

## Lesson Plans

### Introductory Animation Physics Course

- 12-Week Semester
- Each lesson is designed for a 2-3 hour class.
- Animation assignments are based on the assumption that students will use 3D modeling/animation software, but can be easily adapted for traditional animation classes by substituting any instructions to “model” with the word “draw”.
- Assignment questions in separate attachment.

Lesson	Reading/Lecture	Real-World or Written Assignment	Animation Assignment
1	<a href="#">Chapter 1: Matter and Masses</a> Matter Masses <a href="#">Chapter 2: Motion and Timing</a> Motion Lines and Paths Linear Motion Circular Motion	Assignment 1 (see attachment)	Create or find an image of a character in motion and draw the line of motion over the character.
2	Wave Motion Timing	Assignment 2	<p>1. Animate a simple wave motion. Answer these questions:</p> <ol style="list-style-type: none"><li>What is the type of wave?</li><li>What is the wavelength?</li><li>What is the frequency?</li><li>What is the amplitude?</li></ol> <p>2. Plan an animation of a moving car stopping using the Odd Rule. The car is going 20mph at the start of the animation and comes to a complete stop over 5 frames. Show how far the car travels over the entire 5 frames, and the distance it travels between each frame.</p>

3	Chapter 3: Forces Components of Force Gravity	Hang an everyday object from a string in two or more different ways to determine its center of gravity. Turn in the photos with the CG marked with an X.	Plan an animation of a ball being dropped from a height of 90 feet. Assuming 30fps, how many frames will it take for the ball to hit the ground? Show the distance the ball will travel between each frame.  (For character animation classes) Rough out a character standing with its CG over its base of support, and the same character with its CG not over its base of support.
4	Chapter 3: Forces Friction Pressure and Gases	Assignment 4	Find an example (on YouTube or elsewhere) of a real-world object actually exploding or blowing apart due to gas pressure buildup. Answer as best you can: How did the breach in the container come about? How long was the actual “exploding” part (in frames or seconds)? What happened after the container blew apart?  Now animate your own rough version of what occurred with simple primitives. Pay particular attention to the direction of any motion, the speed of the breach opening, motion of escaping gases or debris, etc.
5	Chapter 3: Forces Torque	Take photos of two or three different levers in your everyday environment. What types of levers are they? Draw the fulcrum, the effort, and the load.	Model a simple lever mechanism (such as a jaw or other mechanism shown in the book) with pivot points in correct places. Animate the lever in motion (simple keyframe animation with 3-5 frames). What type of lever is it? How could you increase (or decrease) its efficiency?

6	Chapter 3: Forces Action/Reaction	Assignment 6	<p>Create a series of simple animations with two identical objects. In each animation, Object 1 starts off stationary and Object 2 moves to hit Object 1. Use the same speed in each animation.</p> <p>Using what you know about the relationship between force, mass, and acceleration, create sequences where:  Object 1 weighs the same as Object 2.  Object 1 weighs twice as much as Object 2.  Object 1 weighs half as much as Object 2.</p>
7	Chapter 3: Forces Electricity and Magnetism Chapter 4: Light and Color Light Basics Shadows	Assignment 7	<p>Create a physically accurate model or drawing showing an object reflected in a mirror.</p> <p>Find or create an image that shows light decay.</p> <p>Find or create an image showing occlusion shadows.</p>
8	Chapter 4: Light and Color Reflection Refraction	<p>Find an image that includes an object with anisotropic highlights. What material is the object made of?</p> <p>Find two images of similar objects made of very different materials. Describe the differences in the diffuse and specular reflections in the two materials.</p>	<p>Create a rendering of an object that shows both diffuse and specular reflection.</p> <p>Create a rendering that includes visible refraction. Create three versions with different “index of refraction” settings. Which one is the most realistic? Does this match the real-world index of refraction for that medium?</p>

For the remaining weeks, choose a Character Animation or VFX track depending on the focus of your class.

## Character Animation Track

Lesson	Reading/Lecture	Real-World or Written Assignment	Animation Assignment
9	<a href="#">Chapter 5: Character Design</a> Size and Scale Joints Weight Distribution	Assignment 9	<p>Design an animal or human character. First, choose an animal (or human body type) to base the character on. Then study the characteristics of the real-life animal such as weight, lifespan, and heart rate. List out the character's attributes such as agility, speed, thin/chubby, young/old, furriness, pitch of voice, etc. Using these attributes, draw a sketch of this character.</p> <p>Draw the character in an action pose, and draw in the center of gravity and line of gravity.</p>
10	<a href="#">Chapter 6: Character Animation</a> Jumping	Jump in the air (or have someone else jump in the air) and time the jump time (the total time in the air). What is the longest amount of time you can stay in the air?	Create the keyframes for a jump for the animal character you designed in the previous lesson. Show your work with regard to Push Time, Jump Time, and Stop Time.
11	<a href="#">Chapter 6: Character Animation</a> Walking Dancing and Gymnastics Lifting Weight	Practice walking with your hips and shoulders moving in different directions, then the same direction. Now try it with exaggerated hip and shoulder motions. What did you learn from this exercise?	Animate a walk cycle for your character.
12	<a href="#">Chapter 6: Character Animation</a> Getting Hit Tipping Over Drag and Follow Through	Assignment 12	<p>Animate your character getting hit by something and tipping over. Pay attention to the line of gravity and note the point when the character's center of gravity moves off its base of support.</p> <p>Add drag and follow-through to the animation via any hair, limbs or feathers, or a hat or some other adornment.</p>

## VFX Track

Lesson	Reading/Lecture	Assignment
9	Chapter 7: Environment Clouds Rain Lightning	Animation of the visual effects principles described in the chapter.
10	Chapter 8: Fire and Explosions Fire Smoke Explosions Shockwaves Breakage and Fracture	
11	Chapter 9: Fluid Effects Properties of Fluids Oceans and Lakes	
12	Chapter 10: Earth and Outer Space Earth's Layers Formation of Earth Outer Space	