



Curriculum-in-a-Box | Lesson Plan 3

MAKING ATTRIBUTES WORK FOR ME

This lesson is designed to introduce students to the ideas of attributes being stored on geometry, and how that can be used in Houdini. The process of working with attributes is probably one of the most distinct parts of using Houdini, and it's important for students to know these ideas before moving on to more complex topics. Since almost everything in Houdini is driven by attributes, this is one of the most foundational concepts to new learners.

As an instructor, it is recommended that you first complete the “Foundations” Learning Path on [Houdini Insight](#) or through the SideFX website. That knowledge, along with this document and supplemental materials, will allow you to craft more compelling classroom experiences for your students. Please feel free to adjust anything found in these materials so that they fit your needs. We will strive to make our teaching methods clear through these materials, so that you feel empowered to do the same in your classroom.

If necessary, sections of the “Foundations” book will be packaged along with this document. If you would like digital access to the entire book you can follow this link: sidefx.com/tutorials/foundations-book/

PREREQUISITES

Some suggested prerequisites include:

- *Lesson 1: Let's Play with Houdini*
- *Lesson 2: Manipulating Geometry*
- Understand the basics of navigating the Houdini UI | **Houdini**
- Plotting (x,y) data on a graph | **Mathematics**
- Have a general understanding of polygonal geometry | **Mathematics**
- Understanding the difference between vectors, integers, and rational decimals | **Mathematics**

LEARNING OBJECTIVES

- Students will obtain an understanding of what attributes are in Houdini.
- Students will be able to manipulate geometry by using attributes.
- Students will begin to explore how the Copy to Points SOP functions, and how to manipulate its inputs to achieve different outputs.

LECTURE

During the lecture portion of the lesson, we recommend that the students are “hands off” the computer, and just listening/watching the teacher. Questions are encouraged, but there will be time for them to work with the software in the next portion of the lesson.

In order to get students up to speed with what attributes are and how they're used in Houdini, we have provided a Powerpoint presentation that you can use to enhance your classroom activities as you see fit. During the lecture

portion of your lesson, we suggest that you address the following topics:

- Finding attributes in the world around us
 - Talk about items in our surrounding environment and some of their attributes
 - Position
 - Hardness
 - Transparency
 - Speed
 - Scale
 - Use the coffee cup example here
- Understanding how Houdini uses attributes to describe geometry
 - All of these attributes below are some of the “reserved” attributes in Houdini; it knows what to do with these without us telling it anything:
 - P = Position
 - Cd = Color
 - N = Outside direction of a polygonal surface
 - v = Speed
 - pscale = uniform scale
- Discussing Groups
 - Sets of geometry
 - Geometry elements belong or are excluded
 - Values are 1 or 0
 - Which number would be “True”?; Which number would be “False”?

GUIDED WORK

Students are now asked to follow-along with the teacher as they build something in Houdini. For this lesson, we’ll have our students follow along as we use attributes to control how geometry is scattered in our scene. There are a few different options for you to use, depending on what type of workflow you’re interested in showing your students. Regardless of which one you choose, you will be able to show the power of attributes on geometry in Houdini.

Since the purpose of this exercise is to work with attributes and scattering, the rendering of a final image is not specifically included. If you’d like to enhance this guided work, you could have your students follow the rendering steps from the end of Lesson 1. This would give them a final image of their model.

For this portion of the lesson, there are three pieces of material:

- A video that demonstrates our thought process for teaching this lesson
- A PDF document that outlines the step-by-step process that the class will follow together
 - This could be helpful for the instructor to become familiar with the steps, or it could be distributed to the students to reinforce the directions
- A HIP file that shows the end product of the activity, along with HIP files to use for each section of the lesson (if students get lost along the way)

INDEPENDENT WORK

For this section of our lesson, we recommend letting students work independently. This can be assigned as a lab exercise or as homework, depending on the structure of your course/school and the availability of suitable computers in your students' homes.

For part one of this lesson's independent work, you will have your students create a scene where one of the Houdini test geometries will be animated underneath a grid. They will then manipulate attributes in order to simulate that object digging underneath the ground. This exercise has a Tutorial video for students to follow along with.

For the second part of the independent work, we suggest instructing students to find a household item, create a list of attributes that would be associated with it, and bring it into class to discuss. These attributes may be applicable to the whole object, or could be limited to a section of it. Some ideas would be mass (weight), roughness, transparency, and color. However, these are just a few suggestions. Encourage them to come up with as many attributes as possible. You could also assign them the task of creating values for the attributes. This would allow them to decide how to appropriately format the values (i.e. normalized 0-1 values). For example, something like Roughness might be on a scale of 0-1, where as Displacement Height would have an unbounded upper limit and a lower limit of 0.

QUIZ

For instructors that are looking for an element of assessment during this lesson, we've provided a quiz PDF that could be given to students. This will test their understanding of the concepts introduced throughout the course of exercises outlined above.

SUPPLEMENTAL MATERIALS

In order to better understand the concepts of this lesson, please refer to the following supplemental materials:

- [Geometry Attributes](#)
- [Copy and Instancing Point Attributes](#)
- [Groups](#)

STANDARDS MAPPINGS

[CSTA Standards](#)

3A-DA-11

Create interactive data visualizations using software tools to help others better understand real-world phenomena.

3A-AP-13

Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests.

3A-AP-17

Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.

3A-AP-18

Create artifacts by using procedures within a program, combinations of data and procedures, or independent but



interrelated programs.

3B-AP-13

Illustrate the flow of execution of a recursive algorithm.

ISTE Standards

1.5.d Algorithmic Thinking

Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

1.6.c Models and Visualizations

Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.