" x 3" x 3"
4. Minimum size is 1" x 1" x 1"
5. Your 3D item must have AT LEAST the following:
  - Two pieces connecting to a main piece
  - Include at least two different shapes/pieces
  - Use at least two different colors
  - Involve some creative detail

Set limits to help  
with print times

### Reminders:

1. When connecting parts – Make sure you securely connect your pieces so they stay together when your project is printed.
2. Check the thickness of your pieces. Very thin pieces tend to break.

Keep reminding while creating

# Tinkercad Lesson Rubric

Name \_\_\_\_\_ Period \_\_\_\_\_

File Name (name of your project file) \_\_\_\_\_

Description of your 3D object (what does it look like?) \_\_\_\_\_  
\_\_\_\_\_

AO Teacher \_\_\_\_\_ Room # \_\_\_\_\_

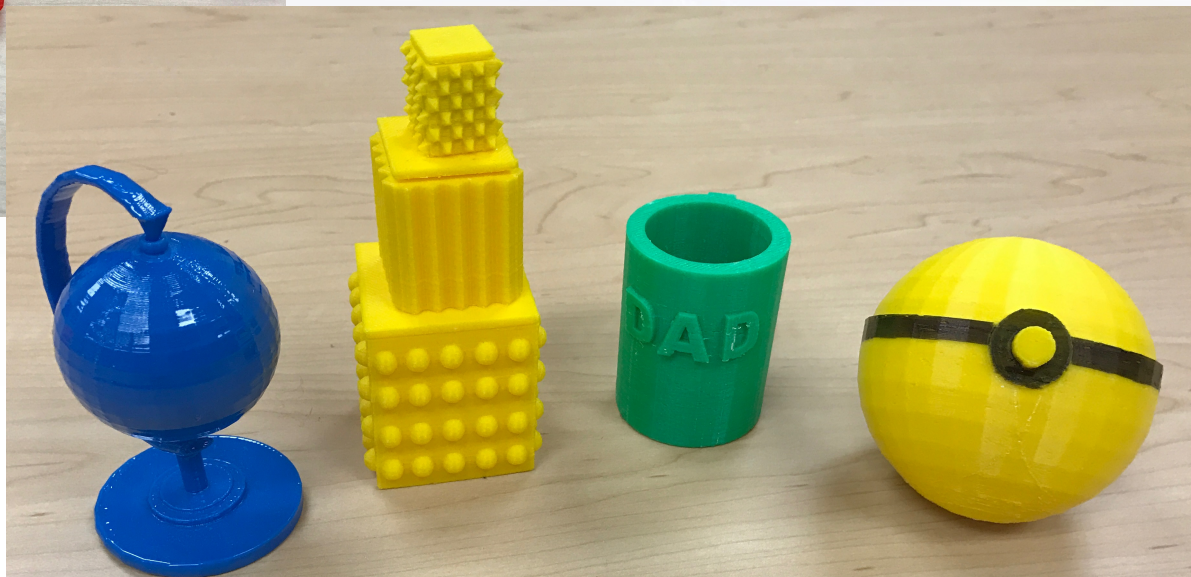
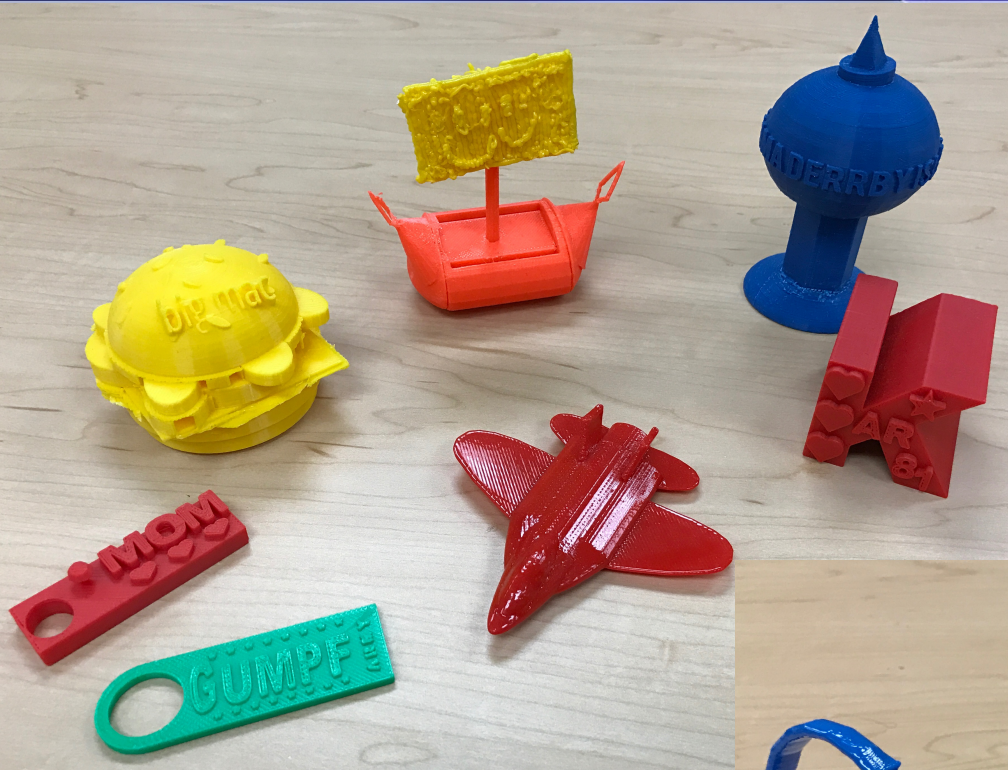
What class will you have next 9 weeks instead of STEM? \_\_\_\_\_

