THE AR FLOATING FARM PROJECT

STUDENT GUIDE

THE UNIVERSITY OF ARIZONA
Cooperative Extension

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A note from the Development Team

Greetings!

Though this may seem like a short project here marks the beginning of a journey. Your interests, ideas, and actions have the power to make an impact and change things for the better. The premise of this guide is to introduce you to augmented reality, a technology we still don't fully understand. This technology is still changing and found in many different fields. Through your experience with this technology you will explore new ways to apply AR into everyday life.

Throughout this project you will learn how to bring your ideas to life, and hopefully, provide you with the confidence to share your work and teach others. We hope you enjoy this project as much as we enjoyed creating it.

Respectfully,

The Floating Farm Development Team

ABOUT THE PROJECT

In the process of creating this AR (Augmented Reality) S.T.E.M. (Science. Technology. Engineering. Mathmatics) project we wanted to merge this new technology with an agricultural perspective (farm). When you create a farm using AR software it potrays the farm as "floating", thus the name AR Floating Farm. One of our writer's siblings coined the term in the curriculum's early development stages. As you can see in his first drawing and later shown in a 3D model.

Original Floating Farm sketch by Aizen Villarino

Original Floating Farm model by Aizen Villarino

The Floating Farm is a project designed to teach youth and adults about augmented reality. Augmented reality is a technology that places virtual objects and features onto a physical surface using a camera. Students learn its history and the basics of AR. Youth will create a virtual farm using free software; **Unity, Tinkercad, and Vuforia**. At the conclusion of the project youth will host their work online and share with family, friends and peers.

From humble beginnings as an experimental workshop series, the Floating Farm has grown to now provide instruction via facilitator/student guide, online video tutorials, as well as scheduled virtual workshops training sessions through our online website.This project is aimed at making augmented reality more accessable. Whether one decides to use AR in their classroom, for a school project, or just for fun we hope you have a better understanding of the resources used to create an AR experience. The photos below are samples of student work.

Student work from Summer 2020

AR safety review checklist

ENVIRONMENT

- Ensure you are in a safe space to use technology
- Be sure using the equipment will not interfere with another person/thing
- Make sure you have plenty of room to work in

TIME PERIOD

- Set break times away from the screen
- Ensure each group member has had a turn

EQUIPMENT

- Make sure the equipment is charged and undamaged
- Ensure while one is using the gear, outside members do not interfere (poke, etc.)

PRIVACY

- Does the application ask to use certain features of your equipment (ex. phone's camera)
- Are there any strange occurrences when interacting with the AR application (like flickering screen or moving files)?

COPYRIGHT

- Did you credit the proper sources
- If there is no credit did you use open source materials or music?

SYSTEM REQUIREMENTS

MATERIALS NEEDED

1) A computer running Windows or iOS (Mac)
2) Computer mouse
3) A webcam or tablet
4) Internet connection

Several of the listed software and activities are for offline or online use. Please plan accordingly if you have limited wifi availability.
Offline Apps: Unity, Morphi 3D, 3DC.io, most of the workbook activities
Online Apps: Sketchfab, Vuforia, Tinkercad
Phone/Tablet Requirements: Android 6.0+ or iOS 12+
Sourced: https://library.vuforia.com/platform-support/supported-versions.html

REQUIREMENTS TO RUN UNITY 2019 (VERSION USED FOR THIS PROJECT)

For development

System	Minimum requirements
Operating system	**Windows:** 7 SP1+, 8, 10, 64-bit versions only **macOS:** 10.12+ **Linux:** Fixed at: Ubuntu 16.04, 18.04 and CentOS 7 Server versions of Windows and OS X are untested.
CPU	SSE2 instruction set support.
GPU	Graphics card with DX10 (shader model 4.0) capabilities.
Devices	
iOS	Mac computer running minimum macOS 10.12.6 and Xcode 9.4 or higher.
Android	Android SDK and Java Development Kit (JDK). IL2CPP scripting backend requires Android NDK.
Universal Windows Platform	Windows 10 (64-bit), Visual Studio 2015 with C++ Tools component or later and Windows 10 SDK.

THE AR FLOATING FARM PROJECT OVERVIEW

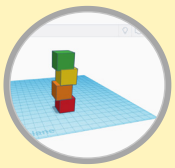
This project consists of 8 modules covering multiple topics such as AR history, development, social and industry usage, and user capabilities. Youth will explore topics throughout the modules through lessons and activities that will provide background information for participants to learn the skills to apply AR and other technolgies towards the creation of their AR Floating Farm project.

Each of the modules contain a lesson plan which covers learning objectives, lessons, activities, steps to compelete the final **AR Floating Farm Project**, and an estimated time to complete each lesson, activity, or step. Modules are designed to fit into 2-3 hour sessions but this may vary based on the amount of youth enrolled, technological capability, and experience. Therefore, sessions can be broken up into smaller timeframes to meet your needs.

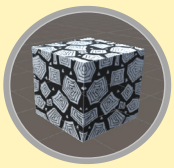
This project is designed to be delivered either virtually, in-person, or a hybrid of virtual and in-person participants. For example, youth can meet at the county cooperative extention office, an after-school program, or any other location. Zoom or another virtual meeting tool can be used to connect the instructor delivering the AR project curriculum.

MODULES

Module 1
What is Augmented Reality?



Module 2
Intro to 3D Models



Module 3
What is a Marker?

Module 4
Intro to Unity Part I or Sketchfab

Module 5
Intro to Unity Part II or Sketchfab

Module 6
Intro to Unity Part III or Sketchfab

Module 7
Preparing your Project Presentations

Module 8
Final Presentation Day

This project focuses on the softwares Sketchfab and Unity as a means to create an AR experience. Unity was chosen due to the ability for creators to retain all creative rights and have the ability to freely publish/sell their application in the future. Sketchfab is an alternative software that is easy to upload 3D models to. These software applications are not the only options to create an AR or VR experience.

THE AR FLOATING FARM
PROJECT OUTLINE

A FLOATING FARM

Planning Phase

Module 1 Step 1: Forming a team
- Gather into groups of 2+ or work individually

Module 1 Step 2: Brainstorming Your Farm
- Share ideas amongst your group for a farm design. What good or service will the farm provide?

Module 1 Step 3: Scheduling
- Learn of different tools to help you schedule when to meet with your groups outside of the workshop

Creating Phase

Module 2 Step 1: Creating 3D models
- Design and create 3D models using the online software Tinkercad or the offline 3D softwares 3DC.io OR Morphi 3D Modeling

Module 3 Step 2: Creating AR Markers
- Understand how to format an AR Marker and it's uses

Module 4 Step 3: Intro to the Game Engine Unity/or Software Sketchfab
- Learn how to navigate the Unity Game Engine or online 3D model site Sketchfab

Module 5 Step 4: Setting up your AR Scene
- Learn how to set up Unity for your AR app or upload your 3D model to Sketchfab's XR app

Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene
- Learn to add sound effects and special effects into your virtual farm project

Presenting Phase

Module 7 Step 1: Preparing Your Presentation
- Prepare to present your virtual farm

Module 8 Step 2: Presenting Your AR Floating Farm Project
- Present your virtual farm

Module 8 Step 3: Publishing Your AR Floating Farm Project
- Share your virtual farm project with family and friends!

YOU WILL LEARN TO...

- Create 3D models
- Develop in a game engine
- Time management
- Character/Object design
- Visual/Audial storytelling
- Creating a "Marker AR" app

PROJECT REQUIREMENTS

Having a basic understanding of how augmented reality works and operates you will design and develop a virtual farm! The farm can exist in any time, space, shape, or form as long as it holds the necessary key elements:

1) The AR scene must have at least one character (human or non)

2) The farm must produce a good or service

3) The AR scene must have both 2D and 3D elements

4) A narrative/story must accompany the virtual farm in either written or spoken form. Discuss what impact the farm has and how it functions

MODULE 1: WHAT IS AR?

Module 1: What is AR?

Learning Objectives

By the end of the module, you will be able to;

- Define AR terms
- State what AR stands for
- Describe how AR works
- List the types of AR
- Have an overview of the history of AR
- List industries that are using AR technology
- Review the safety checklist
- Review poster for using and developing Augmented Reality experiences

Module Outline	Estimated Time to Complete
1) Lesson 1: What is Augmented Reality?	5 mins
2) Lesson 2: Types of AR	5 mins
3) Activity #1: The History of AR	20 mins
4) Activity #2: How it works: Demystifying AR	15 mins
5) Lesson 3: Who is using AR	5 mins
6) Activity #3: Trying AR apps	30 mins
8) Planning Phase Step 1: Forming a Team	15 mins
9) Planning Phase Step 2: Brainstorming Your Farm	15 mins
10) Planning Phase Step 3: Scheduling	15 mins
11) Reflection (Record Book)	30 mins
	Total = 2 hours 35 mins

Homework

Activity #1: The History of AR

Activity #2: How it works: Demystifying AR

Activity #3: Trying AR apps

Planning Phase Step 1: Forming a Team

Planning Phase Step 2: Brainstorming Your Farm

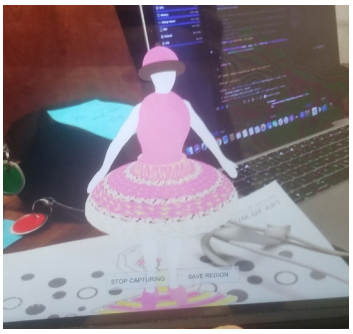
Planning Phase Step 3: Scheduling

Lesson 1: What is Augmented Reality?

Module 1
Slide 7

Introduction

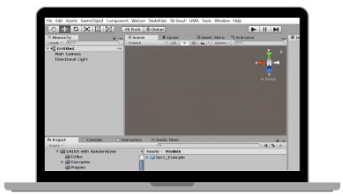
Augmented reality is a combination of the physical world and virtual (computer-generated) worlds. Some types of augmented reality can use your sight, touch, hearing, or even your sense of smell! The shortened term for augmented reality is "AR".



KEYWORDS

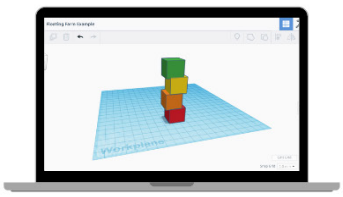
AUGMENTED REALITY	combination of the physical and virtual (computer-generated) worlds
LOCATION-BASED AR	virtual projection or text is displayed based on GPS coordinates
INDIRECT AUGMENTED REALITY	using a combination of panoramas, virtual objects, and pre-captured photos the software creates a high-quality representation of a location/landscape
MARKER	two dimensional symbol or image that allows the AR software to project a virtual image or text
MARKER-BASED (IMAGE)	Image shows the virtual projection or object
MARKER-BASED (OBJECT)	a physical object can project the virtual projection/object
OUTLINING AR	combination of the physical and virtual (computer-generated) worlds

How does AR work?



Use a program or software to recognize an area/image to place virtual content

Obtain your object/marker



Upload your virtual content (3D model, 2D mode, music, etc.) to that program/software

Test your AR project!

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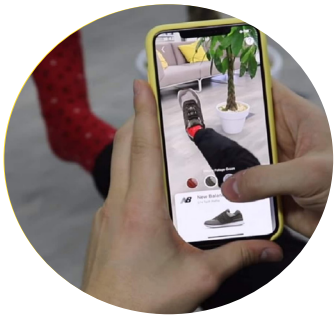
• CATEGORIES •

LESSON 2: THE TYPES OF AR

MARKER-BASED (IMAGE)

Image shows the virtual projection or object.

Example: AR Shirts



MARKER-BASED (OBJECT)

A physical object can project the virtual projection/object

Example: Wanna Kicks AR Shoe

LOCATION-BASED AR

Virtual projection or text is displayed based on GPS coordinates

Example: Star Walk

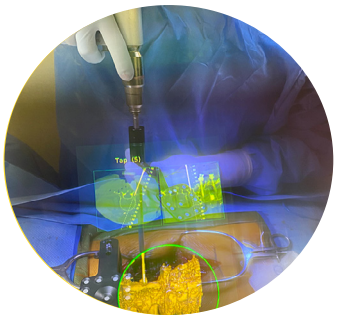
INDIRECT AUGMENTED REALITY (IAR)

Using a combination of panoramas, virtual objects, and pre-captured photos this is a kind of AR you don't need a headset to experience.

Example: Videoplace

Using a combination of panoramas, virtual objects, and pre-captured photos the software creates a high-quality representation of a location/landscape

Example: Videoplace



OUTLINING/ SUPERIMPOSITION AR

These are applications that are built specifically for monitoring hard-to-see areas, odd lighting, or on top of areas being observed for long periods of time

Example: Johns Hopkins AR Surgery

These are applications that are built specifically for monitoring hard-to-see areas, odd lighting, or on top of areas being observed for long periods of time

Example: Johns Hopkins AR Surgery

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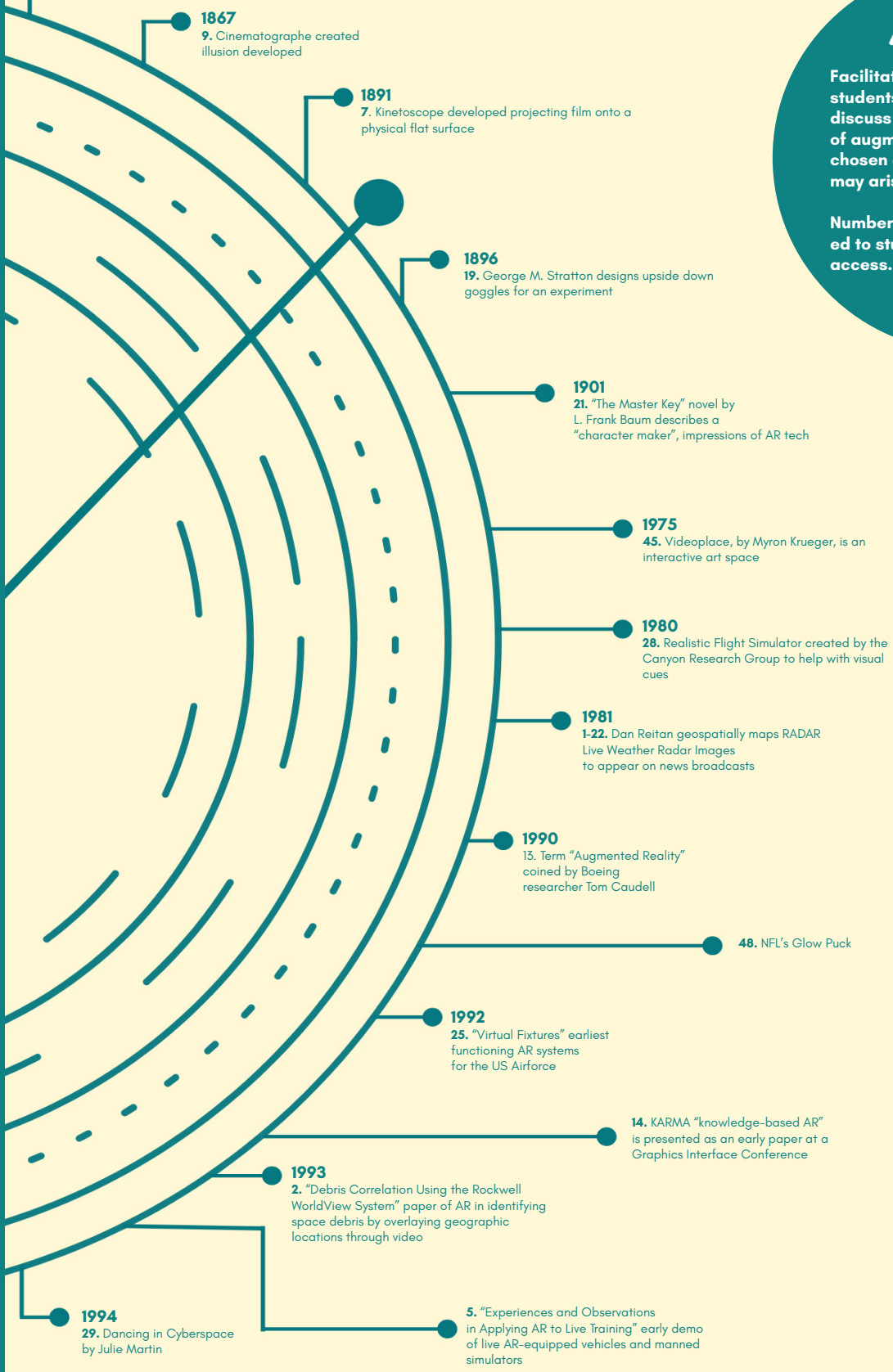
HISTORY OF AR TIMELINE



1862
46. Pepper's Ghost illusion developed

1867
9. Cinematographe created illusion developed

1891
7. Kinetoscope developed projecting film onto a physical flat surface

1896
19. George M. Stratton designs upside down goggles for an experiment

1901
21. "The Master Key" novel by L. Frank Baum describes a "character maker", impressions of AR tech

1975
45. Videoplace, by Myron Krueger, is an interactive art space

1980
28. Realistic Flight Simulator created by the Canyon Research Group to help with visual cues

1981
1-22. Dan Reitan geospatially maps RADAR Live Weather Radar Images to appear on news broadcasts

1990
13. Term "Augmented Reality" coined by Boeing researcher Tom Caudell

48. NFL's Glow Puck

1992
25. "Virtual Fixtures" earliest functioning AR systems for the US Airforce

14. KARMA "knowledge-based AR" is presented as an early paper at a Graphics Interface Conference

1993
2. "Debris Correlation Using the Rockwell WorldView System" paper of AR in identifying space debris by overlaying geographic locations through video

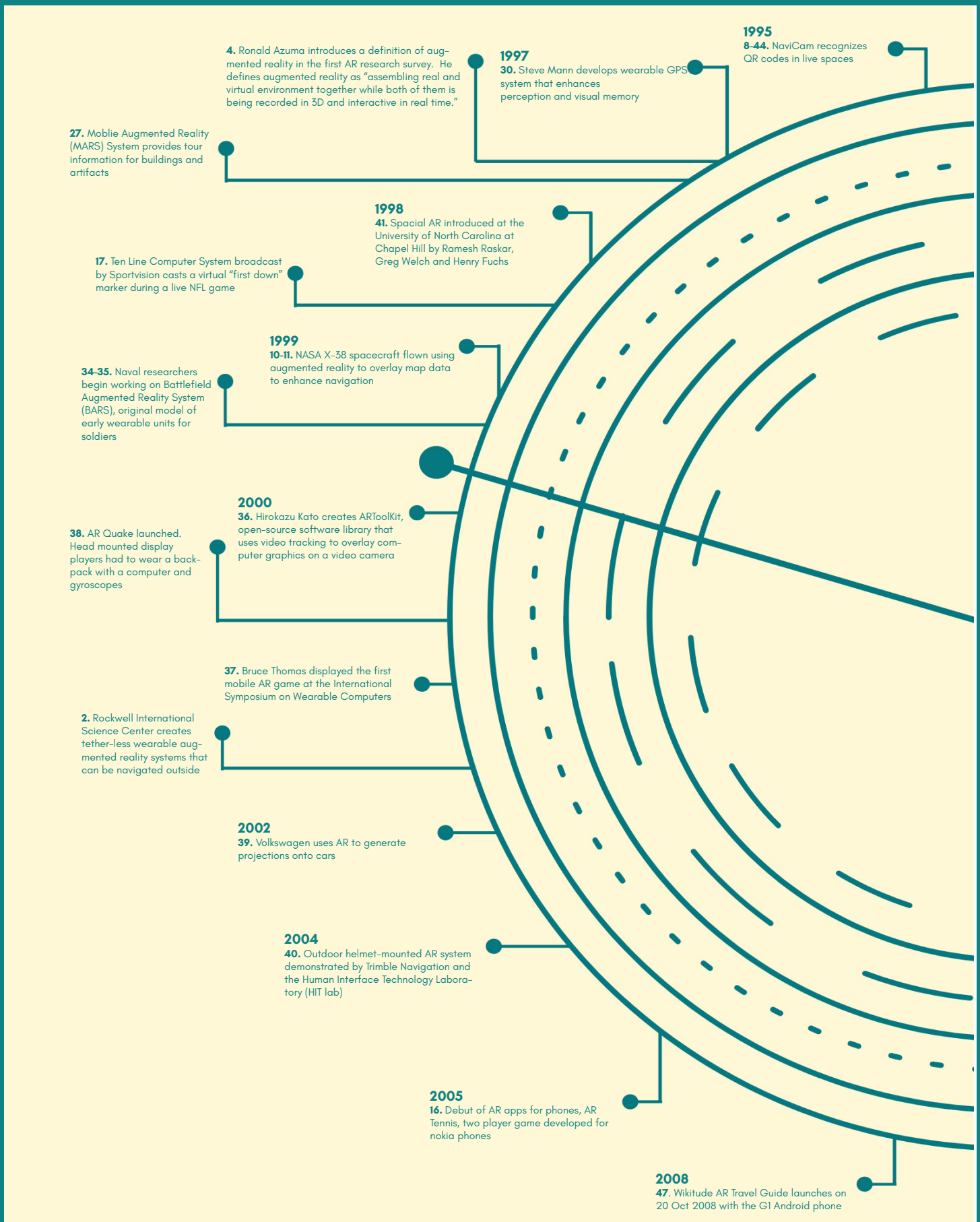
1994
29. Dancing in Cyberspace by Julie Martin

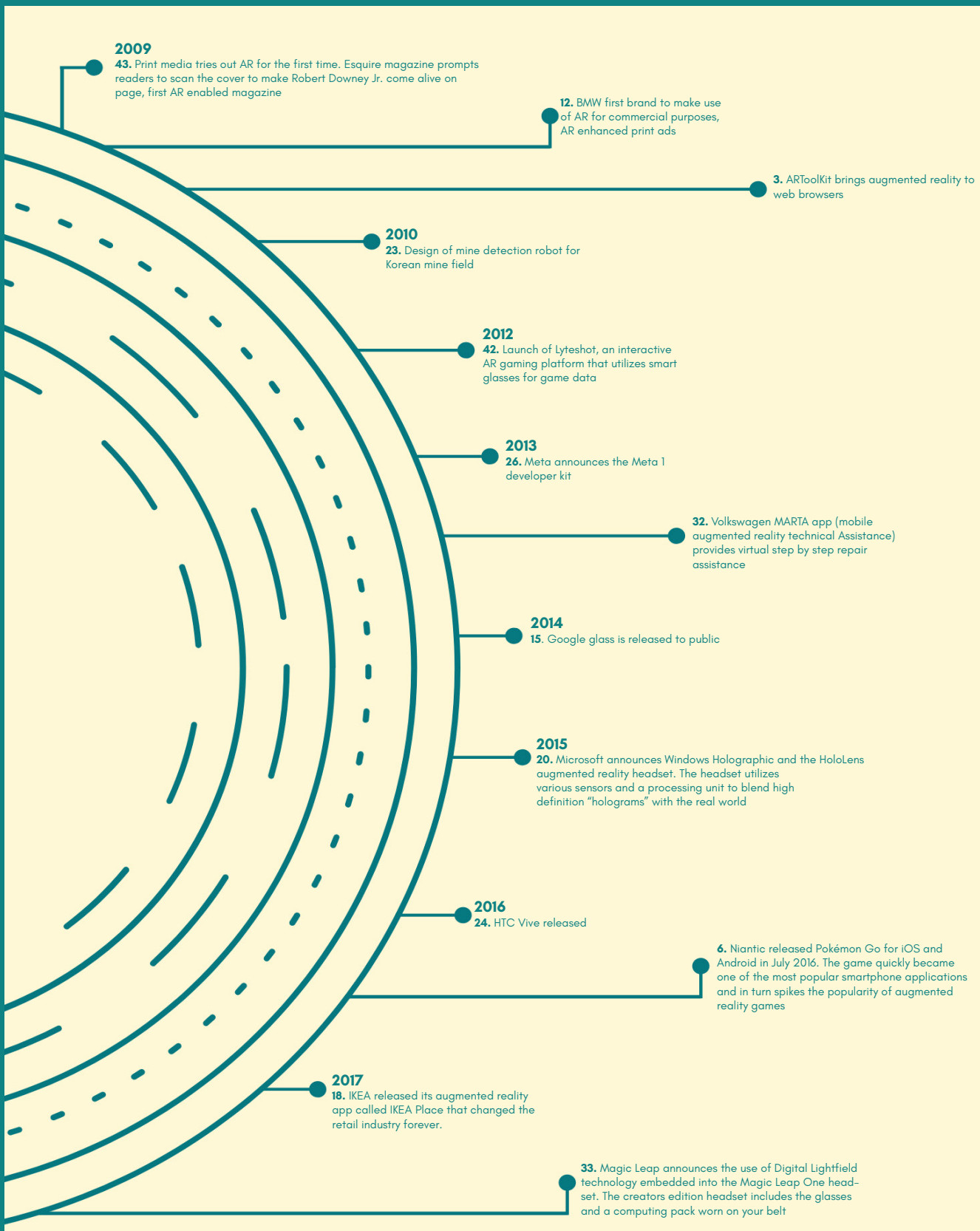
5. "Experiences and Observations in Applying AR to Live Training" early demo of live AR-equipped vehicles and manned simulators

ACTIVITY #1

Facilitator Note: In groups have students choose 5 inventions and discuss with one another the type of augmented reality technology chosen and any questions that may arise.

Numbered references are provid ed to students for quick and easy access.


1995
8-44. NaviCam recognizes QR codes in live spaces
4. Ronald Azuma introduces a definition of augmented reality in the first AR research survey. He defines augmented reality as "assembling real and virtual environment together while both of them is being recorded in 3D and interactive in real time."
1997
30. Steve Mann develops wearable GPS system that enhances perception and visual memory
27. Moblie Augmented Reality (MARS) System provides tour information for buildings and artifacts
1998
41. Spacial AR introduced at the University of North Carolina at Chapel Hill by Ramesh Raskar, Greg Welch and Henry Fuchs
17. Ten Line Computer System broadcast by Sportvision casts a virtual "first down" marker during a live NFL game
1999
10-11. NASA X-38 spacecraft flown using augmented reality to overlay map data to enhance navigation
34-35. Naval researchers begin working on Battlefield Augmented Reality System (BARS), original model of early wearable units for soldiers
2000
36. Hirokazu Kato creates ARToolKit, open-source software library that uses video tracking to overlay computer graphics on a video camera
38. AR Quake launched. Head mounted display players had to wear a backpack with a computer and gyroscopes
37. Bruce Thomas displayed the first mobile AR game at the International Symposium on Wearable Computers
2. Rockwell International Science Center creates tether-less wearable augmented reality systems that can be navigated outside
2002
39. Volkswagen uses AR to generate projections onto cars
2004
40. Outdoor helmet-mounted AR system demonstrated by Trimble Navigation and the Human Interface Technology Laboratory (HIT lab)
2005
16. Debut of AR apps for phones, AR Tennis, two player game developed for nokia phones
2008
47. Wikitude AR Travel Guide launches on 20 Oct 2008 with the G1 Android phone



2009
43. Print media tries out AR for the first time. Esquire magazine prompts readers to scan the cover to make Robert Downey Jr. come alive on page, first AR enabled magazine

12. BMW first brand to make use of AR for commercial purposes, AR enhanced print ads

3. ARToolKit brings augmented reality to web browsers

2010
23. Design of mine detection robot for Korean mine field

2012
42. Launch of Lyteshot, an interactive AR gaming platform that utilizes smart glasses for game data

2013
26. Meta announces the Meta 1 developer kit

32. Volkswagen MARTA app (mobile augmented reality technical Assistance) provides virtual step by step repair assistance

2014
15. Google glass is released to public

2015
20. Microsoft announces Windows Holographic and the HoloLens augmented reality headset. The headset utilizes various sensors and a processing unit to blend high definition "holograms" with the real world

2016
24. HTC Vive released

6. Niantic released Pokémon Go for iOS and Android in July 2016. The game quickly became one of the most popular smartphone applications and in turn spikes the popularity of augmented reality games

2017
18. IKEA released its augmented reality app called IKEA Place that changed the retail industry forever.

33. Magic Leap announces the use of Digital Lightfield technology embedded into the Magic Leap One head-set. The creators edition headset includes the glasses and a computing pack worn on your belt

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DE-MYSTIFYING AUGMENTED REALITY

How it works

De-Mystifying Augmented Reality

Activity #2

Why is the image below an AR headset and not a VR headset?
Answer at bottom of page.

Augmented reality is a combination of the physical world and virtual (computer-generated) world overlapping objects, text, or other effects to enhance the scene. The term was coined by Boeing researcher Tom Caudel in 1990. Augmented reality differs from Virtual reality by placing virtual content onto an existing physical surface, thus combining realities. *But how does it work?* Whether it's AR through a headset, handheld device, or computer the first thing needed for an AR experience is a camera for the software to recognize an area or image. Once the computer software has read the scene or image it projects objects or text over the area. These experiences can include interactive buttons, eye tracking, voice command, or the ability to move virtual objects to fit into a physical space much like in Ikea's IKEA Place app.

Image: Screengrab via IKEA USA/YouTube

AR interaction and immersion on mobile or tablet devices is so efficient due to the hardware structure the devices hold, which often incorporate a gyroscope, camera, accelerometer, GPS, microelectromechanical systems (MEMS), and solid state compases. Some precursor technology to augmented reality included devices such as the Head-Up Display (HUD), bionic contact lenses, holography, Virtual Retinal Display (VRD), and projection mapping. Considerations when creating an AR experience include:

- The location and time of day the app can be used
- The parts of the device (phone, computer) that are being accessed
- The audience
- Movement (little, constant, etc.)
- The amount of visual or auditory cues
- The depth and light/shadow of the virtual objects in the scene (immersion)

Image: An augmented reality headset

If you look closely you can see the user's eyes! This device is reflecting light off of the tinted headset to give the illusion that digital content is placed right on top of their physical space around them. Were this a VR headset the screen would be completely dark so the user could only see the virtual content.

The Virtuality Continuum

Module 1
Slide 13

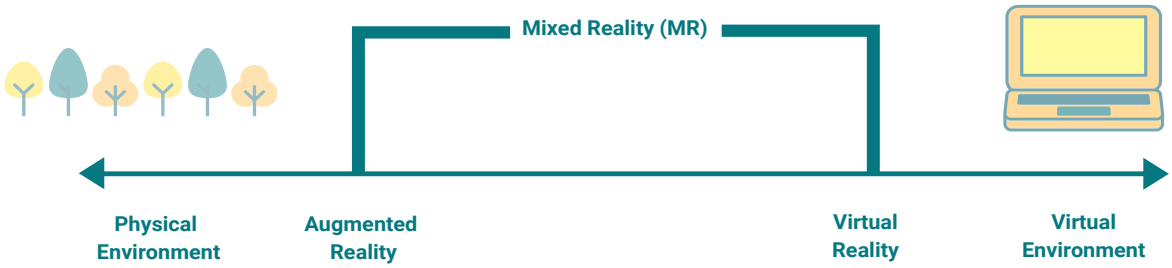

Diagram based on Paul Milgram and Fumio Kishino's Virtuality Continuum

Diagram based on Paul Milgram and Fumio Kishino's Virtuality Continuum

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Webley, Kayla. The 50 Best Inventions of 2010 – EyeWriter Time, 11 November 2010.

