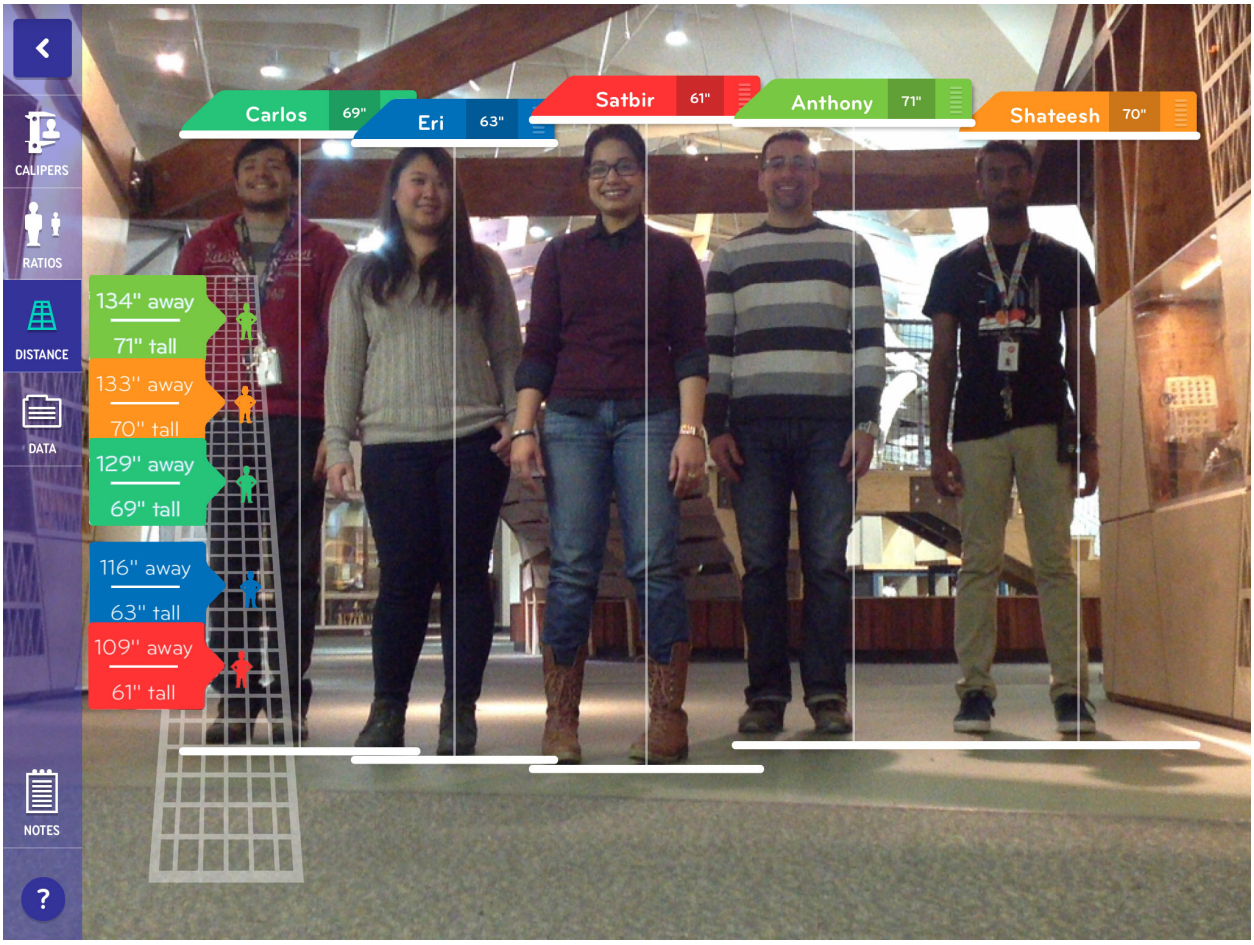
# Size Wise Activity 4: Everyone is Equal

## *Exploring Direct Proportional Relationships*

### Overview

Students will take photos where everyone in the photos – and a few other objects – all look the same height. They'll use the Calipers Tool to collect data and will create a graph of object height vs. object distance for everything in the photo.




### Big Idea

By holding image size constant, students will explore the relationship between an object's real height and the distance it needs to be from the camera. Object height and object distance are directly proportional. Taller objects need to be farther back in order to have the same image size. In other words, as the height of an object is larger, so is the distance it needs to be from the camera. Students can graph the data and reveal the straight line.

Students interact with the concepts of ratios and proportionality in different ways:

- By manipulating the image size and distance of objects, visually and kinesthetically making sense of these relationships.
- By gathering related data to create representations of the relationship at hand.
- By graphing the data to reveal this direct proportion.

## Learning Objectives

From this activity, students will be able to:

- Use ratio language to describe a ratio relationship between two quantities
- Follow a multi-step procedure when performing technical tasks
- Use ratios to solve real world problems that pertain to designing digital media.
- Students will identify important quantities in a practical situation, graph their relationships, and analyze them.

## Vocabulary

- Increase
- Decrease
- Comparison
- Image Size
- Object Distance
- Ratio
- Proportion
- Slope

## Grades

6-8, middle school

## Standards Addressed

**Common Core State Standards-Math**
*Ratio and Proportional Relationships*
6.RP.A.1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

**Common Core State Standards-Math**
*Mathematical Practices*
MP2 Reason abstractly and quantitatively.
MP4 Model with mathematics.

**Common Core State Standards-ELA**
*Literacy*
RST.6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

## Classroom Strategies

*Single-device implementation:*
Have volunteers go to the front of the class and line them up so that their image height is the same. Have classmates observe their positions. Share examples via your smart board or projector and discuss what children noticed about the image size and distance relationships.