## RUBRIC:

1. All information above filled out completely	4	3	2	1
2. File saved properly (as .STL) and given to teacher as directed	4	3	2	1
3. School appropriate	4	3	2	1
4. Meets size requirements = Minimum 1"x1" x 1" Maximum 3"x3" x 3"	4	3	2	1
5. At least two pieces connecting to a main piece	4	3	2	1
6. Include at least two different shapes/pieces	4	3	2	1
7. Use at least two different colors	4	3	2	1
8. Involve some creative detail	4	3	2	1

Final Grade: \_\_\_\_\_/32

# student samples



# 3D CURRICULUMS - LESSONS

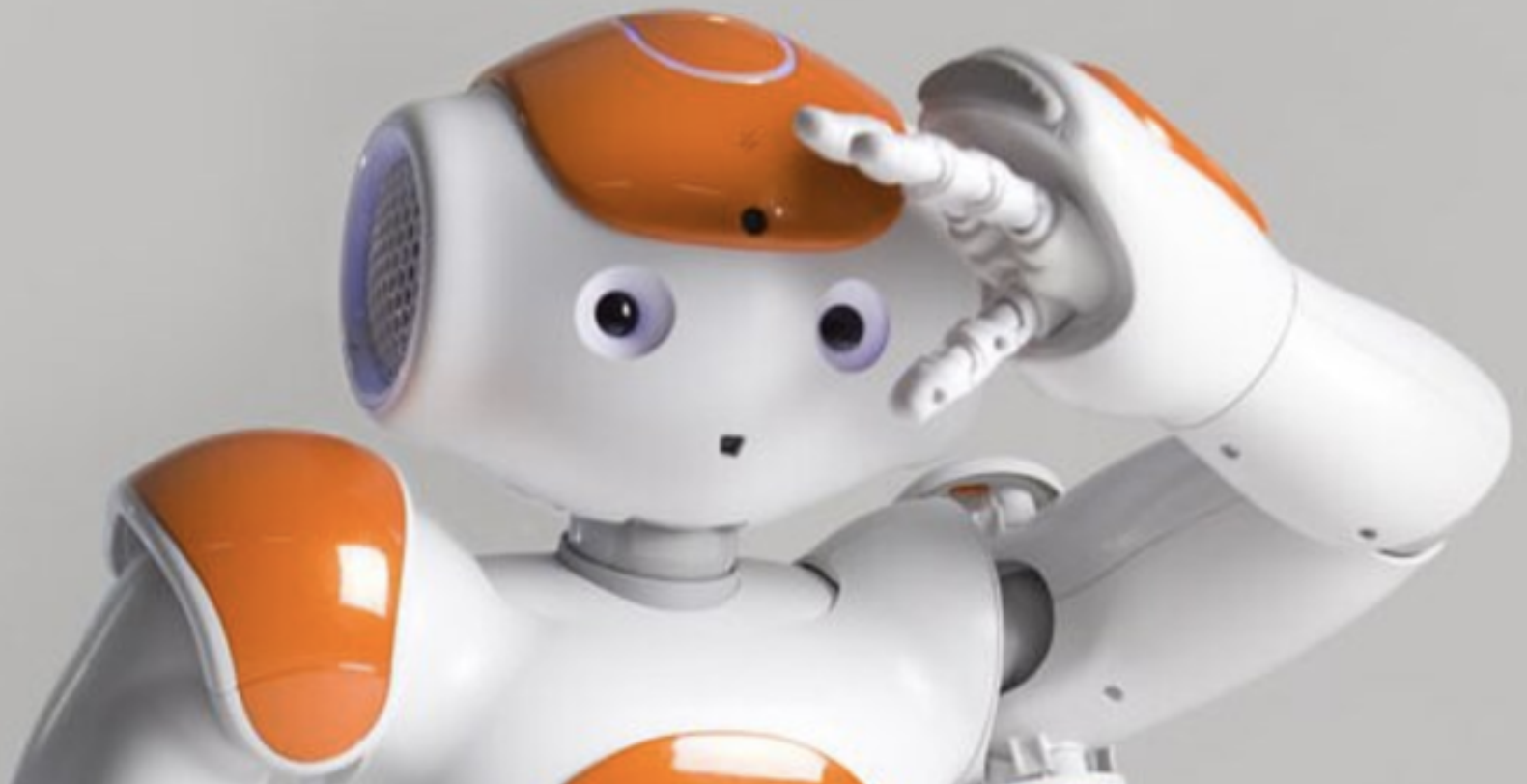
The screenshot shows the Tinkercad website interface. At the top left is the Tinkercad logo (TINKERCAD) and navigation links: TINKERCAD FOR..., GALLERY, COMMUNITY, LEARN, and TEACH. A search bar and a user profile icon are on the top right. Below the navigation is a grid of 8 project cards, each with a title, author, and a small 3D model. The cards are:

- Introduction to 3D Primitive Shapes** by John Helfen (tinkercad-support)
- Let's Learn Tinkercad!** by Project-Ignite (tinkercad-support)
- Build a Tinkercad House** by John Helfen (tinkercad-support)
- Design the Best Wind Farm Blade: STEM Challenge** by MyStemKits (MyStemKits)
- How to Design the Best Boat in Tinker...** by MyStemKits (MyStemKits)
- Create a 3D printed Penny Whistle** by Jay Brockman (tinkercad-support)
- Balloon Powered Car** by John Helfen (tinkercad-support)
- Build a Fountain Using the Align Tool** by Smart with Art (tinkercad-support)

- Some projects include lesson plan with standards
- All have a description and step by step procedures to complete the project



