Deep Math Projects
Building Fractions
Introduction

Topics

- Multiple representations of fractions
- Equivalent fractions
- Combining fractions

Materials

- Colors (for showing different parts of a whole)

What students should know

- Understand the meaning of fractions as parts of a whole

How the activity extends math standards

- Represent fractions in multiple, creative ways
- Search for multiple combinations to make 1 whole
- Use diagrams to begin exploring addition and subtraction of fractions

Getting started

Display or hand out copies of the Opener. Start an open-ended discussion by asking students what they *notice* and *wonder*. Use the "I notice/I wonder" T-chart if you like. Give students plenty of time to get comfortable sharing math ideas openly.

The *Noticing and Wondering: Sample Responses* page has ideas to help you guide discussion. These are only suggestions. The ideas should come mainly from your students. It may be easier for students to notice than to wonder.

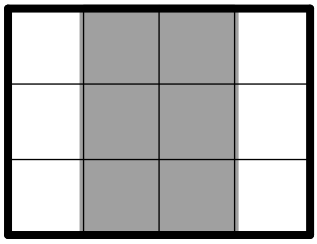
If you are not available to lead the opening discussion, ask your students to work in small groups to discuss and write down the things that they notice and wonder. You may check back with them later to help them identify questions to explore.

Once your students understand the problem and have created some questions to explore, they may begin working on answering some of their questions. If you prefer, you may hand out the Directions page so that they have a specific list of questions to answer. However, it is important that students have a chance to answer questions that *they* create as well. For example, even though the Directions do not include questions about symmetry, some students may see symmetry in the drawings and may like to create fraction drawings that have (or don't have) certain kinds of symmetry.

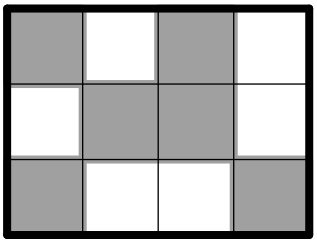
Building Fractions
Opener

What do you notice? What do you wonder?

1



2



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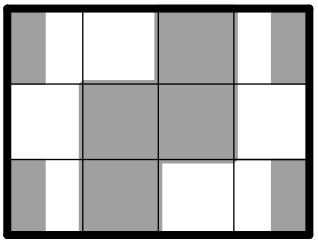

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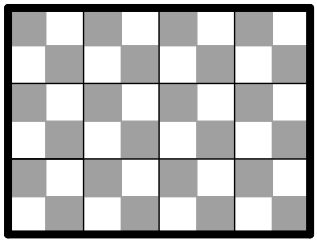

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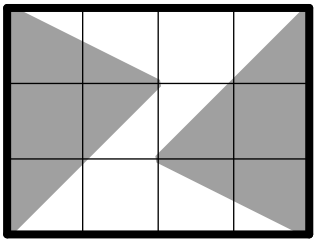


6

Name _____

Building Fractions

I notice	I wonder

Building Fractions
Noticing and Wondering: Sample Responses

Note: Students may have many ideas that are not on this page.

1. **Before starting the problem**

   I notice that the first two pictures have 6 whole squares shaded.
   I notice that picture #1 is the only one that has a single grey shape.
   I notice that picture #2 is the only one that looks different if you turn it upside-down.
   I notice that picture #3 is the only one that has half-shaded squares.
   I notice that picture #4 is the only one that has quarter-shaded squares.
   I notice that picture #5 is the only one that has triangles (or diagonal sides).
   I notice that picture #6 is the only one that does not have 12 squares.
   I notice that all six pictures look like they have about the same amount of grey and white.
   I notice that 1 half of every picture is shaded grey.
   I notice that the fraction for picture #6 equals the fractions for the other pictures even though it has less grey in it.

   I wonder how many more ways I can shade the rectangle so that 1 half of it is grey.
   I wonder how many ways I can name 1 half (1 third, etc.) using my pictures
   I wonder if I can show a lot of ways to shade in other fractions (like 1 third, 1 fourth, etc.)
   I wonder if I can show these fractions on rectangles with more or fewer squares.
   I wonder where I can see fractions like these in the everyday life.
   I wonder how many ways I can make 1 whole using simple fractions like 1 half, 1 third, 1 fourth, and 1 sixth.
   I wonder if I could use my pictures to add and subtract fractions.
   I wonder how many more pictures I can make for 1 half (or other fractions) make that look the same when I turn them upside-down.

