

# pH Scale

PhET Sim design document

version 5

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## Recent Changes

- new colors
- another attempt at showing a linear scale (zoom buttons)
- molecules shown in the beaker -- no special "microscope view"

# Basic Sim Operation

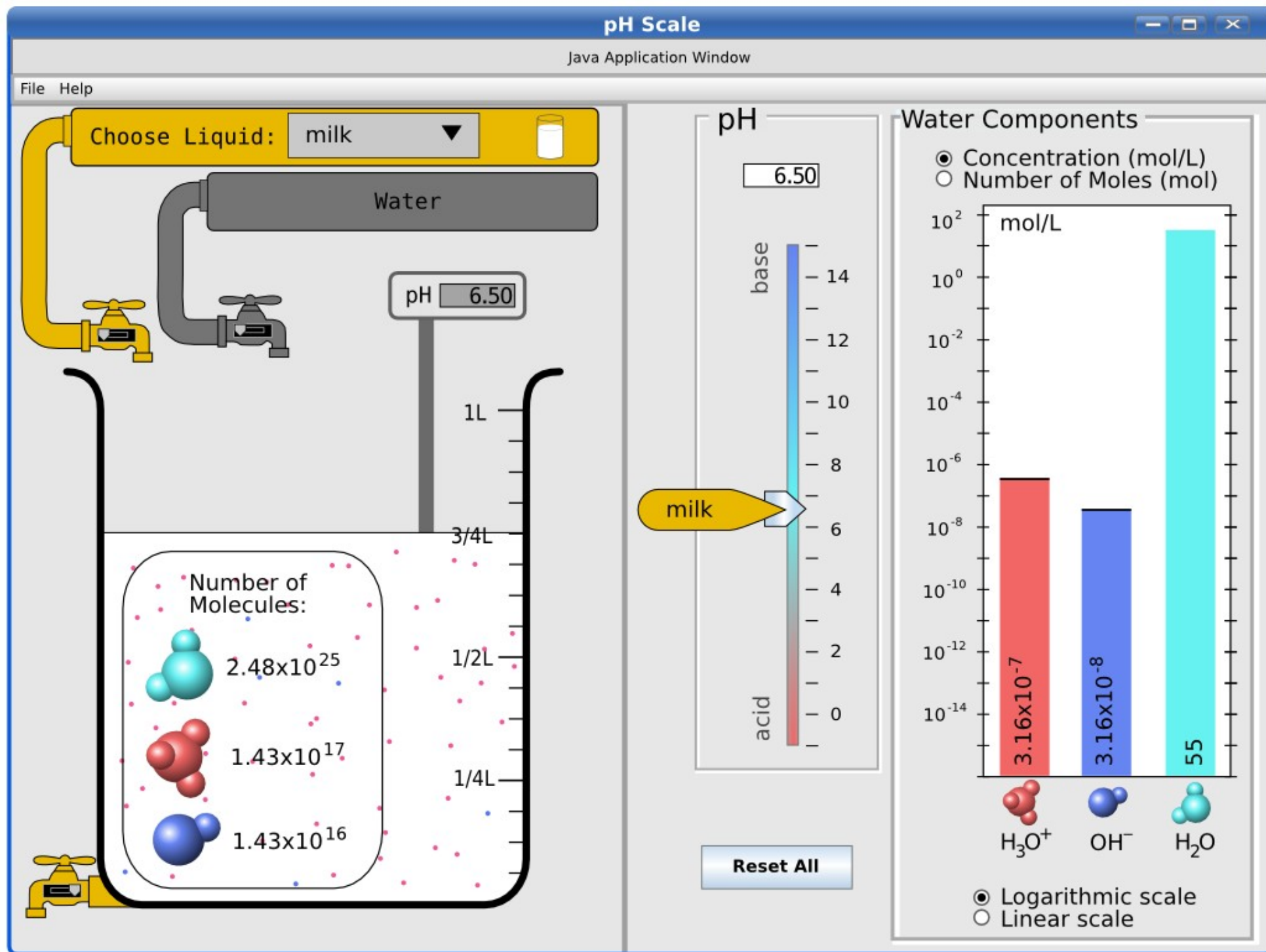
(rough notes only, presently)

