# Creating a Biology AR poster using Unity

This lesson is recommended for Years 9 and higher



### Summary

In this lesson, students explore how to design and implement a simple Augmented Reality (AR) world to project DNA model using Unity 3D and Vuforia SDK for Unity 3D.

### **Developer requirements**

- 1. Unity 3D This lesson is developed using Unity 3D (2018 4.9f1) although any new version would work
- 2. Free account with Unity 3d (<u>https://id.unity.com</u>)
- 3. Vuforia SDK (V8.5.8) for Unity 3D
- 4. Free account with Vuforia developer (<u>https://developer.vuforia.com</u>)

### Resources

- 1. Printed copy of an **Image Target** (a sample is included in the 'Appendix' of this lesson). Download the image target used in this project from here <u>http://bit.ly/ARBiologyDNA</u>
- 2. 3D object that you want to overlay image (Note: this lesson uses freely available 3D objects)
- 3. Computer to install Unity 3D (check 'system requirements' for development <u>https://docs.unity3d.com/Manual/system-requirements.html</u>)
- 4. iPad or a computer with a webcam (in-built or wired) to test AR poster

### Step 1: Unity 3D installation

1. If you haven't installed Unity in your computer, please follow the comprehensive steps listed in the Unity documentation

(https://docs.unity3d.com/Manual/GettingStartedInstallingUnity.html).

- 2. You will need a free account with Unity 3D to access free Unity assets. Follow the instructions to create an account (<u>https://id.unity.com</u>).
- 3. You will need to add 'Vuforia AR' resources when you are installing Unity. 'Check' the Vuforia Augmented Reality Support during Unity installation as below. If you want to test your project using iOS or Android devices, check the corresponding components (Note: Be mindful about the Install Size of these components since you will need free disk space in your computer to install these). To develop this lesson, we used 'Vuforia Augmented Reality Support' and 'iOS Build Support'.

0 0 0	Download And Install Unity			
	Unity	component selection		
	Install	Component	Download Size	Installed Size
		Example Project	311 MB	525 MB
		Android Build Support (*)	161 MB	399 MB
License		iOS Build Support (*)	1.18 GB	2.72 GB
Components		tvOS Build Support (*)	407 MB	992 MB
Destination Salast		Linux Build Support (*)	199 MB	561 MB
Destination Select		SamsungTV Build Suppor	43.6 MB	123 MB
Download		Tizen Build Support (*)	74.2 MB	188 MB
Installation		Vuforia Augmented Realit	62.0 MB	117 MB
Summary		WebGL Build Support (*)	281 MB	717 MB
• Summary		Windows Build Support (*)	235 MB	866 MB
		Facebook Gameroom Buil	41.7 MB	94.5 MB
		(*) Indicates that the	component requires	Unity to be installed
	Space	Required: 10.99 GB Space	e remaining: 20	.47 GB
🚭 unity	Allows b	uilding your Unity projects for the	Vuforia-AR platfo	rm
			Go Back	Continue

4. If you have completed the above steps, click the **New** button to start developing this lesson.

Projects	Learn	New 🗅 Open 🕐 My Account
	Project name	Template
	AR Biology poster	3D ~
	Location	
	C:\Users\THUSH	Add Asset Package
	Organization	
	tasha108 ~	ON Enable Unity Analytics ?
		Create project

- 5. Provide a name for the project (e.g. AR Biology poster), select **Template** as **3D** and choose a location from the computer to store the project files and click **Create project** (Note: it might take a while to import things needed for your project such as assets).
- 6. Please complete steps 2-4 in order to set up the environment for your Unity-AR project.
- 7. Once these steps are completed, start 'Step 5' to start developing your AR project.

### **Optional Steps: Familiar with Unity 3D environment**

 If this is your first time working with Unity, you can try out step-by-step tutorials to get familiar with the Unity environment by downloading basic tutorials (e.g. Play & Edit Mode). These basic tutorials are recommended for beginners prior to try out our lesson since this lesson will not provide information about features in the Unity environment (such as Assets, Objects, Inspector).

### G Unity 2018.4.9f1 × Dpen Projects Learn A New My Account 01 : Play & Edit Mode **Basic Tutorials** Take your first steps inside the Unity editor, as you learn the difference between the 2 main modes in Unity - Edit mode for working on your project, and Play mode for testing. This **Tutorial Projects** project is for Unity 2018.3 and above. 02 : Game Objects & Components - Rigidbodies to the rescue Resources We build games in Unity using Game Objects and components. Learn about how addi Links Rigidbody component to your game objects adds Physics behaviour. This project is for Unity 2018 3 and above 03 : Tweaking Components - Values vs Zombies Develop your component knowledge further as you learn about values and how they affect ameplay. Can you slow down the polygon-eating zombie in time to es or Unity 2018.3 and above. ape? This p 04 : Prefab power - Ramping up Prefabs are the secret sauce behind all Unity games, in this lesson you'll learn about building them as you ramp up your knowledge and escape another laser death trap! This project is for Unity 2018.3 and above.