2. **While solving the problem**

   Because this project has so many possible questions to explore, the next page contains an optional set of Directions that you can use with students. However, it is equally (or more) important for students to explore questions that *they* create!

   Students should continue noticing and wondering while they work on answering their own questions or the ones in the directions. They may come up with ideas that are not listed on this page, the Directions, or the Solutions!

3. **After solving the problem**

   The process of asking and answering new questions continue even after students have "finished" the problem. There are always new things to explore—and you never stop noticing and wondering!

Building Fractions

Directions

Part 1

1. Show 1 half in many different ways on a Fraction Recording Page. Use the pictures to name 1 half in different ways.

2. Do the same for 1 third, 1 fourth, and 1 sixth on Recording Page 1 or 3.

3. Find interesting examples of these fractions in the real world.

4. Digging Deeper: Show 1 fourth on Recording Page 2, or show 1 fifth on Recording Page 3.

Part 2

5. Combine halves, thirds, fourths, and sixths in different ways to make one whole.

   - Find as many ways as you can. Tell how many of each you need.
   - Show each solution on a Fraction Recording Page of your choice.

6. Digging Deeper: Include eighths, twelfths (or other fractions with 1 in the numerator) to make one whole.

   See *Extending the Challenge in Mathematics* by Linda Jensen Sheffield (Corwin Press, 2003) for a similar activity and more information.

Part 3

7. Write each of these expressions as one number with one unit.

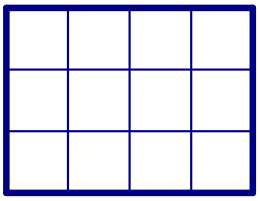
1 half + 1 fourth	1 half – 1 sixth
1 half + 1 third	1 third – 1 fourth

8. Digging Deeper: Create your own fraction recording pages with different numbers of rows and columns. Use them to add or subtract fractions of your choice.

