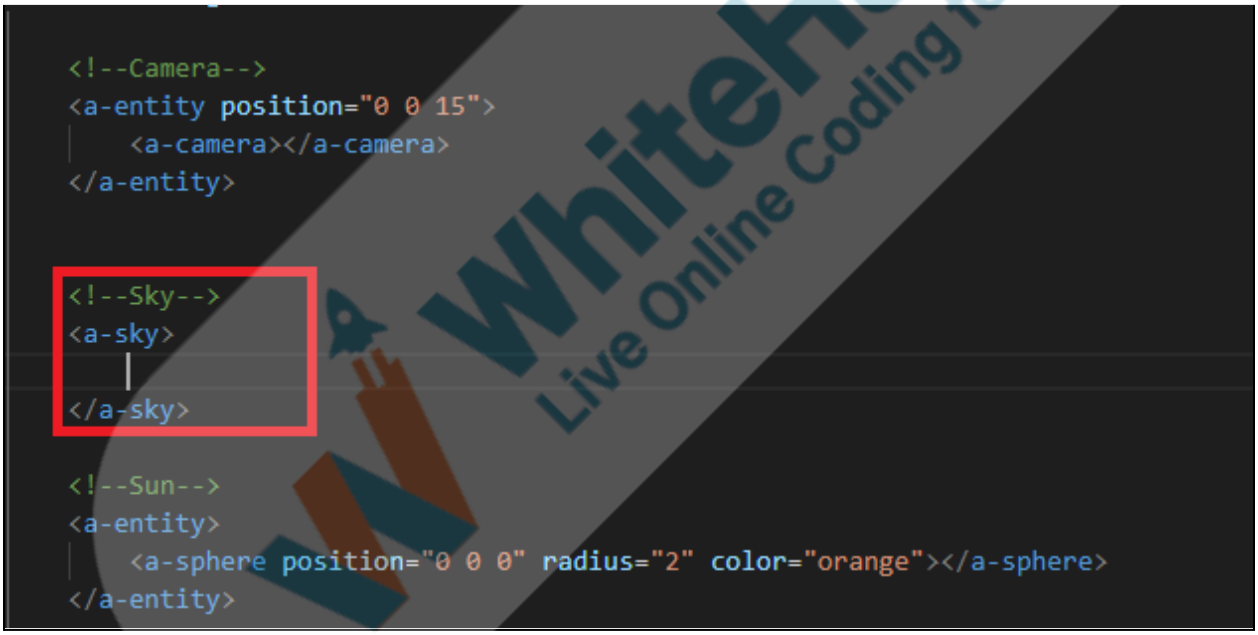
Topic	SKY, TEXTURES & RELATIVE POSITION	
Class Description	**Students learn how to add texture to any entity A-Frame web framework. Students will learn how to add sky and torus components in A-Frame. Students will learn the concept of relative positioning using the parent/child entity component system.**	
Class	**C147**	
Class time	**45 mins**	
Goal	• Add a sky element in the AFrame scene. • Add texture to planets and the sun. • Add torus for orbital path. • Add sound in the solar system. • Add the moon and the saturn rings using the concept of relative position and the parent/child entity.	

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** **15 mins** **20 mins** **05 mins**
WARM-UP SESSION - 05 mins		
CONTEXT • **Introduce A-Frame entity, animation and camera components for animating**		