Module 1
Slide 14

LIVE APPLICATION

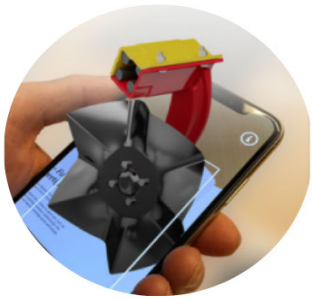
LESSON 3: WHO IS USING AR

NEDAP COW CONTROL

This new technology brings the farmer's real world and digital information together. It enriches his field of view with relevant cow data at the right time and place using Microsoft's HoloLens

POWERFUL PLANTS

The Powerful Plants by Burpee AR experience provides a fun new way to learn about plants and their importance to the human condition.



VADERSTAND AR

The technology enables trainees to familiarize themselves with farm machinery without having to operate it in the actual sense.

FARM AR MOBILE

Created by Farm VR. Place and interact with agricultural 3D models! Use Farm AR to bring the digital farm to your real world using ARKit/ARCore technologies.

VITAL FARMS

Vital Farms designed an egg carton that can also be used as an AR marker!

EON XR

Students can now take the front row seat in their own AR/VR classroom, to examine how technology has changed the farming industry over the course of the century.

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Activity #3: Trying AR Apps

These following apps and printables are free AR activities you can try on your own! They provide great examples of the various types of AR including Marker-AR with images and objects, location-based AR, and more.

Quiver is a company that creates augmented reality coloring pages. What you color on the page texturizes the 3D model you see through their downloadable app (for iOS and Android).

http://www.quivervision.com/

1) Go to the Quiver Vision website and download/print their coloring pages. Some of these will be available to purchase but most are free to use.

2) Download Quiver Vision for just the AR coloring pages. For a "snapchat" like experience with "face detection" you can also download Quiver Masks.

NOTE: Quiver Vision and Quiver Masks are two seperate apps. One with a butterfly logo and the other a face logo

Please look at the coloring pages you print or download and see (at the bottom) whether you see just the regular Quiver Vision butterly or the Quiver Masks face logo.

Merge Cube is a company that uses a cube to showcase augmented reality.

Merge Cube does have their own developer software, but you do not need to purchase items to use free apps available on the app store or to use the cube itself. There is a paper version taht is free to use and works just the same as their foam cube that is sold in stores and online.

To download a printable cube: https://docs.wixstatic.com/ugd/879cdc_2146ac3eac0045dcb440d715042de3bd.pdf

Check out the app store by searching "Merge Cube" and there are several free apps to try and download. There is not one sole company that creates Merge Cube compatable apps.

Free Merge Cube Apps:

- Th!ngs
- HoloGlobe
- Galactic Explorer
- MyARquarium

Sketchfab is a website where you can showcase your own 3D models. Though the app (for iOS and Android) you can see these models in a virtual or augmented scene.

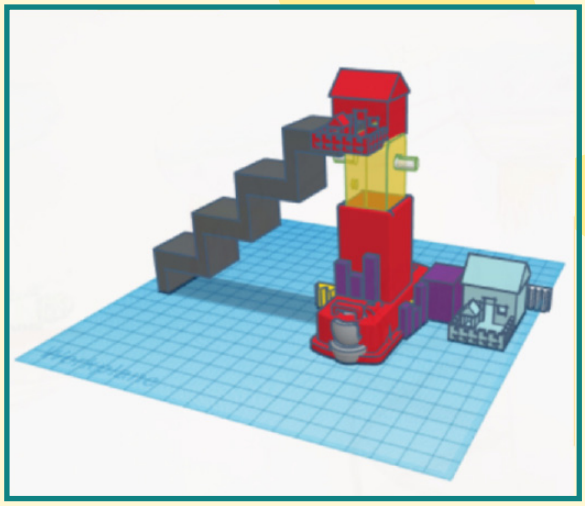
To try this you will need to go to the app store and download the "Sketchfab App". Then you can browse the different 3D models on the site and view them in AR and VR.

https://sketchfab.com/4-H_STEM_YOUniversity

PLANNING PHASE

Module 1
Slide 22

Aizen Villarino's initial ideas of his Floating Farm, 2D drawing



Aizen Villarino building his 2D drawing into a 3D space, using Tinkercad 3D model

The Floating Farm Project is divided into three phases;

1) A planning phase
2) A creating phase
3) A presenting phase

The planning phase consists of 3 steps. First, you must identify your team size and it's members (even if it's just yourself). Next, discussing amongst your team what your farm's purpose is, the creation of the farm's layout, and explaining the reasoning behind your ideas. Finally, you and your group will generate a schedule of how to build your virtual farm and when to set aside time to work on your project.

The creating phase consists of 5 steps. First, you will understand how to build and design 3D models for your virtual farm. Second, you will create an AR marker for your virtual farm to appear on. Step 3 is beginning to learn about game engine tools or platforms for your virtual farm to appear on. Step 4 will review the Unity game engine interface or the online Sketchfab website's interface. Finally, Step 5 is where you will learn to add sound effects and special effects into your virtual farm.

The presenting phase consists of 3 steps. First, you will prepare the presentation of your virtual farm. This will include writing a project statement describing life on your farm. Next you will create a slide show presentation outlining your virtual farm. The second step is presenting your slideshow and project. Finally, you will learn how to publish your AR project onto a website or mobile device.

STEPS TO CREATING A FLOATING FARM

Planning Phase
Module 1 Step 1: Forming a team
Module 1 Step 2: Brainstorming Your Farm
Module 1 Step 3: Scheduling

Creating Phase
Module 2 Step 1: Creating 3D models
Module 3 Step 2: Creating AR Markers
Module 4 Step 3: Getting started with Game Engine Unity or Sketchfab website
Module 5 Step 4: Setting up AR scene in Unity or Sketchfab website
Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene

Presenting Phase
Module 7 Step 1: Preparing Your Presentation
Module 8 Step 2: Presenting Your AR Floating Farm Project
Module 8 Step 3: Publishing Your AR Floating Farm Project

1 PLANNING PHASE
STEP 1: FORMING A TEAM

Gather into groups and introduce yourselves.

Ask one another the following questions:

1) Discuss any AR technology or apps you have already used.

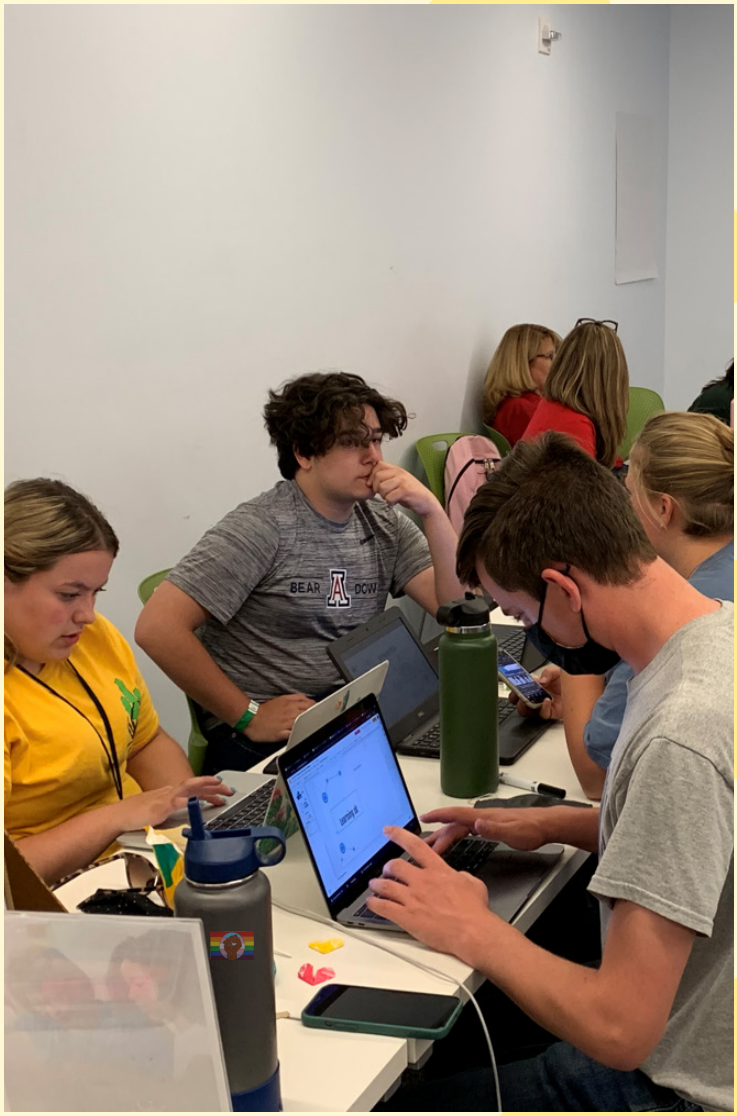
2) Would there be something you would like to see built or improvements to apps you've used?

3) What do you think of AR technology?

Once your group has met and talked complete the following:

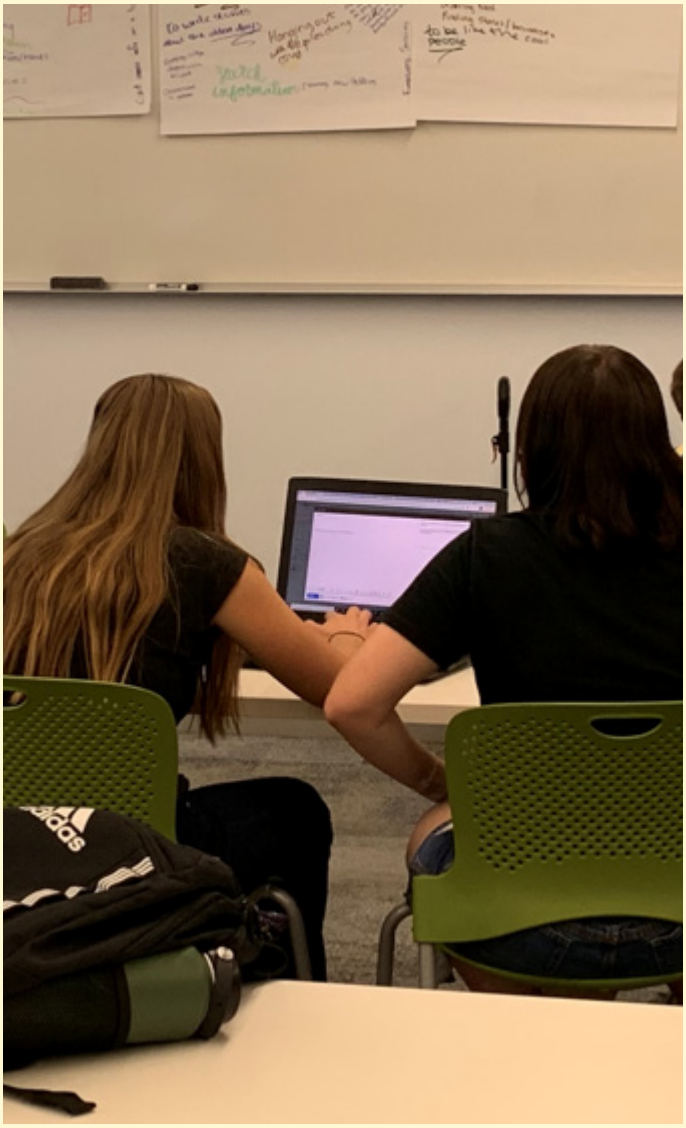
1) Pick a team name

2) Get ready to brainstorm ideas for what kind of farm your project will be based on. What goods and services it provides and any animals or people that live there.



Notes:

2 PLANNING PHASE
STEP 2: BRAINSTORMING YOUR FARM



After forming into groups you will discuss the purpose and structure of your virtual farm.

To get ideas discuss examples of farms you know of. What goods or services do these farms provide? What kind of animal or people live on the farm?

PROJECT REQUIREMENTS

Thoughout this project you will develop a basic understanding of how augmented reality works and operates. With this knowledge you will go on to design and develop a virtual farm! The farm can exist in any time, space, shape, or form as long as it holds the necessary key elements:

1) The AR scene must have at least one character (human or non)

2) The farm must produce a good or service

3) The AR scene must have both 2D and 3D elements

4) A narrative/story must accompany the virtual farm in either written or spoken form. Discuss what impact the farm has and how it functions

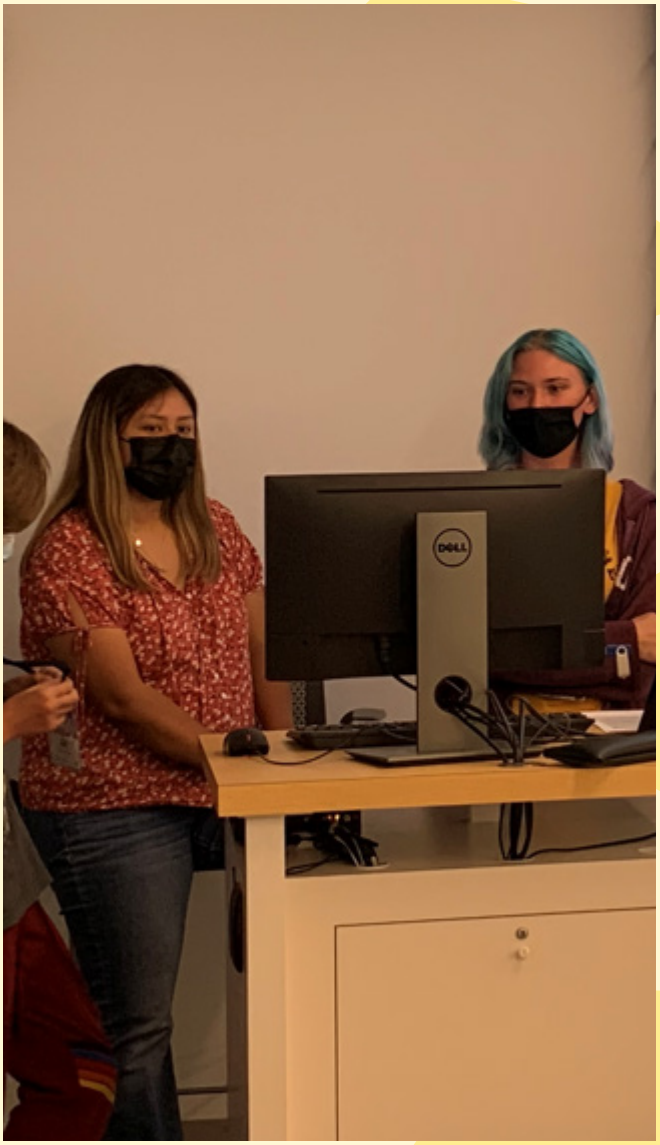
Notes:

3 PLANNING PHASE
STEP 3: SCHEDULING

Now that you've formed teams and have ideas for what your farm will look like and function, it is time to start scheduling when to meet with your team outside of the workshop!

You can choose to meet at a certain time every week, or there are scheduling tools to help you navigate an available time and day.

Scheduling: https://doodle.com



Notes:

4-H Record Books

Please leave the duration of class for students to fill out their project record book!

THINGS TO CONSIDER FOR YOUR RECORD BOOK:

- Project Goals
- Project Activities
- Project Accomplishments
- Project Inventory
- Project Inventory and Expense Record
- Financial Summary

REFLECTION (RECORD BOOK)

• LEARNED THE HISTORY, FUNCTION, AND USES OF AUGMENTED REALITY
• ASSEMBLED A TEAM TO BUILD A VIRTUAL FARM
• BRAINSTORMED IDEAS FOR A FARM AND ORGANIZED A SCHEDULE TO WORK ON THE PROJECT

IN YOUR RECORD BOOK NOTE WHAT YOU LEARNED TODAY AND THE PROGRESS ON YOUR FINAL PROJECT.

MODULE TWO: INTRO TO 3D MODELS

Module 2: Intro to 3D Models

Learning Objectives

By the end of the module, you will be able to;

- Navigate the Tinkercad website and software
- Learn how to create 3D models
- Learn how to create a papercraft

Module Outline	Estimated Time to Complete
1) Lesson 1: What is a 3D model?	5 mins
2) Lesson 2: Navigating Tinkercad OR 3DC.io for offline 3D modeling OR Morphi 3D for offline 3D modeling	10 mins
3) Creating Phase Step 1: Creating 3D models	30 mins
4) Activity #1: Papercrafting	15 mins
5) Reflection (Record book)	30 mins
	Total = 1 hour 30 mins

Homework

Creating Phase Step 1: Creating 3D models

Activity #1: Papercrafting

Module 2
Slide 6

LESSON 1: WHAT IS A 3D MODEL?

WHAT IS A 3D MODEL?

A 3D model is a virtual representation of an object, person, or thing. 3D models are 3-dimentional, meaning you can see on top, around, under, and in front of the model. There are many different computer programs that allow you to create 3D models through code, dragging corners, or sculpting your model as if it were made of clay!

When creating a 3D model there are several terms to think about in reference to the texture and look of the model itself. Smoothness is the glossiness or roughness of a 3D model's surface. Metallic is when the 3D model seems to be made of metal more than not. Is your model of a paper boat? A giant robot? Try different styles to get closer to your desired effect.

What is Tinkercad?

Tinkercad is an easy-to-use 3D modeling design tool. You can create models through code or dragging and dropping shapes into the scene.

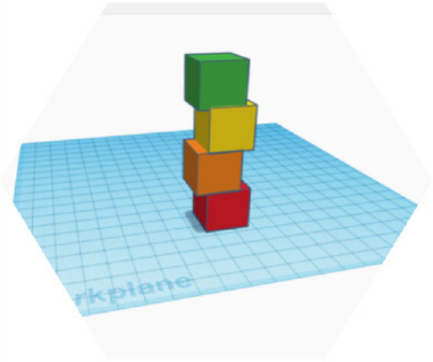
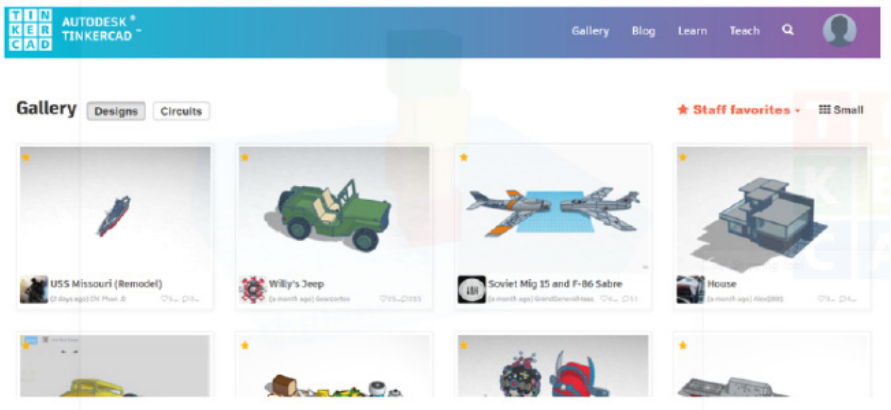


Image 1: Example of Tinkercad model interface

Image 2: Tinkercad Logo



The Tinkercad Gallery

Tinkercad comes with many shapes and colors to get you started building 3D models. There is also a gallery on the home page to check out what kinds of projects you can create using this software!

KEYWORDS

DUPLICATE	to make or be an exact copy of.
COMBINE	to unite two bodies or components into a single component.
CROSS SECTION	to cut an object off at right angles to an axis.
DEBOSS	to stamp a design into the surface of an object so that it is indented. One way to do this is by importing an SVG file and placing it onto the surface of a shape or part, sinking it and aligning it to your specifications, turning the SVG shape into a hole, and then grouping it all together.
DIAMETER	a straight line going through the center of a circle connecting two points on the circumference.
DIMENSIONS	a measurable extent, such as length, width, or height.
EMBOSS	to carve, mold, or stamp a design onto a surface so that it stands out in relief. One way to do this is by importing an SVG file and placing it onto the surface of a shape or part, aligning it to your specifications, and then grouping it all together.
EXTRUDE	to extend a 2D image into a 3D object in a straight line.
FILLET	to make a rounded edge.
GALLERY	a collection of creations grouped together.
GROUP	to combine two or more shapes into a part.
HANDLE	the little squares that appear on the shape when you select it that allow you to resize it by pulling and pushing them.
HOLE	a tool used to subtract from a solid shape.
LOFT	transitioning from one shape to a different shape over a specified distance.
MILIMETER	one thousandth of a meter (0.039 in.)
OFFSET	to move out of alignment.

REFERENCES

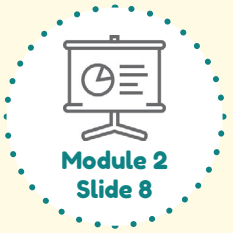
Instructables. "How to Teach the Language of 3D Modeling and Design." Instructables, Instructables, 27 Sept. 2018, www.instructables.com/id/How-to-Teach-the-Language-of-3D-Modeling-and-Desig/.

KEYWORDS

ORTHOGRAPHIC VIEW	two-dimensional view of a three- dimensional object. Orthographic views represent the exact shape of an object as seen from one side at a time as you are looking perpendicularly at it.
PAN	to rotate a camera on the horizontal or vertical axis.
PART	one or more shapes that have been grouped together.
PATH	a path is a line that is made up of a series of points called "anchor points" and line segments between these points.
PERPENDICULAR	at an angle of 90 degrees to a given line, plane, or surface.
PERSPECTIVE VIEW	a view of a three-dimensional image that portrays height, width, and depth for a more realistic image or graphic.
SCULPT	a modeling approach that creates organically shaped models as if they were clay.
SHELL	remove material from a part's interior, creating a hollow cavity.
SLICE	divide a solid object into two or more separate 3D objects.
STL	one of the most commonly used file formats for 3D printing. STL stands for stereolithography.
SUBTRACTION	shape a design by removing material from it.
SVG	scalable vector graphics. SVGs are commonly used for any type of image that might require a great deal of flexibility in size (think company logos that must be tiny for business cards but also blown up huge for billboards.) SVG is also the standard file format for laser cutting.
SYMMETRY	twin parts facing each other, or in multiples, spaced equally around an axis.
TANGENT	a line or plane touching, but not intersecting, a curve or curved surface.

REFERENCES

Instructables. "How to Teach the Language of 3D Modeling and Design." Instructables, Instructables, 27 Sept. 2018, www.instructables.com/id/How-to-Teach-the-Language-of-3D-Modeling-and-Desig/.



LESSON 2:

NAVIGATING TINKERCAD

How do you create a 3D model using software? Today we will be taking a look at an online website called "Tinkercad" to learn how to build 3D models and import them into our augmented reality app!

AUTODESK® TINKERCAD®

KEYBOARD SHORTCUTS

Legend: Ctrl | Cmd / Alt | Option

MOVING OBJECT(S)
(Using keyboard)

Move along X/Y axis	← / ↑ / ↓ / →
Move along Z axis	Ctrl + ↓ / ↑
×10 Nudge along X/Y axis	Shift + ← / ↑ / ↓ / →
×10 Nudge along Z axis	Ctrl + Shift + ↓ / ↑

KEYBOARD + MOUSE SHORTCUTS
(Press and hold the keys, then click and drag the mouse)

Duplicate dragged object(s)	Alt + Drag left mouse button
Select multiple object(s)	Shift + Left mouse button
45° rotation	Shift (Hold while rotating)
Scale in one direction	Alt + Hold side handle
Scale in two directions	Alt + Hold corner handle
Uniform scale	Shift + Hold corner handle
Uniform scale in all directions	Alt + Shift + Corner handle
Uniform scale in all directions	Alt + Shift + Top handle

VIEWING DESIGNS
(With the help of a mouse or a mouse pad)

Orbit the view	Right mouse button
Orbit the view	Ctrl + Left mouse button
Pan the view	Shift + Right mouse button
Pan the view	Ctrl + Shift + left button
Zoom the view in or out	Mouse scroll wheel
Zoom-in	+
Zoom-out	-
Fit selected object(s) into view	F

OBJECT SETTINGS

Transparency toggle	T
Turn object(s) into **Holes**	H
Turn object(s) into **Solids**	S
Lock or **Unlock** object(s)	Ctrl + L
Hide object(s)	Ctrl + H
Show all hidden object(s)	Ctrl + Shift + H

TOOLS AND COMMANDS

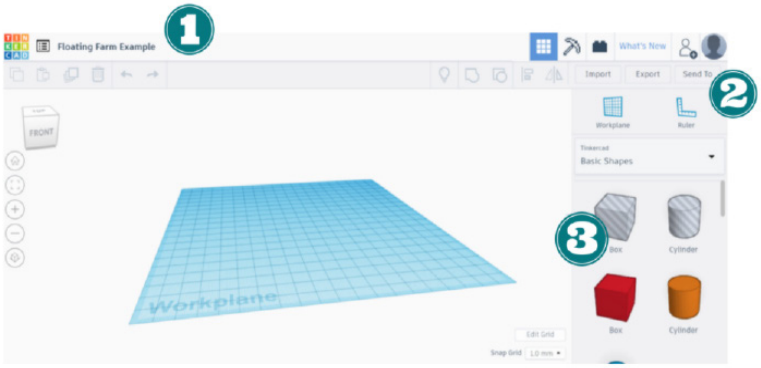
Copy object(s)	Ctrl + C
Paste object(s)	Ctrl + V
Duplicate object(s) in place.	Ctrl + D
Delete object(s)	Del
Undo action(s)	Ctrl + Z
Redo action(s)	Ctrl + Y
Redo action(s)	Ctrl + Shift + Z
Group object(s)	Ctrl + G
Un-group object(s)	Ctrl + Shift + G
Align object(s)	L
Flip/Mirror objects(s)	M
Select all object(s)	Ctrl + A
Place a **Ruler**	R (Shift toggle midpoint/center)
Place a **Workplane**	W (press Shift to flip direction)
Drop object(s) to workplane	D

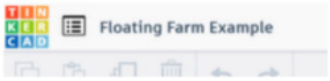
Visit www.tinkercad.com/learn for more tips, step-by-step tutorials, and easy projects. Happy Tinkering!

Shortcut sheet created by Donald Bell
Original site: https://blog.tinkercad.com/keyboard-shortcuts-for-the-3d-editor

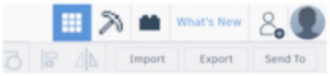
Navigating Tinkercad

The Tinkercad interface (building area) has many tools and easy to learn buttons to create your masterpiece! The tools we will be using most are marked with numbers below.

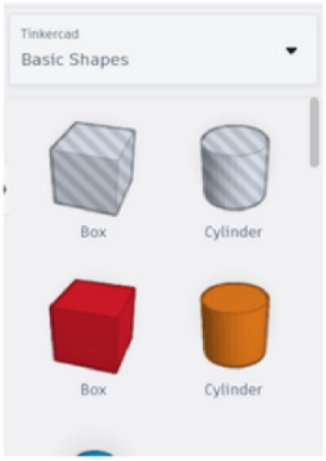


1 

This is where you can name your model

2 

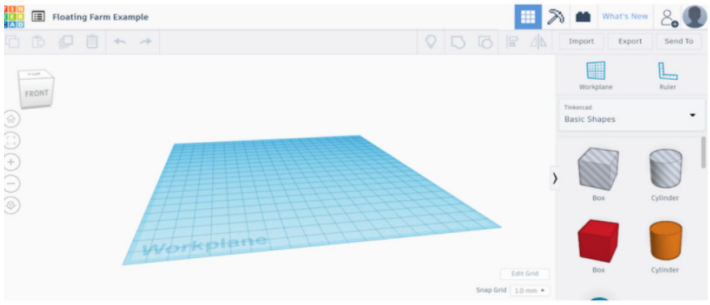
In this area you can import/export your model to Unity. You can also view it in "Minecraft" or "Lego" mode

3 

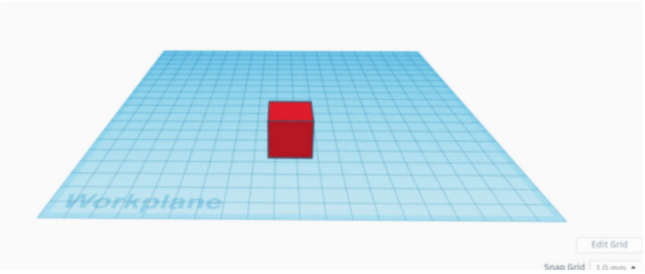
You can choose shapes and their colors to build your model. The "striped" gray models are to create holes/ indentations in your models.

Navigating Tinkercad

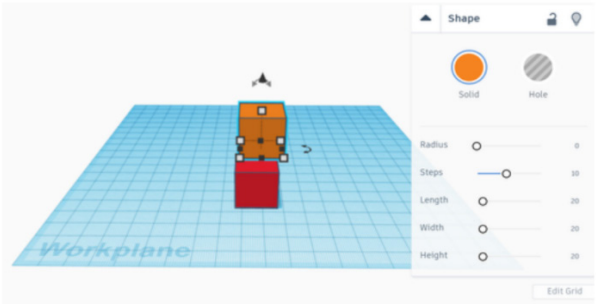
First, drag a cube onto the plane.



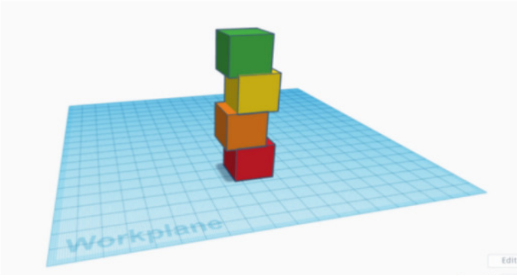
Drag or copy another cube on top of the first cube.



