SUPERMATH

Comparing Fractions

<u>GOAL(S) OF THE UNIT</u>: To learn how to use patterns in data and Origami to infer math rules for comparing fractions, and to then (optionally) apply the discovered rules to figure out how to add and subtract fractions.

Duration	5 days
Approach	Provides students with a visual way of thinking about and representing fractions, and solving simple fraction problems
Supermath software	Fraction Compare
Pre/Corequisite	Knowledge of what a fraction is, definition of numerator and denominator, the symbols > < for greater than and less than (words can be substituted)
Vendor software	None
Followup practice	Comparing and adding fractions with unequal denominators.

Concepts and Skills in this Unit
Comparing fractions with equal and unequal denominators
Finding patterns
Using patterns to develop a math strategy
Equivalent fractions
Finding common denominators
> and <

Materials: Student notebooks, chart paper, post-it notes.

Copies of the blackline masters (at the end of the unit) for all students.

Logistics:

FRACTION COMPARE requires very little set-up. Please read the pedagogical approach to using this software before presenting your lesson. This will help you understand aspects of the lesson that you might otherwise be confused by.

Students should write the strategy in their notebooks to show the teacher before they proceed.

<u>WARNING</u>: FRACTION COMPARE requires more intervention on your part while students are at the computer than any other software as you need to check the strategy that each team writes As a result, we strongly recommend using groups of 3-4 students at each computer for the first day or two when using this program instead of the customary 2-3.

Pedagogical Approach: (See the special CRITICAL note for teachers above.)

FRACTION COMPARE is designed to teach students how to think about and describe problems and strategies in a more sophisticated way by initially misdirecting them. The program expects students to design a strategy to solve a set of problems that involves comparing fractions. At each stage the students call you over to explain the strategy they used to solve the set of problems, and justify their conclusion based on the printout of results. They then move on to the next set which is usually designed such that if they use the same strategy they get mostly wrong answers. They then have to adjust the strategy for that specific type of fraction comparison problem.

As students move from success to frustration, your job is just to smile and wait for them to make the adjustment. Once students adjust to the new situation, be very demanding in getting them to describe and defend their strategies for solving a given set of problems.

The activity with this program builds to a crescendo on the third day when students will probably have trouble solving the problems without additional knowledge. THIS IS DONE DELIBERATELY. The curriculum then calls for you to act in an unusual fashion (for a mathematics teacher) and suggest a silly strategy that does not work and then, when students realize it doesn't, to declare the problems to be too hard and that it is okay to give up. (By the way, the silly strategy is suggested to help students learn that just guessing and not using a strategy doesn't help.)

The posture of giving up and guessing will probably surprise some of your students and may even upset them a bit. However, the unit is written so that the class comes back to these same problems after the students have been exposed to the prerequisite work with equivalent fractions—and then they figure out how to solve the problems that stymied them on their own. At the point of success, the earlier frustration generates a more powerful appreciation of how additional knowledge often makes the development of systematic strategies for solving previously difficult problems easy. The initial frustration also develops a better understanding on the part of the students on how to distinguish between problems in which a strategy is obvious and those for which new knowledge must be brought to bear to solve.

Carrying off this sequence requires you to be a good actor/actress. You must act as though you are mad at the computer for presenting the difficult problems to the student at the early point. You must act surprised when the silly strategy does not work. When the students later on discover the strategy for solving the problems, you must make a big deal out of it and help students understand the significance of their accomplishment.

While the mathematics in this unit is important, a more important goal of this unit is to begin the development of a sense of how to think, reflect, and talk, about mathematics. The primary goal is for students to learn how to articulate and test predictions, how to look for patterns in large sets of data, how to think about proving and defending ideas, and how to figure things out on their own. The key to all this occurring is for you to: a) consistently probe student ideas to produce full articulation, and b) act calm and confident when the students are genuinely struggling and you are not really sure if they are going to come through. You must be demanding, but in a way that communicates that you have confidence in their ability to figure things out. If you simplify things early on for the students they will have learned that they can con you by acting helpless. Do not let that happen.

