3D GRAPHICS

Lesson

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OVERVIEW

PREWORK

LEARNING TARGETS

- ❑ I can describe types of transformations (dilation, translation, rotation, reflection)
- ❑ I can explain the connection between transformations and 3D graphics.

OPTIONAL PRACTICE

- ❑ I can try out AFrame by remixing a template on replit to show various transformations

HW

DELIVERABLES

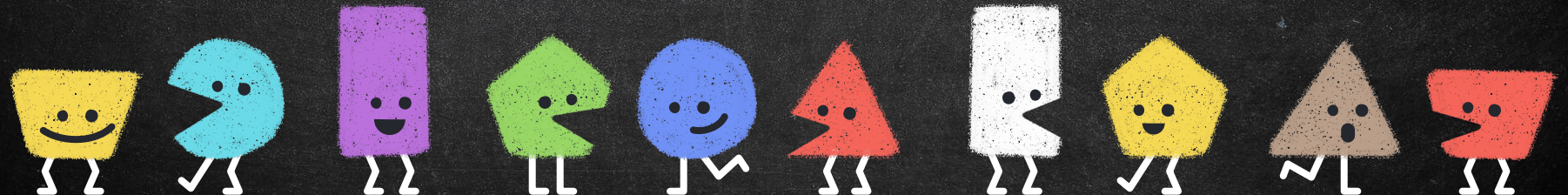
- Review reference slides to create a scene that uses AFrame that demonstrates transformations
  - use checklist criteria
  - can use entity from class

1 2 3

LESSON

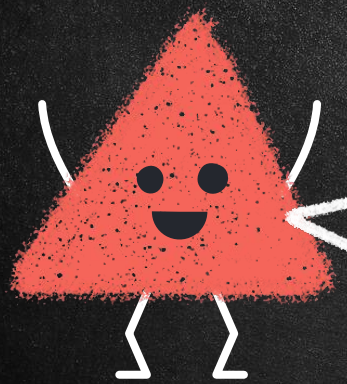
LEARNING TARGETS

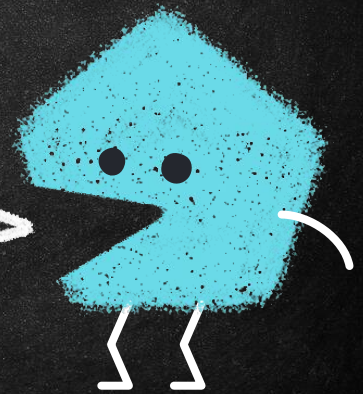
- ❑ I can describe 3D transformations and where they might be used..
- ❑ I can decide which type of transformations will work to move one figure to another.
- ❑ I can create an entity using several shapes using Aframe



Agenda

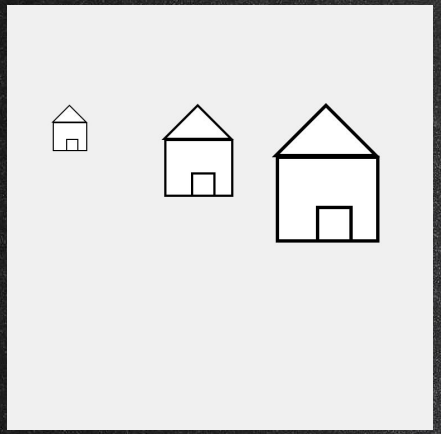
- Quick reminder: 2D Transformations
- Composition of 2D Transformations
- Going from 2D → 3D: Understanding Projection and Perspective
- Why Use AFrame (WebVR)?
- 3D Coordinate System
- 3D Transformations
- 3D Graphics with AFrame
- Resources to keep learning
- Homework

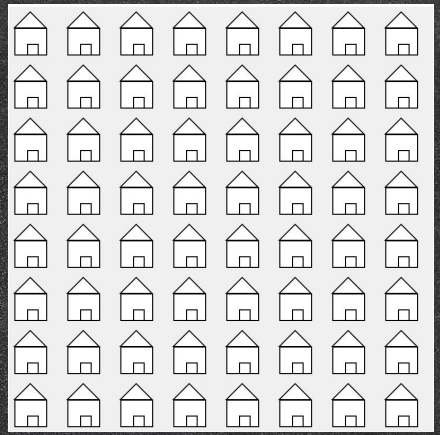


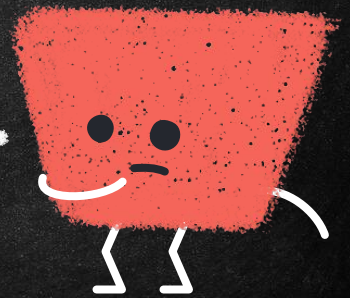


Reminder: 2D Transformations

We can use 2D transformations to update existing designs or create, place, and modify copies of 2D designs, like so:







Source for images and notes for more: https://genekogan.com/code/p5js-transformations/

Composition of 2D Transformations

"SEQUENCE MATTERS!"

