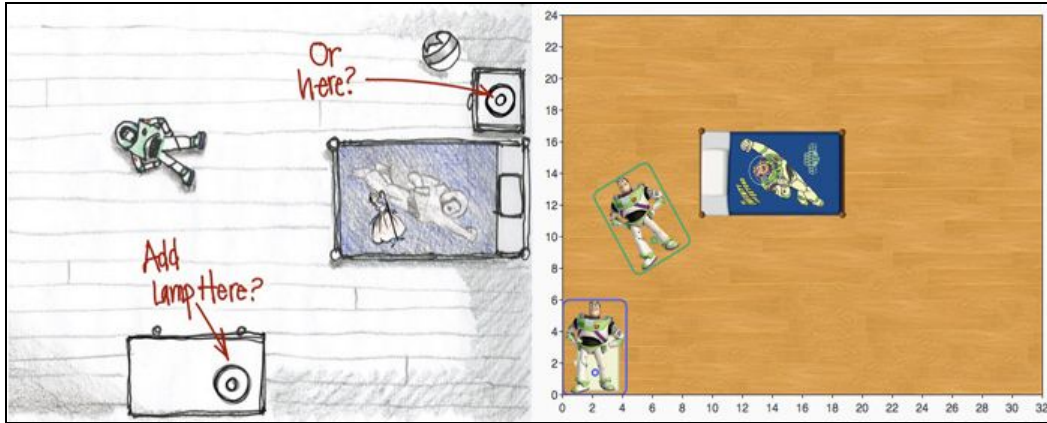


SETS & STAGING: FIRST LESSON ([link to lesson](#))



Standards alignment:
Common Core:
[HSG.SRT.C.8](#),
[HSG.SRT.B.5](#)

Summary/Overview:

Live-action filmmakers make sure that every object in a room or environment is in the right place before they film a scene, and Pixar filmmakers do too, with virtual sets, props, and characters. Practice using geometric transformations to stage your own Pixar scene!

Lesson Structure: This lesson contains 8 videos and 6 practice exercises which alternate back and forth. One way to run this is to watch and discuss all videos as a group (using a screen at the front of the room) while letting students return to their computers to do the exercises when required.

Total Time Recommended:

Approximately 60-90 minutes to complete the videos and exercises.

Age: Grade 5 - infinity and beyond!

Objectives:

In this lesson, students will:

- be given a scene from the Art Department to build.
- explore how the operations of translation, rotation and scaling are used to position objects.

Materials Needed:

- Indoor classroom, lab, or open space with seating and access to the Internet. Space should have enough seating, ideally facing a teacher/facilitator's projection screen.
- Teacher/facilitator should have a computer connected to a large monitor or projector and speakers.
- This lesson assumes that each student or pair of students will require a device to access the lessons online.

VIDEO 0: Introduction to geometric transformations **(length: 4 mins)**

Instructions: How are virtual sets built in the computer? Have everyone sit where they can see the screen. From the lesson page, play the video “Introduction to geometric transformations.” When the video ends, start a discussion with your group using questions below.

Key terms / Vocabulary:

- **Geometric transformations** - basic functions to manipulate the position, orientation, and size of an object.
- **Story reel** - a fast, rough version of the film made of tens of thousands of drawings. It hints at a lot of things, such as composition, camera movement, performance and location.

Discussion questions (5 mins):

- **Q:** What defines a new “shot”?
- **A:** Every time the camera’s point of view changes, which, on average, is every three seconds!
- **Q:** When are shots created?
- **A:** After the story is figured out, in the form of a story reel
- **Q:** What does a set dresser do?
- **A:** Using the story reel and reference from the art department, a set dresser will work out what objects are needed to include in the set before cameras are in there. They will only include things that are essential in staging the shot.
- **Q:** What happens in the Camera and Staging department?
- **A:** They figure out how to shoot the movie through the lens of a virtual camera

VIDEO 1: Coordinate Plane (length: 2 mins)

Instructions: This video introduces the transformations we'll be using in the rest of this lesson. Have everyone sit where they can see the screen. From the lesson page, play the video "Coordinate Plane." When the video ends, start a discussion with your group using questions below.

Key terms / Vocabulary:

- **X coordinate** - how far to the right or left a point is (width)
- **Y coordinate** - how far up or down it is. (height)

Discussion Questions (3-4 minutes):

- **Q:** In what order does Fran recommend assembling or building an environment? Should you start with little details like magazines and pieces of wood in the fireplace, or begin with the largest elements like the giant fireplace first?
- **A:** Work from big to medium to small, adding details last.
- **Q:** If you were staging this room, what elements of this space would you start with first?
- **A:** Look with the group at your surroundings. Have students identify each element from big, medium to smallest.

PRACTICE: Graph Points (5-10 mins)

7 problems covering graphing x and y coordinates

Instructions: After students are nearly finished, check for understanding before moving on to the next video (remind students they can find help in the hints for each question.)

Exercise Questions:

- **Q:** What did you learn about plotting graph points in this exercise?

VIDEO 2: Translation (length: 3 mins)

Instructions: Now we can begin laying out our scene! Starting with translation. Have everyone sit where they can see the screen. From the lesson page, play the video “Translation.” When the video ends, start a discussion with your group using questions below.