EXPLORATION

UNIT TITLE: COMPARING FRACTIONS

SOFTWARE: FRACTION COMPARE

Pre-class setup: Load computers with FRACTION COMPARE to Level One. Some groups may be ready for Level Two by the end of the period. To switch levels choose 'Start Over' under the GAME menu.

Materials: Student notebooks.

Lesson #: 1

<u>PRE-TEACHING ACTIVITIES</u> (Demonstrations, linkages, setting the stage):

Can you think of any times in your life when you might want to compare things? (Shopping for new clothes, choosing a college to attend, deciding on the best route to take to school, etc.)

Those are good examples. In fact, you are going to be faced with many choices in your lives. Any time you have to make a choice, you will probably want to compare the options you have and choose the one that offers you the best deal. Sometimes these choices will involve whole things, and sometimes parts of things. Can anyone think of an example when you might have to choose between two different choices that involve parts of things? (Hopefully, students will be able to think of examples, e.g., Which sale saves you more money, $\frac{1}{2}$ off or $\frac{1}{3}$ off on a $90 pair of shoes, etc.)

In order to make comparisons between parts of things you have to know how to compare fractions. If we are comparing two fractions to help us see which gives us the better deal, what are we going to have to know about the fractions? (Which is larger.) Then say:

Today you are going to work with a new program which lets you choose which of two fractions is larger. When you finish a set of problems, you will enter your strategy for telling which fractions are larger into the computer. Then you will be asked to show me your strategy. By strategy I mean the technique

you used to consistently figure out the correct answers to the problems. Then say:

Before we play the computer game I want to teach you a new dance step. Make up a dance step that uses your feet and arms. Repeat this several times. Then interrupt in the middle and ask: **What comes next?** When students respond, act impressed, and say: **It's amazing! You can predict the future. How did you do it?** (Because the moves repeat.)

Something that repeats is called a 'PATTERN'. Where have you seen patterns before in this class? (Quilts, mosaic board, etc.) **As we have just seen patterns are important for predicting what will happen. Numbers also have patterns. Can someone give me a pattern of numbers?** (1,2,3,1,2,3,1,2,3) Then say:

At first you might not be sure how to tell which fraction is larger. What have we said you should do when you are not sure how to proceed, or how to find an answer? (Experiment) **But when you try different strategies and get different results you still have to be able to figure out which strategy gave you the best results. To do that you usually need to look for a pattern between the problem and the results for a given strategy.** Send students to the computer.

——THE FOLLOWING IS AN EXTENDED COACHING GUIDE——

»» As students develop strategies for determining which fraction is biggest at each level, constantly probe them with questions such as: **How did you do?** (Student responses will vary.) **Did your strategy work—Do you think you should change it?** (Yes or no.) **Do you see a pattern in the fractions that are larger?** (The numerator is larger.) **How can you tell if your strategy is a good one?** (If strategy is getting the correct results.) **What could happen to make you change your strategy?** Tell students to write down the successful strategy for these types of problem in the MATH PROCEDURE section of their notebooks. Try to get them to fully articulate the rule, then let them move on to the next set of problems.

Once it is clear that the students have a successfull strategy for Level One, i.e., get all six problems right, let students move on to Level Two by choosing the '**Start Over**' option under the **GAME** menu. The problems will change, and the original strategy will probably no longer work. The screen will ask them if they want to change their strategy, and then 6 more problems will be presented. Whether students are successful or not, the screen will ask them if they want to review the fractions. If they say yes, graphics are used to illustrate which of the two fractions are larger. The next time they call you over to look at their strategy, then ask:

Is your first strategy still working? (Student answers will vary, but probably the first strategy is not working.) **Why not?** (Different problems, etc.) **How are these problems**

different? (Denominators are different.) **How are you going to change your strategy?** (Student answers will vary.) **If you need more help in figuring out why your strategy didn't work, try asking the computer to help you.**

After students change their strategy, they will have to try their new approach on six more problems. When they have a successful strategy, print out the summary screen again. Have the students analyze the results and check for the pattern where their strategy is repeatedly giving them the right answer. Then have them write down the new rule they discovered, and move on to the next set of problems.