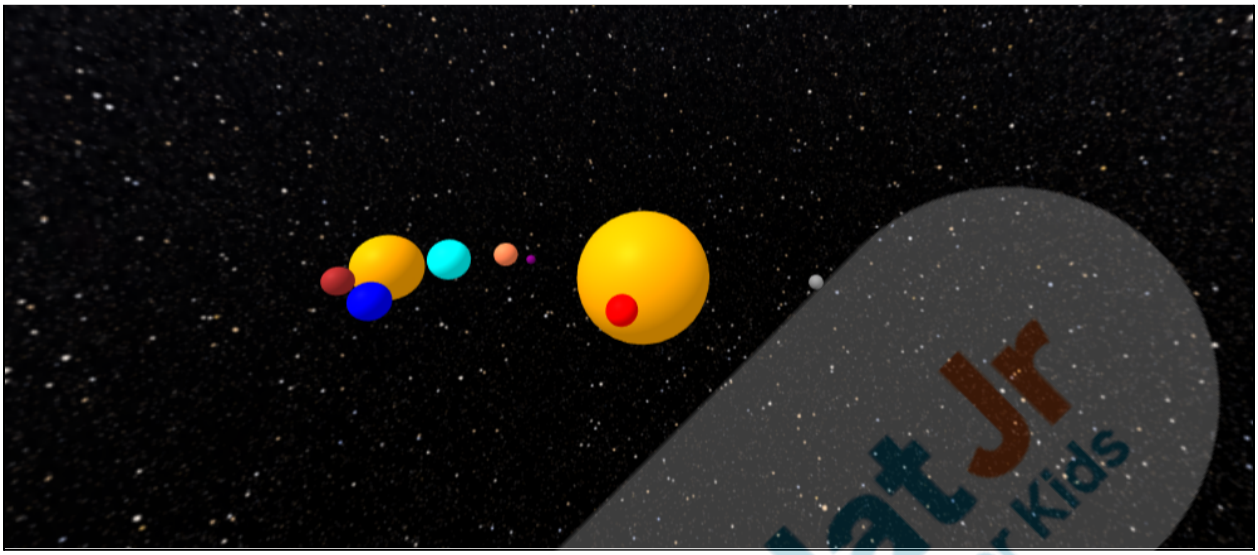
3D components.	
Teacher starts slideshow  **from slides 1 to 14** Refer to speaker notes and follow the instructions on each slide.	
Activity details	**Solution/Guidelines**
Hey <student's name>. How are you? It's great to see you! Are you excited to learn something new today? **Run the presentation 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**
While using the animation component of A-Frame, we can mention the "property" we want to animate and set different attributes for that property. Which of these attributes of the property is incorrect? A. Animate B. To C. Dur D. from	**A**
The _____ 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. A. <a-entity>	**C**

B. <a-scene> C. <a-camera> D. <a-input>	
Continue the WARM-UP session	
Activity details	**Solution/Guidelines**
Run the presentation from slide 4 to slide 14 to set the problem statement. **Following are the WARM-UP session deliverables:** ● Appreciate the student. ● Explain A-Frame entity,animation and camera component.	Narrate the story by using hand gestures and voice modulation methods to bring in more interest in students.
Teacher ends slideshow 	
TEACHER-LED ACTIVITY - 15 mins	
Teacher Initiates Screen Share	
CHALLENGE ● **Complete a virtual 3-D solar system on the web.**	
Step 2: Teacher-led Activity (10 mins)	Let's first create a starry night sky. For this we can use the <a-sky> primitive of the AFrame. <a-sky> can be used to add 360 degree image texture or color to the scene.

	The <a-sky> is a very large sphere which can have texture or color attached to the inner surface. *Teacher opens VS Code Editor, and writes the code to add the <a-sky> tag inside the <a-scene> tag.* ***Imp Note**: Toggle between the code screen and the output browser always to show the difference after updating code.*	
 		
	Now we can add a starry night texture to the sky. What would we need for that?	**ESR:** A night sky image. *Student watches.*