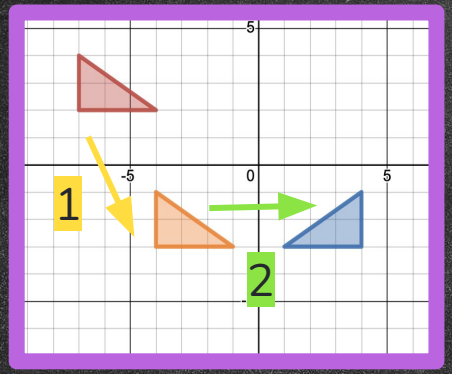
R → O → B

Start position

Final position

STEP 1: TRANSLATE

STEP 2: REFLECT



STEP 1:

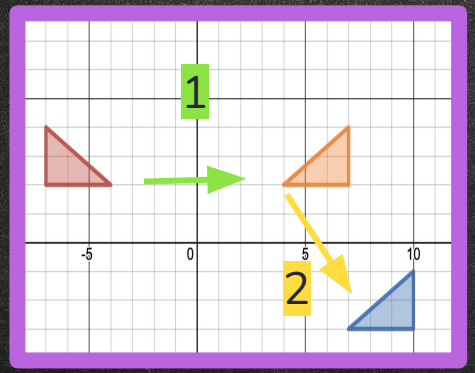
Take gray line 1 stop west

STEP 2:

Go uptown 4 stops

STEP 1: REFLECT

STEP 2: TRANSLATE

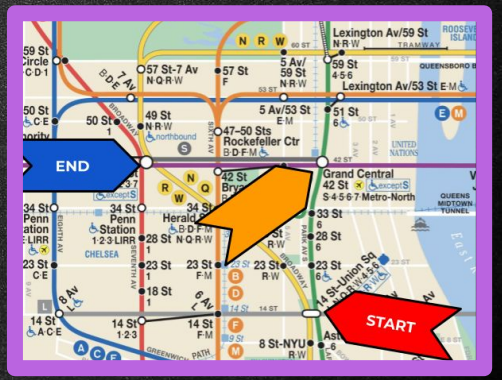


STEP 1:

Go uptown 4 stops

STEP 2:

Take gray line 1 stop west

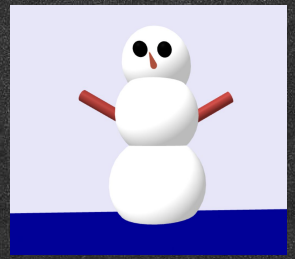


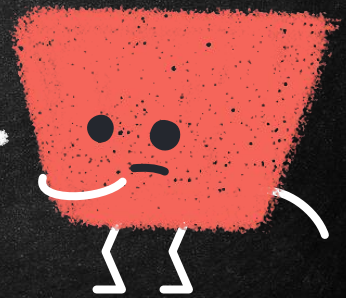
Going from 2D → 3D:

Understanding Projection and Perspective

Making 2D graphics is great! After all, our screens are effectively 2D.

However, to make something look truly 3D on our 2D screens, we need to understand **projection** and **perspective**.





Going from 2D → 3D:

Understanding Projection and Perspective

Projection is the method of converting a 3D object into a 2D object.
Perspective is a type of projection!