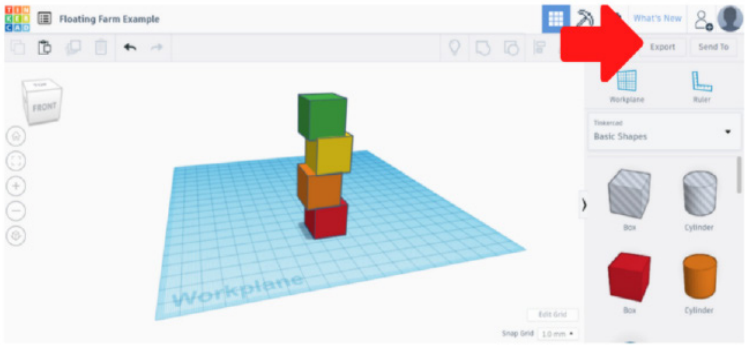
To move an object upward, drag the little black arrow on top of the cube upward. You can arrange where the cube is by dragging it around the work area.



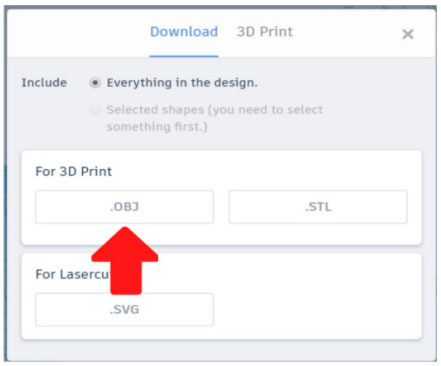
Continue making different colored cubes until you have a stack. Congrats! You have made a 3D model.



Navigating Tinkercad



To export your 3D model, go to the upper right-hand corner and click the button labeled “export”. You will see a screen like the box on the left. Press to export your model as an obj.



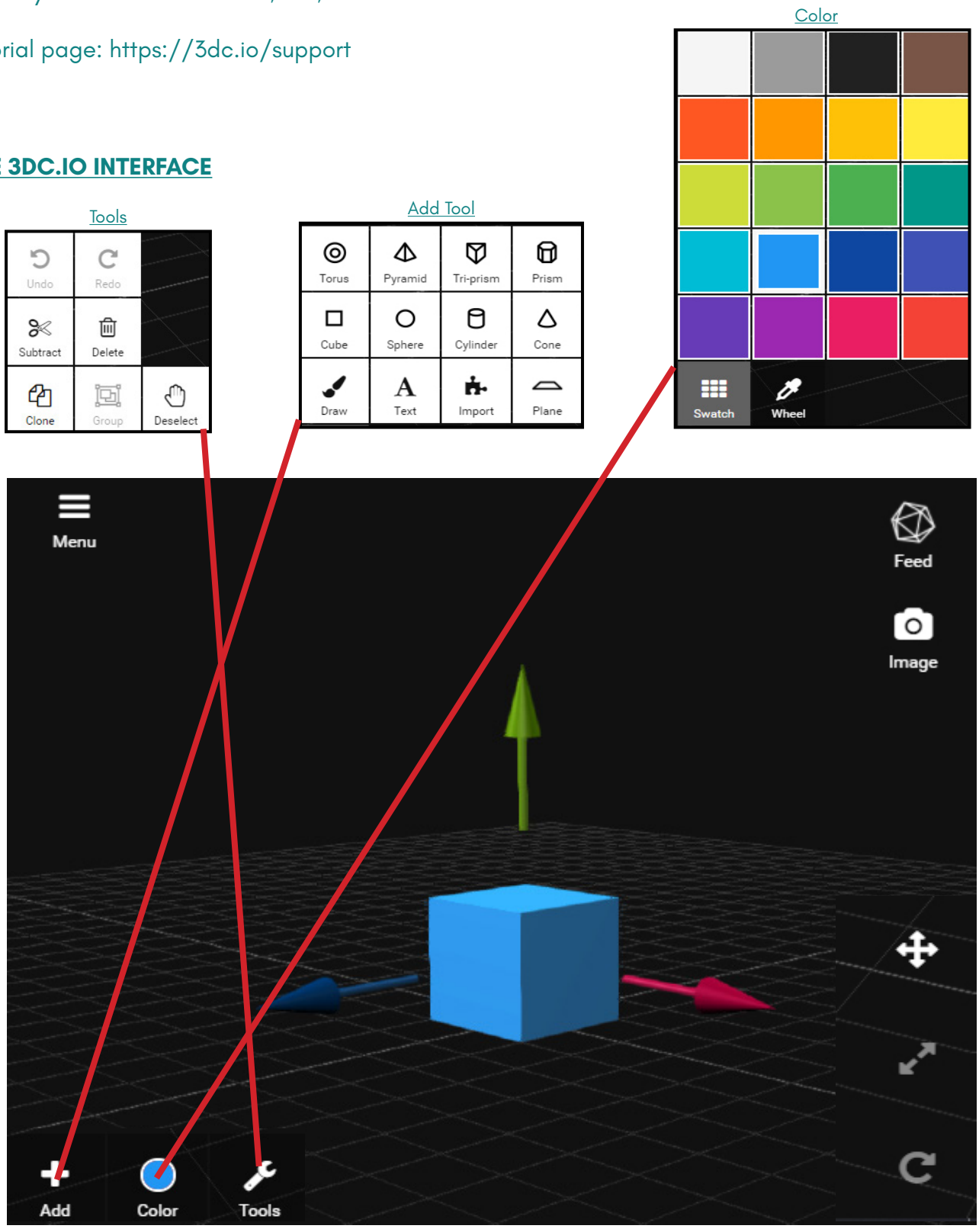
NOTE: In order to import your model with color you will need to make sure the downloaded (unzipped) folder is put into your Unity project!

3DC.IO FOR OFFLINE 3D MODELING

3DC.io is an alternative 3D modeling software you can download onto a tablet or use on the computer. You can export your models as an OBJ, STL, or DAE file.

Tutorial page: https://3dc.io/support

THE 3DC.IO INTERFACE

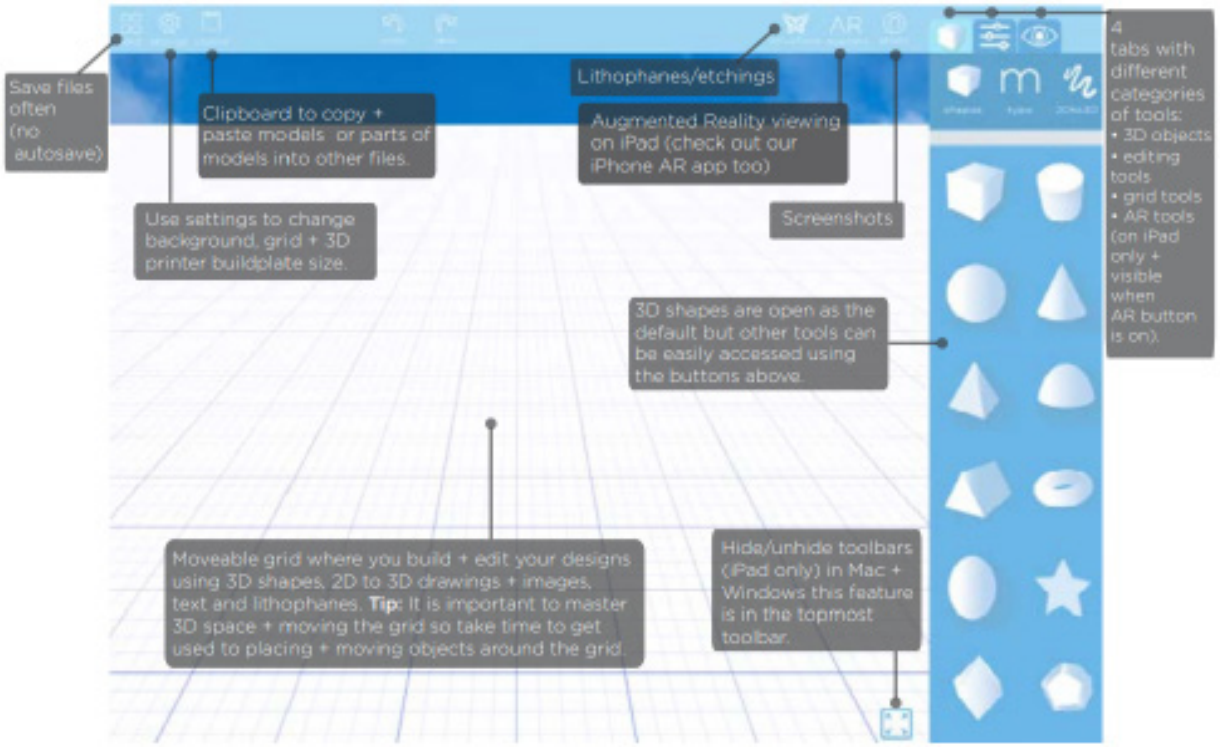


MORPHI 3D FOR OFFLINE 3D MODELING

You can request a free trial (this software does cost money). Very similar to Tinkercad Morphi 3D can be used offline to easily create 3D models.

Download the guide: https://www.morphiapp.com/helpcontact

THE MORPHI 3D INTERFACE



* You will see these tools when you open a new file or an existing file on our iPad versions. Our Mac+Windows versions differ slightly in that save, clipboard + hide/unhide toolbar functions are in the topmost toolbar accessible by hovering anywhere along the top of the screen. There are also no AR or 2Dto3D photo buttons in our Mac + Windows versions.

NOTICE:
Currently Morphi 3D's AR compatibility is ONLY for iOS tablets. You can use this software on tablets or a computer device (Mac or Windows). We will only be listing it's 3D modeling capabilities for this workshop series.

Creating Phase Step 1:

CREATING 3D MODELS

STEPS TO CREATING A FLOATING FARM

Planning Phase
Module 1 Step 1: Forming a team
Module 1 Step 2: Brainstorming Your Farm
Module 1 Step 3: Scheduling

Creating Phase
Module 2 Step 1: Creating 3D models
Module 3 Step 2: Creating AR Markers
Module 4 Step 3: Getting started with Game Engine Unity or Sketchfab website
Module 5 Step 4: Setting up AR scene in Unity or Sketchfab website
Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene

Presenting Phase
Module 7 Step 1: Preparing Your Presentation
Module 8 Step 2: Presenting Your AR Floating Farm Project
Module 8 Step 3: Publishing Your AR Floating Farm Project

This project focuses on the softwares Sketchfab and Unity as a means to create an AR experience. Unity was chosen due to the ability for creators to retain all creative rights and have the ability to freely publish/sell their application in the future. Sketchfab is an alternative software that is easy to upload 3D models to. These software applications are not the only options to create an AR or VR experience.

If you would like more information please refer to page 142 of the facilitator guide.

CREATING 3D MODELS

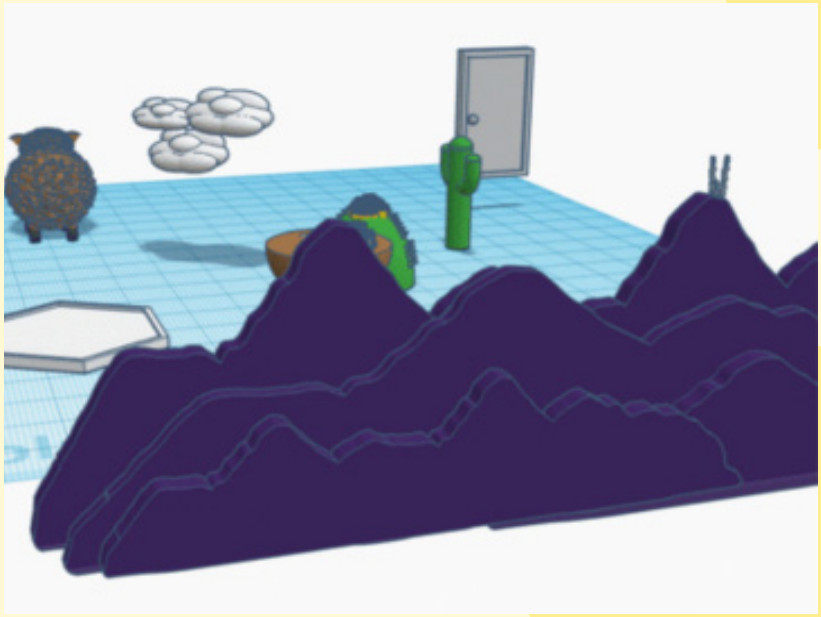
Module 2
Slide 18

Your farm will be composed of several 3D models, not all need to be “hand-made”.

There are several websites you can obtain free models and effects. One being the website **Sketchfab.**

Although you do not need to create every single model for your farm, it is good practice to learn how to create a 3D model especially if you have a unique item or creature in mind.

Choose 3 animals or goods that your farm produces and create models for them in Tinkercad.



ACTIVITY #1: PAPERCRAFTING

Module 2
Slide 19

A papercraft is comparable to assembling a 3D model. You take the mesh (the skin/paper itself) and put it together in a certain manner to create the model. Along the way, you can see how many polygons the model makes up, thus how detailed it looks.

With this papercraft you will be constructing a cube and designing your own skin/texture for it!

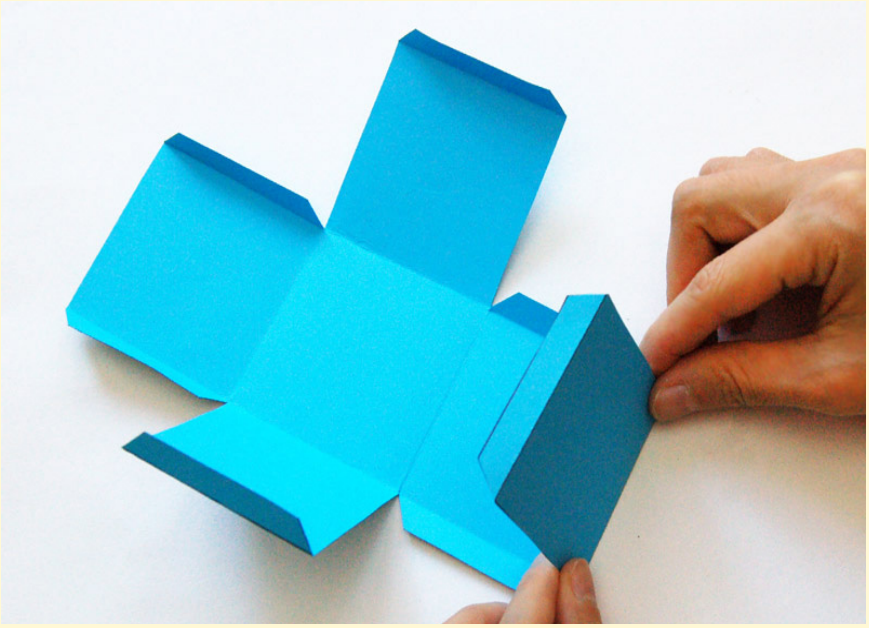
1) Color the papercraft sheet on the next page
2) Cut out the papercraft
3) Scan your papercraft and save the file
4) Glue the edges of your papercraft together
5) You've just created a paper 3D model!

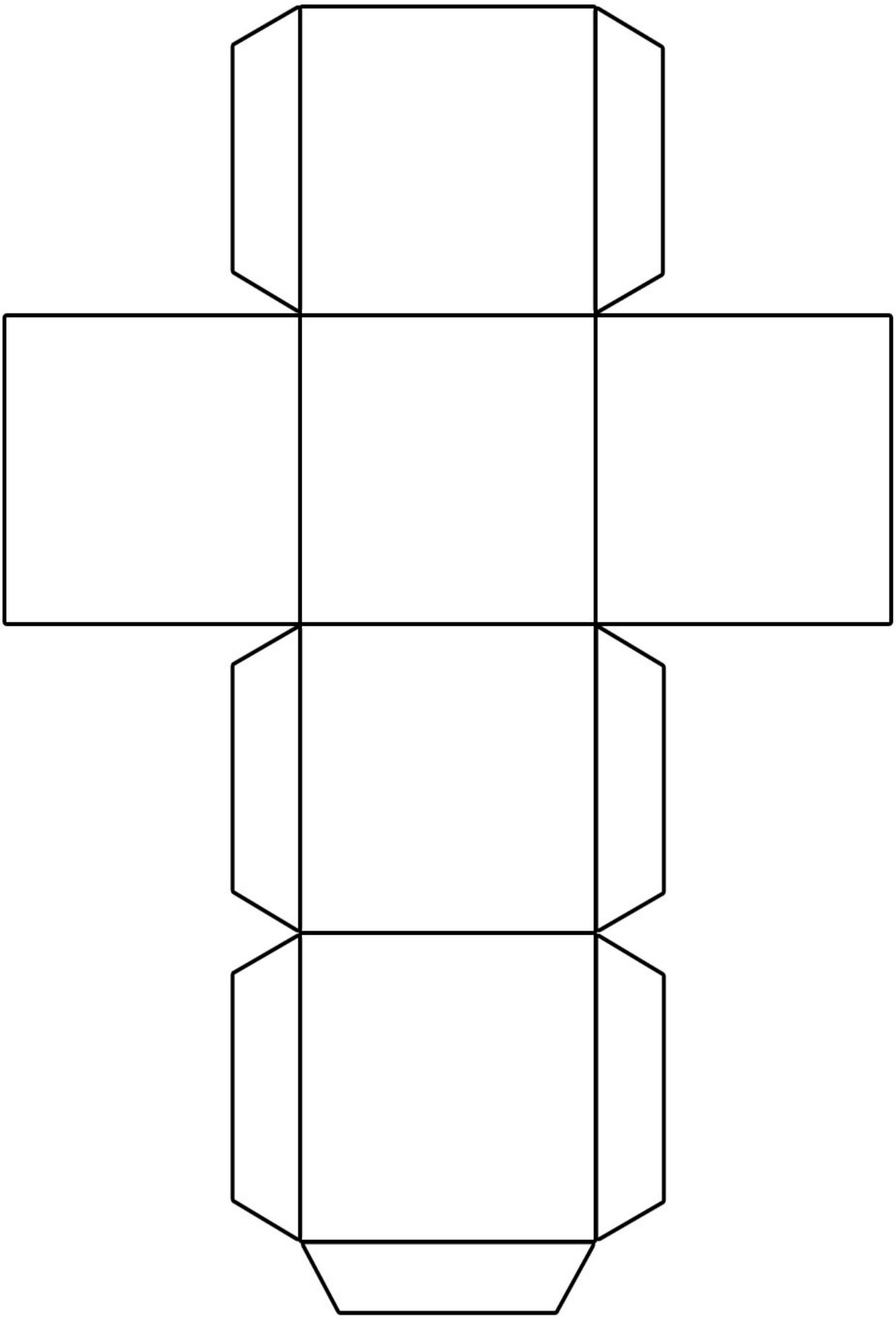
Congrats!

ACTIVITY #1
DEBRIEF QUESTIONS

1) How is paper crafting similar to building 3D models?

2) What is the difference between 3D models and papercraft models?





Source: https://biwin.co.uk/cube-papercraft/cube-paper-craft-template-for-a-cube-kazan-klonec

4-H Record Books

Please leave the duration of class for students to fill out their project record book!

THINGS TO CONSIDER FOR YOUR RECORD BOOK:

- Project Goals
- Project Activities
- Project Accomplishments
- Project Inventory
- Project Inventory and Expense Record
- Financial Summary

MODULE SUMMARY

• LEARNED HOW TO OPERATE A 3D MODELING SOFTWARE
• UNDERSTAND HOW TO BUILD 3D MODELS

IN YOUR RECORD BOOK NOTE WHAT YOU LEARNED TODAY AND THE PROGRESS ON YOUR FINAL PROJECT.

MODULE THREE: WHAT IS A MARKER?

Module 3: What is a Marker?

Learning Objectives

By the end of the module, students will be able to;

- Learn about augmented reality markers and their functions
- Discover how to navigate the AR software vuforia

Module Outline	Estimated Time to Complete
1) Lesson 1: What is a marker?	5 mins
2) Lesson 2: Vuforia marker AR requirements	7 mins
3) Creating Phase Step 2: Creating AR markers	30 mins
4) Lesson 3: Navigating Vuforia	30 mins
5) Reflection (Record Book)	30 mins
	Total = 1 hour 52 mins

Homework

Creating Phase Step 2: Creating AR markers

Module 3
Slide 7

LESSON 1: WHAT IS A MARKER?

Create AR with Vuforia

1) Upload an image to serve as your "marker"

2) Obtain a rating of 4 or 5 stars

3) Download the marker package and open in Unity

4) Set up the AR camera, image, and 3D models in the correct order in Unity

5) Make sure the correct settings are marked to export the AR app

6) Export your app

7) Test your AR scene using your printed marker image

What is a marker?

Marker AR is an image or object used to indicate to the AR software to display virtual content. This can be an image OR object that is used. For this module we will be learning about image marker AR.

What is Vuforia

Vuforia is a tool that allows for the function and the creation of augmented reality applications. Vuforia is now automatically installed into the newer versions of the free game engine, Unity.

KEYWORDS

3D MODEL	a virtual representation of an object/thing.
CROP	to cut out, mostly found in computer programs.
INFASTRUCTURE	the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise.
MESH	a collection of vertices, edges, and faces that can describe the shape of a 3D object.
METALLIC	appearing as if made of metal.
PNG	a type of graphics file similar to a JPG that Tinkercad uses for sharing still images of your designs.
PAPERCRAFT	collection of art forms employing paper or card as the primary artistic medium for the creation of three-dimensional objects.
SMOOTHNESS	appearing smooth, soft.
TEXTURE	the feel, appearance, or consistency of a surface or a substance.

REFERENCES
Instructables. "How to Teach the Language of 3D Modeling and Design." Instructables, Instructables, 27 Sept. 2018, www.instructables.com/id/How-to-Teach-the-Language-of-3D-Modeling-and-Desig/.

LESSON 2:
VUFORIA MARKER AR REQUIREMENTS

The Vuforia AR software can recognize images that are...

- Simple
- Memorable
- Appropriate
- Rich in detail
- Has good contrast
- Does not have repetitive patterns
- PNG or JPG file formats

Aim for a 4 or 5 star rating!

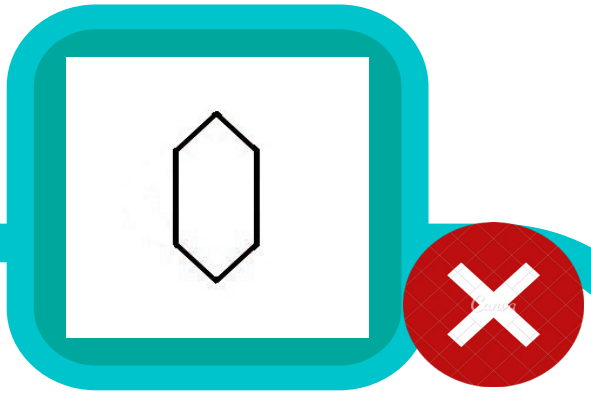
Otherwise, your marker may not work.

If your image does not work on the website, try redesigning it or trying a different picture. There is no "bad" kind of image, just those that the software can recognize!

https://developer.vuforia.com/license-manager

Why it works

- Complex
- Has no repetitive patterns
- Rich in detail
- Memorable
- Has good contrast



Why it does not work

- Too simple
- Repetitive lines
- Too much blank space

BUT! This also has elements of what could make it work. Like:

- Good contrast
- Could be in correct PNG or JPG format

How does the software see my image?

Vuforia is the software that works with Unity in an AR app to tell the camera to pull up specific virtual models when it sees a certain image.

When creating a marker, it's important to look for good contrast. Contrast is the difference or the amount of difference (as in color or brightness) between parts a photo

How we see the image

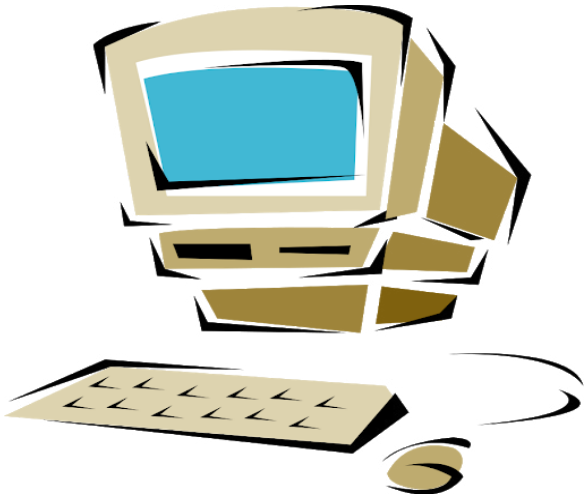
How the software sees the image

Settings for my image

File: Must be 2mb max and either JPEG or PNG

Width: 150

Name: (pick a name with NO spaces)



CREATING PHASE STEP 2:

CREATING AR MARKERS

STEPS TO CREATING A FLOATING FARM

Planning Phase
Module 1 Step 1: Forming a team
Module 1 Step 2: Brainstorming Your Farm
Module 1 Step 3: Scheduling

Creating Phase
Module 2 Step 1: Creating 3D models
Module 3 Step 2: Creating AR Markers
Module 4 Step 3: Getting started with Game Engine Unity or Sketchfab website
Module 5 Step 4: Setting up AR scene in Unity or Sketchfab website
Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene

Presenting Phase
Module 7 Step 1: Preparing Your Presentation
Module 8 Step 2: Presenting Your AR Floating Farm Project
Module 8 Step 3: Publishing Your AR Floating Farm Project

CREATING AR MARKERS

Image 4: Vuforia Marker Quality Examples

You will be learning how to create "Image-based Marker AR". In order for the computer software to recognize where to place your future 3D models, it needs a "marker" which is an image the software (Vuforia) can identify. A clear marker the computer can recognize is:

- Rich in detail
- Has good contrast
- Does not have repetitive patterns

The software sees the marker as if it were in black and white and needs to be able to read it properly to know what to show! For images that are about tabletop distance away the marker should be at least 5 inches or 12 cm in width and of reasonable height for a good AR experience.

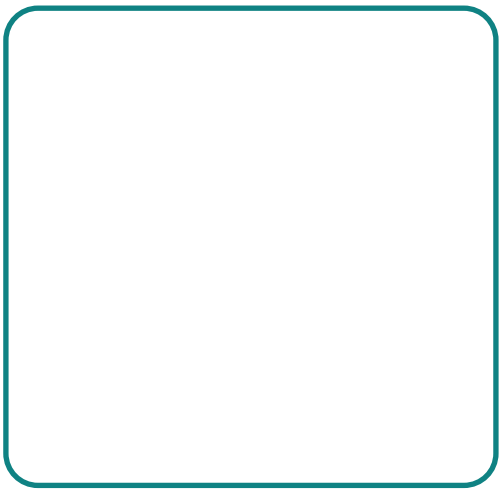
It must also be 8- or 24-bit PNG and JPG formats; less than 2 MB in size; JPGs must be RGB or grayscale (no CMYK). The paper used NEEDS to be flat and not shiny.

REFERENCES

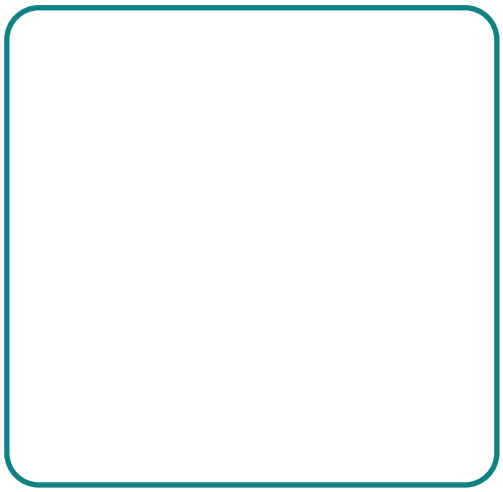
Optimizing Target Detection and Tracking Stability, library.vuforia.com/content/vuforia-library/en/articles/Solution/Optimizing-Target-Detection-and-Tracking-Stability.html.

CREATING PHASE 2:
CREATING AR MARKERS

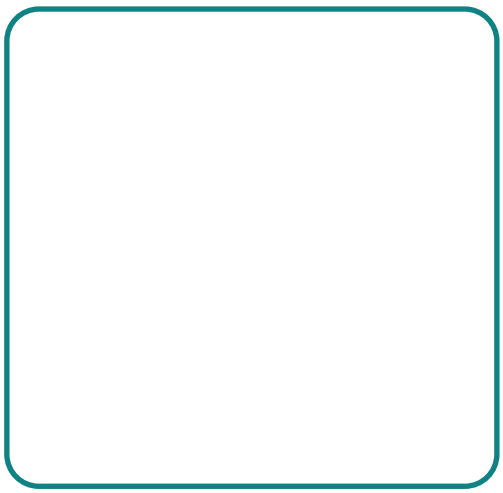
Design 3 kinds of images you can use as your AR marker. Describe the images you chose to use as markers and how they relate to your farm.



MARKER DESIGN #1 DESCRIPTION



MARKER DESIGN #2 DESCRIPTION



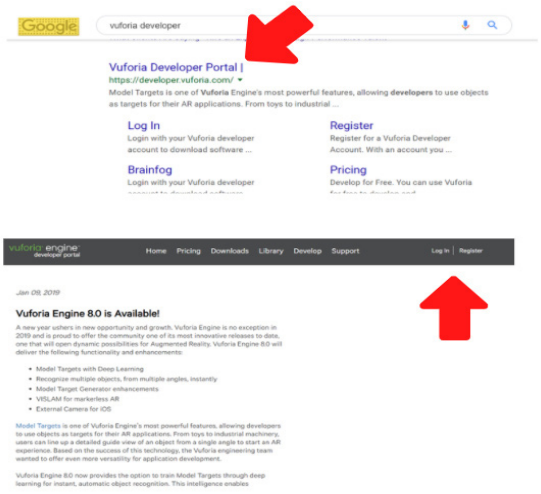
MARKER DESIGN #3 DESCRIPTION

LESSON 3:

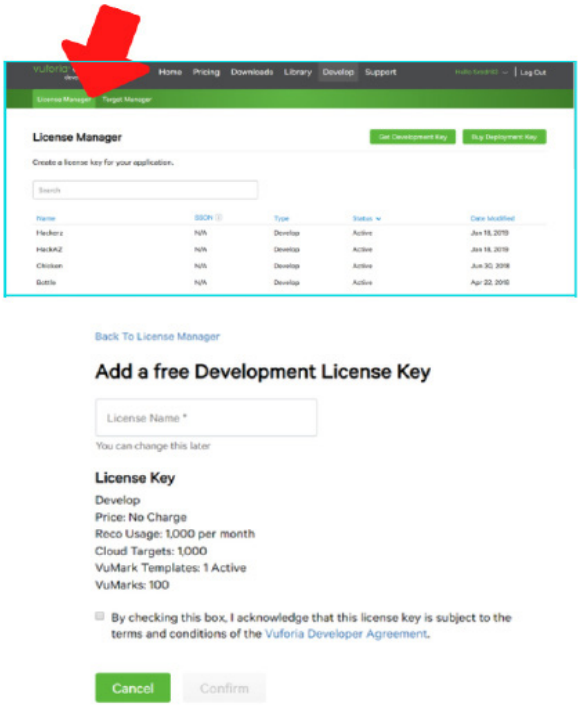
NAVIGATING VUFORIA

Navigating Vuforia

Google “Vuforia Developer” specifically to access the portion of the website that allows you to create your AR marker. It should look like the web page with the grey title bar and title “Vuforia Engine”. To being click on the **REGISTER** button to create an account or the **LOG IN** button to sign in. Creating an account is free!