## Step 2: Vuforia SDK for Unity 3D

### What is Vuforia?

Vuforia is an Augmented Reality (AR) Software Development Kit (SDK) for mobile devices that facilitates the creation of AR applications. It uses **Computer Vision** technology to recognise and track 'Image Targets' in real-time. Vuforia is also used as a Mixed Reality (MR) application development platform.

Vuforia uses Computer Vision technology to recognise image targets and overlays AR experience (e.g. 3D objects, videos) on image targets.

If you need to learn more about Vuforia, please refer to the documentation (<u>https://docs.unity3d.com/Manual/vuforia-sdk-overview.html</u>)

### License key

- 1. You will need a free account with Vuforia developer (<u>https://developer.vuforia.com</u>). Click **Register** and fill required information
- You will also need to get a Vuforia development key to build and test your applications with Unity using License Manager (<u>https://developer.vuforia.com/vui/develop/licenses</u>) and Get Development Key function
- 3. Add a random licence key name (e.g. ar\_biology), 'tick' the agreement box and select **Confirm** to get a free development key

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	Add a free Development License Key						

License Name \* ar\_biology You can change this later License Key Develop Price: No Charge Reco Usage: 1,000 per month Cloud Targets: 1,000 VuMark Templates: 1 Active VuMarks: 100 ☑ By checking this box, I acknowledge that this license key is subject to the terms and conditions of the Vuforia Developer Agreement.

4. Click the licence key and copy it to your application.

### Step 3: Image Target

### What is Image Target (or AR markers)?

AR markers are images or objects (e.g. QR codes, physical reflective markers, Image Targets and 2D tags) registered with the application which act as information triggers in your application. When your device's camera recognizes these markers, this triggers the display of virtual content over the world position of the marker in the camera view.

Vuforia provides free samples of **Image Targets** to reuse in your projects. You can download them from here -

https://library.vuforia.com/content/vuforia-library/en/articles/Solution/sample-apps-target-pdfs.ht ml

Alternatively, you can search free Unity assets within the **Asset Store** tab in Unity. Use the **Search** textbox to find a topic you want (e.g. Science, Biology, DNA). You can add these samples to your asset store and **Import** them to the project. If you are unsure about which assets to import, select **All** and click **Import**.



### Step 4: 3D objects

- 1. When our camera recognises the image target, we want to overlay a 3D object over it.
- If you want to add your own assets, you can create 3D models on your own or download from the web (Note: 3D models that compatible with Unity can be found here -<u>https://docs.unity3d.com/Manual/3D-formats.html</u>)
- 3. Below are some suggested websites to find good 3D models. Feel free to share new suggestions with the CSER community (<u>https://teachingai.blog/</u>)
  - a. <u>https://www.assetstore.unity3d.com/</u>
  - b. <u>https://free3d.com/</u>
  - c. https://grabcad.com/

### Step 5: AR development using Unity

- To start a new project, you will need to add a new scene by selecting File -> New Scene and provide a name for the scene (e.g. DNA). Alternatively, you can reuse the default SampleScene by deleting existing objects that loaded automatically.
- 2. In the left panel (**Hierarchy**), delete the default **Main Camera** and **Directional light** objects. To do this, right-click on each object and select **Delete**.
- Once the existing objects are deleted, add ARCamera to the project by selecting GameObject > Vuforia Engine > AR Camera (if you are prompted for anything, you will have to authorise them all - e.g. importing additional assets).

- 4. You should see the **AR Camera** object added to the **Hierarchy** panel. Once you select AR Camera, you should see the **Inspector** panel on the right hand side. This demonstrates the configurations of the object.
- 5. Towards the bottom of the 'Inspector' section, you should see a button **Open Vuforia Engine Configuration** that is disabled by default.

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6. To enable it, go to Edit > Project Settings and click on the Player button.

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	Icon		
	Resolution and Presentation		
	Splash Image		
	Other Settings		
	XR Settings		
	Virtual Reality Supported		
	Vuforia Augmented Reality Support	ed 🔲	
	360 Stereo Capture		

- 7. In the **XR Settings** section (bottom), select the option **Vuforia Augmented Reality Supported** (Click 'accept' if you were prompted for Vuforia Software Licence).
- 8. You can then close the **Project Settings** window and go back to the AR Camera's configurations window.
- 9. The **Open Vuforia Engine Configuration** button should be enabled by now (click 'AR camera' to see the 'Inspector' window).