IT IS CRITICAL TO GET STUDENTS TO LOOK AT THE ENTIRE SET OF DATA ON THEIR PRINTOUT, NOT JUST THE ANSWER. The primary goal is for students to get practice in finding the pattern in a large set of problems and results. To do this students need to simultaneously relate the different data on the printout (i.e., the problems, their answers, and the computer's answers). If you can get students to carefully look at all the data they will gradually begin to recognize variations in problem type and adjust their strategies accordingly**.** ««

HOMEWORK

Assign or create your own simple problems that ask students to compare fractions.

For Example:

Use >, < or = to compare fractions, e.g., put the appropriate symbol between the following fractions $\frac{1}{2}$ $\frac{1}{4}$.

(NOTE: If students do not know the symbols, >,<, you can either teach it or let them use the words 'greater than' and 'less than'.

EXPLORATION

UNIT TITLE: COMPARING FRACTIONS

SOFTWARE: FRACTION COMPARE

Pre-class setup: Load computers with FRACTION COMPARE set to Level Two.

Materials: None

Lesson #: 2

PRE-TEACHING ACTIVITIES (Demonstrations, linkages, setting the stage):

> **Yesterday on the computer you started comparing fractions. Take out your notebooks. What did you find to be a successful strategy for finding the largest fraction when you first started out?** (The larger the numerator, the larger the fraction.) Then ask:
>
> **Did you have to change your strategy later on—Why?** (Yes, the problems changed.) **How exactly did the problems change?** (At first all the denominators were the same. Later they were different)
>
> **Did anyone develop a strategy for solving the problems when the denominators were unequal?** (The smaller the numerator the larger the fraction.) **How did you know that your strategy was working?** (There was a pattern of correct answers.) Point to the Problem Solving Strategies poster and say:
>
> **You have been making decisions about comparing fractions and trying to find patterns. But I am confused. First, when the denominators were the same, the larger fractions had larger numerators, and all of a sudden the larger fractions had smaller numerators. Can someone give me an example of fractions with unequal denominators where the larger fraction has a smaller numerator and then explain why that fraction is larger.** Make sure students completely articulate their answers. Continue with the following even of students have trouble answering the previous question:
>
> **One strategy that often works for comparing fractions is to estimate the size of the fractions by comparing each to another fraction that you know quite a bit about. For example, how does $\frac{5}{9}$ compare to $\frac{1}{2}$ — how do you know?** ($\frac{5}{9}$ is more than $\frac{1}{2}$ because 5 is more than half of 9.) Then ask: **And how does $\frac{7}{15}$ compare to $\frac{1}{2}$**

— how do you know? ($\frac{7}{15}$ is less than $\frac{1}{2}$ because 7 is less than half of 15). **So if $\frac{5}{9}$ is more than $\frac{1}{2}$ and $\frac{7}{15}$ is less than $\frac{1}{2}$, what can you say about $\frac{5}{9}$ and $\frac{7}{15}$?** ($\frac{5}{9}$ is more than $\frac{7}{15}$). Then ask:

As you continue to look at the pattern of which fractions are larger, when do you think you can get by with looking at only one part of each fraction? (When the denominators are equal or the numerators are equal.) **In all other cases, what are you going to have to do to successfully compare fractions?** (Look at one entire fraction compared to the other entire fraction.) Then say:

As you continue to work, your visualization and estimation skills will come in very handy. When you ask to 'review the fractions' the computer will give you some pictures to help you visualize the fractions. In addition, you can use the idea we just talked about of using a third fraction that you understand well to help you compare. See which approach helps you more. Tomorrow we will talk about your strategies for solving the next set of problems.

»» Some students may be able to reach Level Three, i.e., they are consistently getting all the answers right in Level Two with a valid strategy. ««

NEW COMPUTER USE SKILLS: None.

NUMBER OF STUDENTS PER COMPUTER: 3-4.

