Topic	ENTITY, ANIMATIONS & CAMERA	
Class Description	**Students learn how to create animations using A-Frame web framework. Students will learn about entity components in A-Frame.**	
Class	**C146**	
Class time	**45 mins**	
Goal	• Create a 3-D scene over the web using html and A-Frame lib. • Create spherical planets and the sun. And orbit them around the sun. • Adjust camera positions.	

Resources Required	• Teacher Resources
	  ○ Laptop with internet connectivity
	  ○ Earphones with mic
	  ○ Notebook and pen
	• Student Resources
	  ○ Laptop with internet connectivity
	  ○ Earphones with mic
	  ○ Notebook and pen	

Class structure	**Warm-Up** **Teacher-led Activity** **Student-led Activity** **Wrap-Up**	**05 mins** **20 mins** **15 mins** **05 mins**

WARM-UP SESSION - 05 mins

CONTEXT

- **Introduce A-Frame entity, animation and camera components for animating 3D components.**

Teacher starts slideshow  from slides 1 to 13 Refer to speaker notes and follow the instructions on each slide.	
Activity details	**Solution/Guidelines**
Hey <student's name>. How are you? It's great to see you! Are you excited to learn something new today? **Run the presentation from slide 1 to slide 3** **Following are the WARM-UP session deliverables:** • **Greet the student.** • **Revision of previous class activities.** • **Quizzes**	**ESR**: Hi, thanks, Yes I am excited about it! Click on the slide show tab and present the slides
Q&A Session	
Question	**Answer**
Which of the following is used to create a 3D cube? A. <a-cube> B. <a-box> C. <v-cube> D. <v-box>	**B.**
_____ is the root element of A-Frame which has few default settings for canvas, camera, lights etc. to view the 3D on the web. A. <a-box> B. <a-cube> C. <a-scene> D. <a-frame>	**C.**
Continue the WARM-UP session	

Activity details	Solution/Guidelines
Run the presentation from slide 4 to slide 13 to set the problem statement. **Following are the WARM-UP session deliverables:** • Appreciate the student. • Explain A-Frame entity.	Narrate the story by using hand gestures and voice modulation methods to bring in more interest in students.
Did you know, in earlier times people used to believe that our planet earth is flat? Do you know which was the first planet discovered? Great! Let's bring our grand solar system inside our computer. Excited?	**ESR:** Yes, It was discovered later on that it is actually a Geoid, which is almost like a sphere. **ESR:** Uranus **ESR:** Yes.
So what do we need to start?	**ESR:** A spherical Sun at the center of the solar system.
Great! Let's get started.	
Teacher ends slideshow 	
TEACHER-LED ACTIVITY - 20 mins	

Teacher Initiates Screen Share		
CHALLENGE • **Create a virtual 3-D solar system on the web.**		
Step 2: Teacher-led Activity (10 mins)	We will first create an entity. So, let's first understand about an entity component system in A-Frame. A-Frame is a three.js framework with an entity-component-system (ECS) architecture. A basic definition of ECS involves: • **Entities** are container objects into which components can be attached, similar to tags. • **Components** are reusable modules or data containers that can be attached to entities to provide appearance, behavior, and/or functionality. • **Systems** provide global scope, management, and services for classes of components. Systems are often optional. We will be learning more about these as we progress through the classes. A-Frame entity is represented by <a-entity> tag. Entity can be used to control the behavior and functionalities of the	

	A-Frame component like positions, shape, animations. Without any components, the entity does not have any functionality of its own. *Teacher opens VS Code Editor, and writes the code to add the <a-entity> tag inside the <a-scene> tag.*	
		
	In the previous class we created different A-Frame primitives inside our VR scene. Let's create a sphere at the centre and set its positions along 3 different axes under the entity tag.	*Student watches.*

	We can now add one more sphere for the planet mercury.	

```
<html>
  <head>
    <script src="https://aframe.io/releases/1.0.4/aframe.min.js"></script>
  </head>
  <body>
    <a-scene background="color: #000000">

        <!--Sun-->
        <a-entity>
            <a-sphere position="0 2.5 -5" color="orange"></a-sphere>
        </a-entity>

        <!--Mercury-->
        <a-entity>
            <a-sphere position="2 2.5 -5"  radius="0.2" color="red"></a-sphere>
        </a-entity>

    </a-scene>
```

