

# Create an Analog Clock

## Introduction:

In this activity students will create a working analog clock in Squeak.

They will:

- Analyze what objects are needed to represent a clock
- Identify the units used to measure the clock hand movement
- Script the movement of the hands to simulate time

The screenshot displays a Squeak workspace with the title "analog clock". On the left, a blue circular clock face is shown with numbers 1 through 12. A green arrow (hour hand) points to 12, and a red arrow (minute hand) points to 3. On the right, two code windows are visible. The top window, titled "minutes clockmove1", contains the following code:

```
minutes turn by 6  
hurs turn by 0.5
```

The bottom window, titled "clockface reset12", contains the following code:

```
clockface's heading ← 0  
hurs's x ← clockface's x  
hurs's y ← clockface's y  
hurs's heading ← 0  
minutes's x ← clockface's x  
minutes's y ← clockface's y  
minutes's heading ← 0
```

Below the code windows is a button labeled "clockface reset12". At the bottom left, there is a "Navigator" button with a trash can icon. At the bottom right, there is a "Supplies" button.

**Content:** Mathematics, Squeak, 5-7th grade

**Math topics:**

**Angles & Degrees**

**Ratio**

**Center of Rotation**

**Angular Speed**

**Time**

**Goals:**

After making the Analog Clock Students should be able to:

- Use a graphic interface to create a virtual tool
- Understand the concept of “Center of Rotation”
- Understand the concept of angular speed to move the clock’s hands
- Use the concept of ratio to determine the correct speed for each hand

**Squeak Prerequisites:**

- Painting an object
- Location of “Center of Rotation” of an object
- Familiarity with “basic” menu tiles:  
“turn by-“ ; “heading”; x and y locations
- Making a “Reset” scrip

**Teacher Information**

**Pacing:**

This activity can be done as a whole class discussion with one computer and a projector, in small groups, or be left to each student.

What the students will do:

- 1) Identify the minimum necessary objects (parts) of a Squeak analog-clock. and paint objects to represent them. *Clock-face; Minute-hand; Hour-hand*
- 2) Identify the type of movement of the hands. *Rotation*  
Decide how to create it? *Center and Degrees*

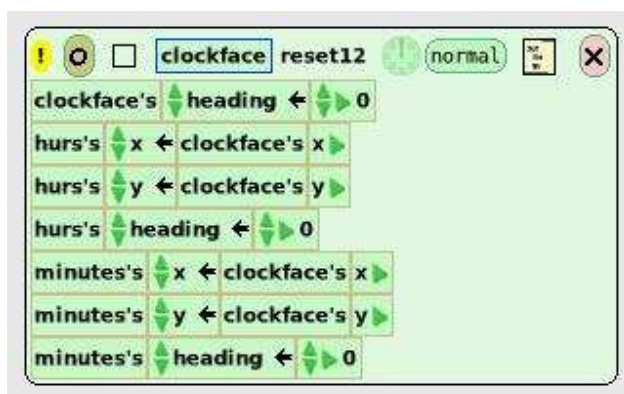
*Note: The moving parts of the clock are turning using a “turn by-“ tile or by the heading tile (extended to “heading increase by-“)*  
*Turning is measured by degrees of a clockwise angle. When an object is turning, it uses a rotation center. This spot should be in the middle of the clock-face. The center of rotation of each hand needs to be moved to this point. The center of rotation is made visible by activating the halo.*

- 3) Discover the mathematical connections between the movement of the minute-hand and the hour- hand and translate this finding into a script that will move the hands.

*Note: In one hour the minute hand moves 360 degrees while the hour-hand moves 30 degrees. Students can discover the ratio and use it to find out how-to set the relative speeds of the hands (what “turn-by” degree can be used for realistic hand movements)*  
*Below are 4 examples of clock-move scripts.*



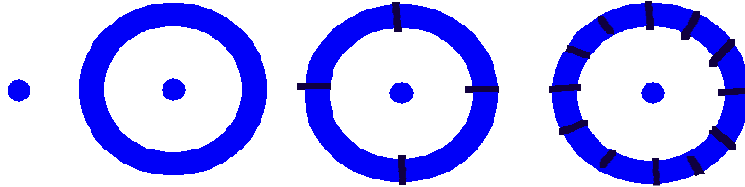
*Having a reset script is useful for while the student is making the ratios work. Firing this script will return the hands to the “Noon” position. Students can then fine tune with ease. Below is an example of a reset script that assembles the clock parts to read 12:00.*