POST-TEACHING:

Was anyone able to find successful strategies today? Let students respond and share answers. **For tonight, I have some more homework that will help you test out your strategies. I would also like you to look at your notebooks and see how your strategies have changed over the last few days. I will give you a chance to share your discoveries with all of us tomorrow.**

HOMEWORK

Assign or create your own problems that ask students to compare fractions.

For Example:

Use >, < or = to compare fractions, e.g., put the appropriate symbol between the following fractions $\frac{1}{2}$ $\frac{1}{4}$

EXPLORATION

UNIT TITLE: COMPARING FRACTIONS

SOFTWARE: FRACTION COMPARE

Pre-class setup: Load computers with FRACTION COMPARE set to Level Three

Materials: One sheet of blank paper for each student to participate in the paper folding activity. One copy of the 'Origami' problems for each student (Blackline Master #1 at the end of the unit).

Lesson #: 3

PRE-TEACHING ACTIVITIES (Demonstrations, linkages, setting the stage):

TEACHER NOTE: Today the students will be presented with very difficult fraction comparison problems by the program. For the most part, these problems will be too hard for the students to solve by visualization because the fractions are closer together in value. In addition, they will not have the graphic aids that the program provided for them yesterday. For these reasons it is expected that they will not do as well on today's activity. If the students start to get frustrated, do not worry. The next few lessons are designed to take advantage of the students' frustration.

Yesterday, I promised to let you share some of the successful strategies you found for comparing fractions. Let's do that now. Make sure they specify what types of problems their strategies work for. e.g. (When the denominators of the two fractions were the same, the fraction with the largest numerator was the largest fraction.) Write their strategies on the board. After sufficient discussion, say:

Since you seem to be catching on to how to do these problems, let's spend just a few minutes on this today and then move on to something else. I will let you go right to the computer.

Give the students enough time at the computers to reach the stage where they are asked to show you their strategies. After all the teams have printed out their summaries, say:

I want everyone's attention! Point to the Problem Solving Strategy poster and say: **Using the strategy we added yesterday, see if the results on your printout show that you have found a pattern for solving the problems today?** (No) **How do you know?** (We are not getting the answers right all the time.) **What's the problem today—It seems that you're not doing as well as you've done before.** (The problems are hard and the computer is not giving any help.) **How are these problems different—Why are they harder?** (Numerators and denominators are closer together.)

I know that you are good at fraction comparisons, I think these problems the computer gave you today are just unfair. Let's just give up and forget about these problems and move on to something else that is easier. In fact, while you were working I wrote a little limerick about these crummy problems:

These fractions we've been comparing,
have just about gotten me swearing.
But I will not let them,
instead let's forget them
and move onto something less daring.

Then say:

Let's do some art instead. The Japanese have a beautiful art form called 'Origami' which is done by folding paper. Many Japanese are also very fond of mathematics. Maybe we can get our math spirits lifted by their art. Hold up a sheet of paper and ask:

How many parts would it take to make a whole the size of this paper—Fold the paper in half lengthwise as you finish the question—**if the parts were <u>this</u> size?** (Two) **Good! Can you tell me with a fraction how much of the paper one of these two parts would cover?** ($\frac{1}{2}$) Hand out a sheet of paper to each of the students, and say:

Watch carefully as I fold the paper again and try to fold your blank sheet the same way. Fold the paper first in half as before, and then in thirds. Unfold the paper and hold it up without saying anything. Now refold the paper and ask: **If the tiles were this size, show me how many it would take to cover the whole paper?** Students should hold up paper showing six sections or hold up six fingers. Unfold the paper and count the six sections.

Can you tell me with a fraction how much of the paper one of these parts will cover? ($\frac{1}{6}$) Write this fraction on the board.