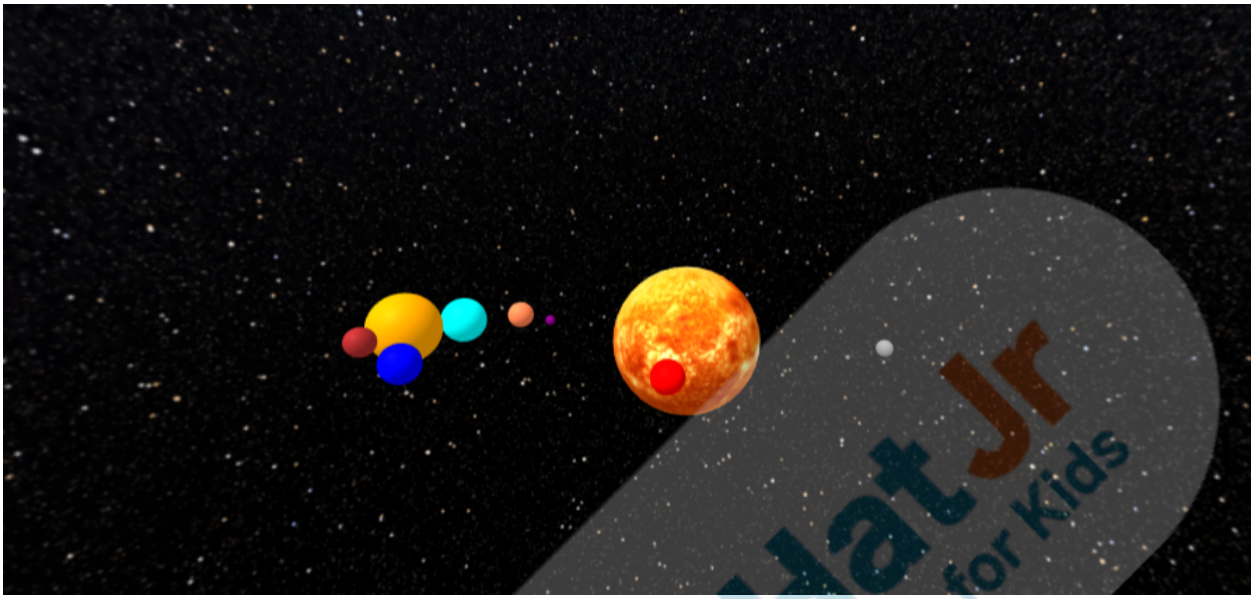
	Great! We can download image textures or we can use online accessible links. After downloading the image we can keep it in the working directory(folder) and use the filename under the “**src**” attribute. We can directly paste the image source link available online for use. Add an attribute **src=“paste the link”**. Let’s add the sky image in the <a-sky> primitive.	

```
<!--Camera-->
<a-entity position="0 0 15">
    <a-camera></a-camera>
</a-entity>


<!--Sky-->
<a-sky src="https://cdn.glitch.com/850dd813-e5e9-4dd0-9751-38981ae74172%2Fvia_lactea.png?v=1604296331712">

</a-sky>

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



	Okay. We have a sky image in our solar system, what's next?	**ESR:** We need to add textures to the sun and the planets.
	Great! Let's see how this can be done. Any idea how we can add texture to the sun? Amazing! Note: Remove the color attribute of the sphere and switch to the output tab to see the difference.	**ESR:** We can add the image source tag to the sphere primitive for the sun also.

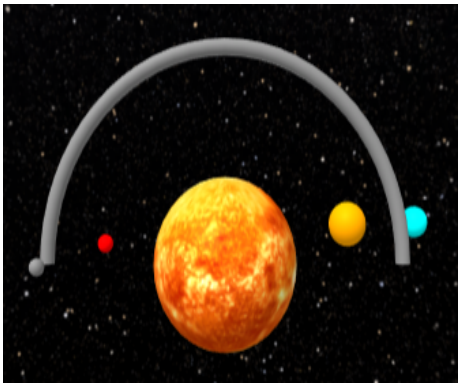
```
<!--Sky-->
<a-sky src="https://cdn.glitch.com/850dd813-e5e9-4dd0-9751-38981ae74172%2Fvia_lactea.png?v=1604296331712">