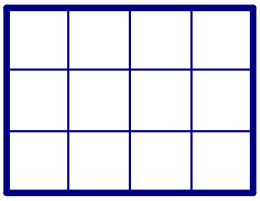
Name _____

Fraction Recording Page 1

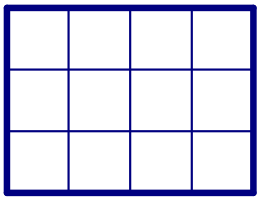
fraction: ___



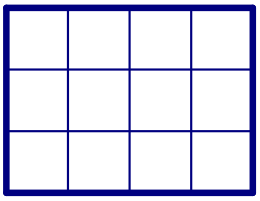
fraction: ___



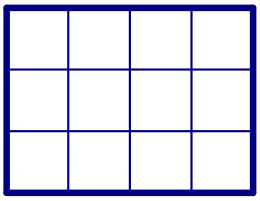
fraction: ___



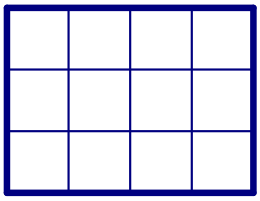
fraction: ___



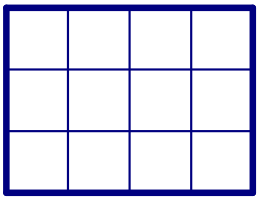
fraction: ___



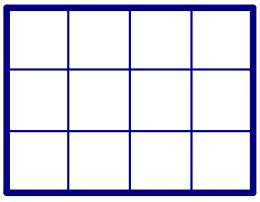
fraction: ___



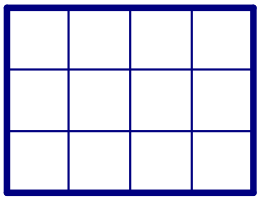
fraction: ___



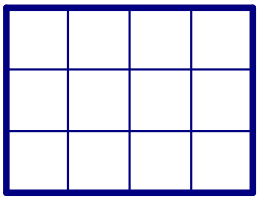
fraction: ___



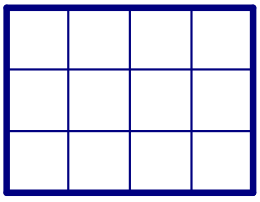
fraction: ___



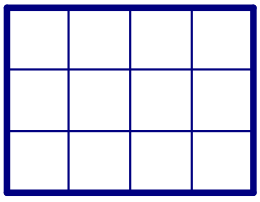
fraction: ___



fraction: ___



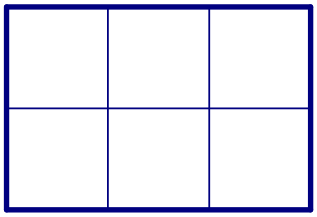
fraction: ___



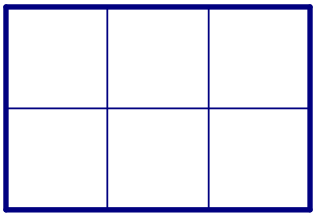
Name _____

Fraction Recording Page 2

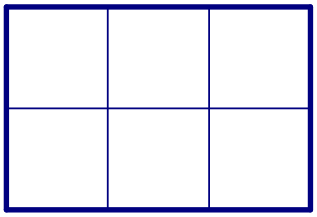
fraction: ___



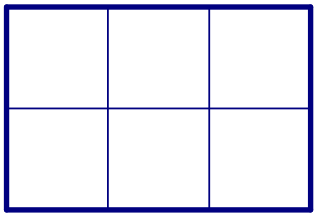
fraction: ___



fraction: ___



fraction: ___



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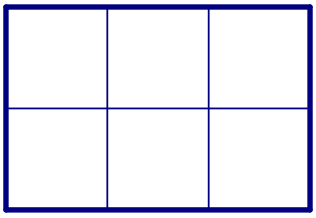
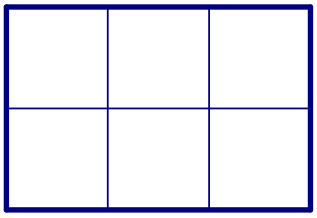
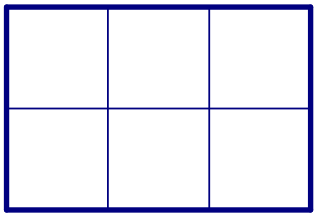


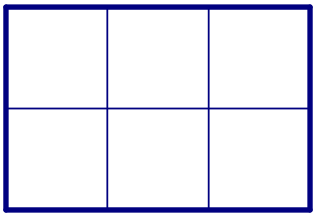
fraction: ___



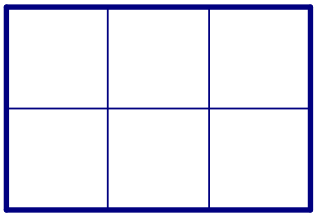
fraction: ___



fraction: ___



fraction: ___



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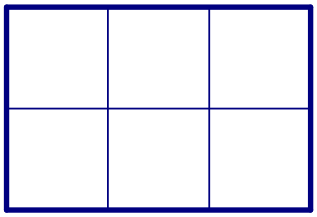

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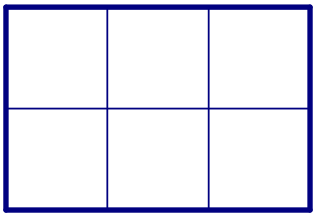
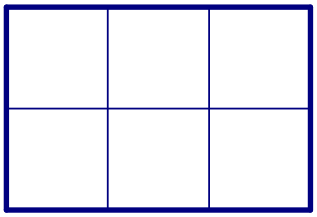