	***Imp Note**: Toggle between the code screen and the output browser always to show the difference after updating code.* Okay. Now we have two objects in our solar system, what's next?	**ESR:** We need to rotate the planet mercury around the sun.
	Great! Any ideas on how we can do that?	*Let the student come up with their own ideas.*
	We can use the **animation component** in A-Frame for orbiting planets around the sun. We can mention the "property" we want to animate and set different attributes for that property such as "from", "to", "dur", "easing", "loop" etc. ,to animate the entity. **property**: Property to animate, it can be component name, property of any component,or just an attribute. **from**: The initial value of the property, if not specified the current property value of the entity will be used. **to**: The final/target value of the property at the end of animation. **dur**: Duration of the animation cycle i.e. for how long each animation will be executed. The duration is	*Student observes and asks questions.*

mentioned in milliseconds. Default value is 1000 milliseconds(**1 sec= 1000 milliseconds**).

easing: It is a timing function, which can be used to change the animation speed per animation cycle. Default value is “easeInQuad”.

loop: How many loops(number) i.e. many times the animation should repeat. If the value is true, the animation will repeat infinitely.

Let’s add the animation component in the <a-entity> tag of mercury.
To add animation to any entity, the positions and rotation components must be set in <a-entity> to give it an initial value.
Adding animations in <a-entity> makes it global to all the components which can be part of the entity.

```
<head>
  <script src="https://aframe.io/releases/1.0.4/aframe.min.js"></script>
</head>
<body>
  <a-scene background="color: #000000">

    <!--Sun-->
    <a-entity>
      <a-sphere position="0 0 0" radius="2" color="orange"></a-sphere>
    </a-entity>

    <!--Mercury-->
    <a-entity position="0 0 0" rotation="0 0 0" animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur: 20000">

      <a-sphere position="1 2.5 -5"  radius="0.2" color="red" ></a-sphere>

    </a-entity>

  </a-scene>
</body>
</html>

```

	Here the property is set to rotation. **to** : “0 360 0” This will rotate the entity on the Y-axis by 360 degrees. **easing**: linear **loop**: true **dur**: 20000 **Note**: Try out different combinations of the values to adjust them properly. Use arrow keys to zoom in and out to see the result. Now, our little mercury planet has started rotating around the sun. Isn’t that interesting. Now that we have learnt how to create animations, you will be creating the Sun and the other orbiting planets. Also you will try to rotate them on their own axis as a challenge. Before we can move on to your activity, let's quickly see how to adjust the camera positions under the <a-entity> component.	

```
<a-scene background="color: #000000">

    <!--Camera-->
    <a-entity position="0 0 25" >
        <a-camera></a-camera>
    </a-entity>

    <!--Sun-->
    <a-entity>
        <a-sphere position="0 0 0" radius="2" color="orange"></a-sphere>
    </a-entity>

    <!--Mercury-->
    <a-entity position="0 0 0" rotation="0 0 0" animation="property: rotation; to: 0 360 0;easing:linear; lo

        <a-sphere position="1  0 -5"  radius="0.2" color="red" ></a-sphere>

    </a-entity>

</a-scene>
```

	The <a-camera> component is used to define the perspective view of the user and it can be attached to the input devices to control the camera movements. But for now we can keep it empty and only adjust it's position to have a better view of the objects on the web without using arrow keys.	