Now let's fold the paper again. Fold the paper in sixths as before, then fold that packet in half. Unfold the paper and hold it up for the class to see. Say: **Can you predict the question I am going to ask you now?** (How many of these small parts does it take to cover the paper? or What fraction of the whole paper would each of these parts cover?) **What would be the answers to these questions?** (Either 12 or $\frac{1}{12}$.) Then say:

Let's fold the page one more time. Fold the paper in twelfths as before and then fold that in half. Hold up the paper and say: **If the parts were this size, how many would it take to make the whole paper?** (24) **What fraction of the whole will one of these small parts cover?** ($\frac{1}{24}$)

Unfold your papers and place them on your desk. As we have discussed, the number of parts it will take to cover this page will depend on what? (The size of the tile that is used.) **Visualize colored parts covering this page. Indicate the size of tiles you think would look the prettiest by drawing the outline of one such part using the paper creases.** After students complete this task, ask:

What size did you select, and how many will it take to cover the page? After students respond, ask:

By the way, what do we call the shape of the paper? (Rectangle) **Place your rectangle on your desk with the long part going from side to side. Take a pencil and lightly shade the top half of your rectangular mosaic. The shaded part is $\frac{1}{2}$ of the page or $\frac{1}{2}$ of the paper. Now look carefully at the fold lines on the page and see how many of your favorite sized tiles are shaded.** Pause till students have counted the number of shaded parts Then say: **Write the shaded part as a fraction using your favorite part.** After students have written their fraction, ask: **What fraction did you get?** Students should respond with fractions such as $\frac{3}{6}$, $\frac{6}{12}$, and $\frac{12}{24}$. As students respond, write the fractions on the board along with $\frac{1}{2}$. Then ask:

What can we say is the relationship between these fractions—and why? (They are all the same because they represent the same shaded area.) **Fractions that represent the same number are called 'EQUIVALENT FRACTIONS'.** Write an '=' sign between the fractions on the board. Hand out copies of the ORIGAMI SHEET. Then say:

This Origami page has several examples of a paper folding design. Below each design are instructions for how to color in the design. For example, 'make $\frac{1}{2}$ red' means to color the design so that half of the total design is red. There are many different ways to color half the design as red, depending on the size part you use. Send students to the computers.

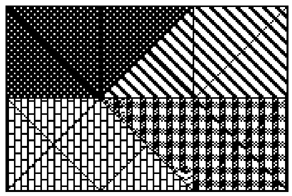
»» When they call you over tell you the fractions have them write the fractions next to the drawings. ««

POST-TEACHING:

For homework I want you to color in the last design in such a way as to divide last design on your page into four equal pieces using the *existing* lines in the design. YOU MAY NOT ADD ANY NEW LINES!

You may want to give a hint that the pieces for the last problem will not be rectangular.

TEACHER NOTE: One possible solution to the Brainbuster problem is as follows:



EXPERIMENTAL/HYPOTHESIS TESTING AND FORMULATION

UNIT TITLE: COMPARING FRACTIONS

SOFTWARE: None

Pre-class setup: None

Materials: Student notebooks. Handout of the two shaded rectangles (Blackline Master #2 at the end of the unit.) for each student.

Lesson #: 4

PRE-TEACHING ACTIVITIES (Demonstrations, linkages, generation of hypotheses):

What did we do with fractions yesterday? (We found different ways to make the same fraction by folding paper.) **Does anyone remember what we call fractions that have the same value?** (Equivalent fractions.) **You are going to discover that knowing how to find equivalent fractions will be very useful to you.**

Look at your Origami patterns that you made yesterday. Let's put some of your equivalent fractions on the board. Have students give some of their examples from the Origami page and computer screen from yesterday. Write the examples on the board with the fraction with the smaller numerator and denominator first, e.g. $\frac{1}{3} = \frac{4}{12}$. Hand out copies of Blackline #2 to each student, and ask:

Quick! How many boxes in the second rectangle on the sheet I just gave you? (32) Then ask: **By looking at these two rectangles, can you tell me a relationship between the number of pieces and the size of each these pieces when we divide a 'whole' into equal parts?** (The more pieces we have, the smaller each piece.)

Both rectangles on the handout are the same size. Let's see how many equivalent fractions you can make from these diagrams. As students come up with the fractions write them on the board together with the others. In addition to the more obvious ones, such as $\frac{3}{4} = \frac{24}{32}$, and $\frac{1}{4} = \frac{8}{32}$ try to get them to also make $\frac{2}{4} = \frac{16}{32}$ by ignoring the shading.