</a-sky>

<!--Sun-->
<a-entity>
    <a-sphere position="0 0 0" radius="2" src="https://cdn.glitch.com/850dd813-e5e9-4dd0-9751-38981ae74172%2Fsol.jpg?v=1604296185621"><
</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">
```



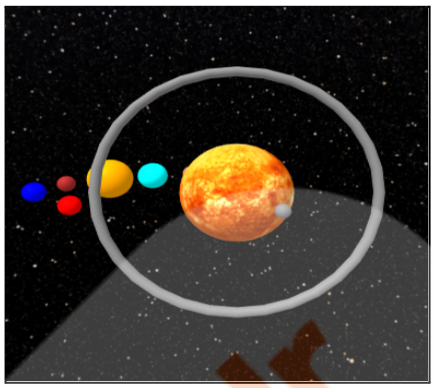
	Now what's next? Let's learn how to show the orbiting path of the planets. We can use the Torus primitive in A-Frame to show the orbiting planet's path around the sun. **The <a-torus> helps to create tube shapes.** We can set many different attributes in <a-torus>. Let's discuss a few of them. **arc**: This attribute sets the arc length of the tube. Default value is 360 degrees, a complete circular tube.	Student observes and asks questions.

	radius: This attribute sets the radius of the tube. **radius-tubular**: This attribute sets the thickness of the tube. **segments-tubular**: This attribute sets the number of segments the tube is made of. Default value is 32 segments. We can set attributes position, rotation to modify the <a-torus> primitive. Let's add the <a-torus> primitive. *Teacher shows the example usage by changing values of the attributes* ***without arc value*** *or with* ***arc=180.***	

```
        <!--Neptune-->
        <a-entity position="0 0 0" rotation="0 0 0"
            animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur: 55000">
            <a-sphere position="36  0 -5" radius="0.3" color="purple"></a-sphere>
        </a-entity>

        <!--Orbital Paths-->
        <!--Mercury-->
        <a-torus color="grey"  arc="180" radius="5" radius-tubular="0.1"></a-torus>