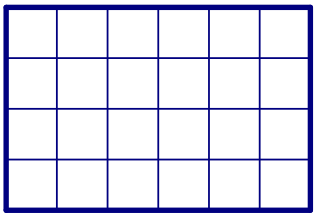
fraction: ___



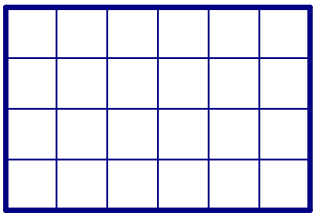
Name _____

Fraction Recording Page 3

fraction: ——



fraction: ——



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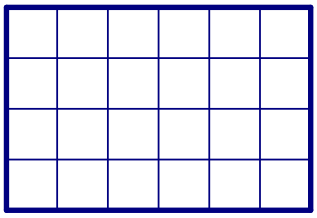

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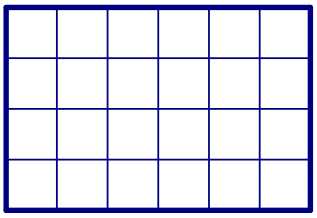

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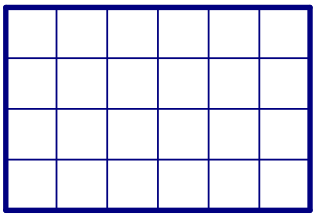

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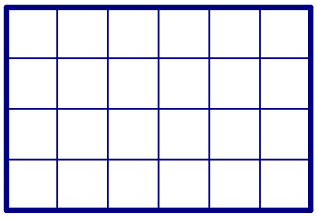

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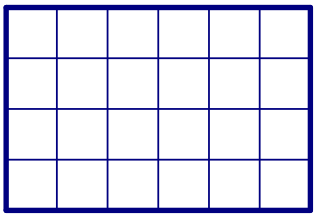
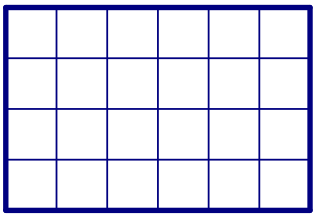
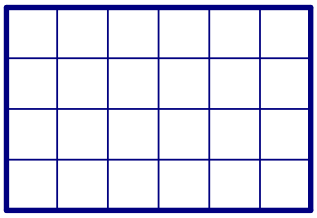


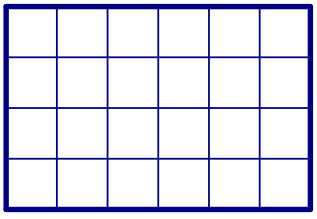
fraction: ——



fraction: ——



fraction: ——



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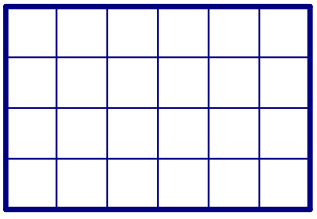
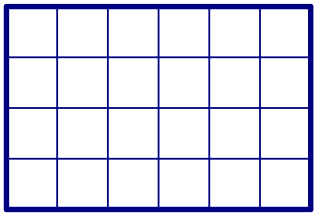


fraction: ——



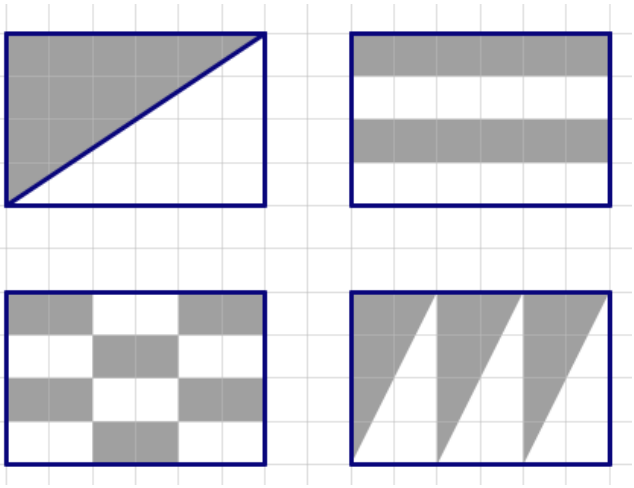
Building Fraction
Math Notes and Solutions

These pages show sample solutions for the questions posed on the Directions page. Many other solutions *and questions* are possible!