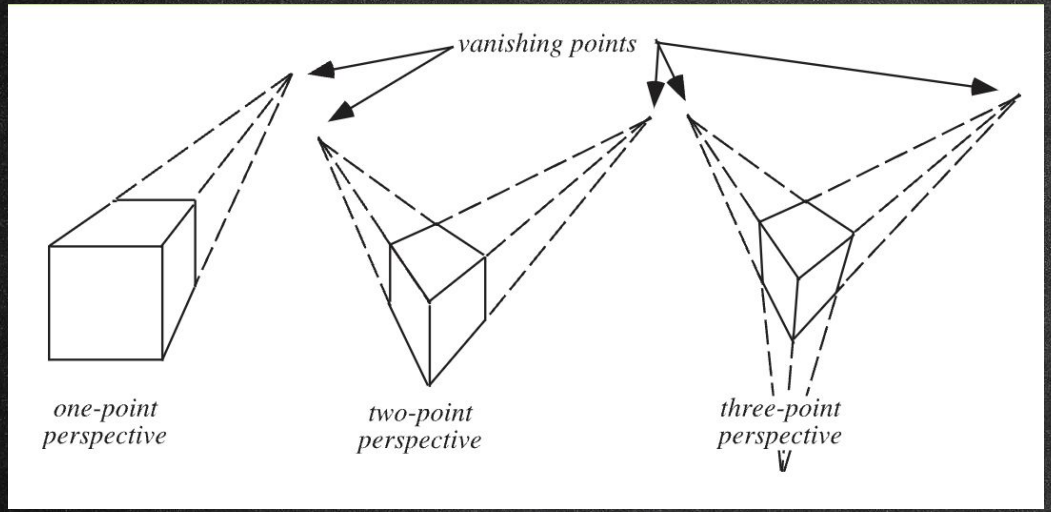
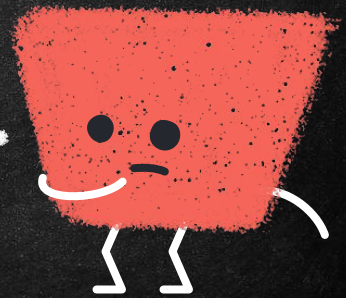
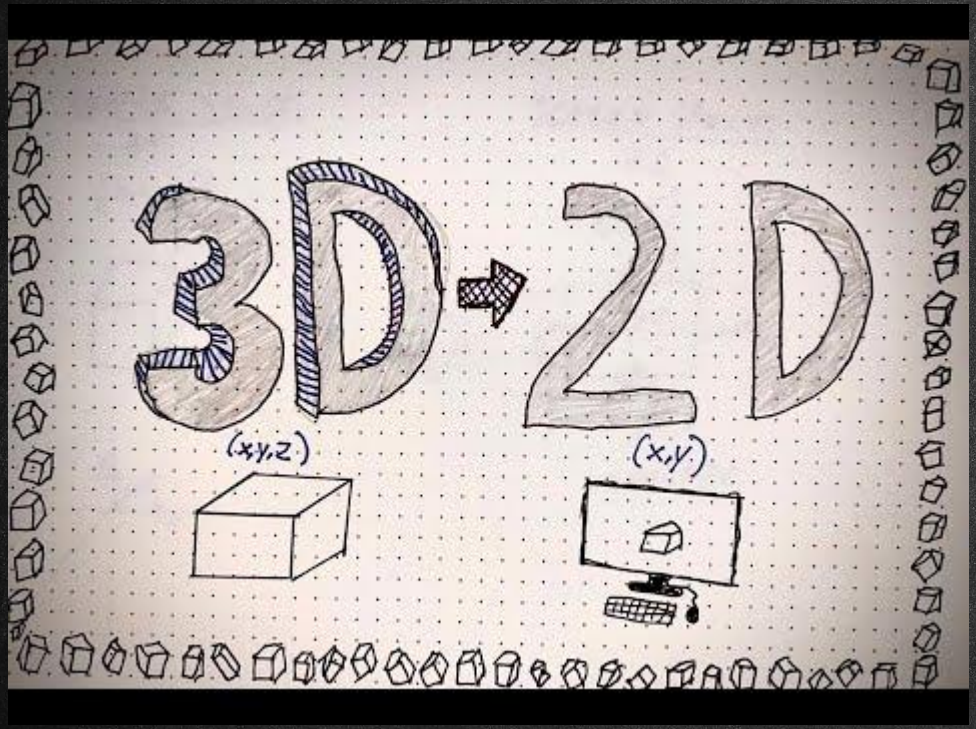


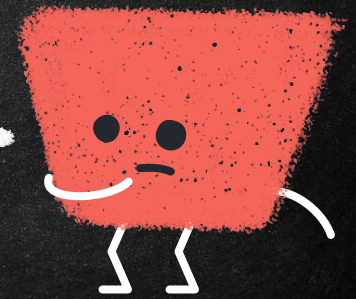
Image source

You likely learned about **perspective** in art class.