Teacher Stops Screen Share

STUDENT-LED ACTIVITY - 15 mins

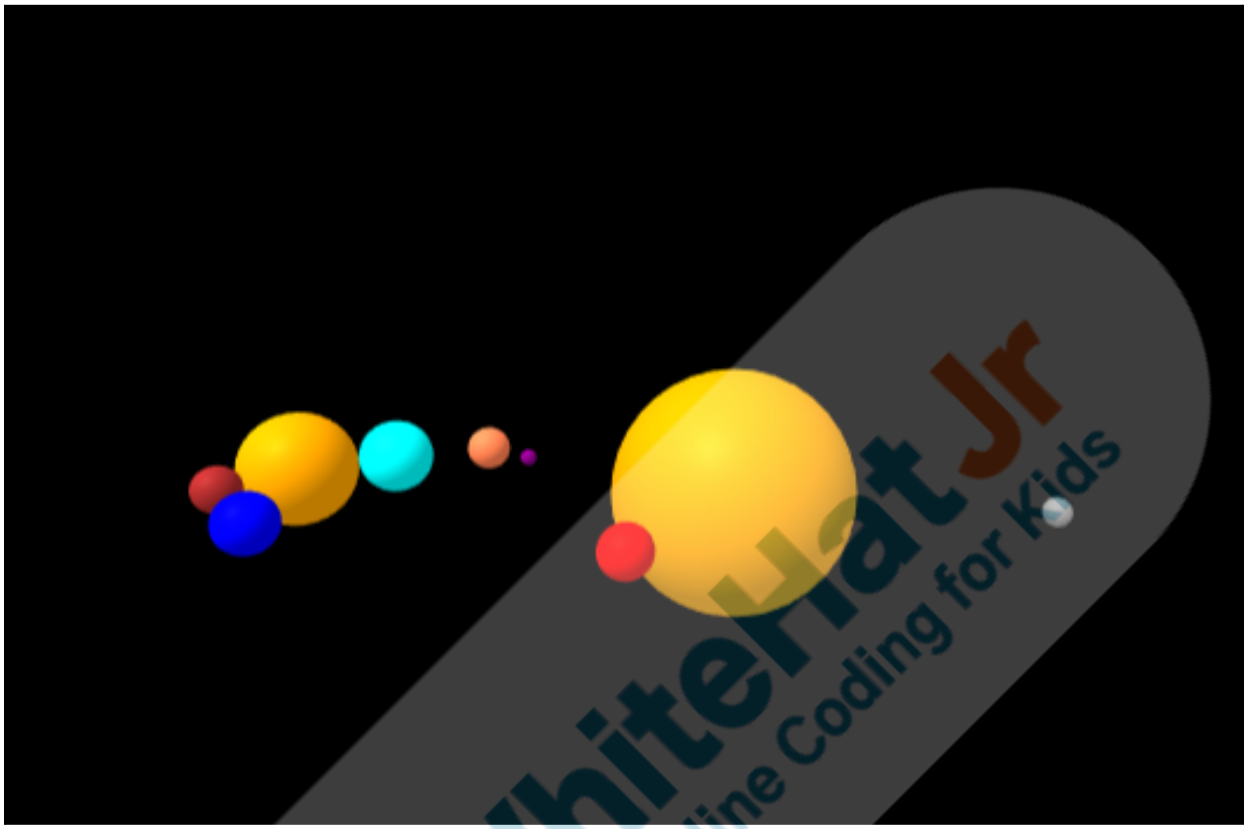
- **Ask Student to press ESC key to come back to panel**
- **Guide Student to start Screen Share**
- **Teacher gets into Fullscreen**

<table>
<tr><td colspan="3"><u>ACTIVITY</u>
• Remix example code and play around with different attributes of primitive shapes.
• Create a new project Solar System and make a Sun and Starry background in the scene.</td></tr>
<tr><td colspan="3">Teacher starts slideshow  from slides 14 to 15
Refer to speaker notes and follow the instructions on each slide.</td></tr>
<tr><td></td><td>Now it's your turn. Please share your screen with me.</td><td></td></tr>
<tr><td colspan="3">Teacher ends slideshow  </td></tr>
<tr><td>Step 3: Student-Led Activity (20 mins)</td><td>Guide the student to open the project in VS Code Editor.

Guide the student to edit code inside index.html file.</td><td></td></tr>
<tr><td></td><td>Encourage the student to edit code and see change in outputs by asking questions and giving challenges.

C1: Guide the student to add <a-entity> component and add <a-sphere> component inside that.</td><td>The student edits the code and tests the output.</td></tr>
</table>

	C2: Guide the student to add sun and other planets using the entity component system. *Guide the student to adjust the position and radius of planets.* Good Job! C3: Now what's next? Great! Let's set property as rotation and its attributes to orbit planets around the sun. *Let the child explore and play with the example.*	*Students will adjust the positions of the planets maintaining the distance. Students will set different radii for the planets.* *Adding Animation.* *Students also experiment with different attributes and values to understand the Animation components.*

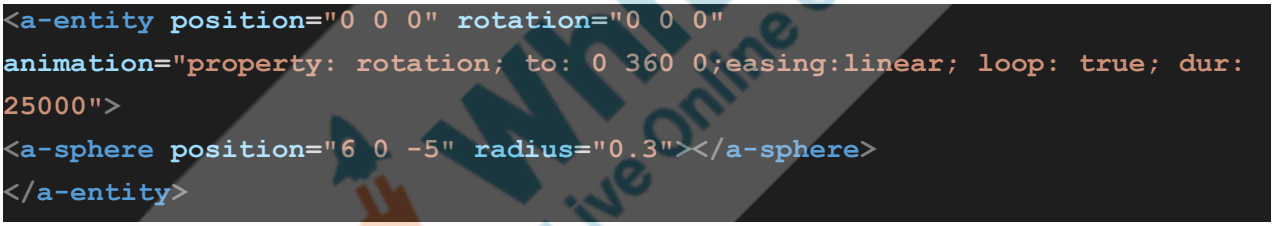


	Good Job! We have our 8 planets revolving around the sun. It was really fun. Let's add the <a-camera>. Do you have any doubts till now? *Clear the doubts which can be solved and for advance doubts tell the child that we will cover them in future classes.*	