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10. Click **Open Vuforia Engine Configuration** button and copy your **App Licence key** that you generated previously and click **Add Licence.** 

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VuforiaConfig	guration	[2]
▼ Global		
Vuforia Version	8.3.8	
We strongly rev enhanced secu below.	commend developers to encry rity. For more information refe e	pt their key for r to the article
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Camera Device Mo	de MODE_DEFAULT	;

11. You will need to have a webcam (either built-in or wired) configured for this project (Note: if you do not have a webcam, alternative steps for testing are listed at the bottom of this lesson). If you have only one camera associated with your PC or laptop, everything should be working fine with the default settings. To confirm this, click **Resources** in the **Assets** tab and select **VuforiaConfiguration.asset.** 

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12. In the **Inspector** window, check **Webcam** settings towards bottom. In the **Camera Device**, select the webcam you want to use for this project. Otherwise, leave **Integrated Webcam** as below.

No webcam prof 'Integrated Web A default profile	ile has been found for your webcam mo cam'. will be used.	del:
Webcam profiles your webcam. You can create 'C:/Program Files/Unity/Hub, nes/VuforiaSupp	: ensure that Play Mode performs well a custom profile for your camera by ed /Editor/2018.4.9f1/Editor/Data/Playb port/VuforiaResources\webcamprofiles	with iting ackEngi .xml'.
Camera Device	Integrated Webcam	

### Adding a custom Image Target to your project

13. To learn more about Image Targets, go to this page https://library.vuforia.com/articles/Training/Image-Target-Guide

- 14. In the Vuforia Developer Portal (<u>https://developer.vuforia.com/vui/develop/databases</u>), select **Target manager.**
- 15. Click Add database, provide a name, select type as Device and click Create.

# Create Database Database Name \* DNA\_Images Type: Device Cloud VuMark Cancel Create

16. Now select the database we have created (e.g. DNA\_Images) and click Add Target.

Add Target			
Туре:			
	$\Box$	07	
Single Image	Cuboid	Cylinder	3D Object
File:			
			Browse
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Name:	's height will be calc	ulated when you uplo	ad your image.
Name must be uniqu this will be reported	ue to a database. Wh in the API.	en a target is detecte	d in your application,
		Cancel	Add

- 17. There should be four different target types. Select **Single Image** and browse your disk to locate the image you want to use as an **Image Target.**
- 18. The Width value (e.g. 5.5 in cm) is a scale value that you need to set to the size you want the image to appear in your Unity Scene (Note: Unity measures everything in your Scene in relation to the size of your Image Target).
- 19. Give a name to the target and upload it.
- 20. Now the uploaded image appears in the list of targets with a rating. If the image you uploaded has low ratings, it may be difficult for the camera to track it (see more information here -

https://library.vuforia.com/articles/Solution/Optimizing-Target-Detection-and-Tracking-Stab ility). In such cases, try to upload a different image. Once you are satisfied with your image's rating, check the box next to **Target Name** and click **Download Database** button.

Target Manager > DNA_Images				
DNA_Images Edit Name Type: Device				
Targets (1)				
Add Target				Download Database (1)
Target Name	Туре	Rating ①	Status 🗸	Date Modified
1 selected Delete				
DNA_image	Single Image	*****	Active	Nov 15, 2019 07:51

21. Under the development platform, select **Unity Editor** and click **Download** and save this file (.unitypackage) in your disk. Alternatively, if you have prompted, you can open the file with Unity Editor and select **Import.** 

Import Unity Package	×
DNA_Images	
<ul> <li>Editor</li> <li>Vuforia</li> <li>ImageTargetTextures</li> <li>ImageTargetTextures</li> </ul>	
DNA_image_scaled.jpg     StreamingAssets     Vicforia	NEW
DNA_Images.dat	NEW.
All None Cancel Imp	ort

- 22. Switch back to your Unity project to use the Unity package in your AR application.
- 23. If you haven't imported image targets using the above steps, you can import an Image Target that we have saved in the local drive (see Resources section above for the link). In the Project window, right click Assets and select Import Package > Custom Package and select the package saved in the disk before.
- 24. Once you have set the image target, the next step is to add the image target to the scene. To add an image target to our project, go to **GameObject** > **Vuforia** > **Image**. This will add the image target to your scene.
- 25. In the **Image Target Behaviour** component, click on the **Database** drop-down list and select your Target database (e.g. DNA\_Images). In the **Image Target** drop-down list, select the name of your Image Target (e.g. DNA\_image) from the database.