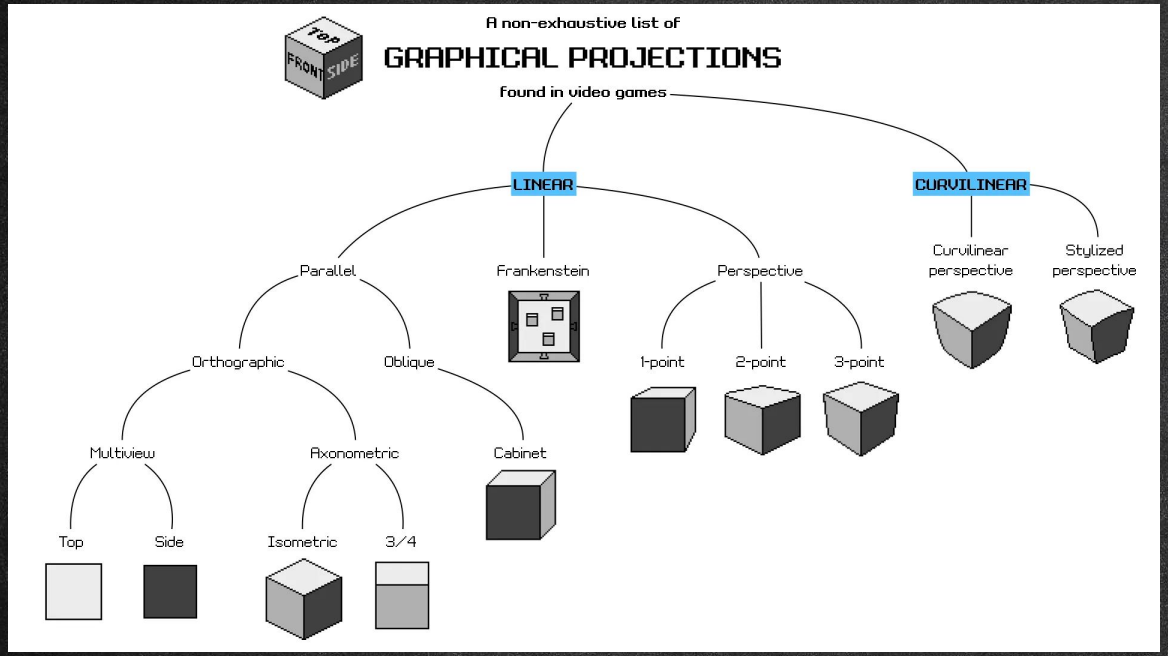
Perspective Projection

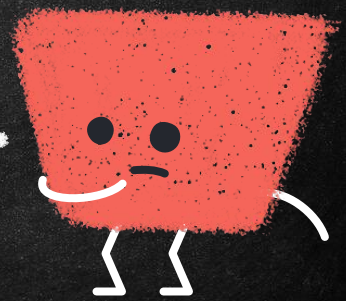




Going from 2D → 3D:

Understanding Projection and Perspective



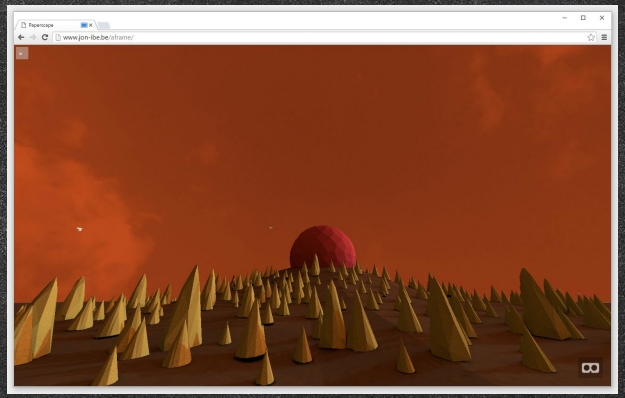


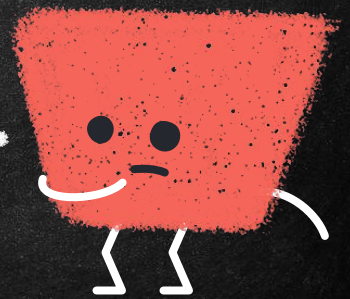
GAME DEVELOPERS GUIDE TO GRAPHICAL PROJECTIONS!