    </a-scene>
</body>
```



When arc=”180”



When arc=”360”(Default)

Here let’s set rotation, radius and radius-tubular attributes.

rotation= “90 0 0”

This will rotate the <a-torus> on the X-axis by 90 degrees.

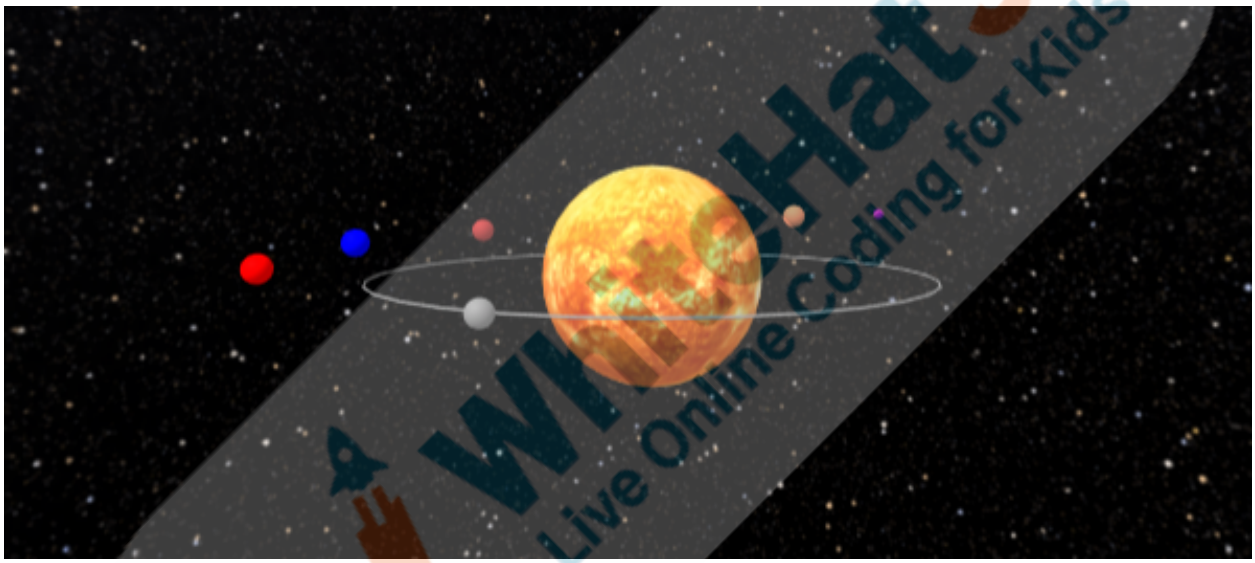
radius: 0.3

radius-tubular: 0.01

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's orbital path can be seen.
Isn’t that cool?

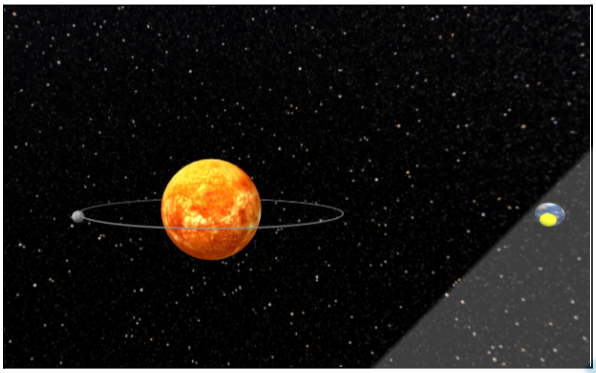
```
        <!--Neptune-->
        <a-entity position="0 0 0" rotation="0 0 0"
            animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur: 55000">
            <a-sphere position="36  0 -5" radius="0.3" color="purple"></a-sphere>
        </a-entity>

        <!--Orbital Paths-->
        <!--Mercury-->
        <a-torus color="grey"  arc="180" radius="5" radius-tubular="0.1"></a-torus>

    </a-scene>
</body>
```

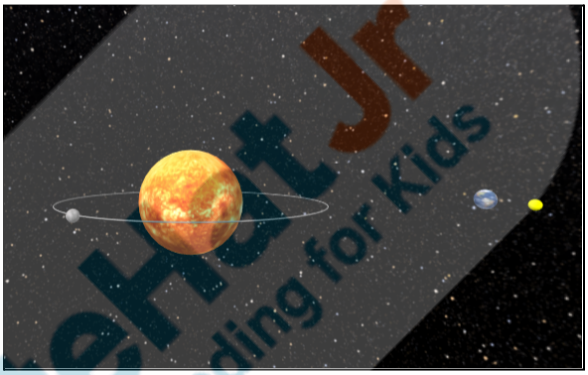


	That looks like we have almost everything inside our solar system. Or are we missing something? Yes. Our planet earth has its own moon, there are many planets which have their own. So, what do you think is the way we can add a moon in our solar system?	**ESR:** No, we do not have the Moon. *Let the student come up with their own ideas.*

	Let's find out. The first thing that we have to keep in mind is that it should be revolving around the earth. And then they both as a team must revolve around the sun, right? For this we have to think in terms of **relative positions** of the objects. **That means the position of one object depends on the other object**. Here in our solar system the position of earth depends on the sun, and the position of the moon depends on the earth. So, **revolving the moon around the earth**, **the moon has been the child entity of the earth**. Let's see how we can do that. Do you have any ideas how I can make one entity as a parent and another one as a child? Amazing!! Let's do that.	**ESR:** Yes! **ESR:** We can make one more sphere entity inside the earth entity.