Excellent, you are getting good at visualizing equivalent fractions. Of course, what is the problem with this approach to finding equivalent fractions? (We will not always have these diagrams and helpers.) **We could really use a Math strategy**

to help us for those times when we do not have diagrams. Point to the Problem Solving Strategy poster and ask:

Which of our strategies for solving problems would be useful to help us find a math procedure for finding equivalent fractions, given that we have all these examples on the board? (Look for patterns in the answers of several related problems.)

It looks like patterns are useful for things besides dancing. I want you to get together with your brainstorming team, and look at all the equivalent fractions on the board to see if you can find a pattern where something you do to the first fraction always produces the second, equivalent one.

Students should see that the numerator and the denominator of the first fraction can be multiplied by the same number to get the numerator and the denominator of the second fraction.

Good idea! It looks like the technique of multiplying numerator and denominator by the same number might work to produce equivalent fractions. The next question is why does it work? Hopefully, students will realize that you are multiplying by 1. If they do not, try the following sequence:

Suppose you had a problem $\frac{1}{3} = \frac{?}{12}$, how could you use the strategy of multiplying the numerator and denominator of the first fraction by the same number to find the missing numerator of the second fraction? (Multiply by 4, the numerator of the second fraction is 1 x 4) Then ask:

If I want to find the equivalent fraction for $\frac{2}{5}$ in terms of thirtieths, in other words a fraction with 30 as the denominator, what would the answer be, and explain how you get the answer? ($\frac{2}{5} = \frac{12}{30}$ multiply the numerator and denominator of the first fraction by 6.)

But how do I know what number to multiply the numerator by? (You know because you can see what the denominator of the second fraction is and you choose the number that will give you that value.) Then say:

OK, now I have a different problem. I started with $\frac{2}{5}$ and ended up with $\frac{12}{30}$. Since they are equivalent fractions, they represent the same number, but I like $\frac{2}{5}$ better. The numbers are smaller and simpler to remember. I want to

UNDO what I've done. If I have the number written as $\frac{12}{30}$, what can I do to undo it back to $\frac{2}{5}$? (Divide top and bottom by 6) **Let's see if that works. Does that give me $\frac{2}{5}$?** (Yes) Then ask:

Who can give me a general rule about what we just found out about changing a fraction to its equivalent form? (Can divide top and bottom by the same number.) **Good. We can multiply or divide the numerator and denominator of a fraction by the same number to find equivalent fractions.** Then ask:

Can someone give me two equivalent fractions for $\frac{10}{12}$, one with a bigger numerator and one with a smaller numerator? ($\frac{20}{24}$ and $\frac{5}{6}$)

There is a general rule that you can divide or multiply the numerator and denominator of a fraction by the same number because it is equivalent to multiplying or dividing by 1. What happens when you multiply any number, including a fraction by 1? (It stays the same.)

You are getting really good at finding good math strategies by looking for patterns in answers.

It is now brainstorming time. I want you to figure out how we can use the process of equivalent fractions that you figured out to compare the following fractions:

7/16 and 3/8

1/10 and 4/50

Students should realize that they can change each fraction to equivalent fractions which have the same denominator, and then see which has the larger numerator. ans. 7/16 and 1/10

<u>EXPERIMENTAL STRATEGY</u> (Method of data collection):

Students will test their newly discovered strategy to find and apply equivalent fractions.

<u>POST-TEACHING</u>: The homework should be pretty easy for you now that you have found a good strategy for finding equivalent fractions.

HOMEWORK

Provide the answer, using equivalent fractions and for the choices you make for the following problems showing your calculations and reasoning:

1. Would you rather have, $\frac{2}{7}$ or $\frac{4}{7}$ of a pizza?

   ____

2. Would you rather have $\frac{3}{8}$ or $\frac{25}{64}$ of a pot of gold?

   ____

3. Would you rather clean $\frac{19}{31}$ or $\frac{21}{93}$ of your room?

   ____

4. Would you rather have $\frac{2}{4}$ or $\frac{4}{8}$ of a banana split?

   ____

5. Would you rather have $\frac{5}{28}$ of an ice cream cone or $\frac{19}{28}$ of a bowl of broccoli?

   ____

EXPERIMENTAL/HYPOTHESIS TESTING AND FORMULATION

UNIT TITLE: COMPARING FRACTIONS

SOFTWARE: FRACTION COMPARE

Pre-class setup: Set the program to Level Three.