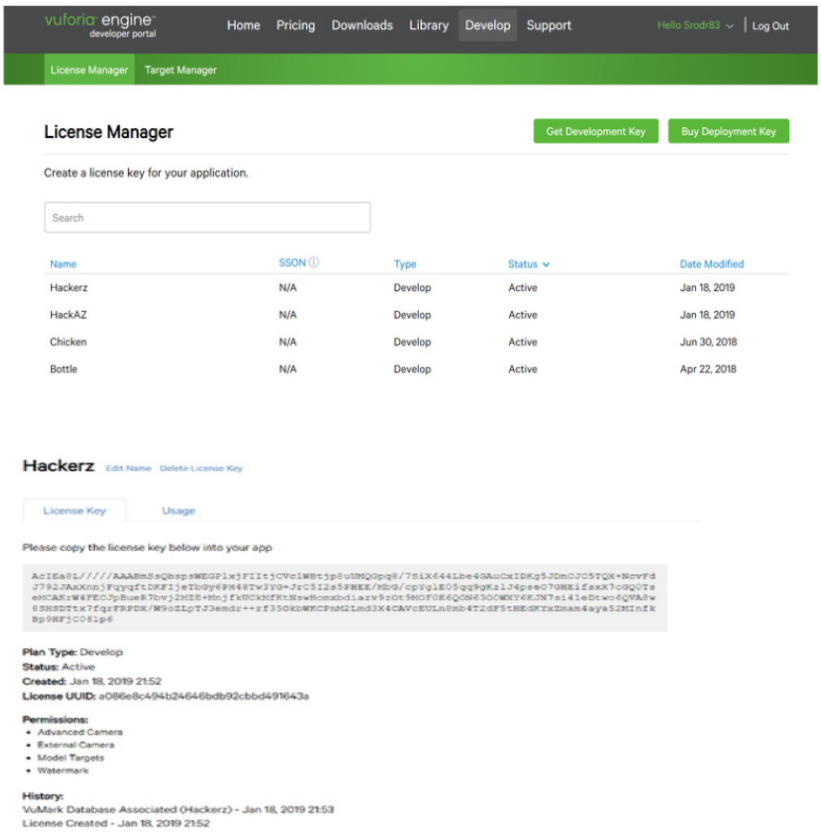


Once you have logged in click on the “License Manager” button on the upper left-hand corner of the page. This will lead you to another page to create a free development license key. This key will allow the Unity Game Engine to link to the Vuforia cloud service to make your AR app function.

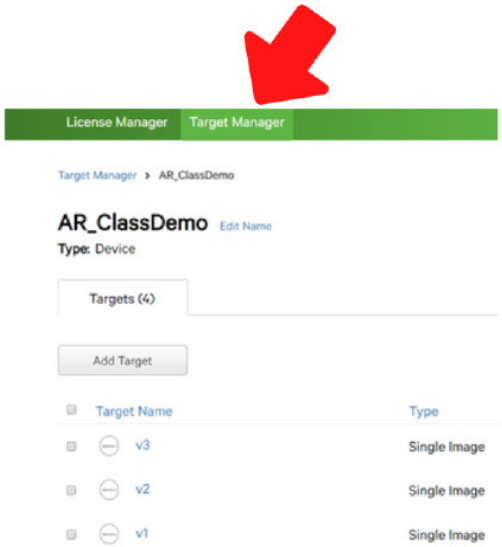


Navigating Vuforia

After you create a development license key you can go back to the manager, select the key, and view the key code (you will need this later on).



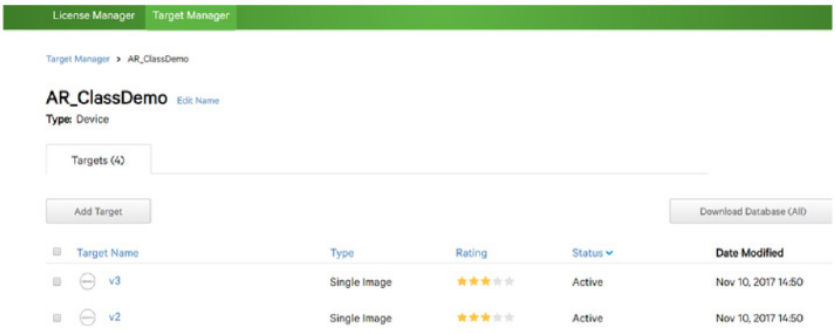
Next, you will click on the "Target Manager" tab located in the upper left-hand corner. This will lead you to create your own AR Marker (or target).



Navigating Vuforia

This is how the marker file appears in your downloads folder on your computer.

To open this in the Unity Game Engine double click while your Unity project/ scene is open.



Here, you will upload your logo design from earlier. Scan your design, save it as a JPG or a PNG file, and upload it to the website. The file must be under 2mb (if the file is too large you can save it and bring it into a paint program to shrink it down. JPEG is the smallest file format).

Select "Single Image". This will place your marker as a flat picture. Afterwards, set the Width for "150". Give your marker a name. Once you have finished it will lead you back to the main page to view how clear the software can see your marker. If it is 5 stars this is the clearest picture Vuforia can recognize. If your marker ranks low, try making the image more complex (less repetitive or simple) or choose/create an image with more color.

4-H Record Books

Please leave the duration of class for students to fill out their project record book!

THINGS TO CONSIDER FOR YOUR RECORD BOOK:

- Project Goals
- Project Activities
- Project Accomplishments
- Project Inventory
- Project Inventory and Expense Record
- Financial Summary

REFLECTION (RECORD BOOK)

• LEARNED ABOUT AUGMENTED REALITY MARKERS AND THEIR FUNCTIONS
• LEARNED HOW TO CREATE AN AR MARKER
• DISCOVERED HOW TO NAVIGATE THE AR SOFTWARE VUFORIA

IN YOUR RECORD BOOK NOTE WHAT YOU LEARNED TODAY AND THE PROGRESS ON YOUR FINAL PROJECT.

MODULE FOUR: INTRO TO UNITY PART 1 OR SKETCHFAB

Module 4: Intro to Unity Part I or Sketchfab

Learning Objectives

By the end of the module, you will be able to;

- Learn how to host your AR project with different tools
- Learn about the Unity game engine and how to navigate it
- Learn how to create texture in Unity from live drawings
- Discover how to use texture in Unity for AR project

Module Outline	Estimated Time to Complete
1) Creating Phase Step 3: Getting started with Unity or Sketchfab website	30 mins
2) Activity #1: Creating texture	15 mins
3) Lesson 2: Using texture in Unity	25 mins
4) Reflection (Record Book)	30 mins
	Total = 1 hour 40 mins

Homework

Creating Phase Step 3: Getting started with Unity or Sketchfab website

Activity #1: Creating texture

KEYWORDS

ASSETS	include everything that can go into a game, including 3D models, sprites, sound effects, music, and code.
ALIGN	place or arrange things in a straight line.
ANGLE	a figure formed by two rays, called the sides of the angle, sharing a common end-point, called the vertex of the angle. It also measures the amount of turn an object is rotating, for example: 90 degrees (also called a "right angle.")
FLIP	create the mirror image of an object or turn it over along an axis.
GROUP	link two or more shapes together.
IMPORT	to bring a file from a different program into the one you're using.
LOGO	a symbol or other design to represent a group/thing.
MARKER	two dimensional symbol or image that allows the AR software to project a virtual image or text.
OBJ	this file type is capable of representing a greater degree of texture and color and, as a result, is more commonly used for animation or with high-end printers that can control color.
OUTLINE	a line or set of lines enclosing or indicating the shape of an object in a sketch or diagram.
PLANE	a flat surface.
PRE-FABS	a pre-made grouping of models and textures ready to use.
PRIMITIVE (OR SHAPE)	a starting point or building block for 3D design. These shapes can be added, sub-tracted, and combined with one another to build just about anything. They include: Cube (Box), Cylinder, Tube, Sphere, Torus, and Cone.
ROTATE	to move in a circle around an axis or center. When you select an object, the arrows are for rotation. You can rotate on any of the planes.
SCALE	change the size of an object while maintaining its original proportions.
SHORTCUT	computer keys that help provide an easier and usually quicker method of navigating and executing commands in computer software programs.
X, Y, AND Z AXES	an axis is an imaginary line about which an object can rotate, which also serves as a
ZOOM	

REFERENCES
Instructables. "How to Teach the Language of 3D Modeling and Design." Instructables, Instructables, 27 Sept. 2018, www.instructables.com/id/How-to-Teach-the-Language-of-3D-Modeling-and-Desig/.

CREATING PHASE STEP 3:

GETTING STARTED WITH UNITY OR SKETCHFAB WEBSITE

STEPS TO CREATING A FLOATING FARM

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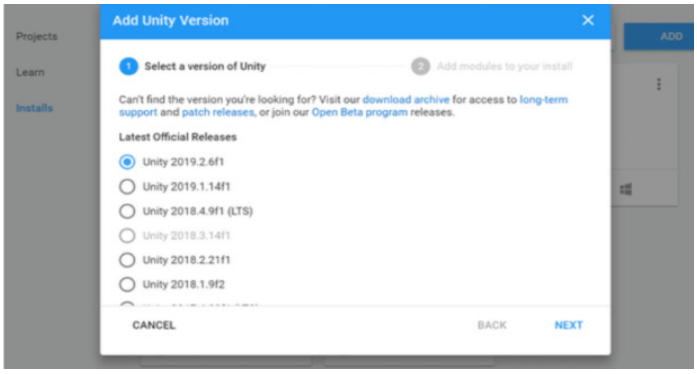
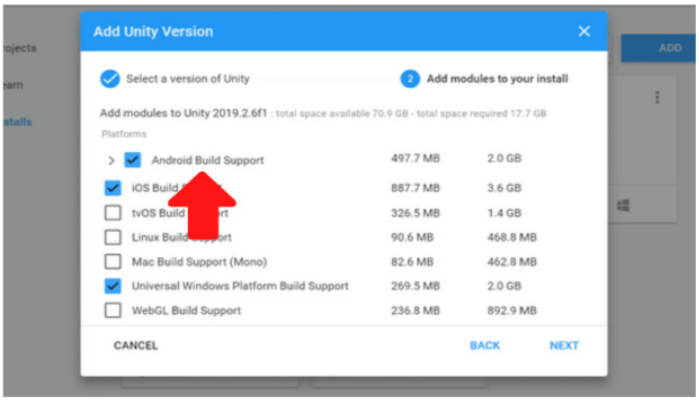
SETTING UP UNITY



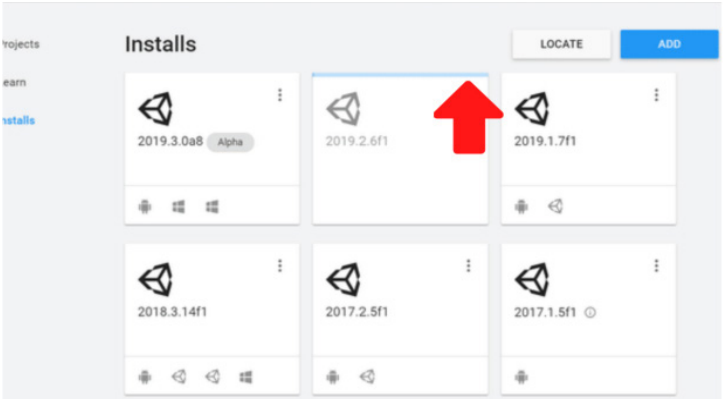
Download the Unity Hub. This will allow you to work between versions if you already have Unity installed or would like to work with a different version. It will also allow for an easier installation of the SDK. This project uses Unity 2019.

Unity Hub: https://unity3d.com/get-unity/download



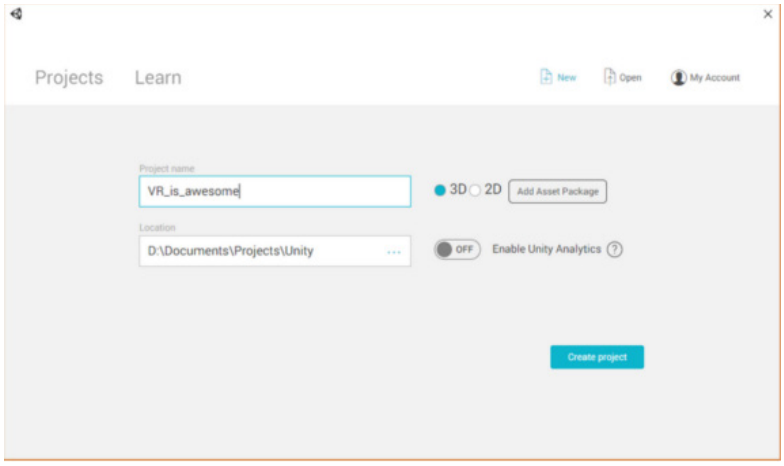
After choosing a version of Unity, be sure to select the Android Build support and select the settings beneath it if you are exporting to an Android tablet/device. For iOS, select the iOS Build support. Make sure you have Xcode installed if you are using a Mac.

If you do not have a mobile or tablet device to export your app to, you can also use your computer's webcam to test your scene. Unity and Vuforia do not have the capability to export AR to the web at this time.

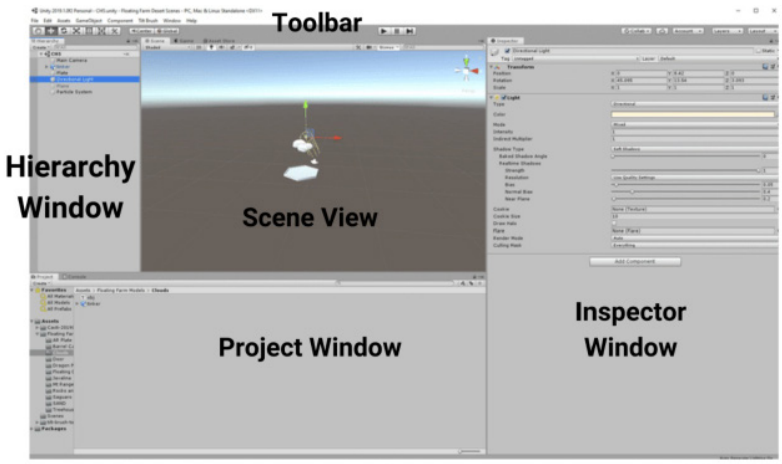


If you forgot to install the settings to export to a device (in the steps above) you can always go back to the Unity hub under "Installs."

SETTING UP UNITY



This is what you will see when you log in for the first time. Click to create a "new" scene, give it a name, and away we go!



When you open your first project the screen will look like the above image. Each area has a certain function:

"Toolbar" is to work with the models/effects you put into your game.

"Scene View" is to let you place objects/see what your game will look like.

"Inspector Window" allows you to modify the smaller details of models/effects.

"Hierarchy Window" is like a list of what is currently places in the "Scene View" or scene.

"Project Window" is like a folder on the computer that stores all of the information, models, and pre-made settings you make as you work on your project.

UNITY NAVIGATION

Images retrieved from Unity Manual https://docs.unity3d.com/Manual

Toolbar

The **Toolbar** consists of seven basic controls. Each relate to different parts of the Editor.

Transform Tools – used with the Scene View

Transform **Gizmo** Toggles – affect the Scene View display

Play/Pause/Step Buttons – used with the Game View

Cloud Button - opens the Unity Services Window.

Account Drop-down - used to access your Unity Account.

Layers Drop-down – controls which objects are displayed in **Scene** View

Layout Drop-down – controls arrangement of all Views

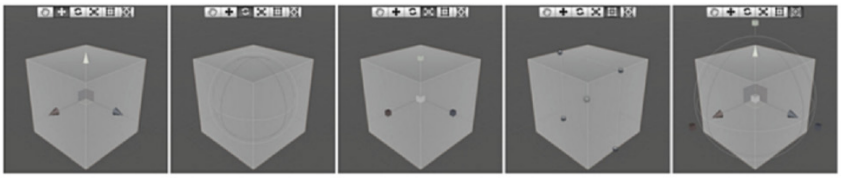
Move, Rotate, scale, and rect transform

Highlighted in red the settings to move an object in the Unity editor are:

- **Move**
- **Scale**
- **Rotate**
- **Rect Transform**
- **Transform Gizmos**

Each of these will allow you to move your models or particles in some way

MOVE	SCALE	ROTATE	RECT TRANSFORM	TRANSFORM GIZMOS



MOVE: Move allows you to do just that. You can move your object back, forth,left, right, up, and down.

SCALE: You can resize your object to be bigger or smaller

ROTATE: You can spin your object to a certain angle

RECT TRANSFORM: You can alter the size of your shape by pulling on certain edges

TRANSFORM GIZMOS: All of the buttons above put into one!

UNITY NAVIGATION

Images retrieved from
Unity Manual
https://docs.unity3d.com/Manual

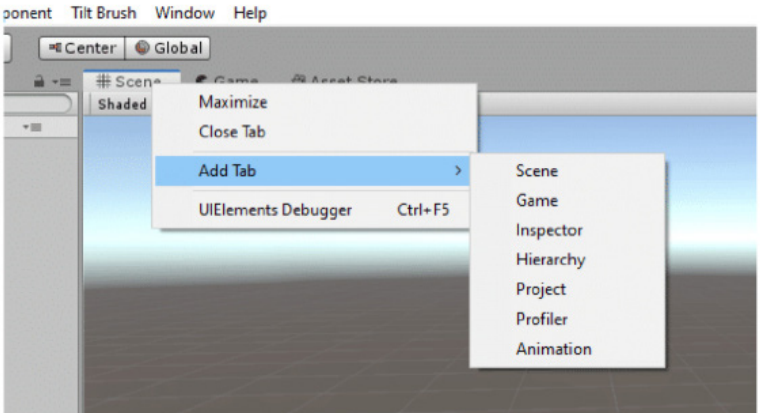
Mouse Navigation:

Alt + Left Mouse = Orbit
Shift + Ctrl + Alt + Left Mouse = Drag
Alt + Left Mouse = Orbit

Shortcuts:

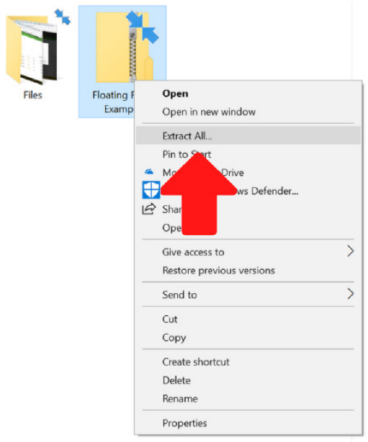
Q = Hand
W = Move
E = Rotate
R =Scale
Z =Pivot Mode
X = Pivot Rotation
Up/Down Arrow (Key) = Zoom
Left/Right Arrow (Key) = Move

In the Unity editor there are many different kinds of tabs. These tabs are windows into different tools you can use to edit your project.



IMPORTING MODELS

Images retrieved from Unity Manual
https://docs.unity3d.com/Manual

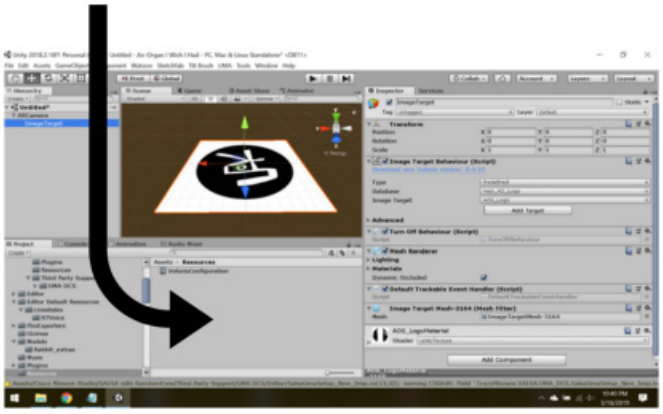


Floating Farm Example

After you download your model, it will appear as a "zipped" folder in the "downloads" section of your computer files.

Right click and choose to "extract all" files. It should then look like a regular folder. Draw this entire folder into the Project Section of your Unity scene.

You can also go to your Unity folder, open "Assets", and the paste your model files there.

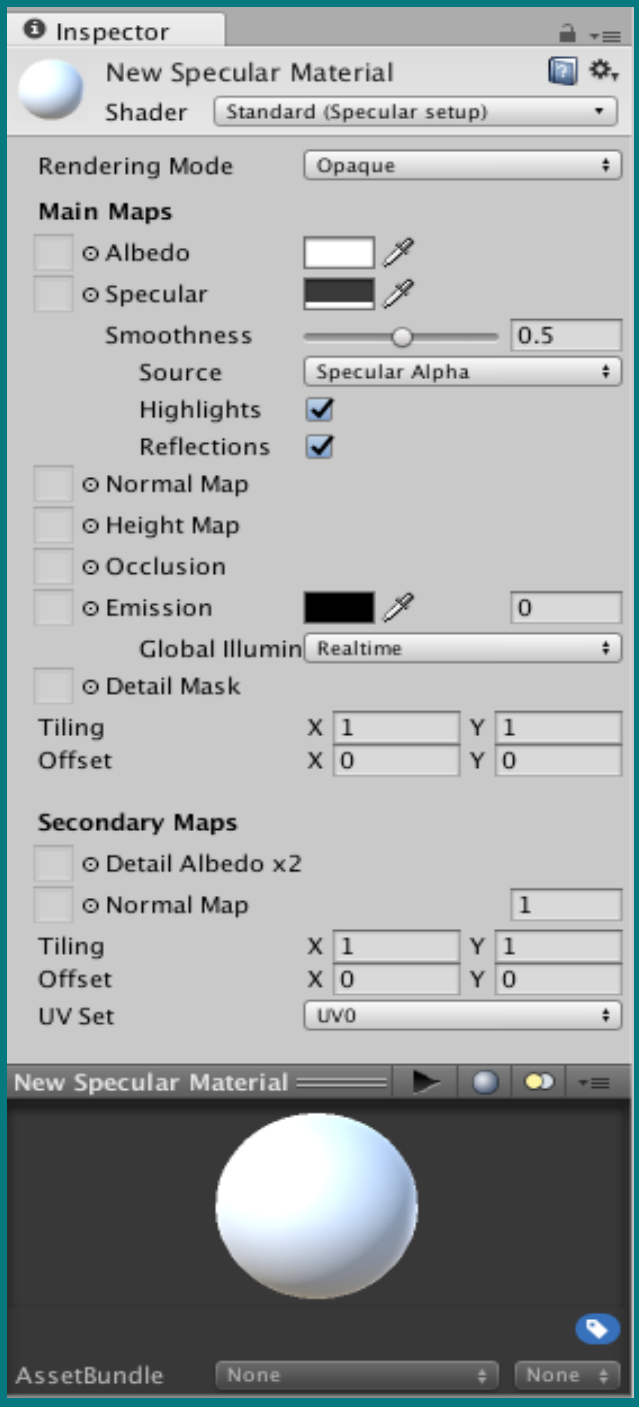


Material Settings

Rendering for material, can make transparent for PNGs

To change the color of the material

Smoothness of the material

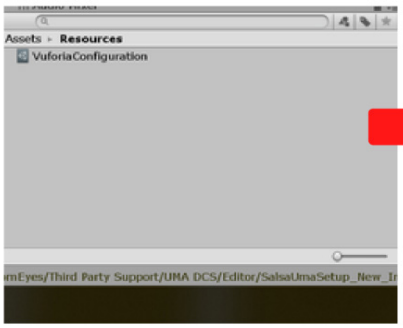


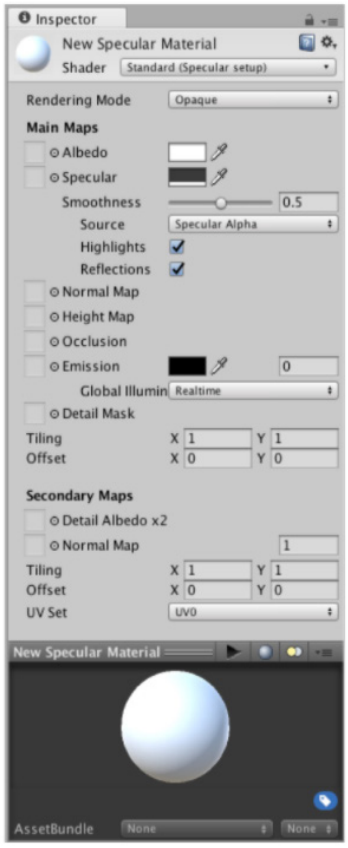
Preview of the material

Note: Materials are the coloring of a 3D model or object.

ADDING COLOR TO A MODEL

Images retrieved from Unity Manual
https://docs.unity3d.com/Manual

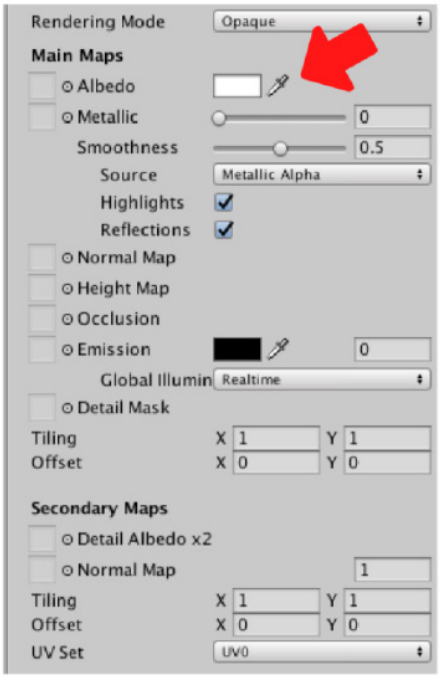




To create a color right click in the "Project" window where you just placed your model files. Select "Create New Material".

This is how you can color models in Unity. Name the material and then press on it. You should then see a menu on the right-hand side like this image. To change the color click on the white box. You can also adjust how metallic or smooth your object looks!

Drag the color from the "Project" window onto your model.



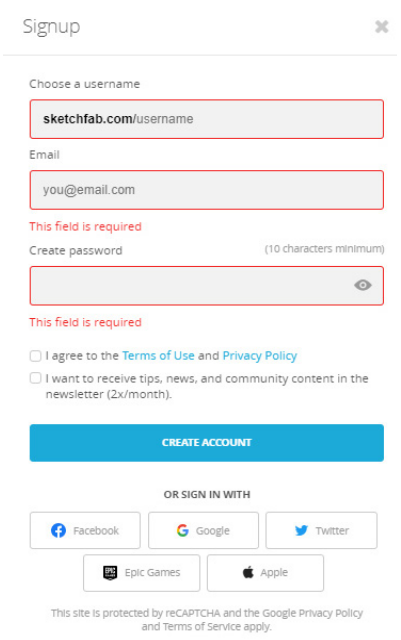
Not able to download Unity? No problem! There is an alternative website called Sketchfab where you can create an AR experience.

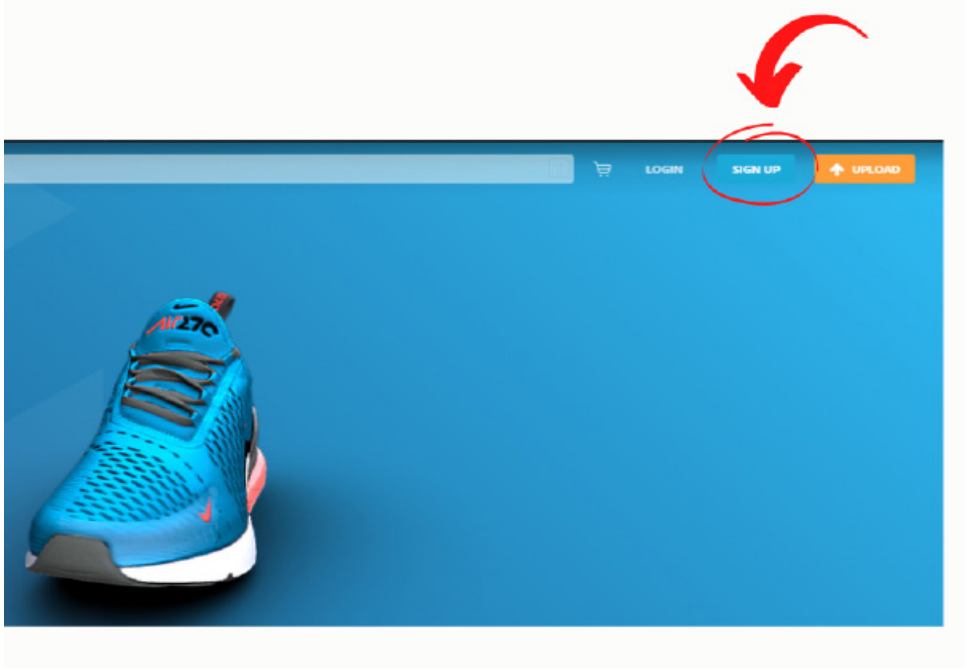
Sketchfab is a 3D model website where you can upload your own models or download ones others have made (free or for a small fee).

Sketchfab also has a free app for iOS and Android devices to place these models into an AR or VR environment.

Step 1: Creating a Sketchfab Account

1) Log into the Sketchfab website and create an account. This is so you can save 3D models and download models.