# PROJECT IDEAS



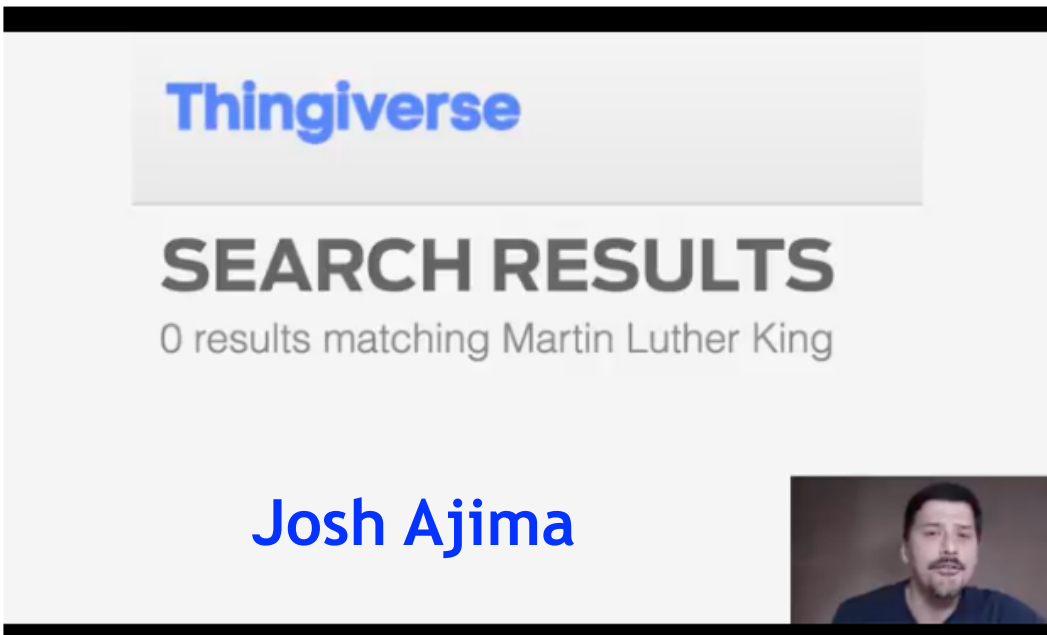
Ultimaker

MatterHackers

fppt.com

## Ornament Design Challenge = Diversity Lesson

<https://designmaketeach.com/0things/>



The screenshot shows a search interface on Thingiverse. At the top, the 'Thingiverse' logo is displayed in blue. Below it, the text 'SEARCH RESULTS' is shown in large, bold, black letters. Underneath, it says '0 results matching Martin Luther King' in a smaller, grey font. At the bottom of the screenshot, the name 'Josh Ajima' is written in blue, and there is a small video thumbnail of a man with a beard and mustache, wearing a dark blue shirt, looking directly at the camera.

# PROJECT IDEAS

## Ornament Design Challenge = Diversity Lesson

- **Present Challenge - Design an ornament**
  - Within seconds a student will respond with “You mean a Christmas ornament”
  - Another student will say “What if we don’t celebrate Christmas?”
- **BAM - your lesson in diversity begins!! AMAZING CONVERSATIONS!**
  - What are ornaments?
    - Anything that can be hung
    - Hang from car mirror, window, tree, ceiling, etc.
  - We live in a diverse society - if we just open our eyes and ears, we can learn so much about others. It’s quite fascinating to learn about different cultures, religions, races, etc.

# Ornament Design Challenge = Diversity Lesson



**Fan** = They are Chinese

**Star** = 5 points for 5 people in her family

**Cross** = They are Christians

**Symbol on right** = Means "China"



Represents the student being Polish



For sibling  
in heaven



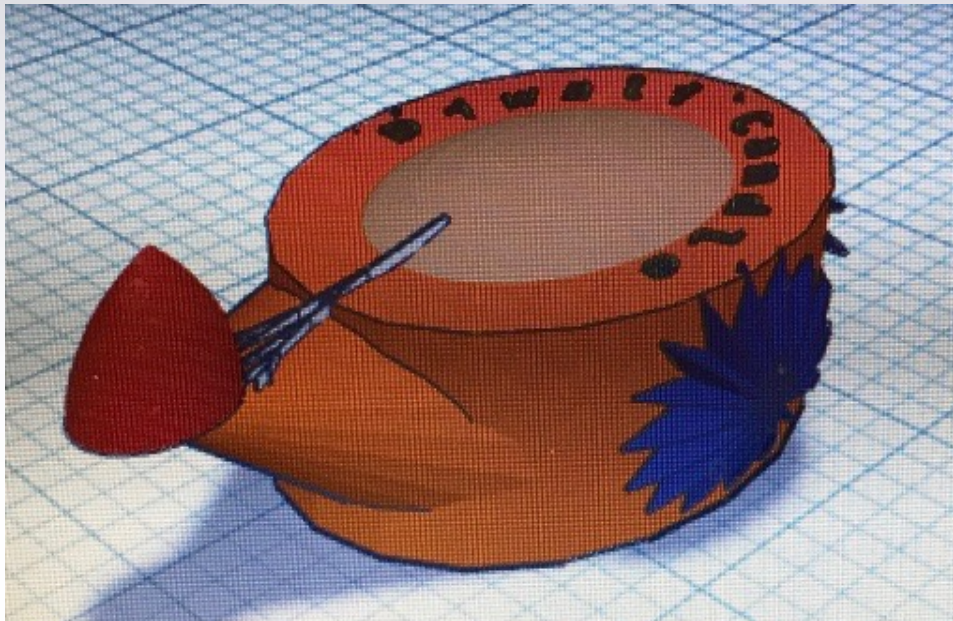
Mom got married, 7 in  
new family, Christian



For his grandfather  
that is from  
Mexico

# Ornament Design Challenge = Diversity Lesson

Student example: Diwali - Hindu festival of lights.