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			Add Ta	arget			

26. You may have to zoom in a little bit inside your scene to see the image.



- 27. We used **predefined** as the **Type** of **Image Target Behaviour**.
- 28. Now we will need to add a 3D object to the Image Target
- 29. For this, right-click on the ImageTarget in the left panel and select Vuforia > ModelTarget.
- 30. We will reuse a 3D model downloaded from DNA project in the Unity Asset Store. To overlay this, select **Project > Assets > DNA > Prefabs** and drag and drop DNA 3D model as **Model Target** over our DNA image target.



- 31. By default, the 3D model is quite big. Therefore, we need to scale it down.
- 32. Click on the **ModelTarget** object in the left panel and update its scale in the right panel. A scale X, Y and Z of 0.7 should work well.

33. After scaling it down, it should look something like below.



34. You might want to change the position of the model, change the values of the Scale / Rotation (inside the inspector) to get it into the right place

### **Step 6: Testing the project**

### **Option 1: Testing using the computer**

- In order to test your project with a computer, you will need a built-in or wired web camera. If you do not have access to these, please try out 'option 2: Testing using the iPad' below.
- 2. Now you can try out the AR experience by clicking the **Play** button of Unity and pointing the printed poster (or a mobile device loaded with the image target) to the camera

Note: We have included the **Image Target** used in this lesson at the end of this lesson (Appendix)



(image source: <a href="https://www.turbosquid.com">https://www.turbosquid.com</a> with Royalty Free Licence)

3. If everything is working properly, a 3D model should appear when you point the image target to the computer's camera. To stop running the project, hold and press the **Play** button again.



### **Option 2: Testing using the iPad**

- 1. To test your project with an iPad, you will need an iPad with the 'Unity Remote 5' app loaded. If you do not have access to these, please try out 'option 1: Testing using the computer' above.
- 2. To test the project with iPad, we will have to switch platform to iOS. Select File -> Build settings and then select iOS as the platform

Build Settings		×
Scenes In Build		
SamplesResources/Scenes/0-Splash SamplesResources/Scenes/1-Menu SamplesResources/Scenes/2-Loading SamplesResources/Scenes/3-CylinderTarg SamplesResources/Scenes/3-GroundPlane SamplesResources/Scenes/3-ModelTargets SamplesResources/Scenes/3-MultiTargets SamplesResources/Scenes/3-OhiertReco	iets :s	0 + 1 2 3 4 5 6 7 8 • •
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Universal Windows Platform		
		Learn about Unity Cloud Build
Player Settings	Sv	vitch Platform Build And Run

3. If you do not have iOS modules loaded (see image above), click **Open Download Page** and you will be prompted to **Save** iOS support file. Download this file to your local computer and double click to install it (Note: this installation required ~2 GB of your disk space)

Opening UnitySetup-iOS-Support-for-E	ditor-2018.4.9f1.exe	×
You have chosen to open:		
UnitySetup-iOS-Support-for-Education	litor-2018.4.9f1.exe	
which is: Binary File (717 MB)		
from: http://download.unity3d.org	:om	
Would you like to save this file?		
	Save File	Cancel

- Once you have installed iOS support, make sure you restart Unity. Now go back to File -> Build setting -> iOS (step 2 above) and click switch platform at the bottom and wait until switching platform done
- 5. If switching of platform is successful, you will see a window like below in **Build settings**

Build Settings		x
Scenes In Build		
SamplesResources/Scenes/0-Splash SamplesResources/Scenes/1-Menu SamplesResources/Scenes/2-Loading SamplesResources/Scenes/3-CloudReco SamplesResources/Scenes/3-CloudReco SamplesResources/Scenes/3-GroundPlant SamplesResources/Scenes/3-ImageTarget SamplesResources/Scenes/3-MultiTargets SamplesResources/Scenes/3-ObjectReco	gets e ts is	0 4 1 2 3 4 5 6 7 8 4 7 8 4 7 8 4 7 8 4 7 8 4 7 8 4 7 8 4 7 8 4 7 7 8 7 8
Platform		
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ios 📢	Run in Xcode as	Release +
WebGL	Autoconnect Profiler Script Debugging	
∉t∨ tvos	Scripts Only Build	
Android		
Xbox One	Compression Method	(Default +)
₽SA PS4		
Universal Windows Platform		
		Learn about Unity Cloud Build
Player Settings		Build Build And Run