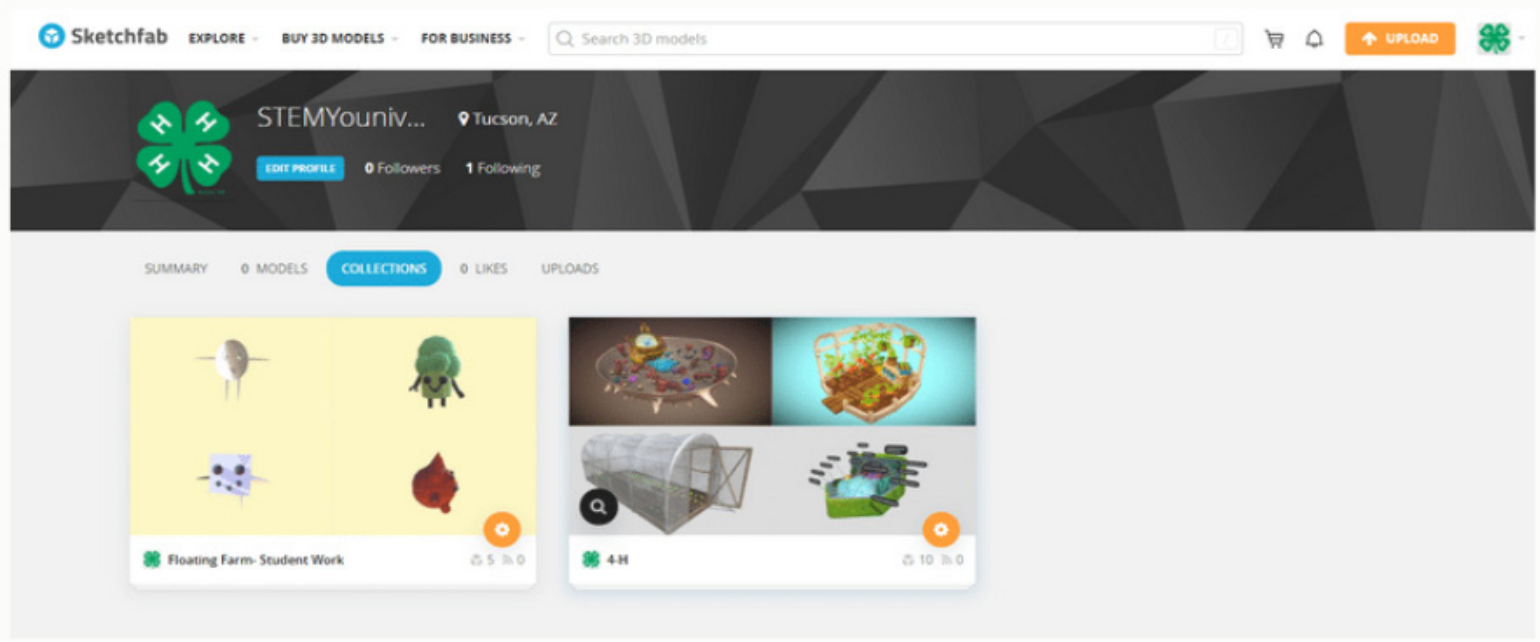
Follow us on Sketchfab! At https://sketchfab.com/4-H_STEM_YOUniversity

Step 2: Creating a model collection

If you are going to be creating your own playlist and not using one of the pre-made ones in the STEM YOUniversity account skip to "Playlist Creation Exercise". If you would like to use a pre-made playlist continue to the instructions below

Go to the 4-H STEM YOUniversity Sketchfab account at https://sketchfab.com/STEM_YOUniversity

On the left-hand side, click on the Collections tab. Here you will find the different playlists saved. Skip ahead to Step 4: Trying out the Sketchfab app



Step 3: Collection creation exercise

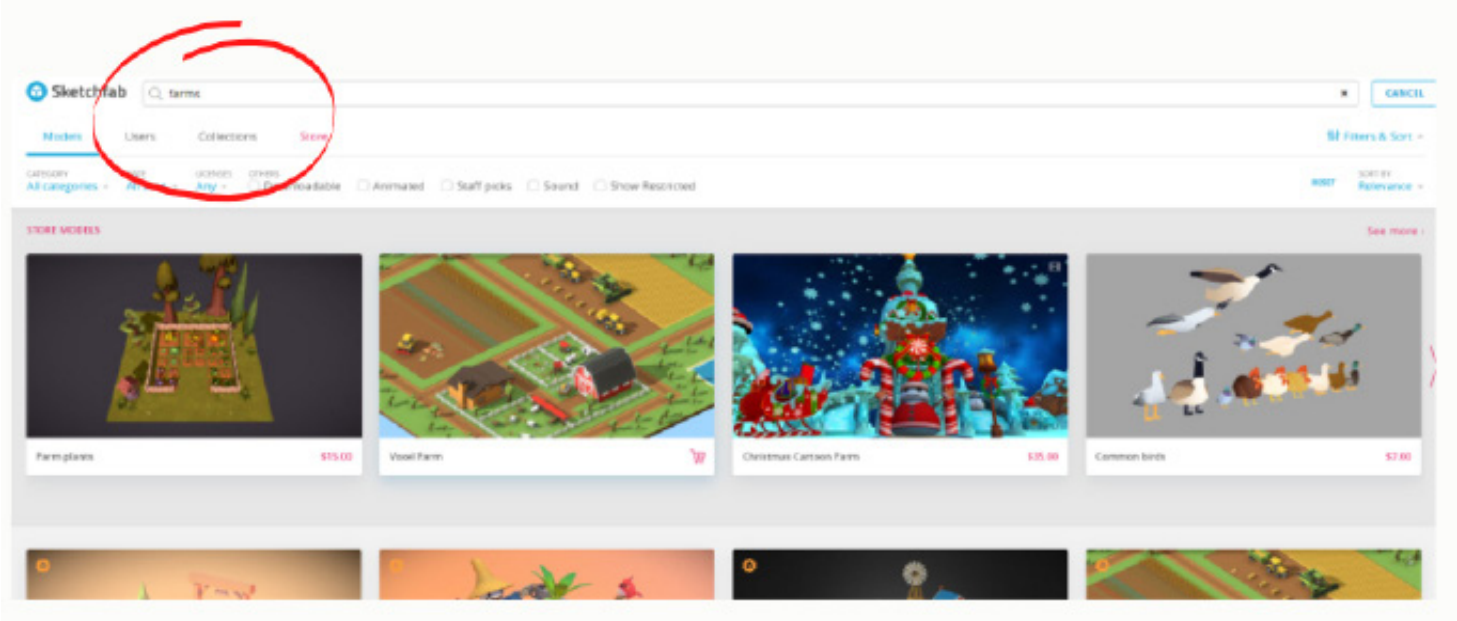
Please write a few sentences for the following

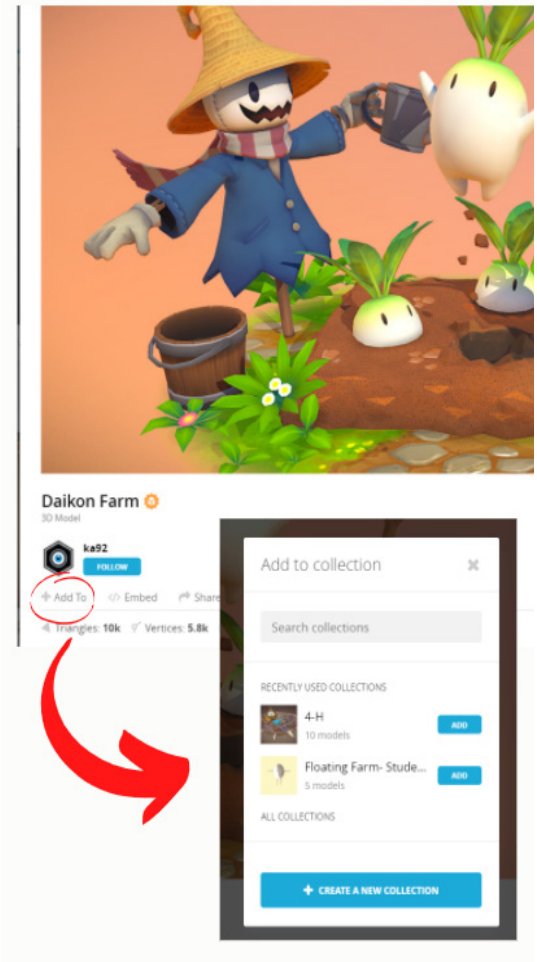
1. List your interests and skills as single words. The reason for this is the Sketchfab search engine (when you are looking up models) tends to bring up more variety if you keep the words placed into the search engine short. Single words bring up the most options in models.

2. What other 4-H projects are you working on? Do you have any interests or skills that you would like to share with the community? How can these be demonstrated through 3D models?

Step 4: Creating a collection of 3D models on the Sketchfab website

After coming up with a few different ideas for models from the exercise, use the search bar at the top of the Sketchfab website to find models to add to your collection.





To add a model to a playlist to view later, click on the image and go to the lower left-hand corner to "Add to"

From there, a window will pop up. You can add to your current collection or you can create a band new collection.

Repeat these steps until you have around 5-10 models in your playlist to view.

Step 5: Trying out the Sketchfab app

Download the Sketchfab app:

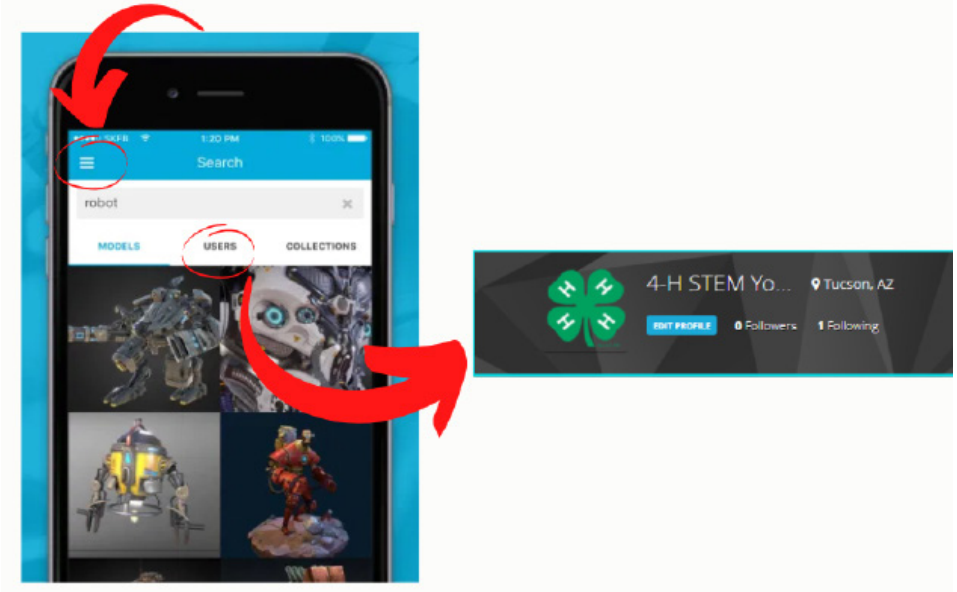
https://sketchfab.com/mobile

Log in using your credentials (so you can find your playlist) OR look up the 4-H STEM YOUniversity account by clicking on the lines on the left-hand side of the app and clicking on "Search"

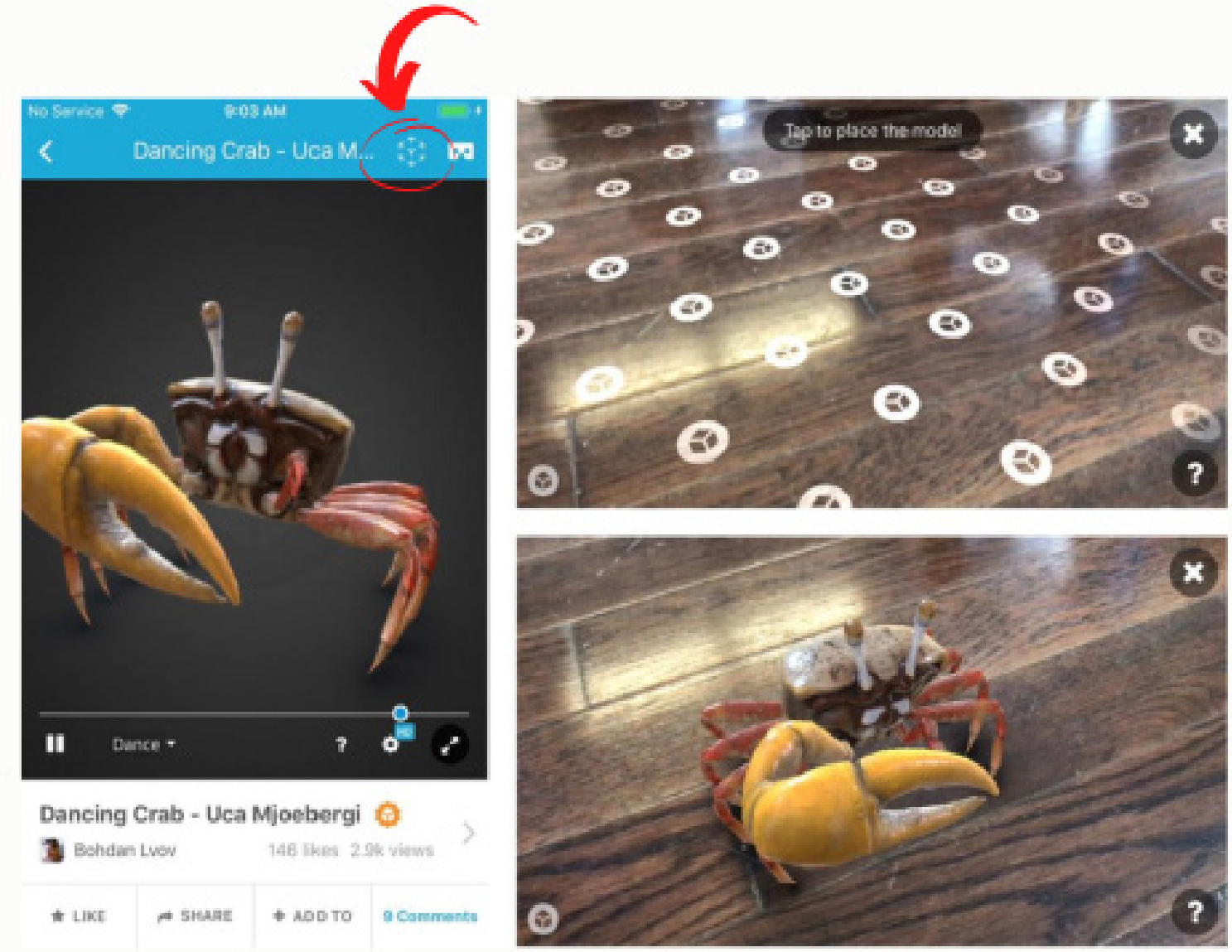
Under search type in "4-H STEM YOUniversity" and you will then select the "Users" tab

Under the "Users" tab search for the profile with the 4-H clover logo.

You can then access the playlists listed under this account to showcase to users.



To present an item as an AR object, select the cube in the app in the upper right-hand corner and scan a surface to place the model on top!



ACTIVITY #1: CREATING TEXTURE

Module 4
Slide 12

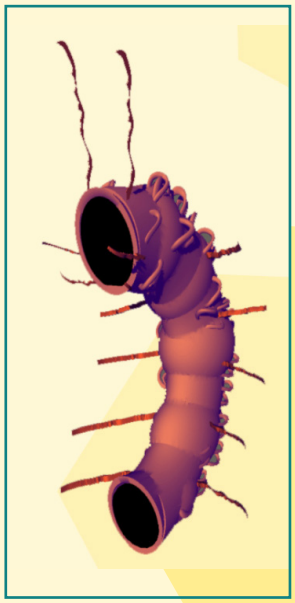
Textures or 2D images can be used for many things in the Unity editor. They can be used for skins, backdrops, shaders, and unique cutouts for characters or environments. Textures are NOT the same as AR markers. Textures are just pictures. AR markers are images that specifically tell a software to generate virtual content.

Experiment with different kinds of patterns and shapes. It's better to have a variety of options, though one image can have multiple uses.

For example, the image to the right was used as a 2D backdrop for the scene "The Impastar Monster".

File Name: __Impasta Bug__

Example of 2D backdrop being used for environment



Impastar Monster

Designing textures

DRAW SOME TEXTURES OR SHAPES YOU WOULD LIKE TO USE IN YOUR VIRTUAL ENVIRONMENT

File Name: _____ File Name: _____ File Name: _____

File Name: _____ File Name: _____ File Name: _____

File Name: _____ File Name: _____ File Name: _____

LESSON 3: USING TEXTURE IN UNITY

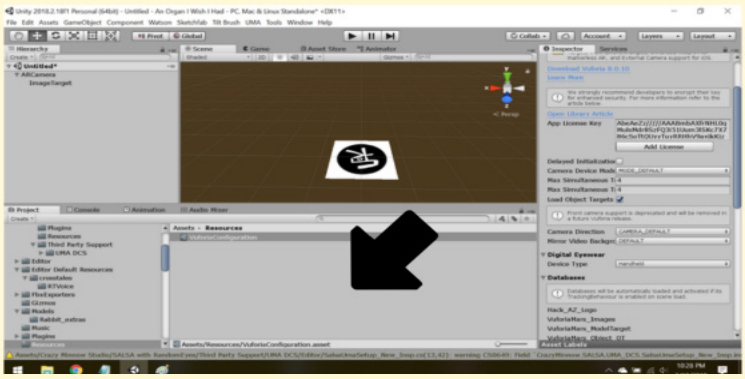
Module 4
Slide 11

To use the textures you created “cut” or “crop” the boxes and photograph or scan them in order to save them as JPEG or PNG files.

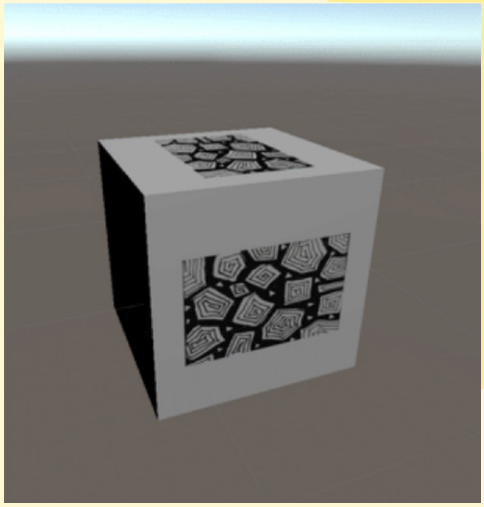
You can also use programs such as MS Paint or Online PNG to create textures.
https://onlinepngtools.com/crop-png

File Name: __Impasta Bug__

Save each texture box as a separate PNG. Drag the files into the “Project Window”



You can then drag the image right on to the 3D model for which you want to use it. The texture can also be placed onto flat surfaces or used as a background. These are NOT the same as your image target (marker AR).



4-H Record Books

Please leave the duration of class for students to fill out their project record book!

THINGS TO CONSIDER FOR YOUR RECORD BOOK:

- Project Goals
- Project Activities
- Project Accomplishments
- Project Inventory
- Project Inventory and Expense Record
- Financial Summary

REFLECTION (RECORD BOOK)

• LEARNED ABOUT THE UNITY GAME ENGINE AND HOW TO NAVIGATE IT OR SKETCHFAB WEBSITE
• LEARNED HOW TO CREATE TEXTURE IN UNITY FROM LIVE DRAWINGS
• DISCOVERED HOW TO USE TEXTURE IN UNITY FOR AN AR PROJECT

IN YOUR RECORD BOOK NOTE WHAT YOU LEARNED TODAY AND THE PROGRESS ON YOUR FINAL PROJECT.

MODULE FIVE: INTRO TO UNITY PART 2 OR SKETCHFAB

Module 5 : Intro to Unity Part 2 or Sketchfab Website

Learning Objectives

By the end of the module, you will be able to;

- Learn how to set up unity for vuforia to use your drawn markers in your ar app
- Learn how to test an ar app in unity
- Review the guidelines for the final project

Module Outline	Estimated Time to Complete
1) Creating Phase Step 4: Setting up AR scene in Unity or Sketchfab website	45 mins
2) Reflection (Record Book)	30 mins
	Total = 1 hour 15 mins

Homework

Creating Phase Step 4: Setting up AR scene in Unity or Sketchfab website

CREATING PHASE STEP 4:

SETTING UP AR SCENE IN UNITY OR SKETCHFAB

STEPS TO CREATING A FLOATING FARM

Planning Phase
Module 1 Step 1: Forming a team
Module 1 Step 2: Brainstorming Your Farm
Module 1 Step 3: Scheduling

Creating Phase
Module 2 Step 1: Creating 3D models
Module 3 Step 2: Creating AR Markers
Module 4 Step 3: Getting started with Game Engine Unity or Sketchfab website
Module 5 Step 4: Setting up AR scene in Unity or Sketchfab website
Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene

Presenting Phase
Module 7 Step 1: Preparing Your Presentation
Module 8 Step 2: Presenting Your AR Floating Farm Project
Module 8 Step 3: Publishing Your AR Floating Farm Project

Creating Phase Step 4: Setting up AR Scene in Unity

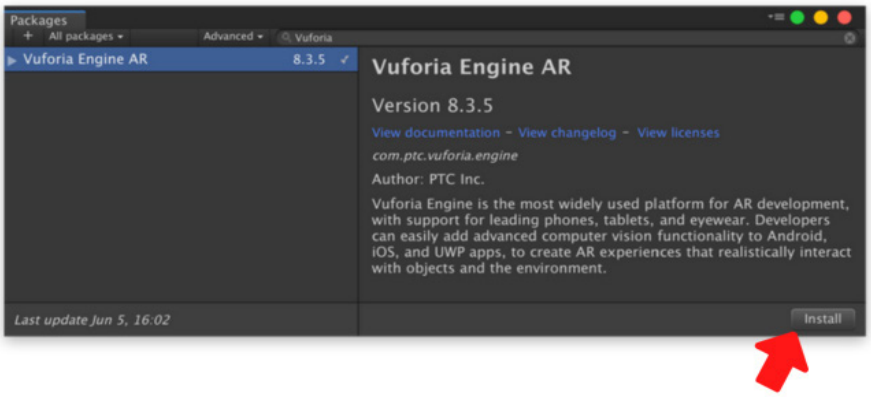
First you will need to activate Vuforia in Unity. To do this:

1) Go to the Window tab

2) Select "Package Manager"

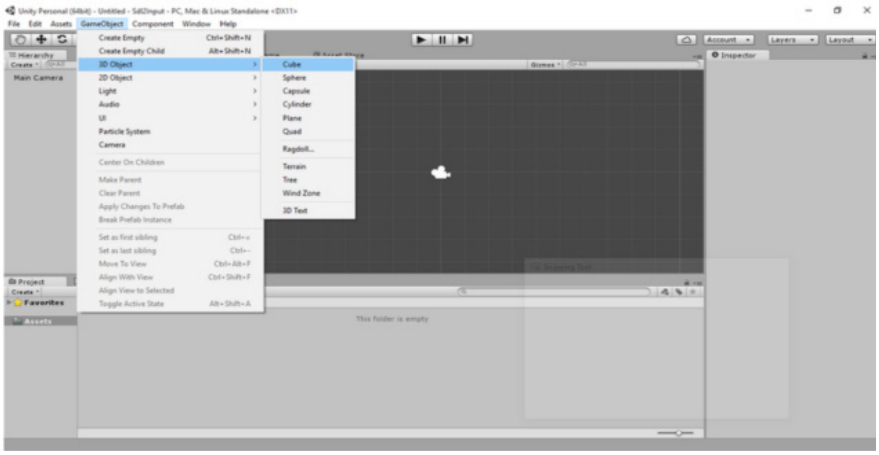
3) At the top left of the Package Manager be sure the selection box says "All Packages" (as shown with the red arrow for the image on the right)

From here scroll downwards until you find the Vuforia Engine AR. Click on the Install button to import the package. This may take a while, so you may want to take a break at this point while the files install.

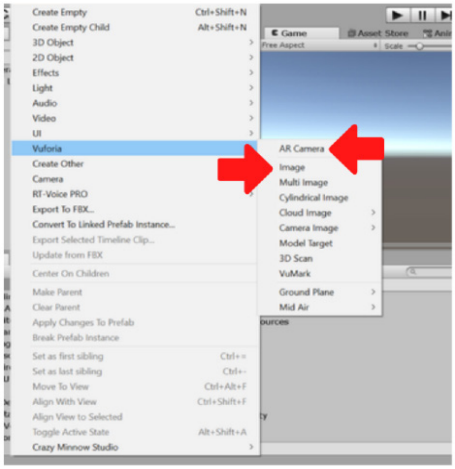


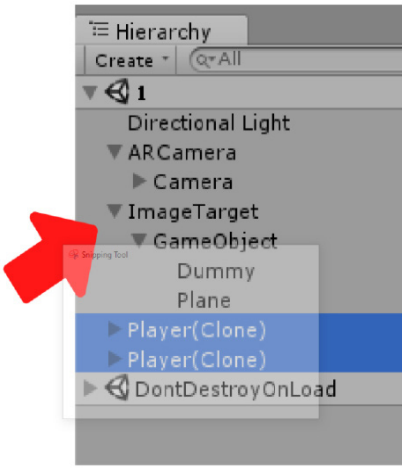
Creating Phase Step 4: Setting up AR Scene in Unity

Once the files have finished installing, on the left-hand side (under your Hierarchy panel) delete the plane, light, and camera as we are going to put the AR tools into the scene.

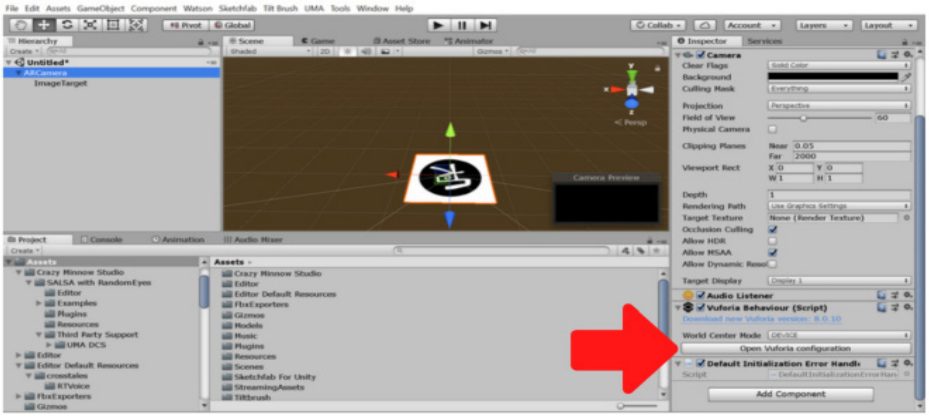


To use an image target from your Vuforia account, click on “Game Object” and select “Vuforia Engine”. Click on “AR Camera”. Return to AR Camera and click on “Image”. In the “Hierarchy” window on the left, drag “Image Target” onto “AR Camera” to make it a subset of the camera.

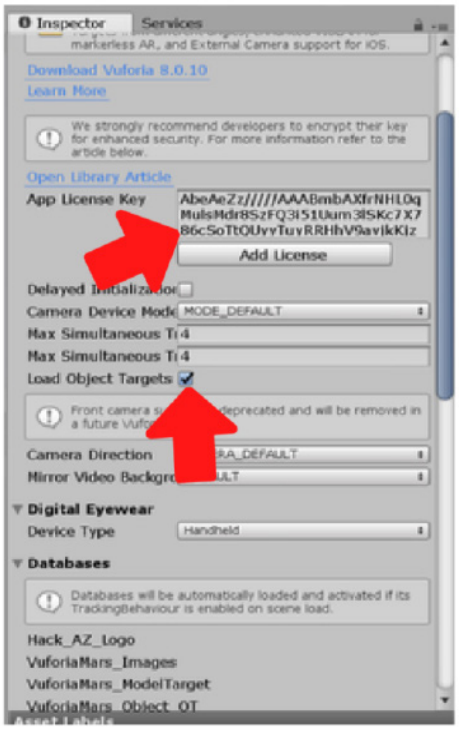


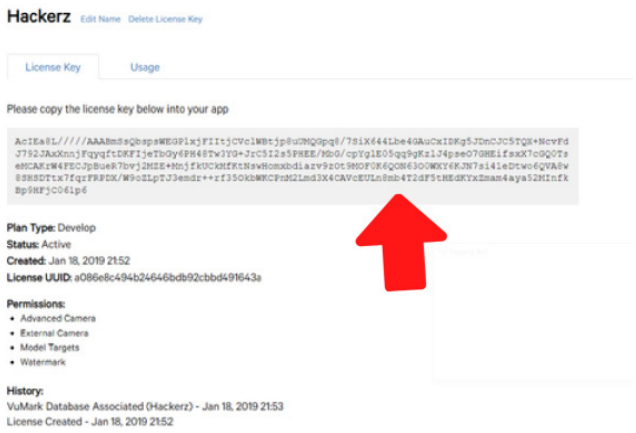


Click on “AR Camera” in the Hierarchy window. In the “Inspector” tab that opens on the right, click on “Open Vuforia Engine Configuration”.



Creating Phase Step 4: Setting up AR Scene in Unity

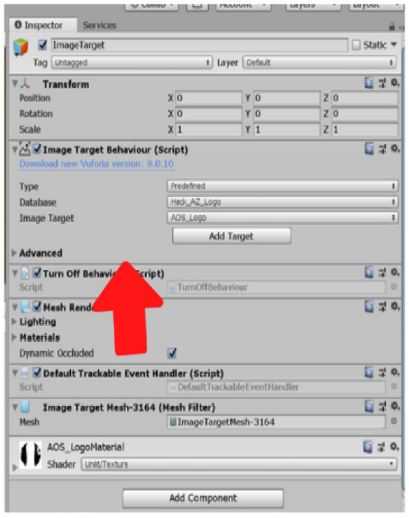




Remember the developer key you created in the Vuforia tutorial? In your Vuforia account, click on the "License key. Now paste it into the "App License Key" box in Unity.

Make sure "Load Object Targets" is checked off and the "Max Simultaneous Tracked Images" is set to 1. You can change how many Objects are in the scene, as this takes into account how many 3D models the AR software can detect at a time (only you can decide this number).

Remember the Target Image you downloaded from the Vuforia site? If you have not yet done so, double click on the package and open it in the Unity editor.



If you click on "Image Target" on the right-handed box (under AR Camera) in Unity you can then select your logo name!