Ultimaker

MatterHackers

fppt.com

# PROJECT IDEAS

## Ultimaker Design Challenge

The Starter Pack can be used to:

- Generate new projects
- Help students become creative
- Causes students to think outside the box
- Dig deeper into the 3D design software



# Ultimaker Design Challenge

Don't fill in boxes until final cards have been distributed

-Some cards have you pass certain cards to someone else

-Some cards have you pick more cards, or give one to someone else

## Ultimaker Design Engine Challenge

Group Member Names: \_\_\_\_\_  
\_\_\_\_\_

### STEP #1

Fill in the information from the cards you received in the corresponding boxes. You will use this information when designing your item.

Challenge Card	
Parameter Card #1 (Text that is right side up is the parameter)	Parameter Card #2 (Text that is right side up is the parameter)
Modeling Modifier Card	Gameplay Modifier Card

### STEP #2

Each group member should draw their design/idea on a piece of paper. Each member should come up with their **QWN** design.

# Ultimaker Design Challenge

## STEP #1

**Accessibility**

**Exclusivity**

**Inside**

**Outside**

**Taper**

A feature of your design must include a "taper."

**Back to the drawing board**

Design a tool that can be used for drawing and sketching.

Blank card with a blue border.

**Back to basics**

Ignore your parameter and modifier cards.

Ultimaker Design Engine Challenge

Group Member Names: Ashley, Miles, Lucas

Period 4-5

**STEP #1**  
Fill in the information from the cards you received in the corresponding boxes. You information when designing your item.

File: Lucas

<b>Challenge Card</b> <u>Back to the drawing board:</u> <u>Design a tool that can be used for drawing and sketching</u>	
<b>Parameter Card #1</b> (Text that is right side up is the parameter) <u>Accessibility</u> <u>Inside</u>	<b>Parameter Card #2</b> (Text that is right side up is the parameter) <u>Back to basics</u>
<b>Modeling Modifier Card</b> <u>taper.</u> <u>The feature of your design must include a "taper"</u>	<b>Gameplay Modifier Card</b> <u>Back to basics:</u> <u>Ignore your parameter and modifier cards.</u>

**STEP #2**  
Each group member should draw their design/idea on a piece of paper. Each member come up with their QWIN design.

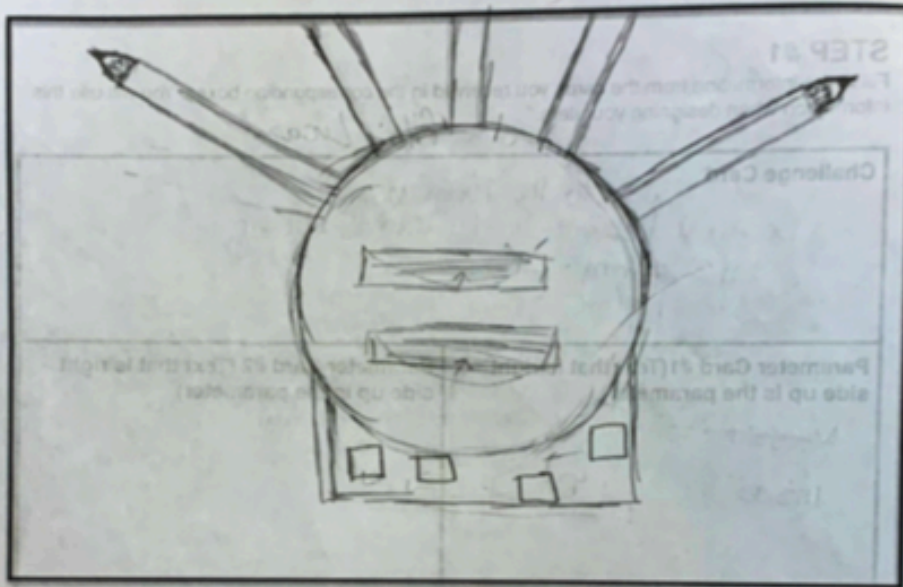
Blue flashdrive Name: 5(2).stl



## STEP #3

### STEP #3

Take the individual drawings/ideas each group member drew on their own paper, as a group - discuss the positives/negatives of each design. Then come up with a design the group agrees on (remember you can combine parts of different designs to make your final design). Draw your group design below AND complete the description of your item.



**Description of your item:** A circular shape with hollow long cylinders on top (to hold pencils) in the middle of the cylinder there are two holes to store pens, pencils, and other small supplies at the bottom, a cube base to keep the cylinder upright and small compartments to store square erasers.

