

Shopping Screen

Discover the unit rate while shopping for fruits, vegetables, and candy. Use the double number line to reason about rates and solve real-world problems.

DRAG bags onto scale (bags of fruit will open)

CHOOSE item with different unit rate

EXPLORE rates of \$/item (fruit & vegetables) or \$/lb (candy)

BUILD double number line by placing bags on scale

SOLVE problems using the unit rate (answers will be added to double number line)

CYCLE through 4 sets of questions

Shopping Lab Screen

In the Shopping Lab, students can directly set the rate.

PLACE tick marks on the double number line

HIDE the rate

SET the rate

HIDE the cost

CLEAR double number line

SEE truncated cost when not perfectly divisible

RETURN items to shelf and re-bag (if fruit)

Racing Lab Screen

The Racing Lab screen allows students to compare rates on the race track. Students can explore tracks with different lengths and cars with different rates.

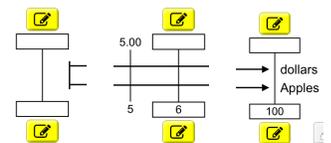
The screenshot shows the Racing Lab interface with several callouts:

- BUILD** double number line by racing cars: Points to the 'Double Number Line 1' control.
- HIDE** timer: Points to the '6.00 hours' timer display.
- DRAG** flag to adjust track length: Points to the flag icon on the track.
- SET** the rate: Points to the 'Rate 1' control showing 50 miles and 2.0 hours.
- START/STOP** the race: Points to the play/pause button and the stop sign icon.
- RETURN** cars to starting line: Points to the refresh/circular arrow button.

The interface also shows 'Double Number Line 2' with a rate of 100 miles and 8.0 hours, and a bottom navigation bar with 'Unit Rates', 'Shopping', 'Shopping Lab', 'Racing Lab', and 'PIET'.

Complex Controls

- On the Shopping screen, the default item is chosen randomly on startup. For each item, there are four sets of Questions, which are randomly ordered. The refresh button cycles through the sets of questions. If a student answers a question, their response (whether correct or incorrect) will be saved, so make sure to reset the sim between classes.
- A tick mark will automatically be added to the double number line if (1) items/bags are placed on the scale, (2) a Question is correctly answered, or (3) a car reaches the finish line.
- Tick marks can be manually added to the double number line by using the edit tool. After a value is entered, the edit tool will automatically slide to the corresponding location on the double number line. If the value is off-scale (>16 items, 1.6 lbs, or 200 miles), the edit tool will slide off the end of the double number line.
- The cost readout (Shopping & Shopping Lab) and timer (Racing Lab) can be minimized to facilitate predictive questions. If items are placed on the scale or the cars reach the finish line, a tick mark will automatically be added to the double number line, thus revealing the hidden cost/time. To avoid this situation, the double number line should also be minimized.



Model Simplifications

- The Shopping Screen groups items into three types: fruits, vegetables, and candy. Tomatoes and cucumbers are grouped with the vegetables, though they are technically fruits.
- On the Shopping Lab screen, the cost readout on the scale will show a third decimal place if the value does not terminate at the hundredths place. The cost readout will be *truncated* at the thousandths place (e.g. a cost of \$1.2349 will be displayed as \$1.234). The corresponding tick

mark on the double number line will be *rounded* to the hundredths place using nearest neighbor rounding, with five always rounding up (e.g. tick mark will be at \$1.23). However, in the real world, prices are always rounded up.

- The currency symbol and units are translatable. A translator may choose to translate lbs as kg. This is purely a cosmetic change, and will not convert the units. For example, a unit rate of \$5/lb, it would become \$5/kg after translation. A metric version of Unit Rates can be found [here](#).

Insights Into Student Use

- The three scenes on the the Shopping screen are in order of increasing of difficulty, with fruit being the easiest and candy being the most difficult. Some students like to start with candy, but may benefit from first working with the fruits.
 - The unit rate for fruits and vegetables is expressed as \$/item, and the unit rate for candy is expressed as \$/lb.
 - Bags of fruit open, leaving behind individual items that can be removed from the scale. All questions can be solved by placing an exact number of items on the scale.
 - Bags of vegetables and candy do not open, and the questions cannot be directly solved by placing the exact amount on the scale. Additionally, the 3rd and 4th questions deal with a number of items that are beyond the range of the double number line (>16 items/1.6 lbs).
- The Questions on the Shopping screen were designed for students to be able to solve without a calculator. The question sets are scaffolded, and can be solved by leveraging the double number line. A few possible strategies using the double number line include: (1) adding two tick marks together, (2) calculating the integer multiple of a tick mark, (3) calculating the midpoint of two tick marks, or (4) adding or subtracting the unit rate from a tick mark. In interviews, some students do leverage these strategies, but still found it helpful to use a pencil and paper to solve the problems.

Suggestions for Use

- Ask students to explain a strategy they used to solve the Questions to the class. After, have students switch items and practice using one of the strategies their classmates described.
- If students work in pairs, they can take turns setting the rate and hiding it, while their partner finds the unit rate.

Sample Challenge Prompts

- For two tracks with the same length, determine two different rates such that the cars reach the finish line at the same time. How do these rates compare to one another?
- For two tracks with different lengths, find two rates such that the cars reach the finish line at the same time. How would you change the rates so that the car on the shorter track finished in half the time?

See all published activities for Unit Rates [here](#).

For more tips on using PhET sims with your students, see [Tips for Using PhET](#).