NOTE: Ignore the Type setting. It needs to stay at "Predefined"

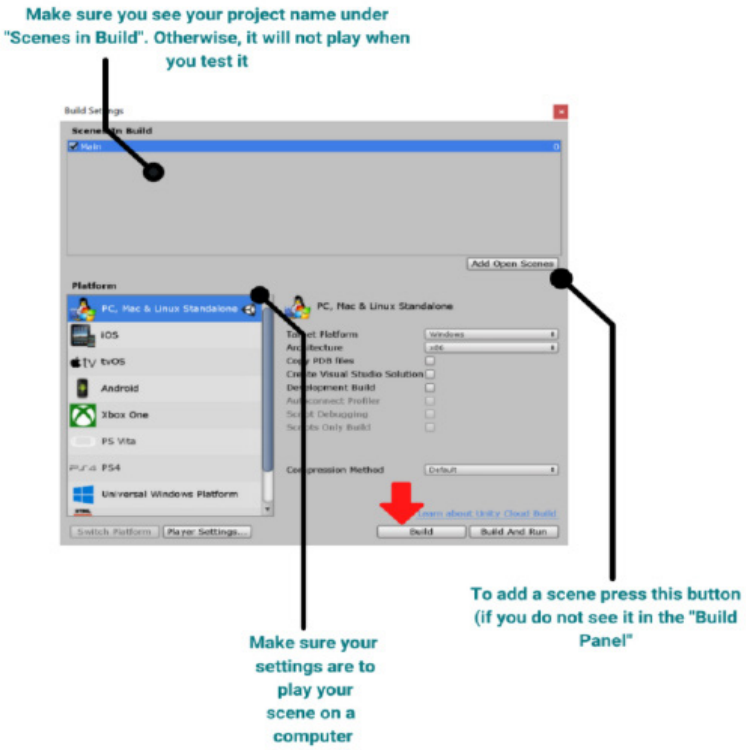
TESTING THE APP IN UNITY

INSTRUCTIONS

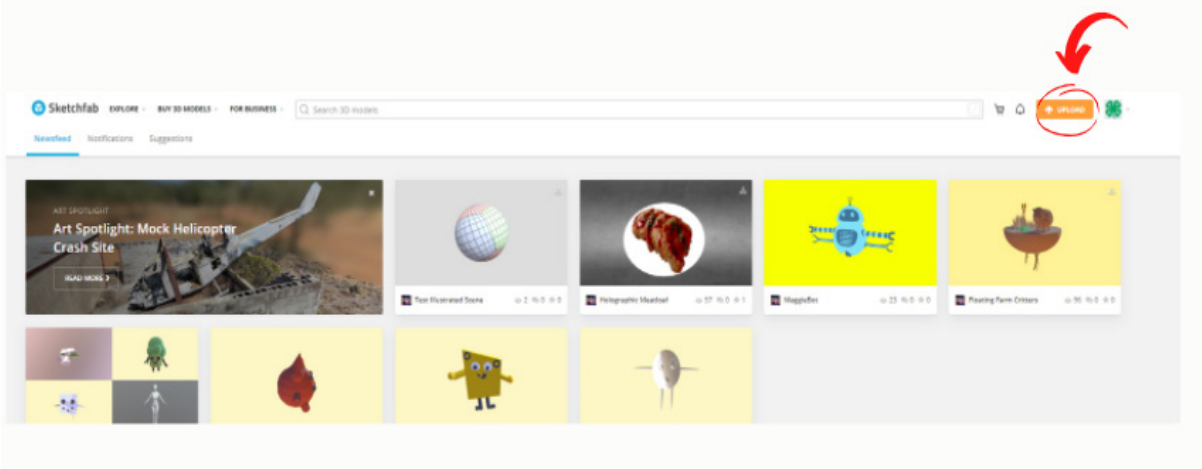
To test your scene on your computer press the play button, but first make sure you are in PC/Computer mode!

Play button located at the top of the Unity Editor

BUILD SETTINGS

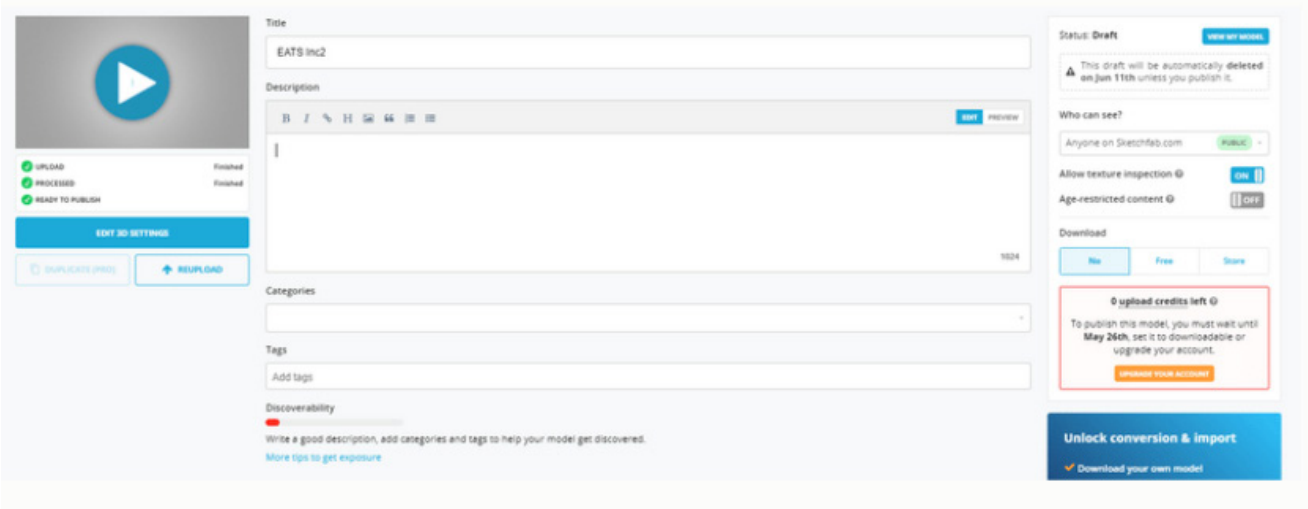


CREATING PHASE STEP 4: UPLOADING YOUR 3D MODEL TO THE SKETCHFAB WEBSITE



Once you have logged in to your Sketchfab account, go to the “Upload” button in the upper-right hand corner.

Select the GLTF (.glb) model you downloaded from the Tinkercad website. Once the upload begins, you can fill out the “Title” and the “Description”.

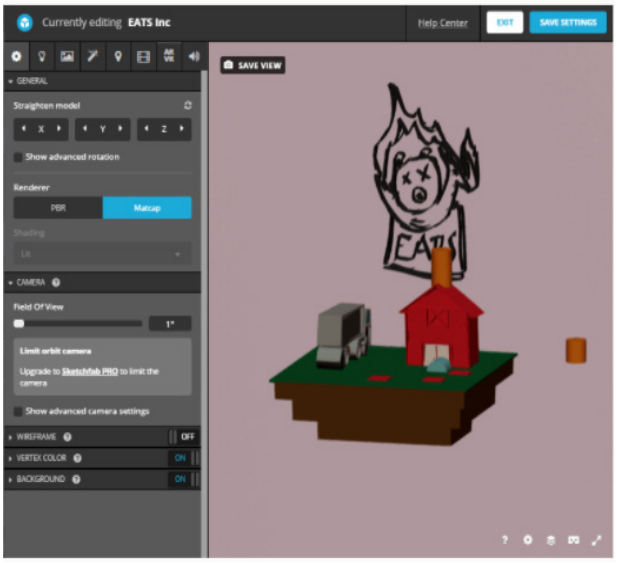


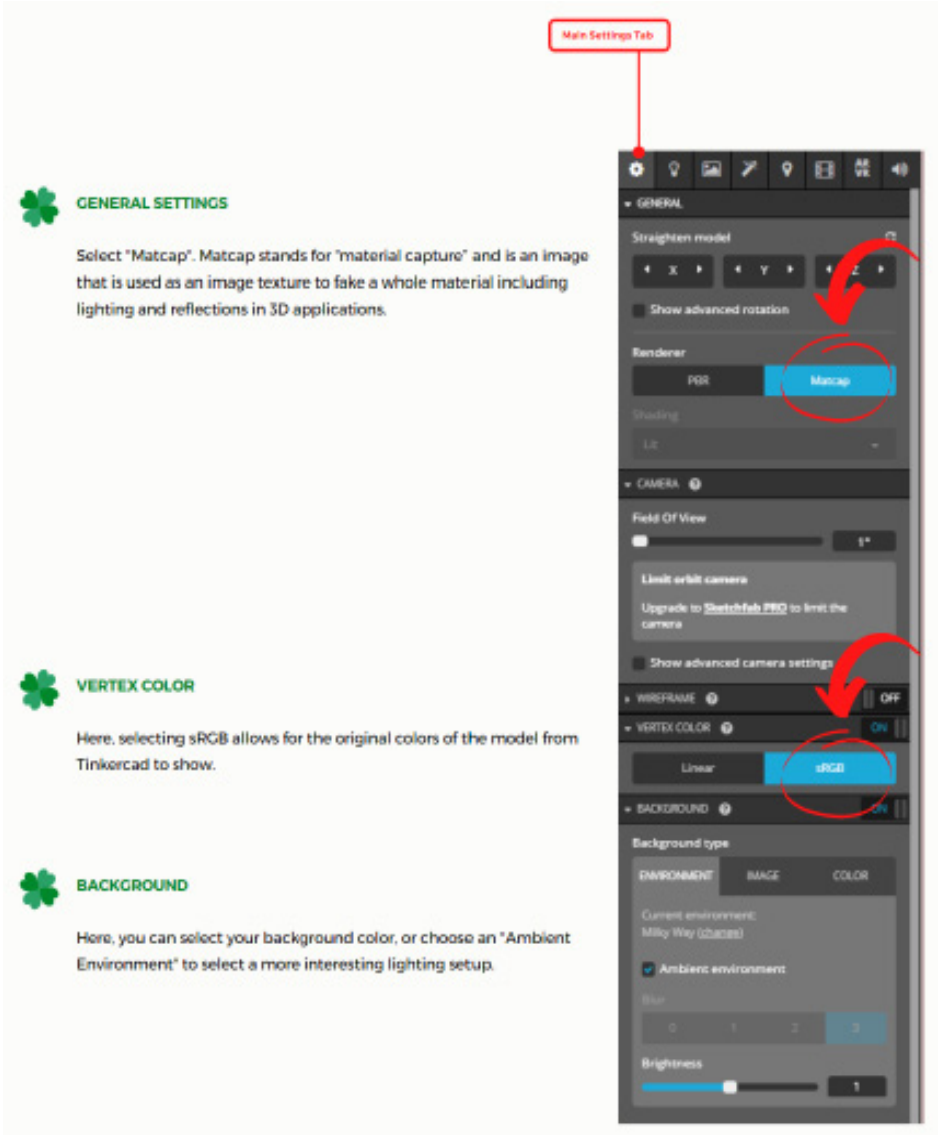
Before testing out your scene you will want to add any wanted sound effects, lighting, and fix the color on the model.

PLEASE NOTE: Sketchfab does have certain features reserved for a paid subscription

CREATING PHASE STEP 4: UPLOADING YOUR 3D MODEL TO THE SKETCHFAB WEBSITE

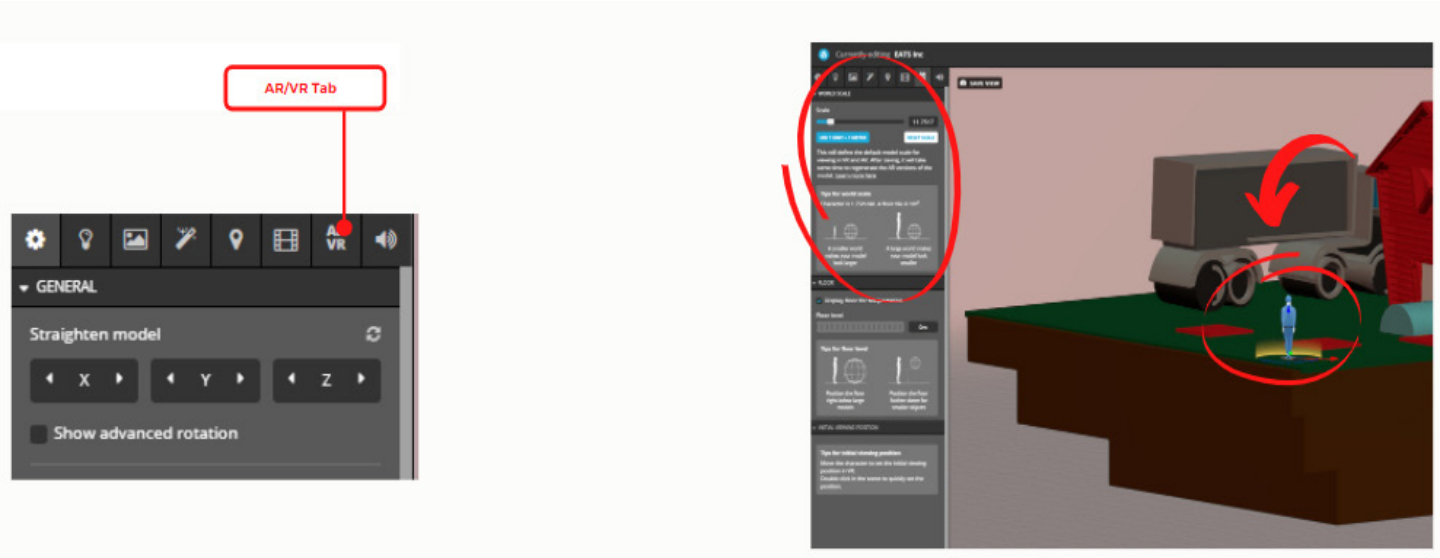
Let's begin in the main settings. Make sure you have selected the gear icon to get there. We will be setting up the color, background, and getting the color back onto the 3D model.





CREATING PHASE STEP 4: UPLOADING YOUR 3D MODEL TO THE SKETCHFAB WEBSITE

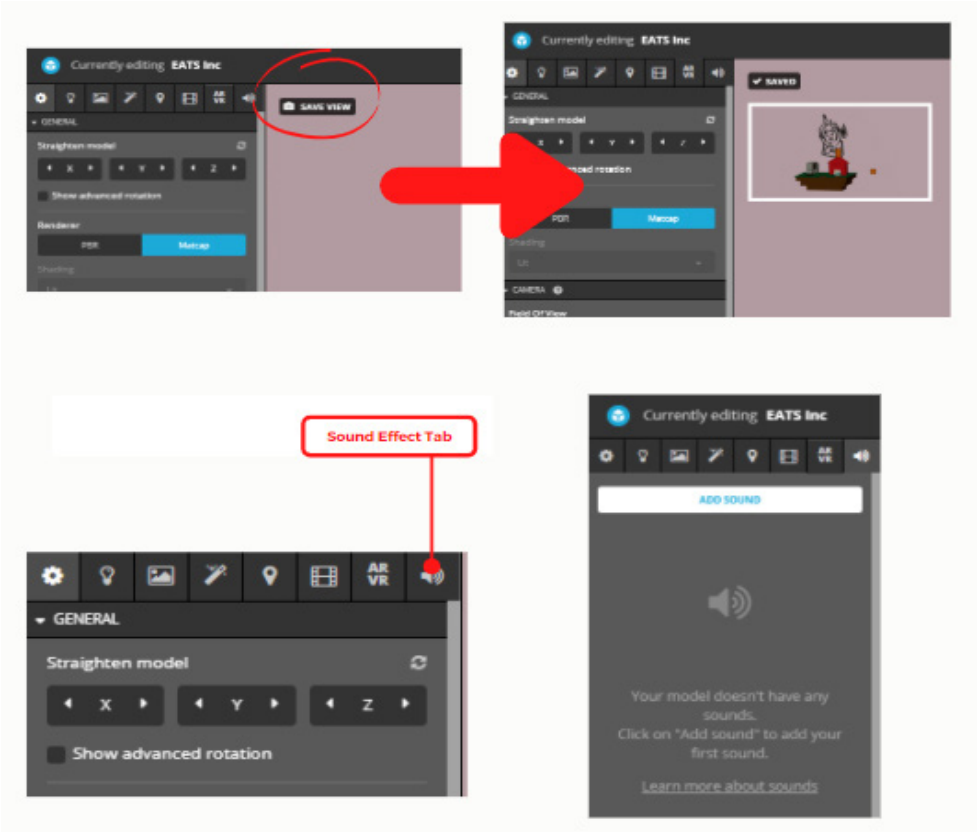
Next, you will select the AR/VR tab to manage the size of your scene when you view it on the Sketchfab app in AR/VR mode



Once you have finished setting the scale and lighting you can save a screenshot of your model using the "Save View" button.

This is how your model will appear when others look for it/ how it will be previewed on your profile.

If you would like to add sound to your scene you can select the "Sound Effect" tab and upload your file.

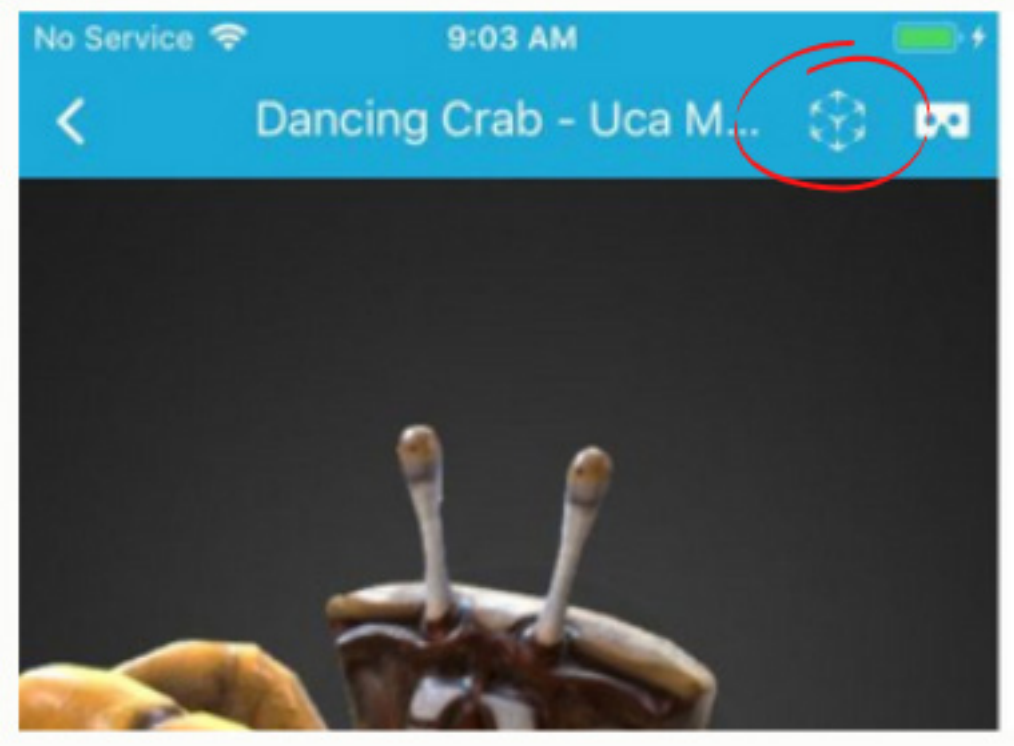


NOTICE:
As of June 2021 sound has temporarily been disabled on Sketchfab. Plan accordingly if the software or website has a feature that does not work in the meantime.

CREATING PHASE STEP 4: UPLOADING YOUR 3D MODEL TO THE SKETCHFAB WEBSITE

To view your model in AR or VR

- Download the Sketchfab app
- Log into your profile on the Sketchfab app
- Select your model and click on the AR button (transparent cube icon)
- Enjoy!



4-H Record Books

Please leave the duration of class for students to fill out their project record book!

THINGS TO CONSIDER FOR YOUR RECORD BOOK:

- Project Goals
- Project Activities
- Project Accomplishments
- Project Inventory
- Project Inventory and Expense Record
- Financial Summary

REFLECTION (RECORD BOOK)

• LEARNED HOW TO SET UP UNITY FOR VUFORIA TO USE YOUR AR MARKERS IN YOUR AR APP OR HOW TO UPLOAD YOUR 3D MODELS TO SKETCHFAB'S XR APP
• LEARNED HOW TO TEST AN AR APP IN UNITY OR SKETCHFAB

IN YOUR RECORD BOOK NOTE WHAT YOU LEARNED TODAY AND THE PROGRESS ON YOUR FINAL PROJECT.

MODULE SIX: INTRO TO UNITY PART 3 OR SKETCHFAB

Module 6: Intro to Unity part 3 or Sketchfab

Learning Objectives

By the end of the module, you will be able to;

- Learn how to add particles and sound effects in unity
- Review the guidelines for the final project

Module Outline	Estimated Time to Complete
1) Lesson 1: What are particles and sound effects?	5 mins
2) Creating Phase Step 5: Putting Sound Effects and Special Effects into your AR Scene	25 - 60 mins
3) Reflection (Record Book)	30 mins
	Total = 1 hour - 1 hour 35 mins

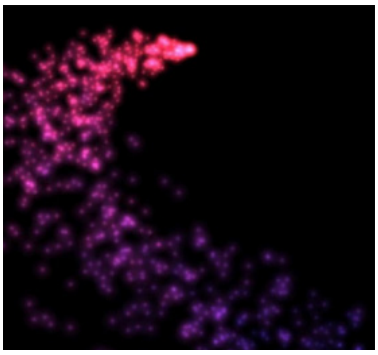
Homework

Creating Phase Step 5: Putting Sound Effects and Special Effects into your AR Scene

LESSON 1: WHAT ARE PARTICLES AND SOUND EFFECTS?

WHAT ARE PARTICLES

Particles are small objects that float around in a scene and can be altered to look like many things: rain, snow, glitter and more! A developer may use particles to create an effect or as an extra touch for their scene or model.



KEYWORDS

APPLICATION (APP)	a program that performs a particular set of tasks
EXPORT	to convert a file into another format than the one it is currently in. For example, you must export your design in order to print it.
PARTICLES	portions of matter (i.e. dust particles)
RENDER	iterations or tests that are meant to provide useful visual feedback in order to better understand and improve a design before it is actually fabricated
SIMULATE	to create a final image of a model that shows all of the surface properties that have been applied to the included objects. This process involves adding all colors, shading, and other elements, such as the physical appearance of materials,

WHAT SOUND EFFECTS?

Sound effects are noises or music that are added to a scene to make it seem more lifelike. Voice recordings are considered to be apart of the SFX (sound effects) category more commonly known as “narration”.

REFERENCES
Instructables. “How to Teach the Language of 3D Modeling and Design.” Instructables, Instructables, 27 Sept. 2018, www.instructables.com/id/How-to-Teach-the-Language-of-3D-Modeling-and-Desig/.

CREATING PHASE STEP 5:

PUTTING SOUND EFFECTS AND SPECIAL EFFECTS INTO YOUR AR SCENE

STEPS TO CREATING A FLOATING FARM

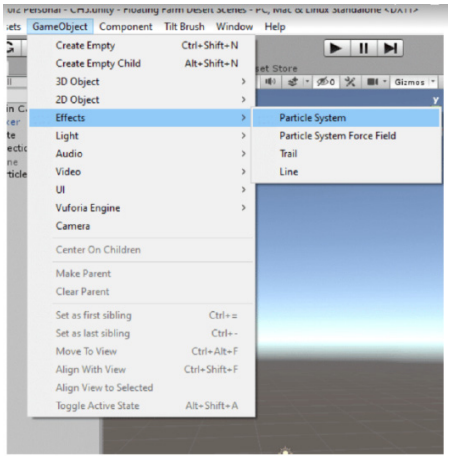
Planning Phase
Module 1 Step 1: Forming a team
Module 1 Step 2: Brainstorming Your Farm
Module 1 Step 3: Scheduling

Creating Phase
Module 2 Step 1: Creating 3D models
Module 3 Step 2: Creating AR Markers
Module 4 Step 3: Getting started with Game Engine Unity or Sketchfab website
Module 5 Step 4: Setting up AR scene in Unity or Sketchfab website
Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene

Presenting Phase
Module 7 Step 1: Preparing Your Presentation
Module 8 Step 2: Presenting Your AR Floating Farm Project
Module 8 Step 3: Publishing Your AR Floating Farm Project

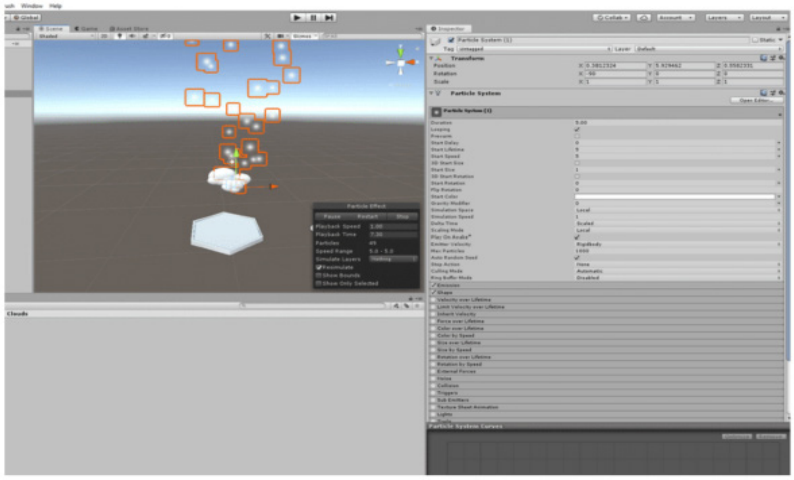
PARTICLES IN UNITY

Particles can be used to create several different effects like rain, show, or sparkles.

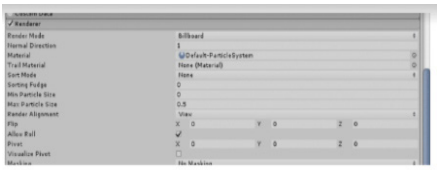


To create a particle system go to "GameObject" and select "Effects."

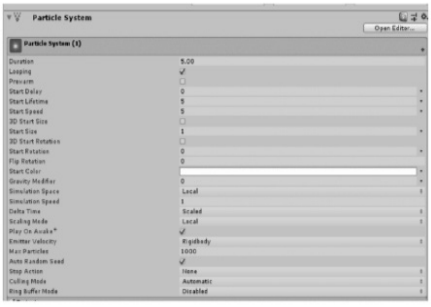
From there select "Particle System."



You can then alter the settings to achieve the desired effect.

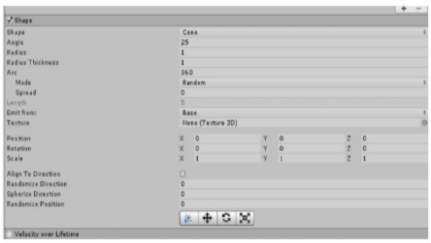


To change the material of the particles go to "Renderer" and select "Material."



To change the color of the particles go to "Particle System" and click on the white rectangular box.

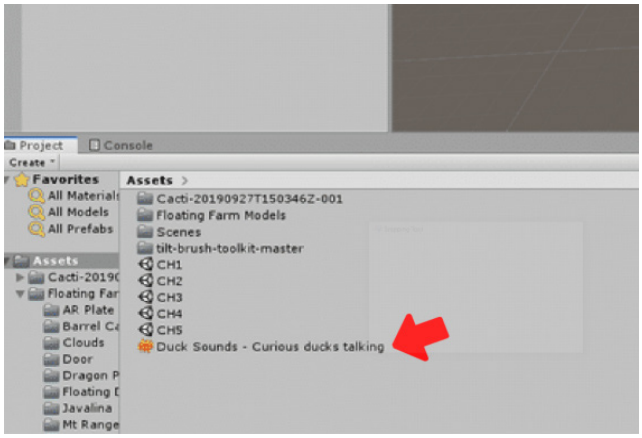
To change the particle material go to "Shape" and select "Shape."



SOUND EFFECTS IN UNITY

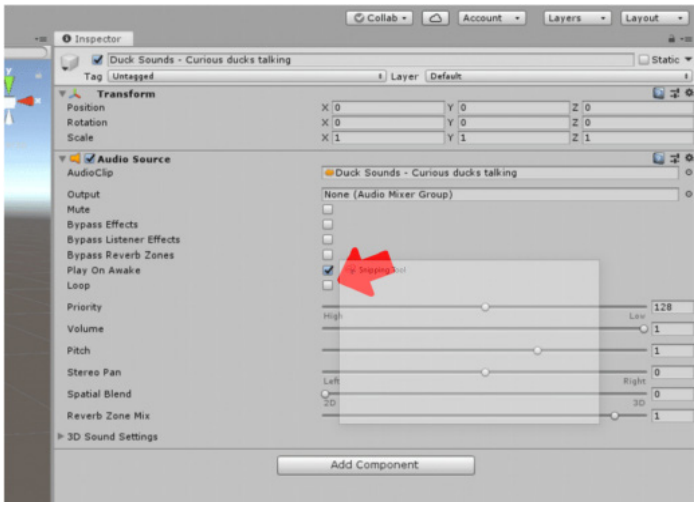
To import sounds or music simply drag the files into the “Project Window.” Acceptable file formats include:

.aif
.wav
.mp3



One example of a website for free sound effects is: https://www.bensound.com/
Drag the file into the “Hierarchy Window” on the left. You can set the sound on a loop by checking off “Play on Awake” and “Loop.”

You can also adjust the volume settings.

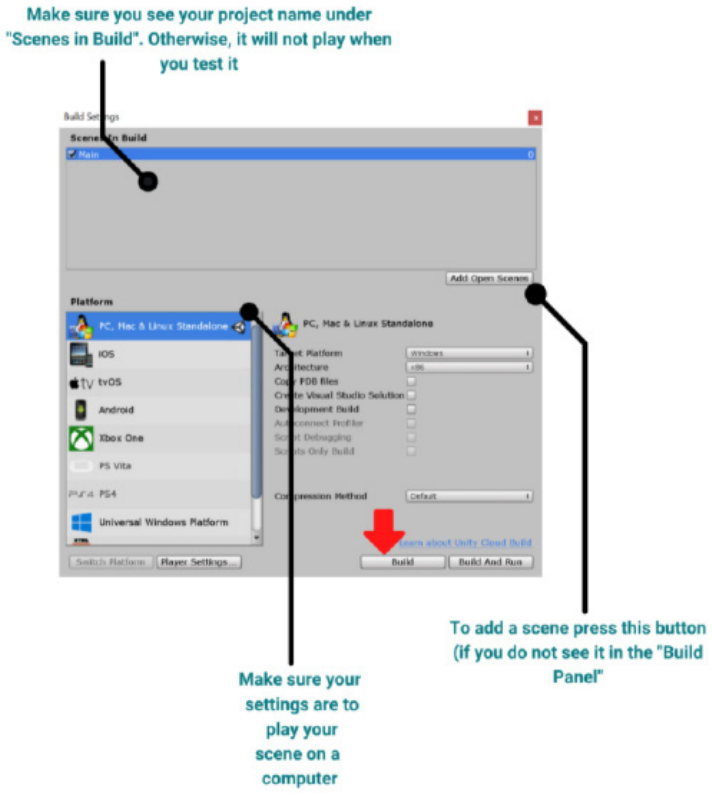


TESTING THE APP IN UNITY

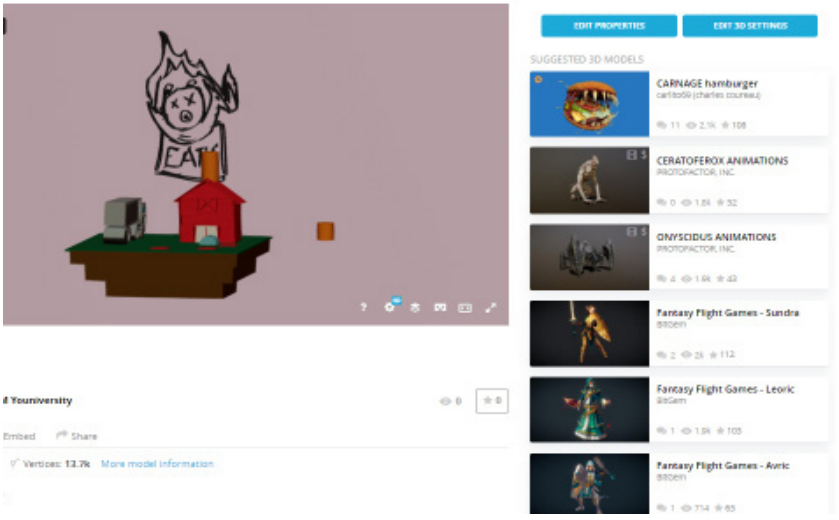
To test your scene on your computer press the play button, but first make sure you are in PC/Computer mode!