## STEP #4

### STEP #4

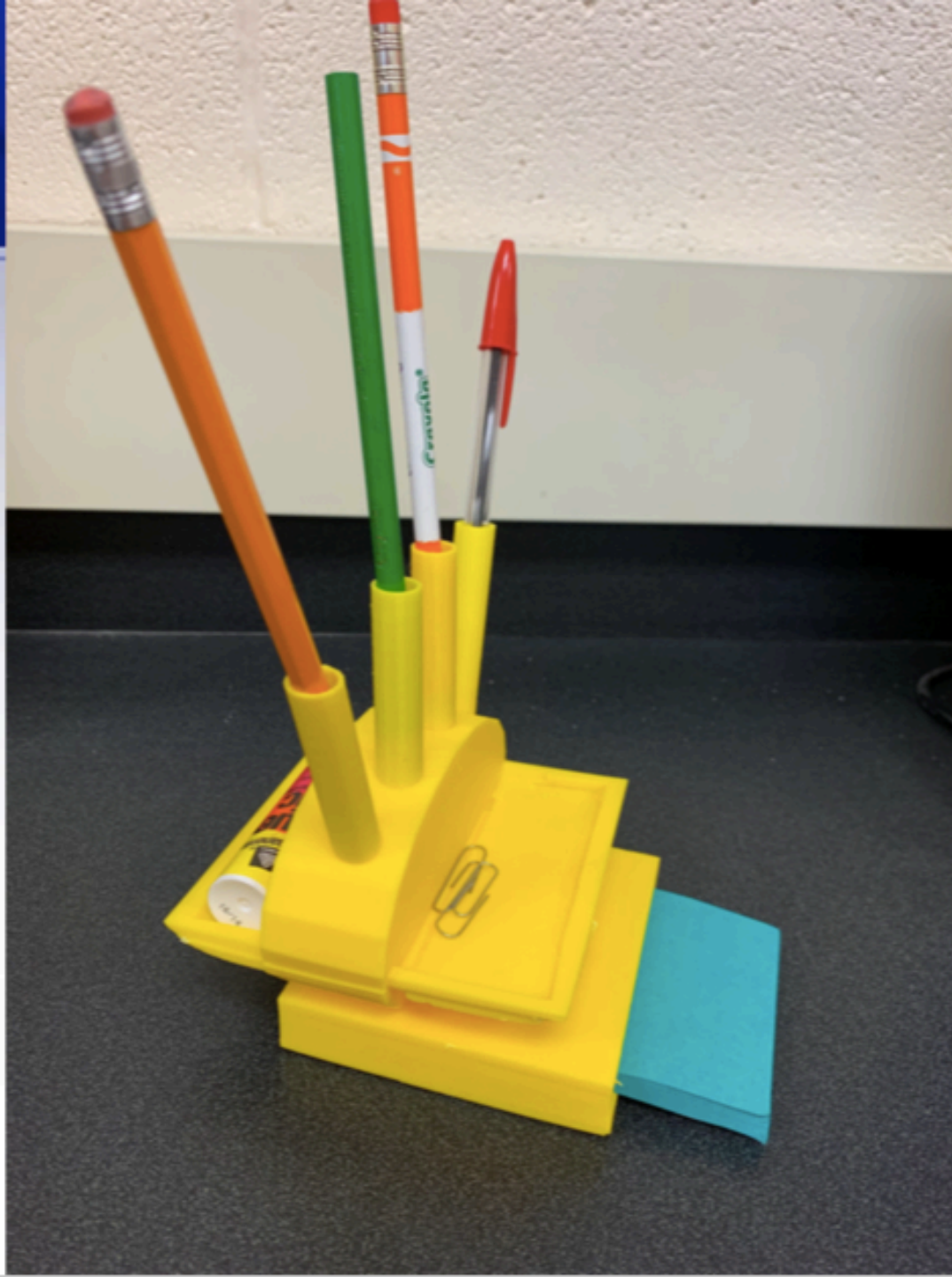
Design your challenge piece!! Please list each group member's name below and indicate what they will do to help with the design process (What is their role?).

Lucas: He is creating the cylinder main piece w the holes

Miles: He is taking measurements from an Eraser on creating the square base w holes

Aubrey: measuring a pencil and creating the hollow cylinders

FINAL  
PRODUCT



# Student Responses

- “Using the connectors caused us to think outside the box. It made us think of different ways to make things move.”
- “I love how it gave us a task but let us use our imagination to design it.”
- “I had to overcome challenges to get it done with people I didn’t know that well.”

# PROJECT IDEAS

## Gumball Machine Challenge

I got the idea from Design Make Teach  
<https://designmaketeach.com/3dgumballgallery/>

### WHY THIS?

- Allows student work to be showcased
- Provides positive/encouraging words to be shared
- Puzzles allow students to work together during lunch
- KIDS LOVE IT!!



# Gumball Machine Challenge

## Changes I Made:

- Paper inside the capsule indicates what student made the piece
  - First Name, Last Initial only (safety)
- Students include:
  - Positive/Encouraging Quote or Poem
- Include puzzles (download)
- Recycle Bucket to save cost in buying more capsules
- Golden Capsule (gift card for slushies)
- Lucky Capsules (candy from me, or snack)
- Students design flyers to market the items

## Requirements:

- Maximum size 1 1/2"
- All pieces must be thick enough to not break off
- Something a majority of students would be interested in
- Create a flyer promoting the gumball machine (marketing)

# HOW TO GET MACHINE & SUPPLIES

## - Gumball Machine

- A parent heard about my idea and donated the money to purchase machine and capsules

- Candymachines.com (\$234.00)
- 2" Capsules (\$25 for 250)



## - Filament

- Take out of class supply money since profits of machine go back to our STEM program

- **Bucket** - Picked up at local store

- **Prizes** - I purchase as my way of giving back (well worth it)



# Gumball Machine Challenge

## POSITIVE/ENCOURAGING WORDS

**Made especially for you by AnnaSophia G.  
In PJHS STEM class**

This object is a fidget cube

"Life isn't about waiting for the storm to pass but learning to dance in the rain (even if you do get struck by lightning)" - Anonymous

**Made especially for you by Bamcey H.  
In PJHS STEM class**

This object is gucci logo

"I've missed, I've lost, I've failed, that is why I succeed" - Michael Jordan

**Made especially for you by AJ B  
In PJHS STEM class**

This object is a plane with wings and a tail fin.

"Hard work + Dedication = success"  
-Anonymous

**Made especially for you by Gavin L.  
In PJHS STEM class**

This object is State of Ohio with PJHS on it

"The best way to prepare for tomorrow is doing your best today." - H. Jackson Brown, Jr.

**Made especially for you by Kendra R, in PJHS  
STEM class**

This object is a "PJHS"

"When there is no sunshine, be the sunshine."

