PhET Tips for Teachers   **Fractions Intro**
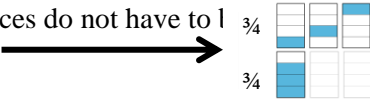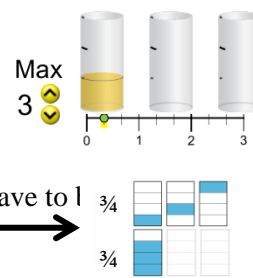
Students that we interviewed had great success using this introduction to fractions with no directions. These teacher tips are meant to help you quickly understand the game operation. We have provided multiple representations to help them with their sense making; they may not use all the representations. Our studies show that student exploration, not explicit directions enable the students to get the most value from this sim.

Teacher Tips for controls:
- Students can choose to work on any level or tab. The **Matching Game** tab is also part of **Fraction Matcher** sim, but has only improper fractions in **Fraction Matcher**. See *Tips for Fraction Matcher* for information about the game.
- **Intro** and **Equality** tabs are designed for students to explore a variety of fraction representations. They can build a clear understanding of how the numerator and the denominator affect the fraction value and the visual representation. This sim uses only improper fractions and the fractions are not always simplified.
- Students can increase the number of containers. On **Intro** tab, use the **Max**. For example, increasing the value to 3 would give three containers or make the number line max 3. On **Build a Fraction**, use \ ⊕ button to get more containers. On **Equality** tab, the number of containers is fixed at 4.
- Students can drag the pieces to many places, so they can see that the pieces do not have to l represented as all in one container. See ¾ represented in two ways
- The numerator and denominator values are changed using ⌄.
- **Equality Lab** enables students to make fractions on the left side and see equivalent representations. They can change the denominator on the right side using ◀▶
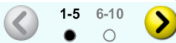
Suggestions for sim use:
- For tips on using PhET sims with your students see: **Guidelines for Inquiry Contributions** and **Using PhET Sims**
- The simulations have been used successfully with homework, lectures, in-class activities, or lab activities. Use them for introduction to concepts, learning new concepts, reinforcement of concepts, as visual aids for interactive demonstrations, or with in-class clicker questions. To read more, see **Teaching Physics using PhET Simulations**
- For activities and lesson plans written by the PhET team and other teachers, see: **Teacher Ideas & Activities**

 Games: Build a Fraction (see also *Tips for Fraction Matcher***)**
- The challenge of the game is to fill the boxes on the right. Some challenges are numeric and others are images.
- Representations are randomly generated so students will get a variety of challenges enabling independent work. Any equal fraction is accepted as correct; the fractions are not simplified. For example, 1 whole would be correct for 2/2.
- There are several ways for students to interact; we found students did not need directions. Here are some tips for the teacher: Reset returns to default ↩ returns the pieces to the bottom. Refresh ⟳ gives the students new objects to use, but at the same level. Pieces are dragged from the bottom into the middle area and then dragged into the boxes on the right; they will stay if they are equal.
- There are 10 levels in **Build a Fraction** of both pictorial and numeric representations.
- When students create a set of equivalent numbers or representations, they see a smiley face and

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Next . They earn 2 points for a correct answer on first try and 1 point for a second try and 0 otherwise. Each game has 6 challenges for a possible total score of 12.

- The button lets students or teacher scroll back to the front page where they can select levels to see what they have done or move to another level.
- 1-5 6-10 is used to navigate from levels 1-5 to 6-10
- When the students end a game (they don't have to finish it to end), a representation for their score is shown by stars. Three full stars would mean they made all six matches on the first try. This representation indicates 10/12 points. This indicates 6/12 points. If students re-do a level, the best score is shown until they close the program and restart. So a student can get a perfect score, but you will not know how many tries it took.
- Turning on the clock provides another way for students to keep track of their progress. Students cannot save their results, but best time for the session is given.

Level Descriptions for Build a Fraction game:

Level	Number of Targets	Target Shape	Simplification required?	Target Fill	Range (N) of Target	Range of Target Denominator (D)
1	3	circles	no	ordered	0<N<1	D∈{2, 3}
2	3	circles or rectangles	no	ordered	0<N<1	D∈{2, 3, 4, 5}
3	3	"six flowers"	yes	ordered	0<N<1	D∈{2, 3, 6}
4	3	triangles	no	ordered	0<N≤1	D∈{2, 3, 4, 5, 6, 7, 8, 9}
5	3	varies	no	ordered	0<N≤1	D∈{2, 3, 4, 5, 6, 7, 8, 9}
6	4	varies	yes	ordered	0<N≤1	D∈{2, 3, 4, 5, 6, 7, 8, 9}
7	4	varies	yes	ordered	0<N<1	D∈{2, 3, 4, 6, 8, 9}
8	4	varies	yes	ordered	0<N<2	D∈{2, 3, 4, 5, 6}
9	4	varies	yes	random	0<N<2	D∈{2, 3, 4, 5, 6, 7, 8, 9}
10	4	varies	yes	random	0<N<2	varies