WHY USE A VR LIKE AFRAME ?

Two types of Virtual Reality (VR):

Native *vs.* *Web*





WHY AFRAME ?

Two types of Virtual Reality (VR):

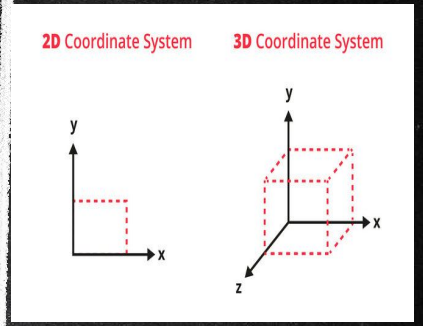
NATIVE - needs a special device/hardware like OCCULUS @$399

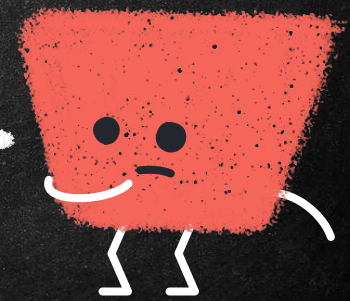
WEB - are applications that run in the browser like AFrame

- Why use WebVR like Aframe ? 00-1:16 Aframe Webvr - VR Development Part 1 - Setting Up

2D to 3D Coordinate Systems

To communicate to the computer what and how we want to draw objects, we need a coordinate system.





3D Coordinates: Right-handed system

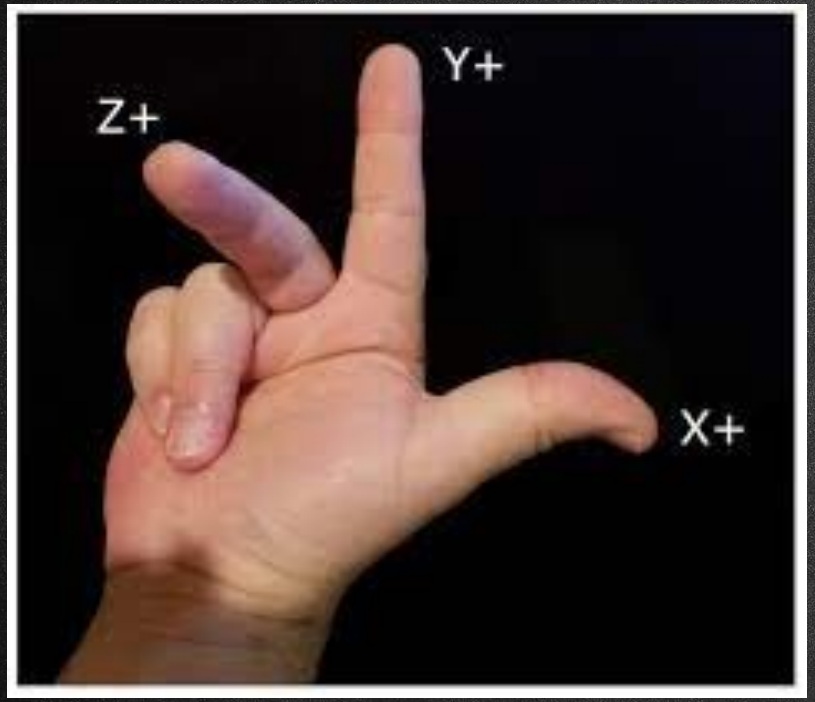
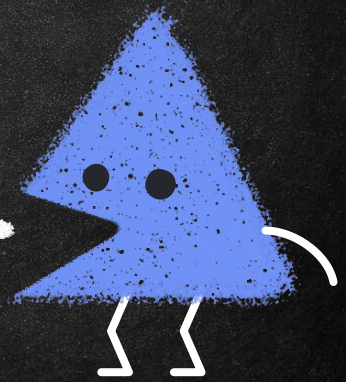
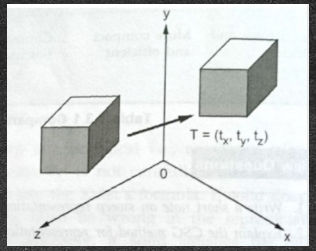


Image source



Translation in 3D



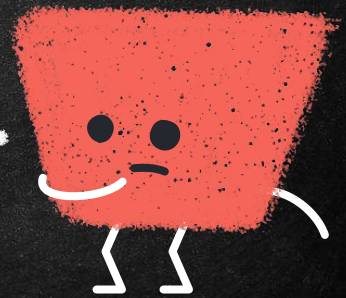
We're still "sliding" just like we did in 2D, but now we can slide in the x, y, and z directions.