Play button located at the top of the Unity editor

BUILD SETTINGS



CREATING PHASE STEP 5: LIGHTING AND SOUND EFFECTS IN SKETCHFAB

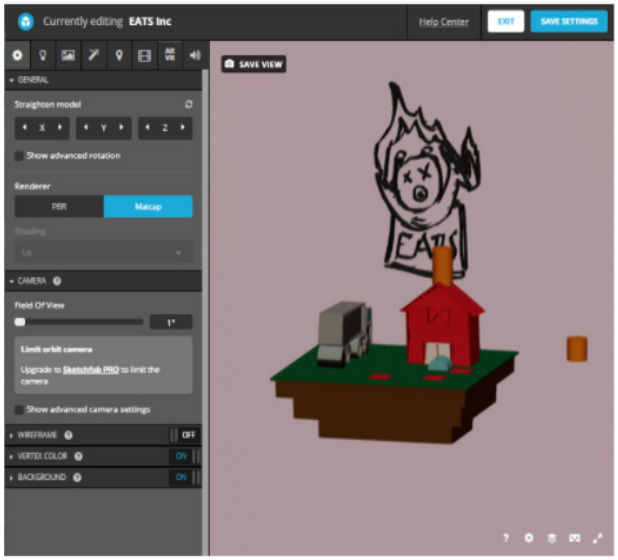


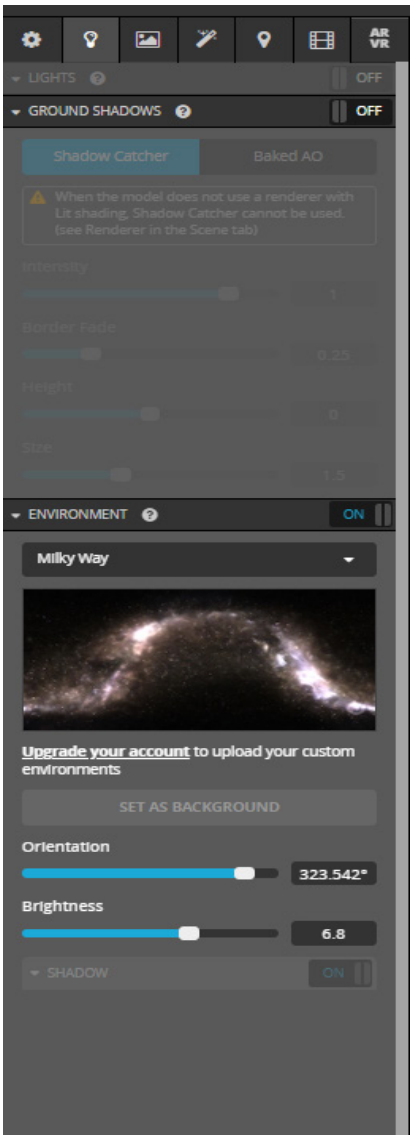
In Sketchfab to edit your sound and lighting you will go to your model and click on “Edit 3D Settings”.

From here you will be redirected to a menu to alter your model’s settings.

Click on the lightbulb icon to alter the lighting in your scene. Please keep in mind lighitng is limited for the free version of Sketchfab.

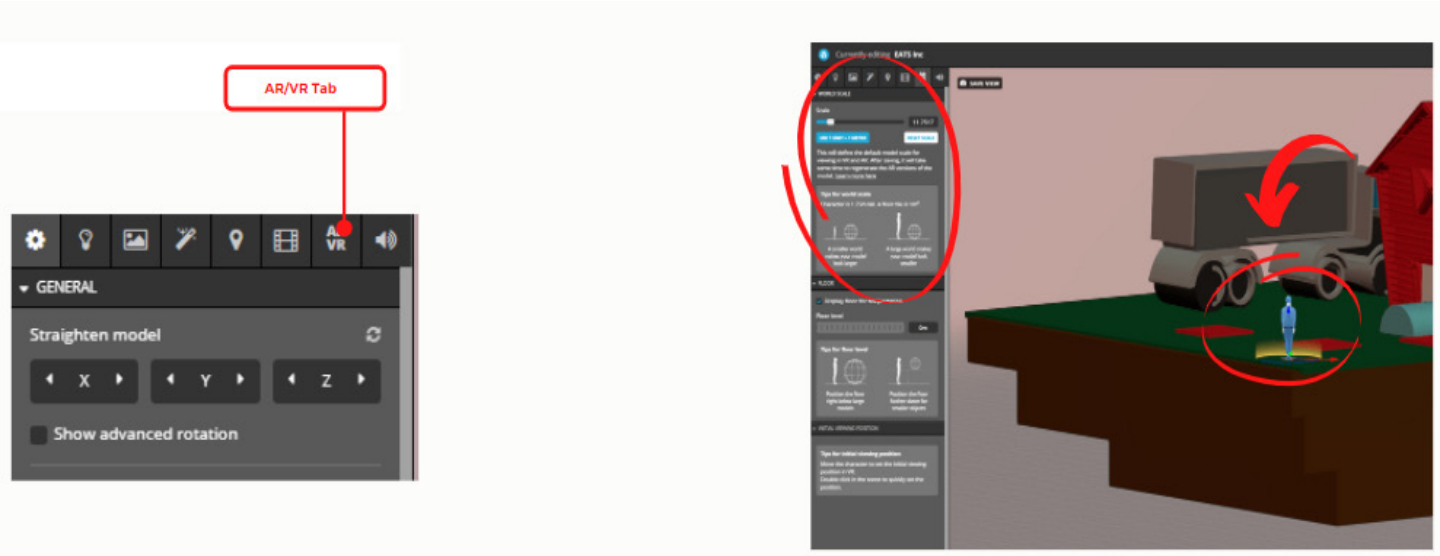
You can always go back into your 3D modeling software and re-export the model to alter colors.



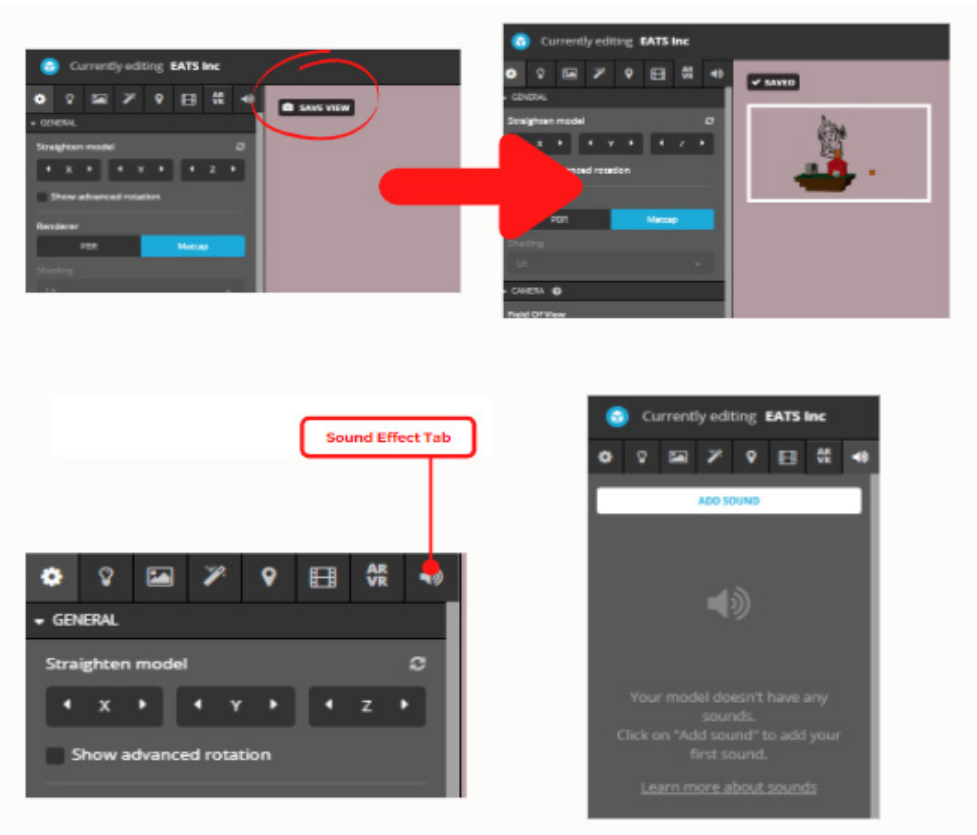


CREATING PHASE STEP 5: LIGHTING AND SOUND EFFECTS IN SKETCHFAB

Select the AR/VR tab to manage the size of your scene when you view it on the Sketchfab app in AR/VR mode



To edit sound in your scene you can select the "Sound Effect" tab and upload your file.



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- Project Accomplishments
- Project Inventory
- Project Inventory and Expense Record
- Financial Summary

REFLECTION (RECORD BOOK)

• LEARNED HOW TO IMPORT SOUND AND SPECIAL EFFECTS INTO YOUR AR PROJECT EITHER FROM UNITY OR THE SKETCHFAB WEBSITE

IN YOUR RECORD BOOK NOTE WHAT YOU LEARNED TODAY AND THE PROGRESS ON YOUR FINAL PROJECT.

MODULE SEVEN: PREPARING YOUR PROJECT PRESENTATIONS

Module 7: Preparing Your Project Presentations

Learning Objectives

By the end of the module, students will be able to;

- Review the guidelines for the final project
- Learn how to write a project statement for a final presentation

Module Outline	Estimated Time to Complete
1) Presenting Phase Step 1: Preparing your Presentation	10 mins
2) Activity #1: Project statement	25 mins
3) Activity #2: Project presentations	30 mins
4) Reflection (Record Book)	30 mins
	Total = 1 hour 35 mins

Homework

Presenting Phase Step 1: Preparing your Presentation

Activity #1: Project statement

Activity #2: Project presentations

Module 7
Slide 7

PRESENTING PHASE STEP 1:
PREPARING YOUR PRESENTATION

STEPS TO CREATING A FLOATING FARM

Planning Phase
Module 1 Step 1: Forming a team
Module 1 Step 2: Brainstorming Your Farm
Module 1 Step 3: Scheduling

Creating Phase
Module 2 Step 1: Creating 3D models
Module 3 Step 2: Creating AR Markers
Module 4 Step 3: Getting started with Game Engine Unity or Sketchfab website
Module 5 Step 4: Setting up AR scene in Unity or Sketchfab website
Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene

Presenting Phase
Module 7 Step 1: Preparing Your Presentation
Module 8 Step 2: Presenting Your AR Floating Farm Project
Module 8 Step 3: Publishing Your AR Floating

Your farm should have the following elements:

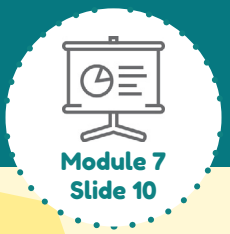
- The AR scene must have at least one character (human or non)
- The farm must produce a good or service
- The AR scene must have both 2D and 3D elements
- A narrative/story must accompany the virtual farm ineither written or spoken form. Discuss what impact the farm has and how it functions

Presentation Format

- Introduce yourself
- Name
- County
- Talk about your farm
- What/who lives on your farm?
- Is there a product the farm creates?
- What is life like on your farm?
- List the software you used
- What challenges have you come across? How have you been able to work around some of these issues?

18 USC 707

Activity #1:
Project Statement



Create a description of your farm including what it produces and life on the farm. You can do this from the perspective of a character or a creature that lives there. Discuss how you came up with the idea for your farm, some problems or times you felt stuck along the way, or perhaps other solutions that helped you create your virtual experience! *This description should be 500 words minimum.*

Optional: You can record yourself describing your farm and place it into your Unity project.

Your farm should have the following elements:

1. The AR scene must have at least one character (human or non)
2. The farm must produce a good or service
3. The AR scene must have both 2D and 3D elements
4. A narrative/story must accompany the virtual farm in either written or spoken form

Title:_____

by _____

Activity #2:

PROJECT PRESENTATIONS

Students will present the ideas for their farms and discuss their plans for the final project.

TIPS IN PREPARING YOUR PRESENTATION

When designing a powerpoint

1) One font, one color, two sizes
2) Do not crowd your slides, keep it simple
3) If you have large photos have them on their own slide
4) Do not overlap text and font
5) You can find many free powerpoint templates online

Resources

Flipgrid: Create video presentations
Google Slides: A free alternative to powerpoint slideshow
Google Jamboard: Brainstorming ideas, plan out your presentation

Presentation Format

- Introduce yourself
- Name
- County
- Talk about your farm
- What/who lives on your farm?
- Is there a product the farm creates?
- What is life like on your farm?
- List the software you used
- What challenges have you come across? How have you been able to work around some of these issues?

Floating Farm Rubric

	Exceeds Standard (5)	Meets Standard (4)	Below Standard (3)	Does Not Meet Standard (1)
Farm Identification (5)	The farm is introduced and well-defined, includes all elements	The farm is introduced, includes 2 of the 3 required elements	-little focus on farm -missing many details about the farm -has one of the required elements	-no focus - farm description is not clear -unrelated and/or off topic - little or no visuals
Presentation (5)	- excellent word choice -descriptions are the student's own writing, not from outside sources - many details included - several pictures/graphics used that relate to the theme	-student uses their own words, does not cite from other sources -ideas presented clearly - some pictures are incorporated and relate to the topic	-ideas not discussed -graphics are not thought out - no consistent theme	- not planned well - no sentence variety -few or no pictures - no consistent theme

Your farm should have the following elements:

- The AR scene must have at least one character (human or non)
- The farm must produce a good or service
- The AR scene must have both 2D and 3D elements
- A narrative/story must accompany the virtual farm in either written OR spoken form. Discuss what impact the farm has and how it functions

Presentation Guidelines

a) Introduce yourself
   i) Name
   ii) County
   iii) A part of STEMRise 4-H Floating Farm Camp

b) What does opportunity mean to you?
   i) List what you learned and received from participating in this workshop
   ii) What was something you had to overcome or was challenging?
   iii) What would you improve upon if you could do it again?
   iv) What did you do that made this project exceptional?

c) Discuss your farm
   i) Show pictures of your virtual farm in Unity or Tinkercad
   ii) Talk about your farm
      (1) What/who lives on your farm?
      (2) Is there a product the farm creates?
      (3) What is life like on your farm?
   iii) Talk about the softwares you used
      (1) Vuforia (AR software)
      (2) Tinkercad (3D modeling software)
      (3) Unity (game engine to create AR space)
      (4) Zoom (virtual meeting tool)
      (5) Flipgrid (video presentation tool)
      (6) Sketchfab (3D model website)
      (7) QR Code technology (a way to experience AR)

4-H Record Books

Please leave the duration of class for students to fill out their project record book!

THINGS TO CONSIDER FOR YOUR RECORD BOOK:

- Project Goals
- Project Activities
- Project Accomplishments
- Project Inventory
- Project Inventory and Expense Record
- Financial Summary

REFLECTION (RECORD BOOK)

• LEARNED WHAT TO PREPARE FOR YOUR FINAL PRESENTATION
• REVIEWED THE GUIDELINES FOR THE FINAL PROJECT

IN YOUR RECORD BOOK NOTE WHAT YOU LEARNED TODAY AND THE PROGRESS ON YOUR FINAL PROJECT.

MODULE EIGHT: FINAL PRESENTATION DAY

Module 8: Final Presentation Day

Learning Objectives

By the end of the module, students will be able to;

- Review the guidelines for the final project
- Create and presented a functional augmented reality app experience

Module Outline	Estimated Time to Complete
1) Presenting Phase Step 2: Presenting your AR Floating Farm Project	30 mins
2) Presenting Phase Step 3: Publishing your AR Floating Farm Project	60 mins
3) Reflection (Record Books)	30 mins
	Total = 2 hours 0 mins

Homework

Presenting Phase Step 2: Presenting your AR Floating Farm Project

Presenting Phase Step 3: Publishing your AR Floating Farm Project

Module 8
Slide 7

PRESENTING PHASE STEP 2: PRESENTING YOUR AR FLOATING FARM PROJECT

STEPS TO CREATING A FLOATING FARM

Planning Phase
Module 1 Step 1: Forming a team
Module 1 Step 2: Brainstorming Your Farm
Module 1 Step 3: Scheduling

Creating Phase
Module 2 Step 1: Creating 3D models
Module 3 Step 2: Creating AR Markers
Module 4 Step 3: Getting started with Game Engine Unity or Sketchfab website
Module 5 Step 4: Setting up AR scene in Unity or Sketchfab website
Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene

Presenting Phase
Module 7 Step 1: Preparing Your Presentation
Module 8 Step 2: Presenting Your AR Floating Farm Project
Module 8 Step 3: Publishing Your AR Floating Farm Project

YOU HAVE LEARNED HOW TO...

- Create 3D models
- Develop in a game engine
- Time management
- Character/Object design
- Visual/Audial storytelling
- Creating a "Marker AR" app

FINAL PROJECT REVIEW

When writing about your virtual farm your description should have the following elements:

1) The AR scene must have at least one character (human or non)
2) The farm must produce a good or service
3) The AR scene must have both 2D and 3D elements
4) A narrative/story must accompany the virtual farm in either written or spoken form. Discuss what impact the farm has and how it functions

QUESTIONS TO CONSIDER

1) List three kinds of software used in your project
2) List what you learned and recieved from participating in this workshop
3) What challenges did you come across?
4) What would you do differently if you participated in this workshop again?

Presenting Phase Step 3:

PUBLISHING YOUR AR FLOATING FARM PROJECT

Learn how to share your AR project with family, friends and peers!

STEPS TO CREATING A FLOATING FARM

Planning Phase
Module 1 Step 1: Forming a team
Module 1 Step 2: Brainstorming Your Farm
Module 1 Step 3: Scheduling

Creating Phase
Module 2 Step 1: Creating 3D models
Module 3 Step 2: Creating AR Markers
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Module 6 Step 5: Putting Sound Effects and Special Effects into your AR Scene

Presenting Phase
Module 7 Step 1: Preparing Your Presentation
Module 8 Step 2: Presenting Your AR Floating Farm Project
Module 8 Step 3: Publishing Your AR Floating Farm Project

EXPORTING YOUR AR APP (FOR ANDROID)

The exporting step is **OPTIONAL** if you are going to transfer the AR project onto a tablet. Currently, you cannot export Vuforia AR to a computer so a workaround is to use the Unity game engine to preview the scene.

Original instructions by Jacob W. Greene found here: https://programminghistorian.org/en/lessons/creating-mobile-augmented-reality-experiences-in-unity

SOFTWARE TO DOWNLOAD

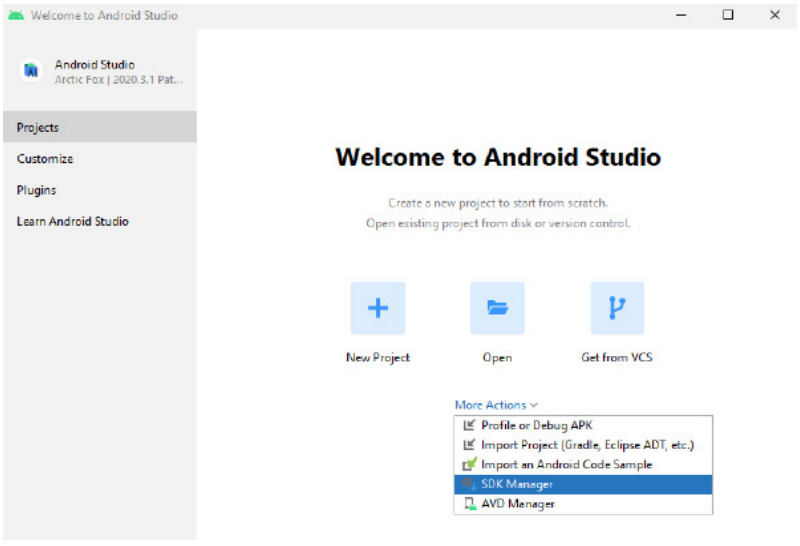
- Java Development Kit 8 (will need to create a free oracle account)
- Android sdk tools 3.1.2

STEP 1: DOWNLOADING THE JAVA DEVELOPMENT KIT

1) Go to the Java website: https://www.oracle.com/java/technologies/downloads/#java8
2) Download Java 8 and follow the installation guide

STEP 2: DOWNLOADING THE ANDROID SDK TOOLS

1) Go to the Android Studio website: https://developer.android.com/studio
2) Choose "Standard Install"*
3) Accept the terms and conditions
4) Install the software
5) Open Android Studio
6) Go to "More actions" and select "SDK Manager"



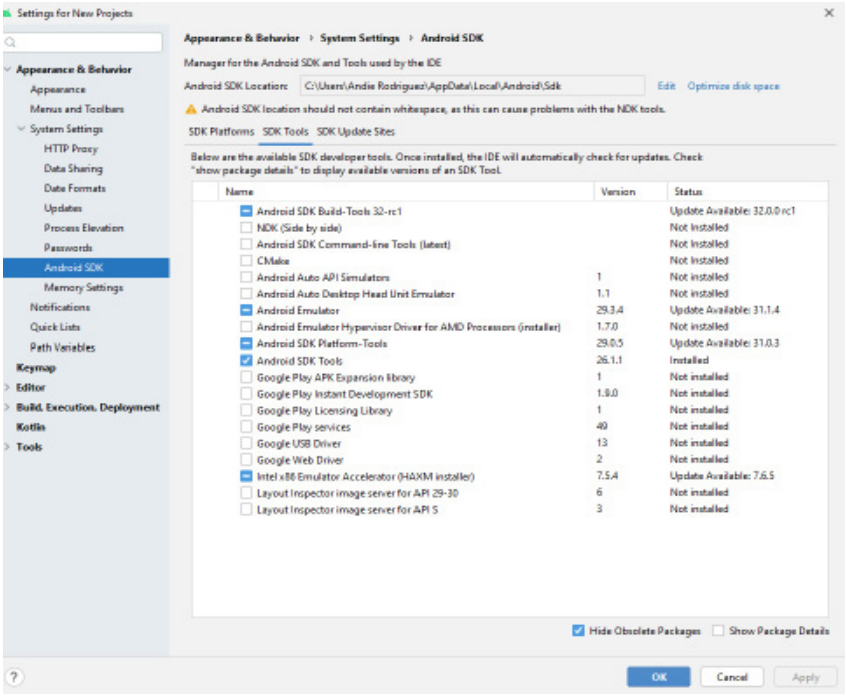
***NOTICE:**
Android Studio is a large program and will take some time to install.
If you are finding it difficult to export your project, we suggest trying Sketchfab instead

EXPORTING YOUR AR APP (FOR ANDROID)

STEP 2: DOWNLOADING THE ANDROID SDK TOOLS (CONTINUED)

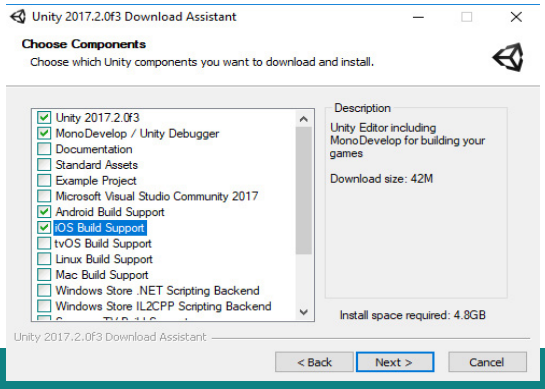
7) Install any packages that are already selected and your device's version (like a phone that runs Android 6). Also install the following packages (found under the SDK Tools section):
- Android SDK Platform-tools
- Android SDK Build-tools
- Google USB Driver

8) Go to the SDK Update Sites and make sure that "Android Repository" and " Android Repository v1" are downloaded and checked off



STEP 3: CONNECTING THE ANDROID SDK AND JAVA DEVELOPMENT KIT TO UNITY

When installing Unity you should have selected "Android Build Support" and "iOS Build Support" to export your app to various devices. If you had forgotten this step you will need to reinstall Unity and follow the steps listed in Module 4, Creating Phase Step 3.



NOTICE:
If you are trying to install the Android packages but keep getting an error about temp folders not being created, close the manager and go to the Android-sdk folder on your computer. Right click the "SDK Manager" application file and select "Run as administrator."

EXPORTING YOUR AR APP (FOR ANDROID)

STEP 3: CONNECTING THE ANDROID SDK AND JAVA DEVELOPMENT KIT TO UNITY (CONTINUED)

1) In Unity go to the tool bar at the top of the screen and select Edit --> Preferences

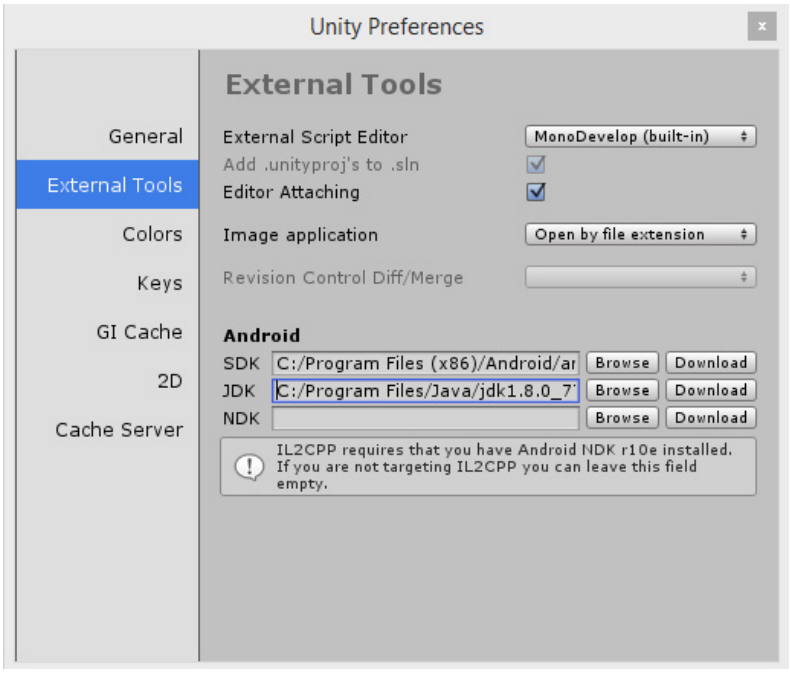
2) Go to "External Tools"

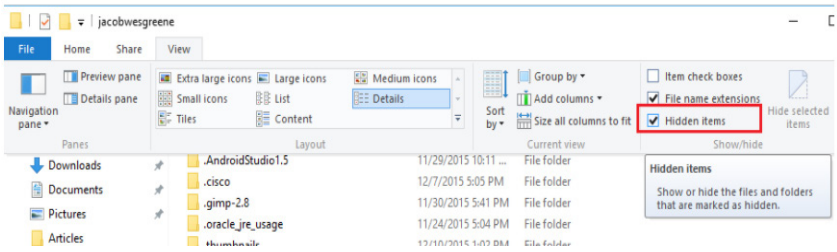
3) For the JDK field be sure the file name has the JDK version number selected.

Example: C:/Program Files/Java/jdk 1.8.0_7

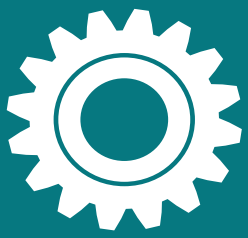
If this field is blank, click on the "Browse" button next to the JDK field and select the JDK verison number in the Java folder you installed.

4) Click the Browse button next to the SDK field and point it to the Android-sdk folder on your computer. This folder should be located in the C:/Program Files/Android folder. If it is not in this folder, then look for it in C:/Users/[your username]/AppData/Local/Android.





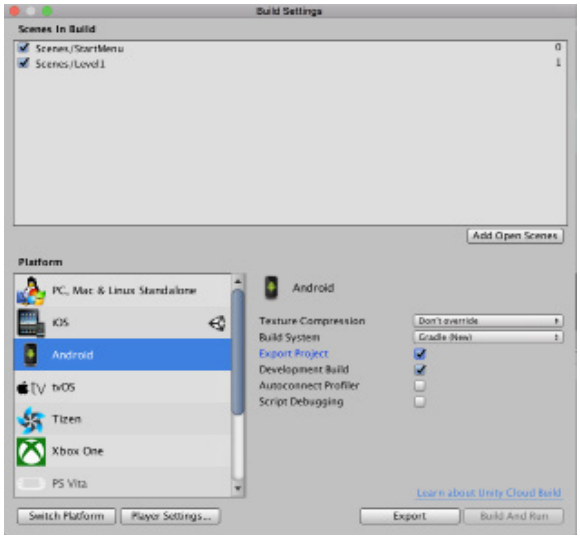
NOTICE:
If you do not see the "AppData" folder, open your file explorer and select the "View" option in the top menu. Select the box labelled "Hidden items."



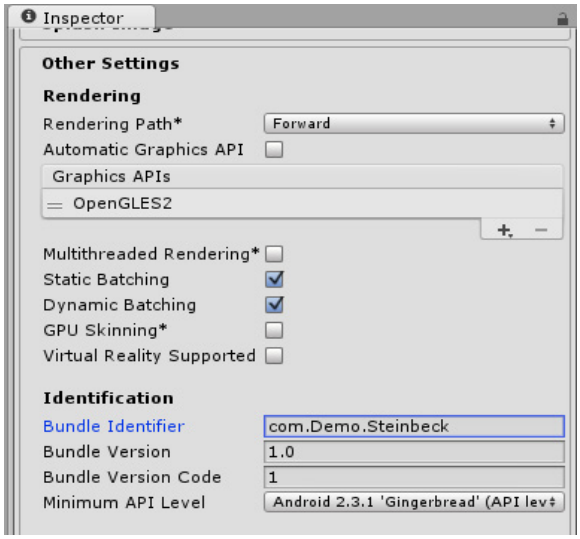
EXPORTING YOUR AR APP (FOR ANDROID)

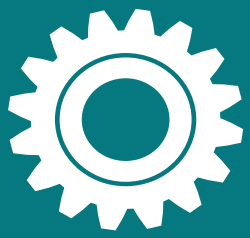
STEP 4: BUILDING YOUR APP TO A MOBILE DEVICE

Return to Unity to setup your application for an Android or iOS build.