Materials: Copies of the homework for each student, calculators.

Lesson #: 5 (You may want to spend an extra day on this lesson to provide additional techniques for, and practice in, finding common denominators.)

PRE-TEACHING ACTIVITIES (Demonstrations, linkages, generation of hypotheses):

Homework Answers:

1) $\frac{4}{7}$ is more of the pizza. 2) $\frac{8}{15}$ is more of the gold.

3) $\frac{21}{93}$ is less work. 4) Makes no difference. These are equivalent.

5) $\frac{19}{28}$ is the larger fraction, but most would probably choose to eat ice cream.

Get ready to put into words the rule for making equivalent fractions. Call on a student. (To make two equivalent fractions, multiply or divide the numerator and denominator of the fraction by the same number.) Probe until student's response mentions how to determine the number used to multiply or divide by. Then write the student's statement on the board and ask them:

There are many times in life where you have to compare things which you cannot compare directly. in such cases you have to set up an additional step, like making equivalent fractions, before a comparison can be made. let me give you a practical example. Let's suppose you and a friend go to the playground and notice that some musicians have put a large rock on one end of two of the see–saws. What kind of musical group would do that? (A rock group) Groan and then continue with:

Suppose you and a friend each sit on one of the two see-saws on the end opposite the big rock. To your surprise each of you balances exactly. What does that mean? (Each person weighs the same as the rock on the see–saw they are sitting on.)

Now suppose you wanted to find out how the rocks compare to each other. How could you do that? (Put them on the same see-saw.) **You try to put them on the same see–saw but the rocks are just too heavy to move.** Say in a puzzled tone: **HMMMM! Can anyone think of a way to compare the rocks to each other without moving them?** (Since the weight of each person was equivalent to the weight of one or the other of the rocks, they could get on the see-saw with each other. Whichever person is heavier was balancing across from the heavier rock.) Then ask:

Is there something that we did in the last few weeks that we had trouble comparing directly? (Yes) **What types of fractions did we have trouble comparing?** (Comparing fractions with unequal denominators.) **What did we end up doing?** (Giving up.) Then ask the students:

Getting two fractions to be expressed in terms of the same units (or denominators) is so useful it has a special name. It is called finding a 'COMMON DENOMINATOR'. Common means that something is the same. Call on two students to stand up and ask: **What do ??? and ???** —Where ??? are the names of the students— **have in common?** Entertain student responses. Then say:

We know from our work with equivalent fractions that we can express a fraction in many different ways without changing its value. We can often change one fraction so that its denominator is the same as another making comparison easy. For example, if we want to compare: $\boxed{\frac{1}{2}}$ and $\frac{6}{14}$, it is easy to find a common denominator and compare the two. Think for a moment and tell me which fraction is the largest and why? ($\frac{1}{2}$, as that is the same as $\frac{7}{14}$)

Now let's try a harder problem. Suppose we wanted to compare $\frac{9}{31}$ and $\frac{5}{17}$. Why is it harder to find a common denominator here? (You have to change both fractions.) **Correct. Let me show you a simple trick how to get a common denominator here. Multiply the numerator and denominator of each fraction by the denominator of the other. Quickly demonstrate:**

$$\frac{9}{31} * \frac{17}{17} = \frac{153}{527} \qquad \frac{5}{17} * \frac{31}{31} = \frac{155}{527}$$

We have now made two equivalent fractions with common denominators. So which fraction is bigger? ($\frac{5}{17}$)

I have set up some problems on the computer for you to solve. With this new technique that we started to develop with the Origami you should find them easy. I expect you to get 100% correct, especially using your new knowledge and these calculators. Hand out calculators.