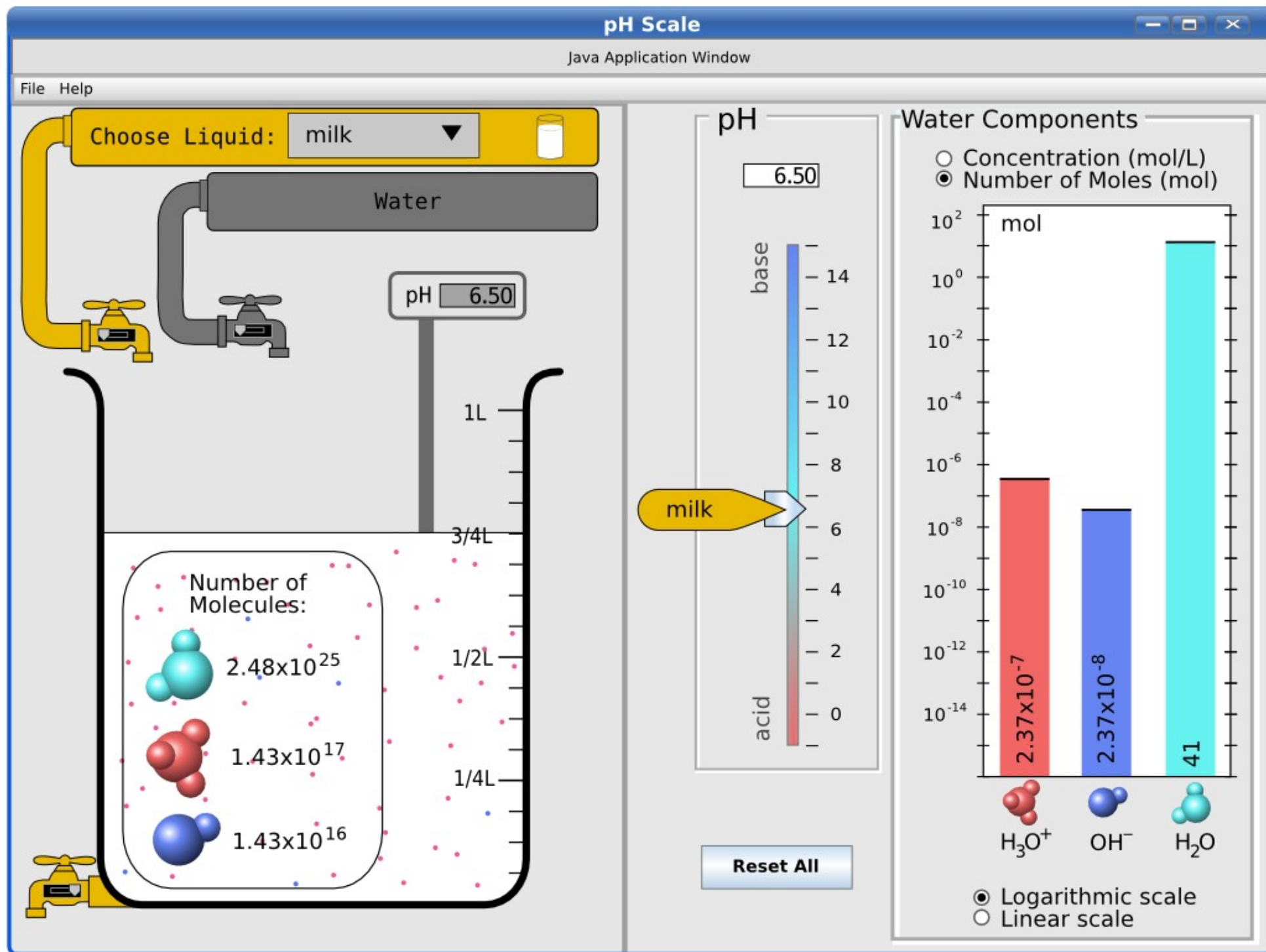
- pH slider
  - changes liquid pH directly
  - adjustment results in liquid type becoming "custom"
- bar charts
  - radio buttons for "concentration" and "number of moles"
    - concentration
      - mol/L bars of both OH and H<sub>3</sub>O are drag-able, and tied to the pH slider
    - number of moles
      - all three bars are drag-able
      - changing the OH and H<sub>3</sub>O bars moves the pH slider
      - changing the H<sub>2</sub>O slider turns on the faucet/drain (for increasing/decreasing the bar height) to change volume in beaker
  - radio buttons for "logarithmic scale" and "linear scale"
    - here's an idea for showing the linear scale: automatically set the scale to include both values H<sub>3</sub>O<sup>+</sup> and OH<sup>-</sup>, water will always be off-scale, so it is represented by bar that turns into an arrow pointing upwards off the chart (see mockup)
- faucet and drain
  - cannot fill above 1 liter
  - neutral water can be added to any liquid (it then becomes "custom")
- Choose a liquid
  - when a new liquid is chosen, the beaker liquid disappears and the faucet turns on to fill with the new liquid
  - a label tag appears on the pH slider to indicate the pH of the current and previous liquids chosen
  - liquid is "custom" if its pH is changed by some other means
- H<sub>3</sub>O<sup>+</sup> OH<sup>-</sup> view / beaker view
  - beaker view includes "Number of Molecules", which is a continuous display of the number of the three molecules in the beaker
  - H<sub>3</sub>O<sup>+</sup> OH<sup>-</sup> view shows particles as dots, also called the "microscope view"