1) Go to File > Build Settings
2) In the Platform section of the dialog box, select Android or iOS and click Switch Platform.
3) Select Add Open Scenes.
4) Click Player Settings and navigate to the inspector panel.
5) Change the Product Name to the name you want to use for your app (e.g. "Programming Historian Demo").
6) Scroll down in the inspector panel and select the Other Settings tab. Change the "Bundle Identifier" settings from **com.Company.ProductName** to a name that will be unique to your application, such as **com.Demo.Steinbeck.**



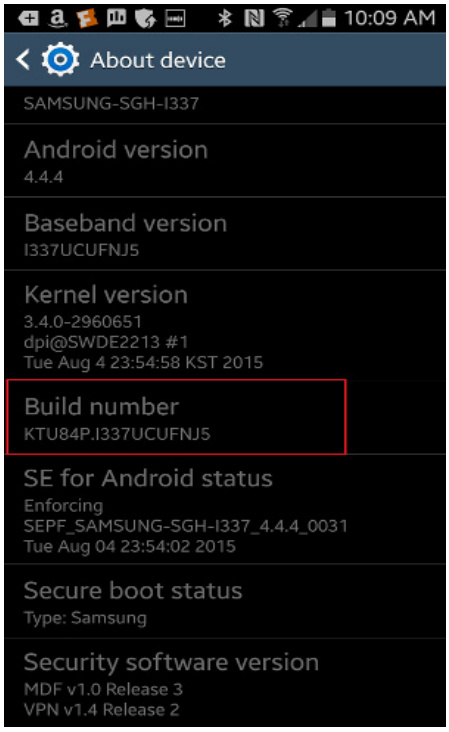


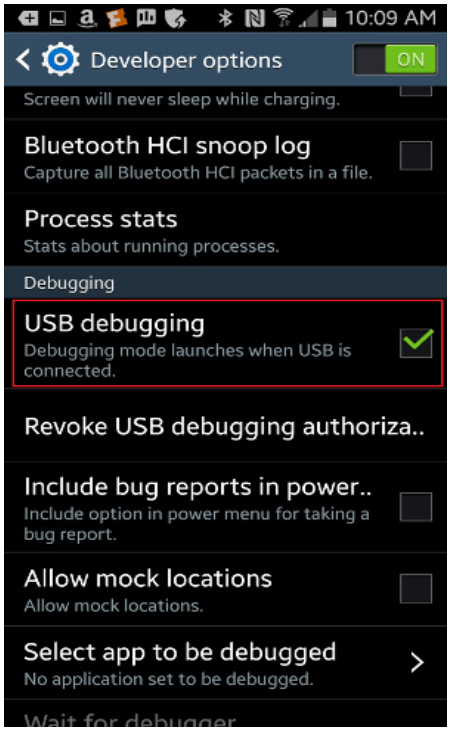
EXPORTING YOUR AR APP (FOR ANDROID)

STEP 5: PREPARING YOUR ANDROID DEVICE FOR YOUR UNITY AR APP

To install your own applications on your Android device,

1) Enable USB debugging by going to Setting > About Device
2) Tap the Build number seven times
3) Return to the previous screen and you should now see a Developer Options tab. Click it and make sure the option for USB debugging is checked.



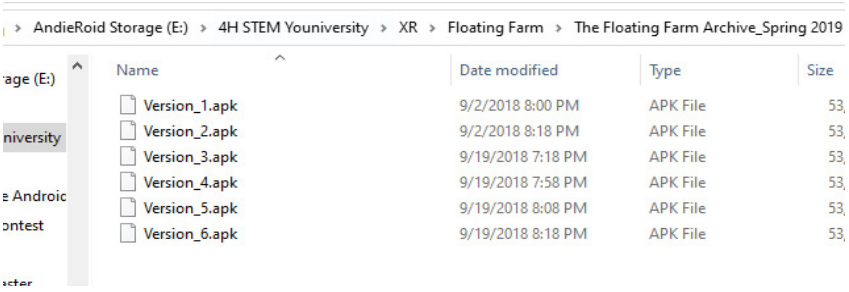


You are now ready to build your application to your mobile device. Connect your device to your computer with a USB cable. Depending on your operating system, your computer might need to download additional drivers in order to interact with your mobile device. Your computer should do this automatically. If the computer is not recognizing your device, follow the first step in the Troubleshooting section at the end of this guide.

EXPORTING YOUR AR APP (FOR ANDROID)

STEP 6: EXPORTING YOUR UNITY AR APP

In the Build Settings window, make sure your scene is listed and click Build and Run. Unity will create a ".apk" (Android Application Package) file for your project. By default, your .apk file will be saved to the root folder of your Unity project. This is the file type that will be uploaded to the Google Play store once your application is complete.



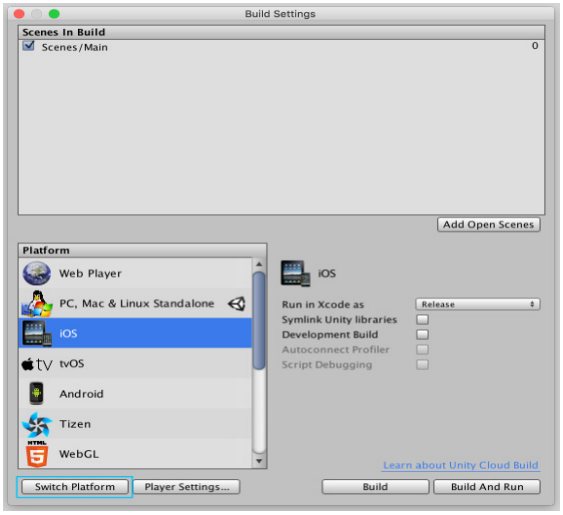
When the application is finished building, you should be able to view and test your application on your Android device.

With Android, it is very easy to share and test your completed application with other Android users without uploading it to the Google Play store. To share your application, simply send the .apk file as an email attachment to anyone with an Android device. However, before other users can download and install the .apk file, they will need to allow their Android device to install .apk files from non-Google Play sources by navigating to Settings > Security on their Android device and checking the box labelled "Unknown sources."

NOTICE:
If you do not see the "AppData" folder, open your file explorer and select the "View" option in the top menu. Select the box labelled "Hidden items."

EXPORTING YOUR AR APP (FOR IOS)

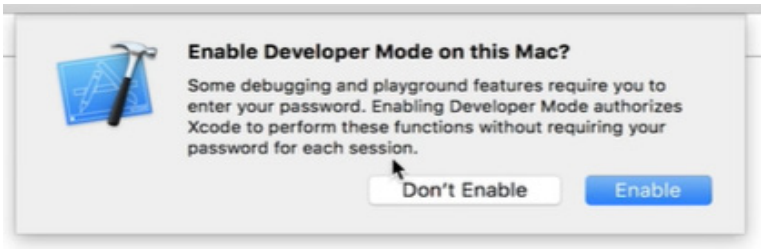
Unity cannot create iOS apps. Instead, it builds Xcode projects, which can then be opened in Xcode and built out to an iOS device. iOS applications also require a camera usage description and minimum iOS version to be set for all apps.



SOFTWARE TO DOWNLOAD

- XCode on the app store

https://apps.apple.com/us/app/xcode/id497799835?mt=12



You may have to enable Developer Mode on your Mac when opening XCode for the first time!

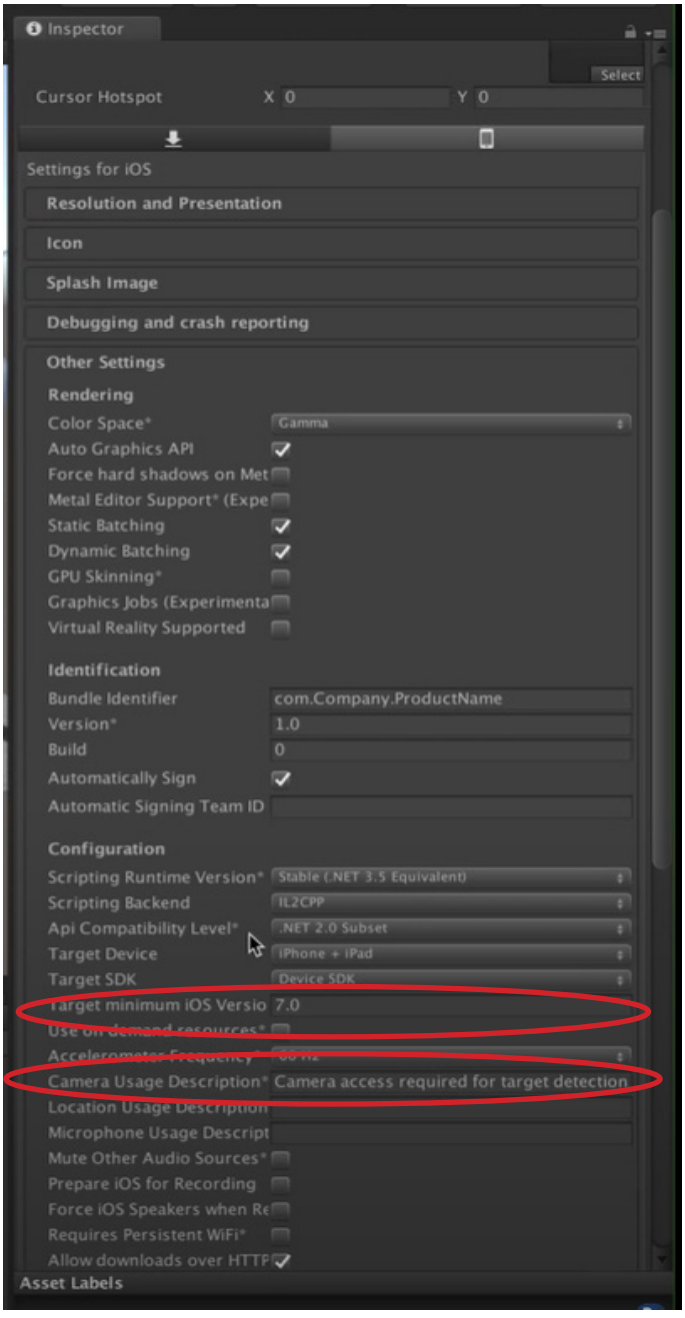
NOTICE:
Please keep in mind that you are limited to the number of devic-es you can export your iOS app. So please be mindful when uploading to your device!

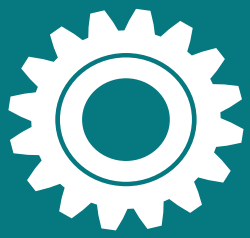
EXPORTING YOUR AR APP (FOR IOS)

NOTICE:
There are additional tutorials on sites such as Youtube that can assist with exporting your Unity AR app to XCode: https://www.youtube.com/watch?v=dwjziS3Jjmk

EXPORTING YOUR UNITY AR APP TO IOS

1) Click "Player Settings..." and expand the option labelled "Other Settings."
2) Add a description in the text field labelled "Camera Usage Description" (e.g. "This application requires access to your device camera.")
3) Next, set the "Target Minimum iOS Version" to 9.0. Scroll to XR Settings and check "Vuforia Augmented Reality."
4) Click "Build" and name your project

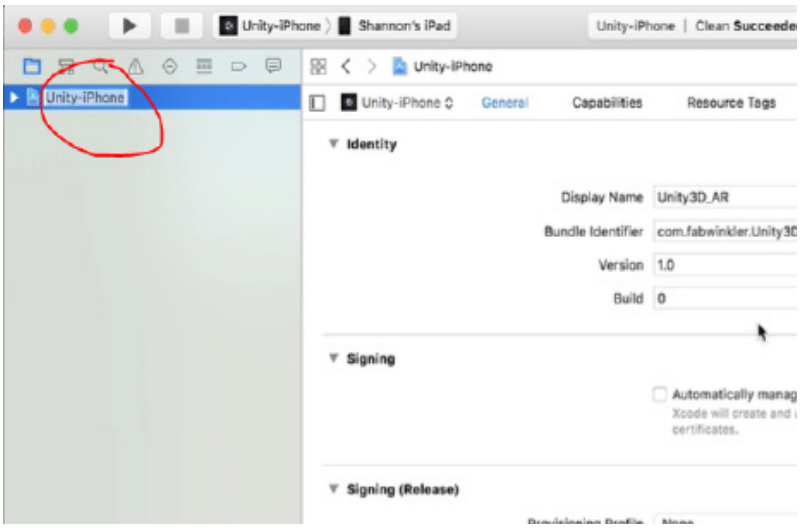




EXPORTING YOUR AR APP (FOR IOS)

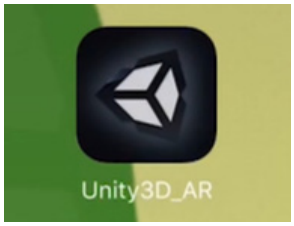
EXPORTING YOUR UNITY AR APP TO IOS (CONTINUED)

5) Open your project in Xcode. If Xcode asks if you would like to update your project to the recommended settings, select "perform changes" and wait for the project to update.
6) Connect an iOS device to your computer with a USB cable. You might have to wait a few minutes while Xcode prepares your device for app development.
7) Link your apple account to Xcode by selecting Xcode > Preferences and choosing the Accounts tab. Sign in using the same Apple ID associated with the iOS device you will be building the app to.
8) Switch over to the "Unity-iPhone" targets menu and click the tab labelled "General." Make sure that "Automatically manage signing" is selected and switch your Team to the Apple ID account you just added.



9) In "Deployment Info" select either iPhone or iPad depending on your target build device.
10) Select "Product > Run" in the top menu and wait for your app to build to your iOS device.

Once the app has finished building, you will need to authorize your Apple ID as a trusted developer. Go to the settings on your iOS device and click "General > Device Management" and choose the option for "Trust [Your Apple ID username]." Start the application by clicking on the application icon on your app home screen.



Publishing and Sharing Online

TINKERCAD
https://www.tinkercad.com

Through the tinkercad website, by publishing models to "public" you can grab the HTML code to embed the model on to a class website. This is a great way to keep a portfolio of work all on one page.

SKETCHFAB
https://sketchfab.com

The Sketchfab website also has an HTML embedding feature available. A unique ability through their premium membership is that you can embed 3D models with a transparent background onto a web page!

ITCH.IO
https://itch.io/

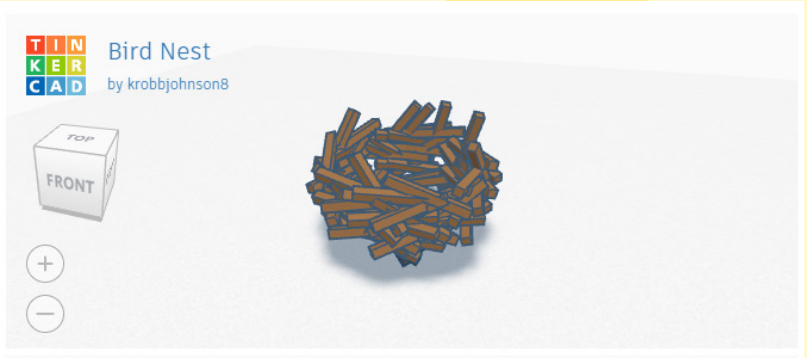
Itch.io is a marketplace for creators to sell or display digital content, primarily games. You can create a class account through this site and publish the AR projects to be downloaded for free or an optional small fee.

PLAY STORE (ANDROID DEVICES)
https://developer.android.com/distribute/console

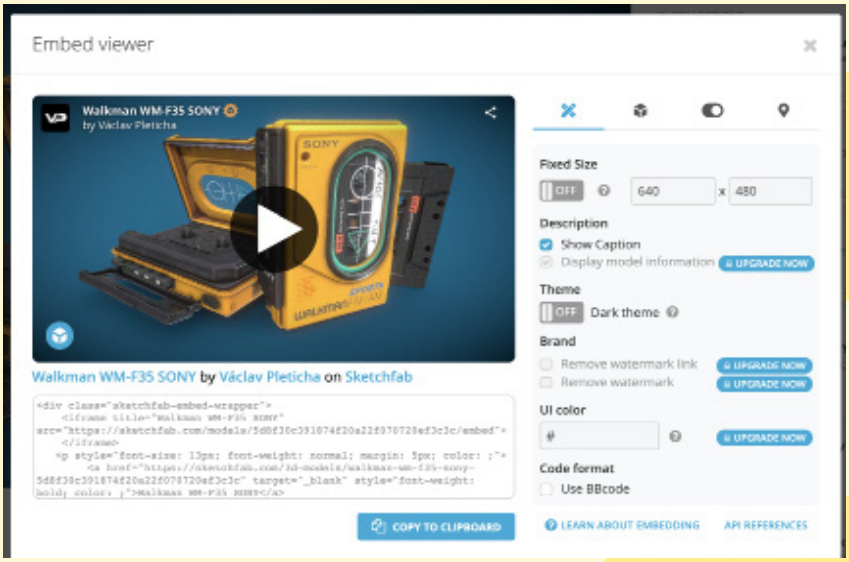
For a one-time fee of $25 you can be granted a developer license to publish apps on the Play Store. Here you can sell your Unity app for an optional fee.

APP STORE (IOS DEVICES)
https://developer.apple.com/app-store/submitting/

For a yearly fee of $99 you can be granted a developer license to publish apps on the App Store. Here you can sell your Unity app for an optional fee.



Example of Embedded HTML from Tinkercad



Example of Embed Viewer HTML from Sketchfab

4-H Record Books

Please leave the duration of class for students to fill out their project record book!

THINGS TO CONSIDER FOR YOUR RECORD BOOK:

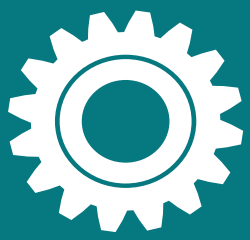
- Project Goals
- Project Activities
- Project Accomplishments
- Project Inventory
- Project Inventory and Expense Record
- Financial Summary

REFLECTION (RECORD BOOK)

• REVIEWED THE GUIDELINES FOR THE FINAL PROJECT
• CREATED AND PRESENTED A FUNCTIONAL AUGMENTED REALITY APP EXPERIENCE
• LEARNED HOW TO SHARE AND PUBLISH YOUR FINAL AR PROJECT

IN YOUR RECORD BOOK NOTE WHAT YOU LEARNED TODAY AND THE PROGRESS ON YOUR FINAL PROJECT.

TROUBLESHOOTING



EXPORTING YOUR AR APP (FOR ANDROID)

TROUBLESHOOTING ANDROID BUILDS

During the build, if you get an error from Unity saying that it cannot locate your Android device, try the following in order:

1) Open the device manager on your computer and right click the Android phone attached as a device. Select "Update Driver Software."

2) (Windows only) Open the Android SDK manager and ensure that the "Google USB Driver" is installed.

3) Unplug your device from the computer. Open the "Developer Options" in the system setting of your Android device. Select the option to "Revoke USB Debugging Authorization." Plug your device back into your computer.

4) Save your scene and close Unity.

5) Open your file explorer and go into the "Android-sdk/platform-tools" folder. Hold shift and right-click. Select the option to "Open command window here." For Mac, open a Terminal and drag the "platform-tools" folder into the window.

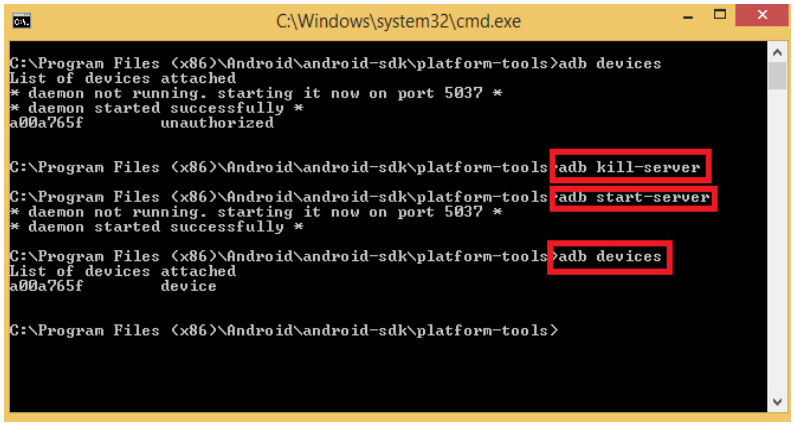
6) Type the following commands and press "Enter" after each. As you enter each command, check your Android device and authorize your computer when prompted.

adb kill-server
adb start-server
adb devices

(Mac only) If adb devices command returns an empty list, you may need to unload EasyTetherUSBEthernet from the command line. To do this, use the following command:

sudo kextunload -v /System/Library/Extensions/EasyTetherUSBEthernet.kext

TROUBLESHOOTING ANDROID BUILDS (CONTINUED)



Once your device is authorized, the command prompt should display 'List of devices attached' along with an alpha-numeric string that represents your Android device.

If you are getting errors that your "Android Build Tools are out of date," open the Android SDK manager and make sure that the Android SDK Platform-tools and "Android SDK Build-tools" options are both installed. If you get an error saying that "Unity cannot install the APK!" go to your player settings and set the install Location to "Automatic."

Vuforia Support Page
https://developer.vuforia.com/support

Unity Support Page
https://unity.com/support-services

Sketchfab Support Page
https://help.sketchfab.com/hc/en-us

3DC.io Support Page
https://3dc.io/support

Morphi 3D Support Page
https://www.morphiapp.com/helpcontact

Tinkercad Support Page
https://tinkercad.zendesk.com/hc/en-us/categories/200357447-FAQ

WHEN REQUESTING HELP ON A FORUM SITE OR SUPPORT PAGE REMEMBER:

1) State in clear and simple terms your issue
2) Give the date you were having issues
3) Include photos of your issue
4) Be patient! It may be a few hours or days until you recieve a response

If support is taking a while be sure to plan ahead and use alternative softwares or tools to finish your project.

EXPORTING YOUR AR APP FROM UNITY

THE CAMERA WILL NOT TURN ON FOR AN AR COMPUTER TEST.
Click on the AR camera and go into Vuforia settings. You may need to select your camera. Make sure the camera turns on in another app to see if it's a hardware issue.

MY FILES ARE CORRUPTED!
Try putting your Unity project folder into a zip folder. Delete the original folder after you have a zipped version. Unzip the folder and try opening the files. Another method is to delete everything EXCEPT the assets folder in your unity files.

NOTE: This may destroy all of your pre-fab settings.

UNITY WILL NOT OPEN.
Try turning your computer on and off. If this continues uninstall and reinstall Unity.

MY MODEL IS BLOCKING THE CAMERA IN AR.
Try turning the camera in the other direction until you can no longer see your model blocking the camera. The software will still have it pop up over your logo when the camera sees it.

It also helps to look up your issue on the internet if you cannot find your issue here!

For Unity they have a service page: https://unity.com/support-services

VOCABULARY

#

3D Model: a virtual representation of an object/thing.

A

Align: place or arrange things in a straight line.

Angle: a figure formed by two rays, called the sides of the angle, sharing a common endpoint, called the vertex of the angle. It also measures the amount of turn an object is rotating, for example: 90 degrees (also called a "right angle.")

Application (App): a program that performs a particular set of tasks.

Assets: include everything that can go into a game, including 3D models, sprites, sound effects, music, and code.

Augmented Reality (AR): combination of the physical and virtual (computer-generated) worlds.

B

C

Combine: unite two bodies or components into a single component.

Components: "containers" for other modeling entities, which can include sketches, construction geometry, bodies, and even other components. Components represent real-world parts; something that is manufactured and that may be assembled to one another. If you already have a plan for what you are making, it is best to begin your design with a component and then construct the bodies within it.

Concentric: circles or shapes which share the same center.

Crop: to cut out, mostly found in computer programs.

Cross section: to cut an object off at right angles to an axis. In Fusion 360, you might do this to analyze your design.

D

Deboss: to stamp a design into the surface of an object so that it is indented. One way to do this is by importing an SVG file and placing it onto the surface of a shape or part, sinking it and aligning it to your specifications, turning the SVG shape into a hole, and then grouping it all together.

Diameter: a straight line going through the center of a circle connecting two points on the circumference.

Dimensions: a measurable extent, such as length, width, or height.

Duplicate: to make or be an exact copy of.

E

Emboss: to carve, mold, or stamp a design onto a surface so that it stands out in relief. One way to do this is by importing an SVG file and placing it onto the surface of a shape or part, aligning it to your specifications, and then grouping it all together.

Export: to convert a file into another format than the one it is currently in. For example, you must export your design in order to print it.

Extrude: to extend a 2D image into a 3D object in a straight line.

F

Fillet: to make a rounded edge.

Flip: create the mirror image of an object or turn it over along an axis.

G

Gallery: a collection of creations grouped together.

Group: to combine two or more shapes into a part. Do this by selecting them and then choosing the Group icon at the top.

H

Handle: the little squares that appear on the shape when you select it that allow you to resize it by pulling and pushing them.

Hole: a tool used to subtract from a solid shape.

I

Import: to bring a file from a different program into the one you're using.

Indirect augmented reality: Using a combination of panoramas, virtual objects, and pre-captured photos the software creates a high-quality representation of a location/landscape.

Infrastructure: the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise.

J

Joint: used to assemble components and create mechanical relationships between components, including defining movement. Learn more about different types of joints here.

K

L

Location Based AR: Virtual projection or text is displayed based on GPS coordinates.

Logo: a symbol or other design to represent a group/thing.

Loft: Transitioning from one shape to a different shape over a specified distance. For example: from a rectangle to a circle or like the hull of a ship.

M

Marker: two dimensional symbol or image that allows the AR software to project a virtual image or text.

Marker Based (Image): Image shows the virtual projection or object.

Marker Based (Object): A physical object can project the virtual projection/object.

Mesh: is a collection of vertices, edges, and faces that can describe the shape of a 3D object.

Metallic: appearing as if made of metal.

Millimeter: one thousandth of a meter (0.039 in.)

N

O

OBJ: this file type is capable of representing a greater degree of texture and color and, as a result, is more commonly used for animation or with high-end printers that can control color.

Offset: to move out of alignment.

Orthographic view: two-dimensional view of a three- dimensional object. Orthographic views represent the exact shape of an object as seen from one side at a time as you are looking perpendicularly at it.

Outline: a line or set of lines enclosing or indicating the shape of an object in a sketch or diagram.

Outlining AR: Applications that are built specifically for monitoring hard-to-see areas, odd lighting, or situations where the user needs to monitor something for long periods of time.

P

Pan: to rotate a camera on the horizontal or vertical axis.

Papercraft: collection of art forms employing paper or card as the primary artistic medium for the creation of three-dimensional objects.

Part: one or more shapes that have been grouped together.

Particles: portions of matter (i.e. dust particles.)

Path: a path is a line that is made up of a series of points called “anchor points” and line segments between these points

Perpendicular: at an angle of 90 degrees to a given line, plane, or surface.

Perspective view: a view of a three-dimensional image that portrays height, width, and depth for a more realistic image or graphic.

Place: Drag and drop an object to start or add onto a design.

Plane: a flat surface in the game engine.

PNG: a type of graphics file similar to a JPG that allows for transparent backgrounds.

Pre-fabs: a pre-made grouping of models and textures ready to use.

Primitive (or shape): a starting point or building block for 3D design. These shapes can be added, subtracted, and combined with one another to build just about anything. They include: Cube (Box), Cylinder, Tube, Sphere, Torus, and Cone.

Profile: a 2D sketch that can be extruded to make a 3D object.

Q

R

Render: to create a final image of a model that shows all of the surface properties that have been applied to an object. This process involves adding all colors, shading, and other elements, such as the physical appearance of materials, that add realism.

Revolve: create a 3D solid or surface by sweeping an object around an axis.

Rotate: to move in a circle around an axis or center. When you select an object, the arrows are for rotation. You can rotate on any of the planes.

S

Scale: change the size of an object while maintaining its original proportions.

Sculpt: a modeling approach that creates organically shaped models as if they were clay.

Shell: remove material from a part interior, creating a hollow cavity.

Shortcut: computer keys that help provide an easier and usually quicker method of navigating and executing commands in computer software programs.

Simulate: to examine and test a design through a computer-aided imitation of how it might function in the real world. These quick iterations or tests are meant to provide useful visual feedback in order to better understand and improve a design before it is actually fabricated.

Slice: to divide a solid object into two or more separate 3D objects.

Smoothness: appearing smooth, soft.

STL: one of the most commonly used file formats for 3D printing. STL stands for stereolithography.

Subtraction: shape a design by removing material from it.

SVG: stands for scalable vector graphics. The big difference between "rasterized bitmap images," like PNGs and JPGs, and vector images is that vector images are composed of a fixed set of shapes, whereas the others are made up of a fixed set of pixels. As a result, scaling the rasterized bitmap reveals the pixels, while scaling the vector image preserves the shapes. SVGs are commonly used for any type of image that might require a great deal of flexibility in size (think company logos that must be tiny for business cards but also blown up huge for billboards.) SVG is also the standard file format for laser cutting.

Sweep: to extend a profile along a curved line into a 3D object. It requires two sketches - one for the profile and one for the path.

Symmetry: twin parts facing each other, or in multiples, spaced equally around an axis.

T

Tangent: a line or plane touching, but not intersecting, a curve or curved surface.

Texture: the feel, appearance, or consistency of a surface or a substance.

U

V

W

Workplane: the large, blue grid where you create your designs. You can drag out new workplanes onto the surfaces of your shapes for easier stacking and more precise measuring.

Work space: the large, blue grid where you create your designs.

X

X, Y, Z axes: an axis is an imaginary line about which an object can rotate, which also serves as a fixed reference for measuring position.

Y

Z

Zoom: to move a camera from a long shot to a close- up gradually. Use the wheel on the mouse to do this.

FREQUENTLY ASKED QUESTIONS

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What should I do before the first lesson?
Review the videos and slideshows and note any information you may still have issues with. Be sure you review the computer requirements on page 4 and possibility of using alternative software to complete your project. Reference the faciliator guide page 144.

What software or technology do I need?
For the course you will need a computer, mouse, a stable internet connection and webcam. Please review the computer requirements on page 4.

What should I do if I cannot finish the assigned tasks during the class time?
You can complete the work as homework, or you can request additional assistance from the facilitator.