```
<!--Earth-->
<a-entity position="0 0 0" rotation="0 0 0"
    animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur: 30000">
        <a-sphere position="11  0 -5" radius="0.4"
            src="https://cdn.glitch.com/850dd813-e5e9-4dd0-9751-38981ae74172%2Fearth.jpg?v=1604312404511">
            <!--Moon-->
            <a-entity  position="0 0 0" rotation="0 0 0"  animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur: 10000">
                <a-sphere color="yellow" position="2  0 0" radius="0.2" ></a-sphere>
            </a-entity>

        </a-sphere>
</a-entity>
```





Now that we have learned how to add sky, texture, torus and relative positioning, you will be adding the textures for the Sun and all other orbiting planets and orbit paths for them and Saturn rings also.

STUDENT-LED ACTIVITY - 20 mins

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

ACTIVITY

- **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.**

Teacher starts slideshow  **from slides 15 to 16** Refer to speaker notes and follow the instructions on each slide.		
	Now it's your turn. Please share your screen with me.	
Teacher ends slideshow 		
Step 3: Student-Led Activity (20 mins)	*Guide the student to open the project in VS Code Editor.* *Guide the student to edit code inside index.html file.*	
	Encourage the student to edit code and see change in outputs by asking questions and giving challenges. *C1: Guide the student to add <a-sky> primitive and add image "src" inside that.* *C2: Guide the student to add image texture for the sun and other planets using "src"*	*The student edits the code and tests the output.* *Students add textures for all the objects.*

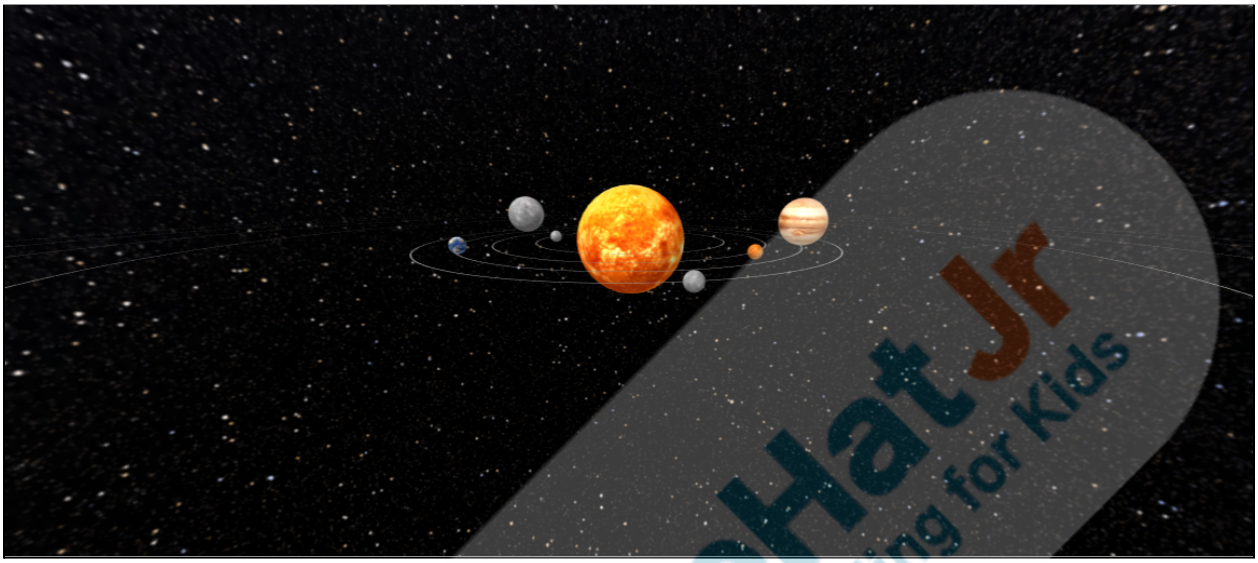
	Note: *Provide the image source links or let the student explore images by himself.* Good Job! C3: Now what's next? Great! Let's set rotation, radius, radius-tubular, segments-tubular.	*Adding <a-torus> for the paths.* *Students also experiment with different attributes and values to understand the <a-torus> primitive.*

Orbital paths:

```
<!--Orbital Paths-->

<!--Mercury-->
<a-torus color="grey" rotation="90 0 0" radius="5" radius-tubular="0.01" segments-tubular="1000"></a-torus>

<!--Venus-->
<a-torus color="grey" rotation="90 0 0" radius="7.8" radius-tubular="0.01" segments-tubular="1000"></a-torus>

<!--Eath-->
<a-torus color="grey" rotation="90 0 0" radius="10.6" radius-tubular="0.01" segments-tubular="1000"></a-torus>

<!--Mars-->
<a-torus color="grey" rotation="90 0 0" radius="14.5" radius-tubular="0.01" segments-tubular="1000"></a-torus>

<!--Juptier-->
<a-torus color="grey" rotation="90 0 0" radius="21.5" radius-tubular="0.01" segments-tubular="1000"></a-torus>

<!--Saturn-->
<a-torus color="grey" rotation="90 0 0" radius="26.5" radius-tubular="0.01" segments-tubular="1000"></a-torus>

<!--Uranus-->
<a-torus color="grey" rotation="90 0 0" radius="31.5" radius-tubular="0.01" segments-tubular="1000"></a-torus>

<!--Neptune-->
<a-torus color="grey" rotation="90 0 0" radius="36.5" radius-tubular="0.01" segments-tubular="1000"></a-torus>
```

	Looks like our solar system is ready, right?Or is there anything else we can do? Yes, we will do that in a while. Before that what if we could add the sounds like we hear when we go to the planetarium. *C4: Guide the student add sound in the in the scene using sound attribute inside the entity tag-* ***<a-entity sound="sound file path; autoplay:true;volume: 0.5"></a-entity>*** We can set the attribute: **autoplay**:true Which can play the sound automatically whenever the application runs. **volume**: 0.5 To set the volume value. *Let the child explore and play with the example.*	**ESR:** Yes. We can add the moon, saturn rings.

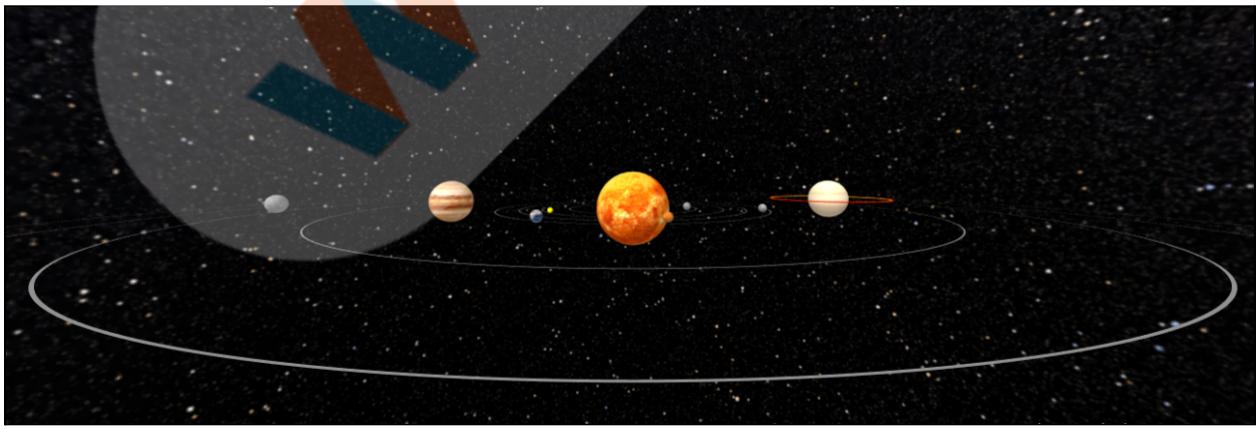
```
<a-entity
    sound="src: https://cdn.glitch.com/850dd813-e5e9-4dd0-9751-38981ae74172%2Ffh_space_discovery_-_earth_proud_music_preview(1).mp3?v=1
</a-entity>
```



	Good Job! We have our 8 planets revolving around the sun with realistic textures that we astronomers have found out over the time. That was fun. Now what's next? Yes, the Moon of the planet earth. And do you know the planet Saturn has 7 large rings around and these are made of the dust, particles, and ice. So how can we make rings for Saturn?	**ESR:** The moon.

	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.	