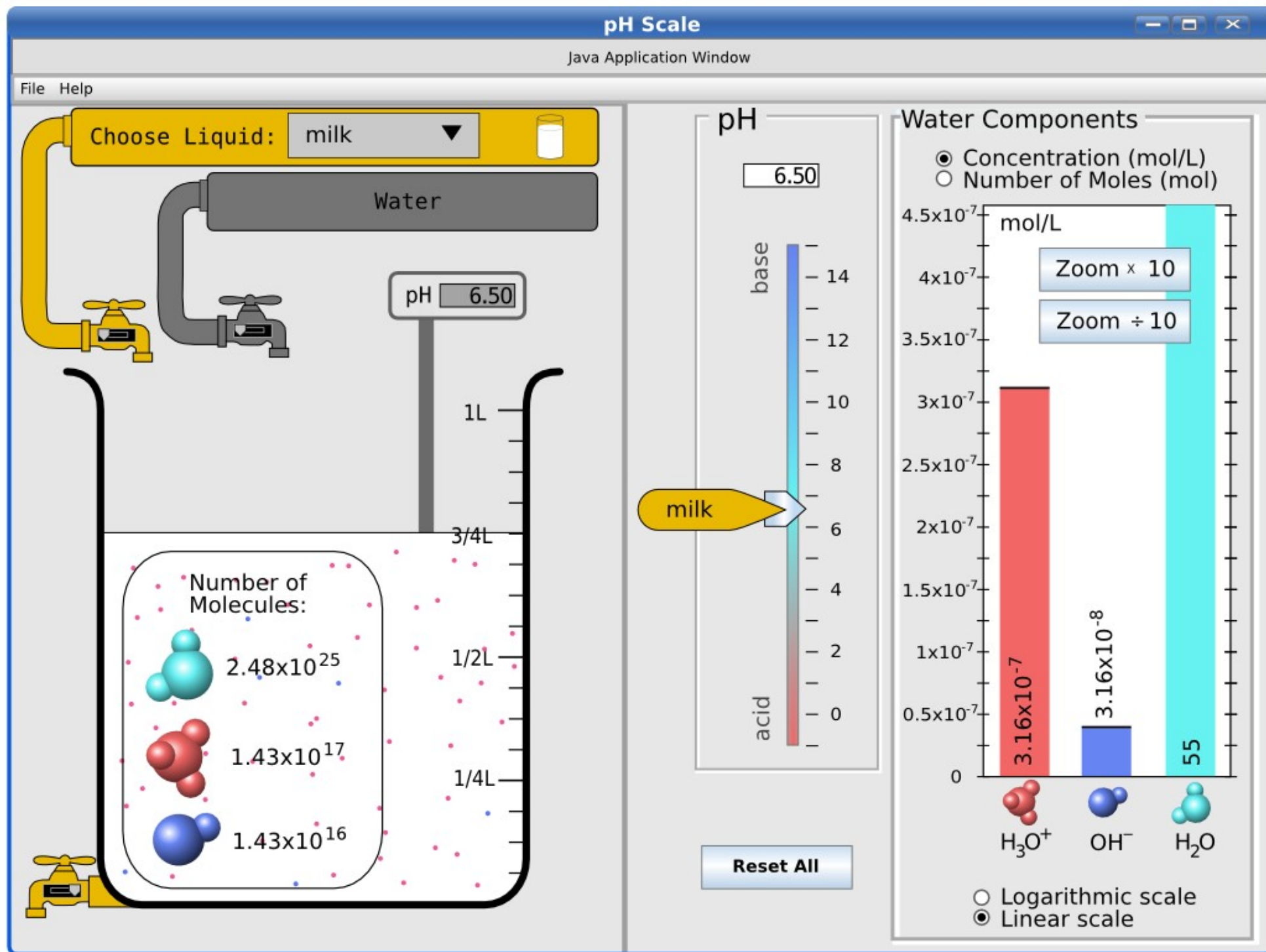
# Mockups

The following mockup screenshots are shown in the next pages:

- p4. default view, milk selected
- p5. bar charts showing number, not concentration
- p6. another attempt at showing linear scale (now with zoom buttons -- there is very little room to put these zoom buttons)







# Learning Goals

Students will be able to use pH scale to write descriptions that demonstrate how to:

- A. Determine if a solution is acidic or basic
- B. Determine if a solution weak or strong by looking at the pH
- C. Place acids or bases in relative order
- D. Describe on a molecular scale, with illustrations, how the water equilibrium varies with pH
- E. Determine concentration of hydroxide, hydronium and water at a given pH

New learning goals (rough):

- 1. pH does not change with volume
- 2. diluting with water moves pH closer to 7



## Outstanding Issues

1. When diluting with water, how does the color of liquid in the vessel change? Can we simply make the color more transparent, or do we need to make the color approach whatever color we use for water?