**Made especially for you by  
In PJHS STEM class Joel C.**

This object is a Cavaliers slogan The Land

"Be who you are and be that well" - St. Francis DeSales

# Gumball Machine Challenge





# Gumball Machine Challenge

You are the  
**GOLDEN CAPSULE Winner!**



Please bring your 3D printed object to Miss Derr's room (230) to claim your gift card!

You are the  
**LUCKY CAPSULE Winner!!!**

Please bring this paper to Miss Derr's room (230) to claim your prize!

**GOLDEN CAPSULES**



# STUDENT MARKETING FLYER



Gumball Machine  
\$.50 each

Golden capsule =  
speedway gift card

Capsule with sticker =  
Ticket way ticket

Main hall/Cafe

Get your  
own fidget  
now!



**KIDS LOVE THIS!!**

# PROJECT IDEAS

## Bobble Heads!!

This project started with a student seeing my solar powered bobbles on my window sill



# Bobble Head



## Tinkercad Projects

- Student found lesson
- Completed on 1st day if not already completed as Tinkercad Day 1-3



Minecraft Bobbleheads  
tinkercad-support

# Bobble Head



instructables

Let's Make ...

Featured

Write an Instructable

Classes Contexts Community Teachers

## 3D Printed Bobblehead

By Paige Russell in Technology > 3D-Printing 18,257 258 17 Featured

Published Jul 24th, 2017

Download Favorites



- Student found lesson
- Completed on 2nd day

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fppt.com

# Bobble Head

- **Day 3**

- Students draw their idea on paper

- **Day 4-7**

- Design bobble head
  - I let my students download the head OR body
  - Student had to design other (head or body) themselves
    - Downloaded piece had to be modified

- **After Printing**

- If time permits, let students paint their bobble head. Not enough time?  
Paint at home and bring back