Key terms / Vocabulary:

- **Model catalog** - a collection of objects to place in a scene
- **Translation** - Changes the position of an object
- **Scaling** - Changes in the size of an object
- **Rotation** - Changes the orientation of an object

Discussion Questions (5 mins):

- **Q:** This model is in 2D. Is that how Pixar does it for a movie?
- **A:** No, Pixar assets are 3D models.
- **Q:** What is the purpose of the reference point in translation?
- **A:** It's the starting point (or anchor point) of the calculation.
- **Q:** For translation, does it matter where you place the reference point?
- **A:** No, but it will matter for scaling or rotation.
- **Q:** Why is the mathematics of translation addition?
- **A:** Because you have to add the x,y coordinate numbers to the reference point numbers in order to get the location

PRACTICE: Laying out a scene using translation **(length: 15 mins)**

Instructions: The director has given you a scene to lay out. Add items to the scene below to match the storyboard. For this task, you can only use translation to move them to the correct position. Ignore items that require scaling or rotation. Once you are happy with the scene, submit it for the director's approval. After students are nearly finished, check for understanding before moving on to the next video.

Exercise Questions:

- **Q:** What did you learn about arranging items with translation in this exercise?

VIDEO 3: Scaling (length: 3 mins)

Instructions: Next we need to explore the mathematics of scaling. Have everyone sit where they can see the screen. From the lesson page, play the video “Scaling.” When the video ends, check for clarifying questions before proceeding to the next exercise.

Discussion Questions (3-4 mins):

- **Q:** If addition is the mathematical function used with *translation*, what is the mathematical function of *scaling*?
- **A:** Multiplication
- **Q:** What do you think would happen if you used a negative number for translation or scaling?
- **A:** A negative number would flip it for the scaling case, and for translation it would just move it in the opposite direction

PRACTICE: Scaling items in a scene (length: 5 mins)

Instructions: Observe the scene at the top of the page. The items that just require translation are already in place. Now you can add items that require translation and scaling. Ignore any item that requires *rotation*. Again, once you are happy with the scene, submit it for the director's approval. After students are nearly finished, check for understanding before moving on to the next video.

Exercise Questions:

- **Q:** What did you learn about scaling items in this exercise?

VIDEO 4: Commutativity (length: 2 mins)

Instructions: We need to be careful with the order of scaling and translation. But why? Have everyone sit where they can see the screen. From the lesson page, play the video “Commutativity.” When the video ends, start a discussion with your group using questions below.

Key terms / Vocabulary:

- **Commutative** - when order of operation doesn't matter
- **Non-commutative** - when order matters!

Discussion Questions (3-5 mins):

- **Q:** What is the correct order to transform objects?
- **A:** Scale, Rotate, then Translate.
- **Q: BONUS:** Why does the order of transformation matter?
- **A:** If we translate then scale from the origin, the distance from the origin is increased, so all the points move farther than if we scaled first

PRACTICE: Commutative and non-commutative transformations (length 10-15 mins)

7 problems covering basic concepts

Instructions: After students are nearly finished, check for understanding before moving on to the next video (remind students they can find help in the hints for each question.)

Exercise Questions:

- **Q:** What did you learn about commutative and non-commutative transformations in this exercise?

VIDEO 5: Rotation (length: 2 mins)

Instructions: Finally we'll need to rotate object to finish our scene. Have everyone sit where they can see the screen. From the lesson page, play the video "Make a Face." When the video ends, start a discussion with your group using questions below.

Discussion Questions (2-3 mins):

- **Q:** What is the name of the operation that changes the *size* of an object?
- **A:** Scaling
- **Q:** What is the name of the operation that changes *placement* of the object?
- **A:** Translation
- **Q:** What is the name of the operation that changes the *orientation* of the object?
- **A:** Rotation

PRACTICE: Finish your scene! (length: 5-10 mins)

Instructions: Here is the scene we are working on. The items that just require translation and scaling are already in place. Now you can add items that also require rotation. Again, once you are happy with the scene, submit it for the director's final approval. After students are nearly finished, check for understanding before moving on to the next video. Ask if any students would like to share their scenes

Exercise Prompts (2-3 mins):

- After you get an approval from the director, see if you can create as many scenes of your own design as you want.
- Can you make some options that the art department and director didn't even ask for?

VIDEO 6: Composite transformations (length: 4 mins)

Instructions: Time to get a little mathy. Let's look at the general form for any transformation. Have everyone sit where they can see the screen. From the lesson page, play the video "Composite transformations." When the video ends, start a discussion with your group using questions below.

Key terms / Vocabulary:

- **Composite transformation** - When two or more transformations are combined.

Discussion Questions (5-10 mins):

- **Q:** What do we mean when we say that translation and scaling "don't commute?"
- **A:** That the order matters

PRACTICE: Composite transformation (length: 5-10 mins)

7 problems covering key concepts

Instructions: After students are nearly finished, check for understanding before moving on to the next video (remind students they can find help in the hints for each question.)

Exercise Questions:

- **Q:** What did you learn about composite transformations in this exercise?

VIDEO 7: Getting to know Fran Kalal (length: 5 mins)

Instructions: Have everyone sit where they can see the screen. From the lesson page, play the video “Getting to know Fran Kalal.” When the video ends, start a discussion with your group using questions below.

Discussion Questions (5-10 mins):

- **Q:** What inspired you about Fran’s experience?