```
<!--Saturn-->
<a-entity position="0 0 0" rotation="0 0 0"
    animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur: 45000">
    <a-sphere position="26  0 -5" radius="0.9"
        src="https://cdn.glitch.com/850dd813-e5e9-4dd0-9751-38981ae74172%2Fsaturn.png?v=1604312433927">

        <!--Saturn Rings-->
        <a-torus color="red" radius="3" rotation="90 0 0 " radius-tubular="0.015" segments-tubular="1000">
        </a-torus>
        <a-torus color="pink" radius="2.9" rotation="90 0 0 " radius-tubular="0.02" segments-tubular="1000">
        </a-torus>
        <a-torus color="orange" radius="2.8" rotation="90 0 0 " radius-tubular="0.025" segments-tubular="1000">
        </a-torus>

    </a-sphere>
</a-entity>

<!--Uranus-->
<a-entity position="0 0 0" rotation="0 0 0"
    animation="property: rotation; to: 0 360 0;easing:linear; loop: true; dur: 50000">
    <a-sphere position="31  0 -5" radius="0.6"
        src="https://cdn.glitch.com/850dd813-e5e9-4dd0-9751-38981ae74172%2Fmercurio.jpg?v=1604298142259">
    </a-sphere>
</a-entity>
```



	Awesome! It was really fun to see the 3D solar system inside the web.	
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 slide 17 to slide 28**		
Activity details		**Solution/Guidelines**
Run the presentation from slide 17 to slide 28 **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**
_____ can be used to add 360 degree image texture or color to the scene.		**A**

A. <a-sky> B. <a-frame> C. <a-environment> D. <a-entity>		
Which of these is an attribute of the <a-torus> primitive? A. degree B. arc C. segment D. diameter		**B**
What is the use of the **segments-tubular** attribute of the <a-torus> primitive? A. This attribute sets the length of the tube. B. This attribute sets the position of the tube. C. This attribute sets the thickness of the tube. D. This attribute sets the number of segments the tube is made of.		**D**
• **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	**ROOM DESIGN** **Goal of the Project:** The student will create a room design with the different textures added to the wall and other objects in the room like chair, coffee table, etc. **Story:** Divya is planning to decorate her room with beautiful paintings and room wall textures. She is not able to decide which would look better in her room. Help her design the interior of the room. I am very excited to see how you will create your scene using gLTF models. Bye!	
Teacher ends slideshow 		
Teacher Clicks 		
Additional Activities	Students can create a 3D Art Gallery tour with different Art textures. Guide the student to download or access online textures.	

Activity	Activity Name	Links
Teacher Activity 1	Teacher Reference	https://github.com/whitehatjr/PRO-C147-Activity-Reference
Student Activity 1	Student Reference	https://github.com/whitehatjr/PRO-C147-Student-Activity/blob/main/index.html
Project Solution Link	Room Design	https://github.com/whitehatjr/VR-PRO-C147
Teacher Ref. Visual Aid Link	Visual Aid link	https://curriculum.whitehatjr.com/Visual+Project+Asset/PRO_VD/PRO_C147_withcues.html
Teacher Ref. In-Class Quiz	In-Class quiz	https://s3-whjr-curriculum-uploads.whjr.online/e6c874ec-6d28-4f23-afc2-1a2429dce5c9.pdf