

OVERVIEW

In this activity, students use TinkerPlots to create their own data factories that build objects with varying characteristics, or **attributes**. To do so, students first have to understand what an attribute is, and what values an attribute can take on in the real world. To improve their factory, students consider how values of an attribute are distributed in the real world and how to use branching devices in TinkerPlots to create group differences.

Students learn how to build a sampler. If students don't already know how to build a single-variable plot by dragging apart data points and stacking, you'll need to show them that skill for Step 11. (See the movie "TinkerPlots Basics.")

Activity Time: Two class periods

Objectives

- View a case (or object) as a collection of attributes.
- Recognize that one attribute of an object may affect the outcome of another attribute of the same object.
- Model an object by defining its attributes.
- Consider the range and distribution of realistic or possible values for different attributes.

Common Core Standards Addressed

Design and use a simulation to generate frequencies for compound events.

Grade 7, Statistics and Probability Standard 8c

Prerequisites

- Understanding of how to make basic graphs in TinkerPlots (could be learned by doing the activity "Backpacks")
- Understanding of the shapes of different kinds of distributions (could be learned by doing the activity "Sketching Distributions")

Materials

- Building a Data Factory worksheet (one per student)
- **Cat Factory.tp**
- **Improved Cat Factory.tp**

LESSON PLAN

Introduction (10 minutes)

Consider watching the movie "Building a Data Factory" in preparation for this activity.

Display **Cat Factory.tp**. First, direct students' attention to the data in the plot. Click a few points and note their characteristics (highlighted in the case table) to help students understand what information has been collected – name, gender, eye color, and length of cats. Call these

labels **attributes**, and refer to the varying outcomes of each attribute as **values**. For example, the attribute *EyeColor* has values “Blue,” “Green,” and “Yellow.” Then explain that these cats were made in a Cat Factory. Move the plot to reveal the “factory” – the sampler. You may want to resize the sampler, the TinkerPlots window, and the plot, so all the items are easily visible.

Click **RUN** to run the sampler at slow speed, adding new cases slowly to the table and plot. Describe two or three cats as they are being made. Then speed up the sampler by dragging the speed slider’s thumb. Note that the factory makes 100 cats – Repeat is set to 100.

Open a new document, and show students how to build the Cat Factory. Add devices for *Gender*, *Name*, *Length*, and *EyeColor*, adding only a few values for each so students may see how it is done. (A description of how to add devices to the sampler is given in Step 7 of the student worksheet.) Show students how to make a sequence of numbers by entering the first value into a device, then clicking the + button.

Hand out the Building a Data Factory worksheet, and tell students that it is their turn to build a factory. They can make anything except cats.

Planning a Data Factory (15 minutes)

Have students work in pairs to decide what objects to make and what their attributes will be. Work with students to help them understand what is meant by *attribute* and *value*. Many students will struggle with this idea in the beginning. Have students describe how their objects will differ from each other to help them think about the difference between attributes and values. It may also help to leave the Cat Factory displayed, so students may look again at how it was built.

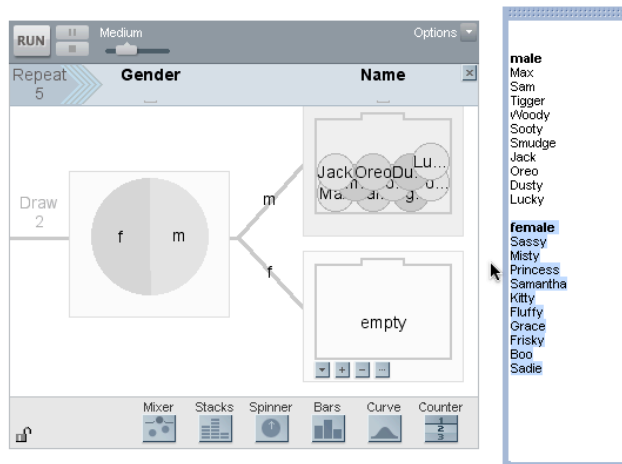
Student Work at Computers (15 minutes)

As soon as students have filled in the worksheet through Step 5, have them move to a computer to build their factory using TinkerPlots.

Discussion (30 minutes)

Once students have built their factories (and are through at least Step 10 on the worksheet), discuss as a class the challenges they faced in getting their factories to make data that looked realistic. Ask them if they notice any similar challenges with the cats built in the Cat Factory. They might notice that some of the cats have a name that doesn’t match their gender.

Show them how to fix this problem by building a new and improved cat factory. Display **Improved Cat Factory.tp**. This document starts with a spinner for the attribute *Gender* and a list of male and female cat names in a text box. Add a mixer to the right of the spinner. To do this, pull a mixer into the sampler. You’ll see pink dots that show you where you can drop the device. Make sure a black box is highlighted before you drop the new device. Change *Attr2* to *Name*. Explain that you would like to send the male cats to one mixer for a name and the female cats to a different mixer. Show them how to create a branch by dragging a new mixer and dropping it at the pink dot right below the other *Name* mixer. When you add this mixer you will have two mixers under the *Name* attribute, as shown below. Rather than typing male and female names for each case in the mixer, copy and paste the male and female names from the text box into the appropriate mixer. See the movie “Building a Data Factory” to learn how to copy values into a mixer.



Now show students how to add additional devices to the right of the Name devices, but don't go on to build the entire factory. They should know enough to continue working.

Give students some time to update their factories using these new techniques. As students work on their factories, help them as needed to, for example, figure out how to merge devices. (See the movie "Building a Data Factory." They might also need help using other types of devices and editing them to reflect appropriate values.)

Wrap-Up (25 minutes)

Have several groups, or each group if you have time, present their factory to the class. Each group should describe their factory, and how well they think the objects of their factory resemble objects from the real world. You can do this by having students walk around from computer to computer, or, if you have remote connection, by displaying their computer screens on the overhead display.

ANSWERS

1. Students will come up with an interesting range of ideas: candy, skateboards, sunglasses, a deck of cards, people, cars, roller coasters, surfboards, computers, and many others.
3. Some students will need to come back to this after they try to answer the next question, where they give examples of values of attributes. Make sure that at least one of the attributes is numeric.
- 4-5. Filling out these two cards gives students a place to start when they move to the computer.
9. Most students will answer "yes," but they will begin to raise issues when answering the next question.
10. Many students, after making their factory, can describe how it is not working as they wish. Using branching devices can often help them to address these challenges.
12. The purpose of this question is to get the students thinking about whether the range of values of their numeric attribute is like what they'd expect from the objects in the real world. If they are heights of rollercoasters, do the minimum and maximum values cover the range of real rollercoasters?



13. If students have not done the activity “Sketching Distributions,” or learned about the shape of distributions in some other way, then this question may not make much sense to them. You may need to remind them of the terms and recreate sketches of each type. Ask them to imagine what a distribution of lengths of skateboards might look like. What are the most common lengths, and how would that appear in a graph?
14. Answers will vary. Students should think about how they set up the factory, and whether the factory produces objects that are good models for real objects.