2. Do the faucets work in microscope mode?
3. When the height of the bars in the graph isn't tall enough to fit the text (eg,  $1 \times 10^{-14}$ ), where is the text placed?
4. How do we show the bar chart on a linear scale? Auto-scaling? Buttons to change scale?
5. How should we do the "microscope view"?
  - none: beaker with dots and the ion counters over the top
  - if none, it's hard to do small volumes in beaker correctly
  - show both beaker and microscope view always?
6. How/whether to do log/linear scales (could do another sim for learning log scales?)
7. Remove water from molecule count on beaker? (then change "molecules" to "ions")

## pH of Common Liquids

The following were taken from the web (<http://www.healthnews-nz.com/table5.html>).

Acid Mine Runoff	-3.6 – 1.0
Battery Acid	< 1.0
Gastric Acid	2.0
Lemon Juice	2.4
Cola	2.5
Vinegar	2.9
Orange or Apple Juice	3.5
Beer	4.5
Coffee	5.0
Tea	5.5
Acid Rain	< 5.6
Milk	6.5
Pure Water	7.0
Human Saliva	6.5 – 7.4
Blood	7.34 – 7.45
Sea Water	8.0
Hand Soap	9.0 – 10.0
Household Ammonia	11.5
Bleach	12.5
Household Lye	13.5