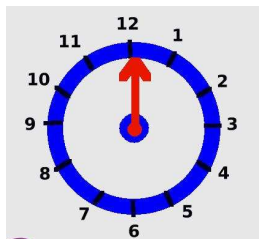
## Creating an Analog Clock

### Directions:

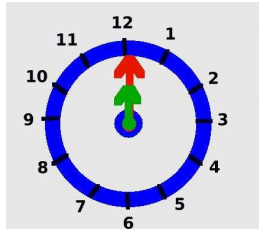
1. Paint a clock face (for a perfect circle see students' information); keep. The picture shows 4 steps for creating a clock-face.



2. Paint a minute-hand to be the size of a radius of the clock-face. Better paint it standing on the clock-face at 12 o'clock position. Keep.



3. Paint an hour-hand; choose different color than the minutes-hand, paint it on 12 o'clock position. Make sure it is shorter than the minutes-hand. Keep.



4. Move rotation center of each hand to the center of the clock face. (This will help you with the reset button as well, since object's "x=" "y=" are those of its rotation center)
5. Open a viewer for each of the 3 objects.
6. Create a script that puts parts together to show 12 o'clock (Name it "reset12" script). Optional: get a button to fire this script.
7. Create the clock-move script.
8. Fire the "reset12" script.
9. Let the clock-move script work. Adjust the pace of each hand to make it work like a real clock with hands passing each other and lining up at the proper times.

### **Challenges and extensions:**

- Make your clock work in “real time” (not “fast forward”)
- Create an analog clock with 3 hands: seconds, minutes and hours.
- We can read the time from the hour hand alone. The minutes-hand just makes it easier on us. Create a script that adjusts the position of the minute-hand to match the position of the hours-hand.
- Create the clock face of your dreams
- Make the clock chime every full hour\*
- Add an AM and PM sign.\*
- Add an alarm feature to the clock.\*
- Create a digital clock. \*

\* These extensions will require the use of the “Test” function of Squeak

### **Useful information:**

Here are some Squeak instructions that can help in the creation of an Analog Clock.

1. To get the halo of an object, place the cursor on the colored part of the object, hold alt-key down and click the mouse.
2. To draw a circle and its center, start by drawing the center, a dot of the desired size. Use that dot as the center from which you start drawing the circle with the circle drawing-tool.
3. To draw a perfect circle, hold the shift key down while using (dragging) the circle drawing tool.
4. To change the location of the rotation center of an object, drag the center while holding the shift-key down.
5. It is a good idea to build a reset script that will put the clock in starting position, ready for work or for a new experiment. This means all hands will be centered on the middle of the clock face and be lined up to read 12:00. In this script every object should have the same values for its x and y, and have headings set to zero. To get a button that fires (executes once) a script: move the cursor to the upper part of the script. Hold it down on the name of the object the script belongs to (in thin blue frame). A menu will open. Click on the one that says: “button to fire this script” and the button will appear.
6. The degrees for headings or for turning do not have to be integers; they can be decimals or even an expression like 6/65.

7. To set the pace of a script, hold the mouse down on the clock at the top of the script. Choose the desired numbers of tics per minutes. The bigger the number, the fastest the script runs.

**Standards:** (NCTM grade 6-8)

**Number and operations:** Understand the use of ratios and proportions to represent quantitative relationships.

Develop, analyze, and explain methods for solving problems involving proportions, such as scaling and finding equivalent ratios.

**Measurement:** Understand, select, and use units of appropriate size and type to measure angles, perimeter, area, surface area, and volume.

Solve simple problems involving rates and derived measurements for such attributes as velocity and density.

**Geometry:** Recognize and apply geometric ideas and relationships in areas outside the Mathematics classroom, such as art, science, and everyday life.

### **Illinois Math standards**

**6.A.3** Represent fractions, decimals, percentages, exponents and scientific notation in equivalent forms

**6.B.3a** Solve practical computation problems involving whole numbers, integers and rational numbers  
**6.B.3b** Apply primes, factors, divisors, multiples, common factors and common multiples in solving problems..

**7.A.3b** Apply the concepts and attributes of length, capacity, weight/mass, perimeter, area, volume, time, temperature and angle measures in practical situations.

**7.B.3** Select and apply instruments including rulers and protractors and units of measure to the degree of accuracy required

Avigail Snir, Feb 2007