# Bobble Head

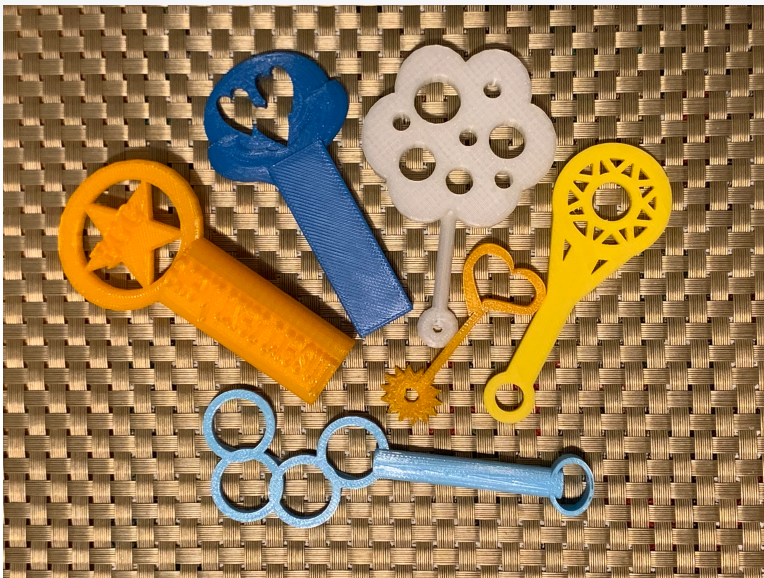




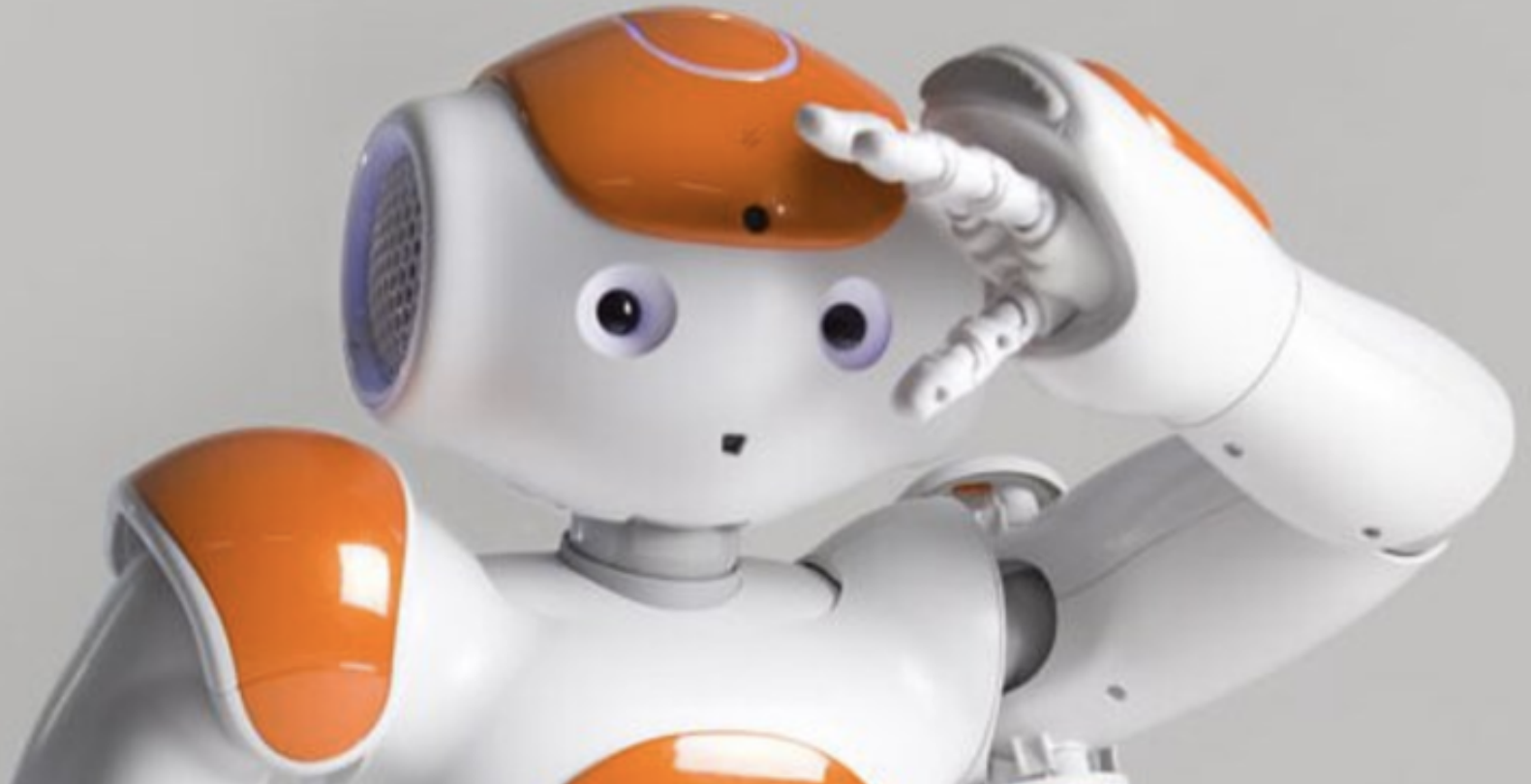
# PROJECT IDEAS

## Bubble Wand Challenge

- Create a Bubble Wand
  - Babysitting your little cousin and you do not have access to electronic devices.
  - Design and print
  - Spend a day outside testing



# Managing Print Jobs



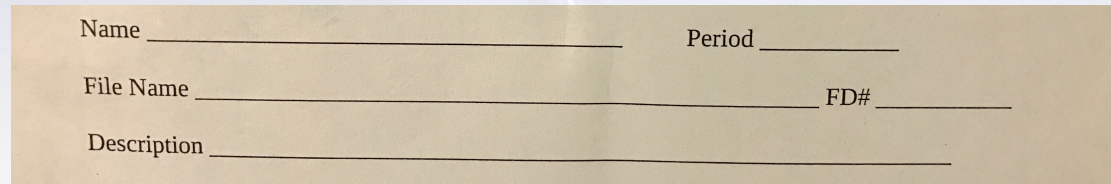
Ultimaker

MatterHackers

fppt.com

# Managing Print Jobs

- Explain to students how printers work
- Let them see/start a print job
- Then:
  - Use print request forms



Name \_\_\_\_\_ Period \_\_\_\_\_  
File Name \_\_\_\_\_ FD# \_\_\_\_\_  
Description \_\_\_\_\_

- All projects saved to Google drive
  - Have printer running all day long
  - **DO NOT HAVE TO PRINT EVERY PROJECT!**
- **Take care of the custodian that cleans your room...**  
**He/She might help you by turning printer off at night.**

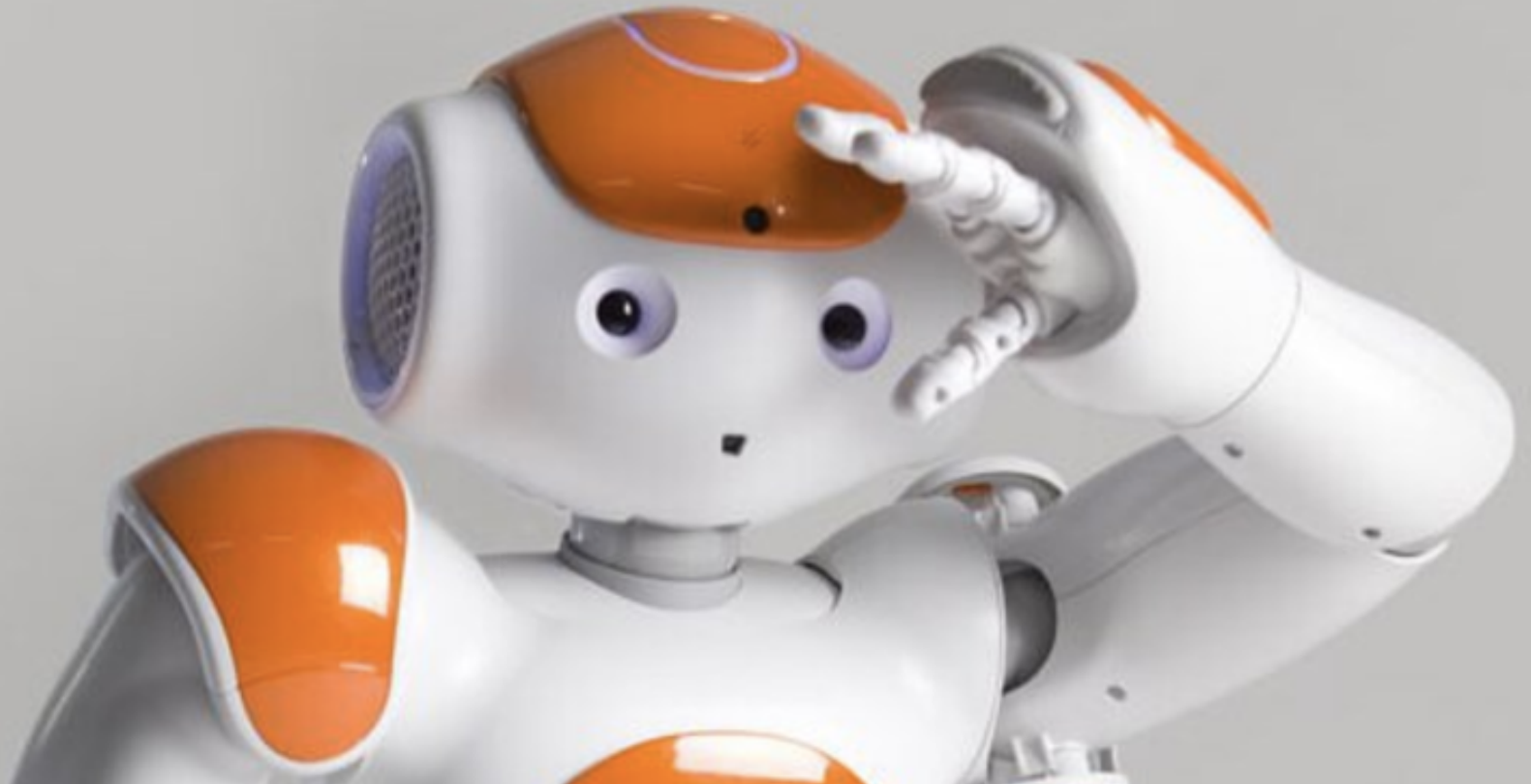
# 3D Design & Printing in Real Life...