- Connect your iPad to the computer using a USB cable (provided for iPad charging) and open Unity Remote 5 app. Once it is opened, click the Play button in the Unity window.
- Click Edit -> Project Settings -> Editor and select the Device that is connected to Unity. You
  will be prompted to select the iPad you are using (Note: iPad name should different from
  what is shown in the image below)

OProject Settings			*=
		(Q	
Audio Editor	Editor		:‡ ¢
Graphics	Unity Remote		
Input	Device	iPad Pro 12.9" 2nd gen Wi-Fi (c51765)	+
Physics	Compression	JPEG	+
Physics 2D	Resolution	Downsize	+
Player	Joystick Source	Remote	+
Preset Manager			
Script Execution Order	Version Control		
Tags and Lavers	Mode	Visible Meta Files	+
TextMesh Pro	Asset Serialization		
Time	Mode	Force Text	+
VFX	Default Behavior Mode		
	Mode	2D	+
	Prefab Editing Environments		
	Regular Environment	€None (Scene Asset)	0
	UI Environment	€None (Scene Asset)	0
	Sprite Packer		
	Mode	Always Enabled(Legacy Sprite Packer)	\$
	Padding Power (Legacy Sprite Packer)	1	+
	C# Project Generation		
	Additional extensions to include	txt; xml; fnt; cd	
	Root namespace	-	

8. You will see the Unity play screen duplicated in your iPad. Now point the printed poster in front of your iPad camera and enjoy the AR experience with 3D models. Enjoy!

### Discussion

The following are some suggested discussion points to create the augmented world with DNA models. You can add answers to following questions as audios, new 3D models, videos, or new Image Targets.

• What does DNA stand for?

- Who discovered DNA and when DNA was discovered?
- What is DNA made of?
- What is the shape of DNA? (See more information here <u>https://en.wikipedia.org/wiki/DNA</u>)
- How does the device recognise the Target image?

### Why is this relevant?

DNA (Deoxyribonucleic acid) is an extremely long macromolecule that is the main component of chromosomes and is the material that transfers genetic characteristics in all life forms, constructed of two nucleotide strands coiled around each other in a ladder like arrangement with the side pieces composed of alternating phosphate and deoxyribose units and the rungs composed of the purine and pyrimidine bases adenine, guanine, cytosine, and thymine: the genetic information of DNA is encoded in the sequence of the bases and is transcribed as the strands unwind and replicate.

In this activity, students are engaged in evaluating the AR posters and considering how they could build their own AR/VR experience about DNA. In doing so they are thinking about the digital content and ways of presenting information in a 3D space. They are learning about how a Target image can be used in AR experiences and how computers/devices recognise Target images.

### Assessment

[We have suggested Assessments, however, you may choose to use your own or for further advice, examples and support around assessment please visit the Digital Technologies Hub at <u>digitaltechnologieshub.edu.au/teachers/assessment</u>]

A group activity to add more information to AR Biology poster as audio and/or 3D text about DNA would be an excellent chance for students to present their AR project to class, along with addressing:

- Project title introducing what is DNA and how it is formed
- Project description (Science) what Science concepts (e.g. DNA types) are coupled with this project
- Project description (Digital Technologies) what Digital Technologies concepts (e.g. digital systems, information systems, Internet) are coupled with this project
- Project description (Artificial Intelligence) what Artificial Intelligence concepts (e.g. computer vision to track target image) are coupled with this project. This is an optional activity for students familiar with AI technology. For more information, please visit our free CSER MOOCS on teaching AI in Secondary years (https://csermoocs.appspot.com/ai\_secondary)
- Project description (Augmented Reality) what AR concepts (e.g. image target, 3D objects) are coupled with this project
- Process of design and development of the project
- What is the experience of developing this AR project, what are the identified challenges and how they were resolved

### **Curriculum links**

Links with the Digital Technologies curriculum area

	Strand	Content
Year band		description
Years 9-10	Processes and	Create interactive solutions for
	Production Skills	sharing ideas and information
		online, taking into account

safety, social contexts and legal
responsibilities (ACTDIP043)
Plan and manage projects using
an iterative and collaborative
approach, identifying risks and
considering safety and
sustainability (ACTDIP044)

ADD Links with other curriculum areas

	Learning	Content
Year band	area	description
Year 9	Science - Science Inquiry	Multi-cellular organisms rely on
	Skills	coordinated and
		interdependent internal
		systems to respond to changes
		to their environment
		(ACSSU175)
Year 10	Science - Science Inquiry	Transmission of heritable
	Skills	characteristics from one
		generation to the next involves
		DNA and genes (ACSSU184)



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Appendix