Part 1

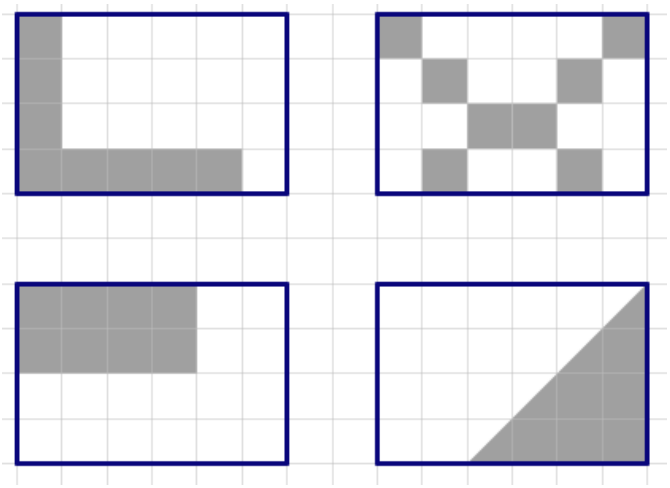
Sample solutions with a 6 by 4 rectangle

1 half:

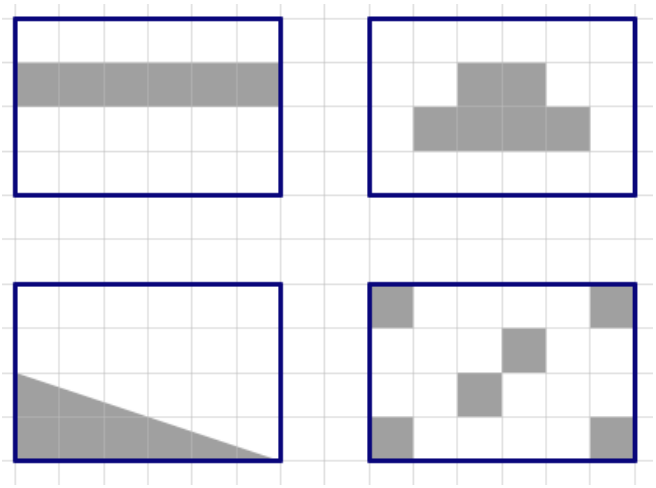


The upper right picture shows that 1 half = 2 fourths
The lower left picture shows that 1 half = 6 twelfths
The lower right picture shows that 1 half = 3 sixths

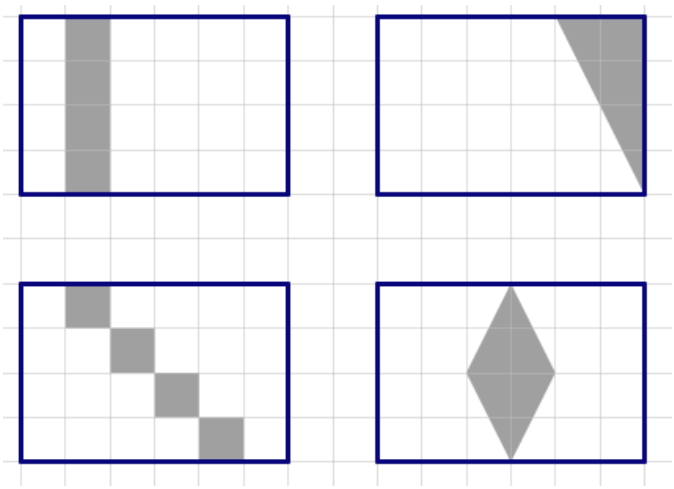
1 third:



1 fourth:



1 sixth:

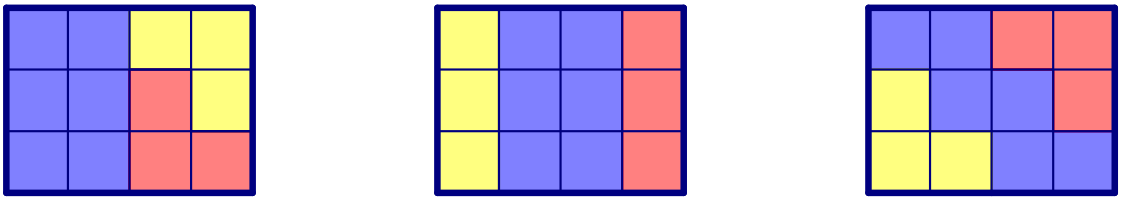


Part 2

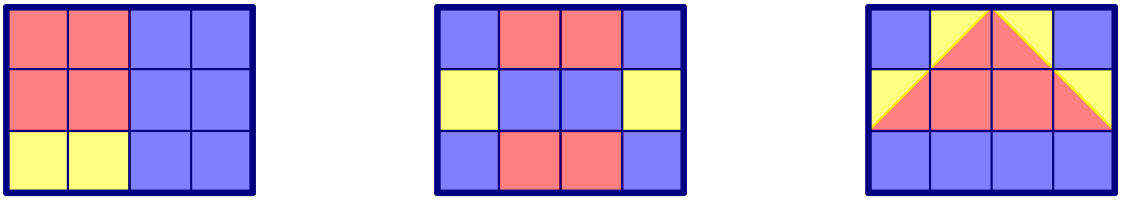
See the book *Extending the Challenge in Mathematics* by Linda Jensen Sheffield (Corwin Press, 2003) for a similar activity and more information. (Her approach does not explicitly use pictures, but she makes a table of solutions.)

There are many combinations to make one whole, and even more ways to show each one. Below are three examples of combinations with three ways to show each. These examples use the 4 by 3 rectangle, but you could use any of the rectangles.

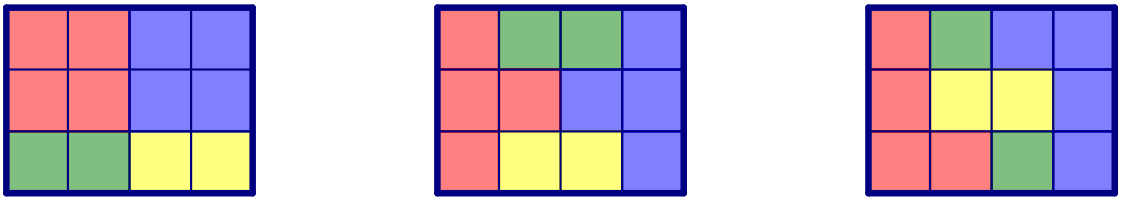
1 half 1 fourth 1 fourth



1 half 1 third 1 sixth



2 thirds 2 sixths



Overall, there are ten ways to create 1 whole using 1 half, 1 third, 1 fourth, and 1 sixth. Can your students find most or all of them if they work together?

There are many more ways if you also include 1 eighth and/or 1 twelfth!

Note: Some students may naturally write their solutions in traditional fraction form, but do not stress this unless they initiate the idea. It is important for them to understand halves, thirds, fourths, sixths, etc. as *units*.

Part 3

Students may use earlier pictures or draw new ones to help them solve the problems. Ask them to use their pictures to explain why their answers make sense!

Answers:

1 half + 1 fourth = 3 fourths
1 whole – 1 sixth = 5 sixths
1 half + 1 third = 5 sixths
1 third – 1 fourth = 1 twelfth

As students use pictures to guide their thinking, encourage them to take opportunities to write equivalent fractions. For example, since the pictures on the previous page show rectangles with twelve parts, students can *see* that

1 half + 1 fourth =
6 twelfths + 3 twelfths =
9 twelfths =
3 fourths

1 whole – 1 sixth =
12 twelfths – 2 twelfths =
10 twelfths =
5 sixths

etc.

All of this thinking can be done using students' pictures only. It is premature for most students in third grade to learn rules about "finding common denominators," though a few may discover some of the ideas themselves. The purpose of this project is to develop conceptual understanding of fractions and equivalent fractions rather than to learn rules and shortcuts.

When students write fractions in "number and word" form as shown in these solutions, it helps them understand that halves, thirds, etc. are *units* (just like inches or minutes). Do not press students to write their numbers in traditional fraction form unless they already know how to do it. Even then, they can learn a lot from continuing to using number and word form as well.