*Multiple-device implementation:*
Because this activity requires collaboration, this is a perfect activity for groups of four or more. Each group should have one iPad. Be sure they measure the photos they take so there is distance data they can compare across the different group members.

## Tips and Tricks

To get everyone to look the same height onscreen, you need to line up everyone's feet as well as their heads. To do this, take the photo from an extremely low angle. It's best if the iPad is resting on the floor, rotated so the lens is as close to the floor as possible. Students might lie of the floor if they are the photographers.

This activity works best with subjects of varying heights, so it's perfect for middle school students. But sometimes students at the extreme ends of the curve are sensitive about their height. It's useful to put things in the picture that are very short (e.g., a backpack, or a pencil cup) and very tall ( e.g., the top of the blackboard). Not only will this assure that the

tallest and smallest things in the photo aren't people, but it will also give you some extra useful data.

## App Features

In **Camera Mode**, students will use:


To enter and calibrate the height of individuals, objects, and group members.


To reflect on the things they notice about the pictures they take.


To see how image sizes of subjects relate to one another.

In **Gallery Mode**, students will use:


To compare data across 4 pics (e.g., distances one has to stand to get different image sizes).


Write ratios seen in the photos they took.

## Expected Activity Time

**Part I: Everyone is Equal Activity** (20 minutes)
**Part 2: Data Exploration** (20 minutes)

## Materials and Prep

- Everyone is Equal Student Sheets
- 1 iPad with Size Wise for each group of 3-4
- Wifi access to send work to other iPads or to online project space
- Measuring tapes (optional)
- Prep 1: Make sure students have ample space to take pictures at different distances (hallways are good)
- Prep 2: Assign roles

## Activity Prompt

Achieve equality! In a photo, anyway. Take a photo of the whole group, making everyone look like they are the same height in the picture. Stand up straight, everyone!

### To Do

Have students stand up straight with two or more friends so that they all appear the same height in the camera view. Students should:

- Choose three or more people who are not the same height.
- Add a couple of other objects to the photo, like a chair, a backpack, a pencil, or a cup, placing them so that their image height is the same, too. To make it easier to line up all subjects, try taking the photo from low down at ground level.
- Measure each person and object with the calipers.
- Go to the Gallery and select the Data Tool.
- Compare the image sizes, actual heights and distances they see associated with each person. What patterns do they notice? Have them describe what they see.
- Using their data, have students draw a diagram of where people were standing in the shot and label their distances. Discuss what relationships they see between distance, image sizes, and actual heights of people. Encourage them to use ratio language to describe the relationships they see.
- Plot the data from one photo on a graph of object height vs. object distance. What do they see?

## Discussion

Prompt students to make observations and encourage students to use ratio language and reasoning while completing the challenge.

- How is the height of an object related to the distance it had to be away from the camera?

- Is there a mathematical way to represent this relationship?

Language and discourse to listen for:

- Bigger objects need to be farther away to be the same size.
- To change an object's image size, you have to change its distance from the camera.

## Extensions and Inquiring Further

If image height is standardized across photos (e.g. all are an equal image size), they can plot the whole class' data on one graph and discover direct proportional relationship between object height and distance. Another fun way to standardize the image height is to choose a virtual prop from the virtual prop library to put in the photo.

Have students research the heights of other people and objects. Once students have uncovered the directly proportional relationship between object height and object distance, they can use that proportional relationship to calculate the positions these objects should stand in order to make their image size "fit" in with the virtual prop (see Strike A Pose activity).

Name: _____ Date: _____

## Part 1: Everyone is Equal

To Do:

- Create a Caliper for each person in your group.
- Arrange a group of three or more differently sized people so they appear to be the same height on screen. To do this, you will need to adjust their distances from the camera.
- Snap a picture of your group shot.
- Go to Gallery and tap the Data Tool. Note the data for each person and record in the table below.

| Group Member | Actual Height | Image Size | Distance from Camera | Ratio: $\frac{\text{Actual Height}}{\text{Distance from Camera}}$ |
|---|---|---|---|---|
| 1. | | | | |
| 2. | | | | |
| 3. | | | | |
| 4. | | | | |

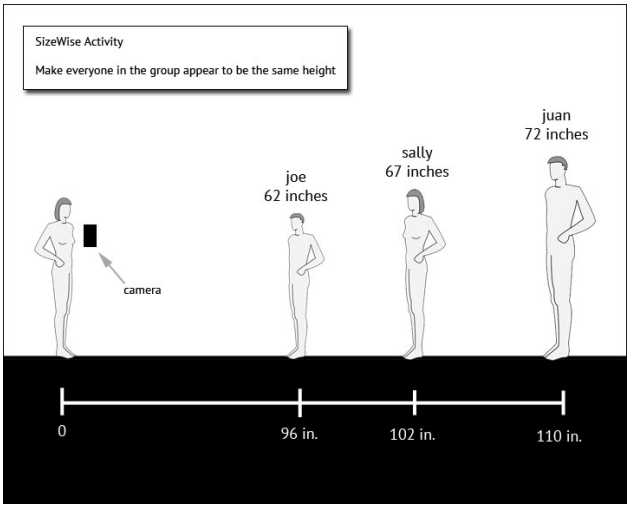
Do you notice patterns in the data? Please describe.

Name: _____ Date: _____

## Part 2: Data Exploration

To Do:

- Create a diagram.
- Label the diagram with your group members' actual heights and the distances they stood from the camera.




What do you notice about the actual heights of your group members versus their distances from the camera?