- Drone racing parts
- Careers in 3D Printing by Mara Hitner  
<https://www.matterhackers.com/articles/careers-in-3d-printing>
- UCSF Surgeons Perform Groundbreaking Elbow Transplant  
<https://abc7news.com/ucsf-elbow-transplant-surgery-medical-breakthrough/1303853/>

She began with C/T scans that were turned into specialized 3D computer models. They allowed doctors to carefully plot out the potential surgery, and practice the techniques on a cadaver. After deciding it was possible, Dr. Lattanza assembled a team of surgeons including Dr. Scott Hansen, Dr. Charles Lee and

Dr. Michael Terry.

# PRINTERS



Ultimaker

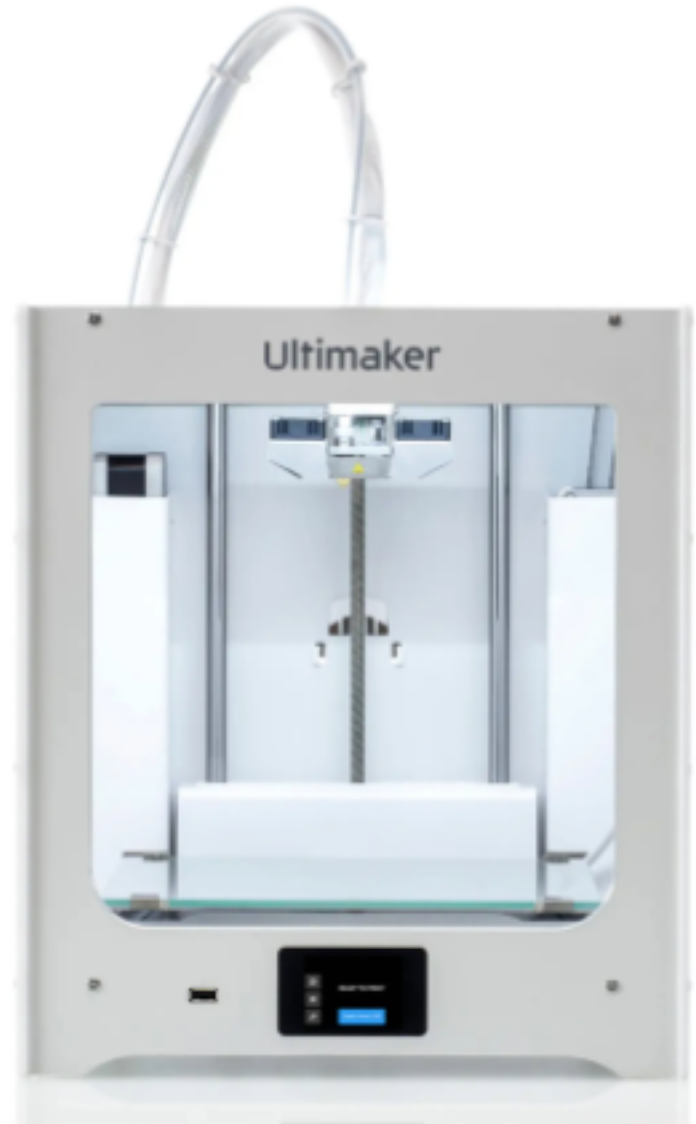
MatterHackers

fppt.com

# PRINTERS

Ultimaker

Ultimaker 2+  
Connect



Ultimaker

MatterHackers

# Ultimaker 2+ Connect

- I was very nervous to order the printer directly from MatterHackers because I was nervous about the set up.
  - What a mistake!!
  - Set up is easy!!
- Recommend downloading the manual for easier set up.
  - Goes step by step

# Ultimaker 2+ Connect

- **Positives about the printer**
  - Easy to set up
  - User friendly for printing
  - Quality prints
  - Affordable
  - Can use a variety of filament



# Ultimaker 2+ Connect

- **Things to consider about the printer**

- Have to remove the support pieces by peeling or clipping them off
  - BUT the first 4 printers I ever had were this way and I didn't know any better.
  - SOLUTION: Have students design items that don't require support.
- Got the Ultimaker S3 this year and now I am spoiled!
  - BUT if I had a limited amount of money I would go with 2+ and possibly get more than one

# Challenge Ideas...

## Thingiverse Design Challenges

<https://www.thingiverse.com/challenges>

## Instructables

<https://www.instructables.com/workshop/3d-printing/projects/>

## MatterHackers - Lesson Plan Pandemic Products

<https://www.matterhackers.com/store/l/printlab-classroom-lesson-plan-pandemic-products/sk/M4R8VRZZ>

Google 3D Design Challenges for your age group



# Questions?