	Awesome! It was really fun to see 3D objects inside the web. In the next class we will create our Solar System. Can you tell what we have in our solar system?	
Teacher Guides Student to Stop Screen Share		
WRAP-UP SESSION - 05 Mins		
FEEDBACK • **Complement the student for her/his effort in the class.** • **Encourage the student to move in the scene using WASD/arrow keys and mouse.**		
Teacher starts slideshow  **from slides 16 to 25** Refer to speaker notes and follow the instructions on each slide.		
Activity details		**Solution/Guidelines**
Run the presentation from slide 16 to slide 25. **Following are the wrap-up session deliverables:** • **Explain the facts and trivias** • **Next class challenge** • **Project for the day** • **Additional Activity**		Guide the student to develop the project and share with us.
Quiz Time - Click on In-Class Quiz		
Question		**Answer**
A-Frame is a _____ framework with an entity-component-system (ECS) architecture.		**C**

A. one.js B. two.js C. three.js D. four.js		
_____ are container objects into which components can be attached, similar to tags. A. Components B. Entities C. Systems D. Frames		**B**
In A-frame, what did we use for orbiting planets around the Sun? A. rotation component B. planet component C. animation component D. revolution component		**C**
• **End the quiz panel**		
	You get a “hats off”. As an assignment, do you think you can create some more shapes in the hello world example like a tetrahedron, torus? Alright. I will look forward to seeing how you create your content. We will be adding planets and animation in the next class.	Make sure you have given at least 2 Hats Off during the class for:   

Project Overview	**ANIMATED ROBOT** **Goal of the Project:** Today, you have learned how to add animations in a 3D scene. In this project, you will have to use some new shapes and place it in your scene to make a robot and move its eye up and down. You can attach an antenna over the head of the robot and move it left and right. **Story:** Rishab was watching a television show called Doremon. He saw in the show Nobita is having Doremon as his friend. He wished it would be awesome if he too could have someone like Nobita. He decided to create one robot for himself using a computer program. Help him to design a 3D robot whose eyes will be moving up and down and its antena will move left and right. I am very excited to see how you will create your scene using gLTF models. Bye!	

Teacher ends slideshow 		
Teacher Clicks ✖ End Class		
Additional Activities	Discuss the idea of rotation of objects on their own axis. Let the student come with their own idea. To **revolve** any 3D primitive we created an entity and added a primitive shape inside and then added the animation to revolve it in a circular path of given radius.	
		
	To **rotate** any 3D object **on their own axis**, the same animation can be added to the primitive shape itself. **Note:** Without any texture over the sphere rotation cannot be differentiated. Teachers can show the rotation with <a-box> or any other shape to make the student understand.	

```
<a-entity position="0 0 0" rotation="0 0 0"
animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur:
25000">
<a-sphere position="6 0 -5" radius="0.3"></a-sphere>
</a-entity>
```

	In this example below, the sphere is both rotating and revolving.	

```
<a-entity position="0 0 0" rotation="0 0 0"
animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur:
25000">
<a-sphere position="6 0 -5" radius="0.3"
animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur:
25000"
></a-sphere>
</a-entity>
```

Activity	Activity Name	Links
Teacher Activity 1	Teacher Reference	https://github.com/whitehatjr/PRO-C146-Teacher-Ref
Student Activity 1	Student Reference	https://github.com/whitehatjr/PRO-C146-Student-Activity/blob/main/index.html
Project Solution Link	Animated Robot	https://github.com/whitehatjr/VR-PRO-C146
Teacher Ref. Visual Aid Link	Visual Aid Link	https://curriculum.whitehatjr.com/Visual+Project+Asset/PRO_VD/PRO_C146_withcues.html
Teacher Ref. In-Class Quiz	In-Class Quiz	https://s3-whjr-curriculum-uploads.whjr.online/584d4250-6a5b-42be-9f33-e41d65f3165a.pdf