We'll use position to translate objects in AFrame.

```
position = "x y z"
```

Default position is 0 0 0, right where we are!

HS math teachers: transformations for graphics are represented with matrices and use homogeneous coordinates.



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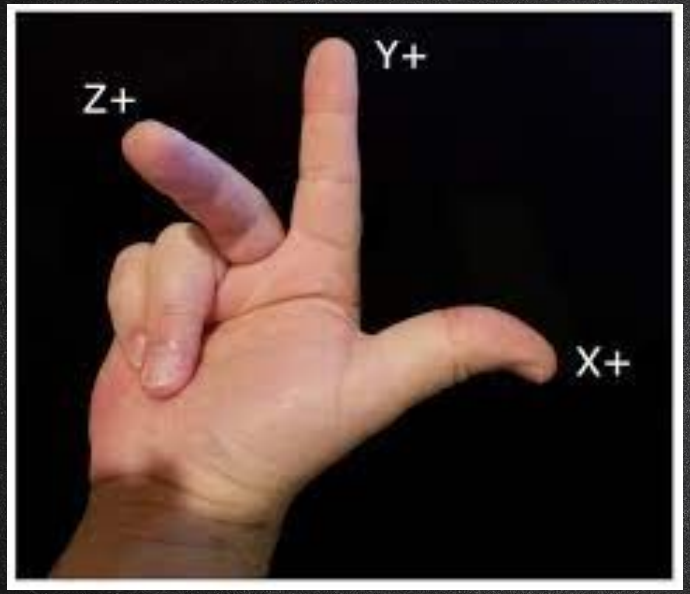
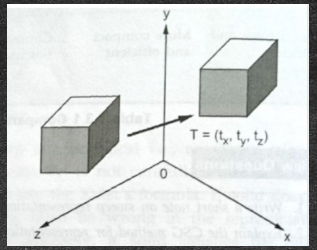


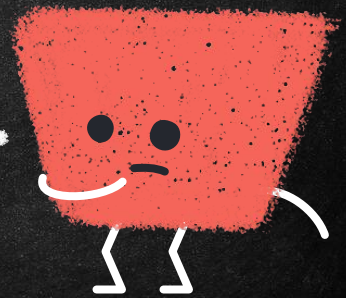
Image source



Try acting this out....

- Translate your hand in the positive x-direction.
- Now translate your pen in the negative x direction.
- Try for positive y, then negative y.
- Finally try for positive z and then negative z.
- Challenge: Translate your hand to (-5, 5, -5)

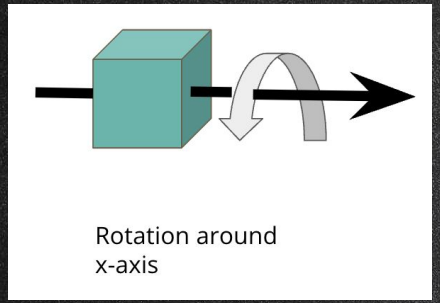
Hint: Use this picture to help you!

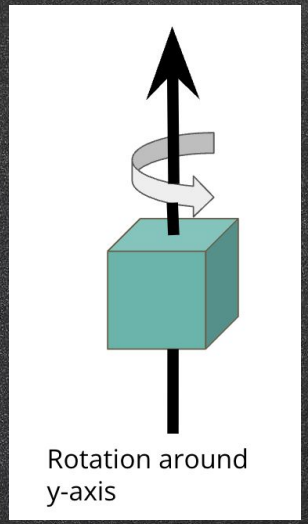


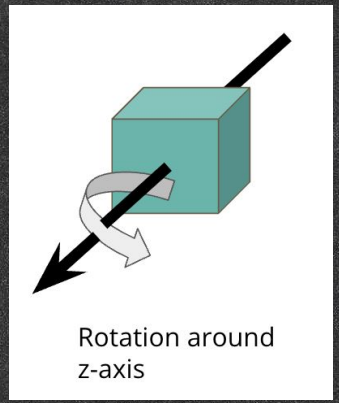
Rotation in 3D

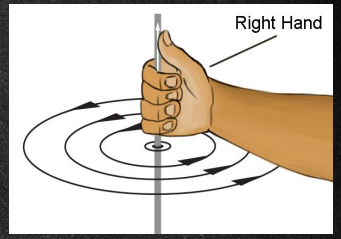
```
rotation = "x y z"
```

We can rotate components around the x, y, and z axes. It can help to visualize the axes going through your object.









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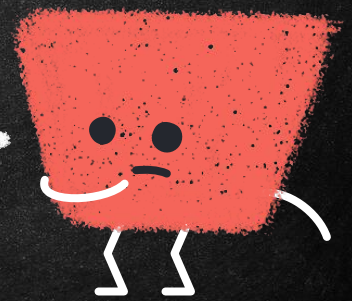
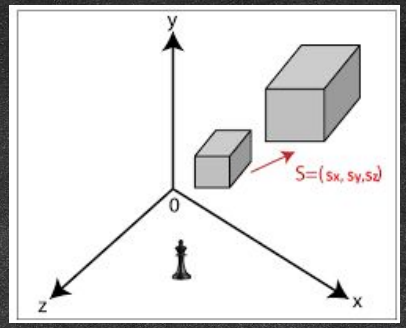


You can still use the right hand rule: if you point your thumb along the axis you wish to rotate around, your fingers will curl in the direction of positive rotation.

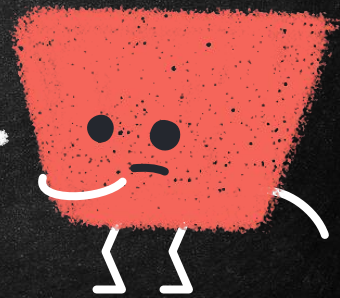
Dilation/Scaling in 3D



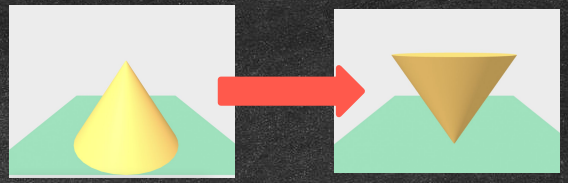
We're still stretching or compressing just like we did in 2D, but now we can stretch or compress in the x, y, and z directions.

We'll use scale to dilate objects in AFrame.

```
scale = "x y z"
```



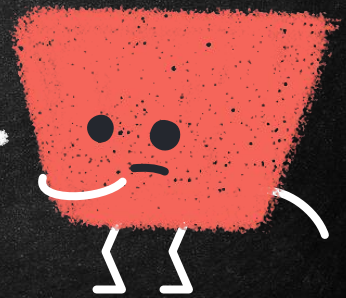
Reflection in 3D



We're still "flipping" just like we did in 2D, but now we can flip in the x, y, or z directions.

We can use scaling to reflect:
set the scale to -1 in the direction you'd like to reflect.

	x	y	z	
`scale =`	`"-1`	`1`	`1"`	reflects over the x-axis
`scale =`	`"1`	`-1`	`1"`	reflects over the y-axis
`scale =`	`"1`	`1`	`-1"`	reflects over the z-axis



3D Graphics with AFrame

Starter Code: Code along!

Breakout Room #1

Reteach of AFrame 1.4

Breakout Room #2

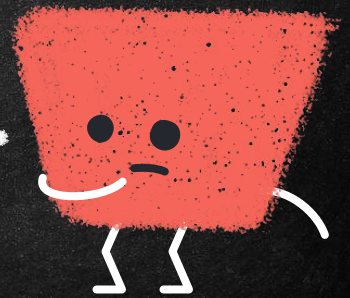
Independent Work with Assistance

(Create a design that you'll transform with entities)

Breakout Room #3

Independent Work without Assistance

(Create your own design that you'll transform with entities)



AFrame reference slide

- Intro to AFrame + VR *[5 min video]*
- replit for code along *press FORK REPL*

- [5 min video]
- replit for code along *press FORK REPL*

- < 5 min video
- replit for code along *press FORK REPL*

- < 5min video
- replit for code along *press FORK REPL*

- < 5 min video
- replit for code along *press FORK REPL*

NEED SOME EXTRA HELP? click here!