If students realize that these are the same problems that you told them to give up on the other day pretend to be surprised. Make sure that they are using the strategy for comparing equivalent fractions.

NUMBER OF STUDENTS PER COMPUTER: 2-3

POST-TEACHING:

Did you find that using your knowledge about equivalent fractions was helpful in comparing fractions when the denominators were different? Entertain student responses.

The other day we had to give up because the problems were too hard, but today we made some real progress with these problems. What did you learn from this experience? (With just a little more information, what once seemed impossible becomes easier.) **This lesson is true not only in math but in life as well. Often a little more information will make what once seemed like an impossible dream, a very real possibility for us. That is why education and continuing to learn is so important. We also learned that art can help us with math.**

TEACHER NOTE: You may want to spend an additional day providing practice on, and techniques for, finding common denominators. While it is okay to ask students to just find common denominators for some problems, have them get back to applying the technique of finding common denominator to compare two fractions as soon as possible.

HOMEWORK

Create problems that have students compare fractions with different denominators.
Choose a difficulty level that is appropriate for your students at this point.

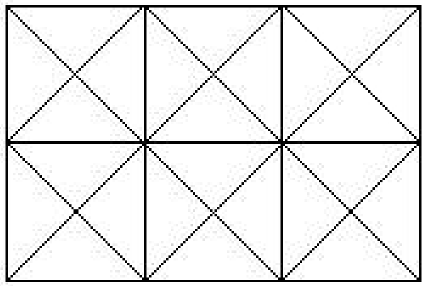
Blackline Masters

for

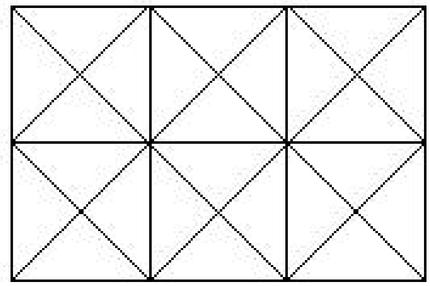
COMPARING FRACTIONS

1. **Origami sheet for lesson #3**
2. **Shaded rectangles for lesson #4**

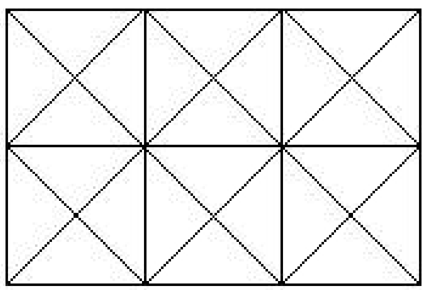
ORIGAMI SHEET



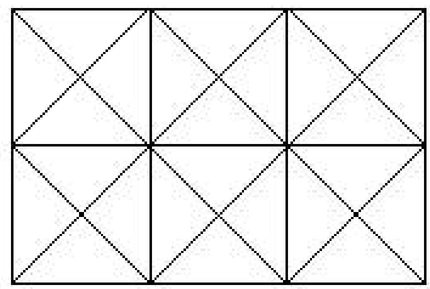
MAKE 1/2 RED



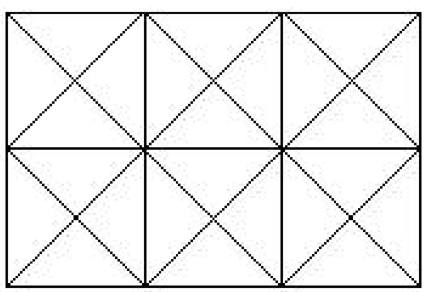
MAKE 4/12 BLUE



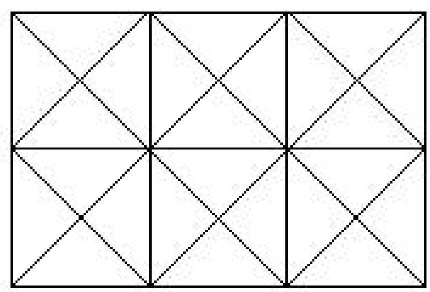
MAKE 4/24 YELLOW



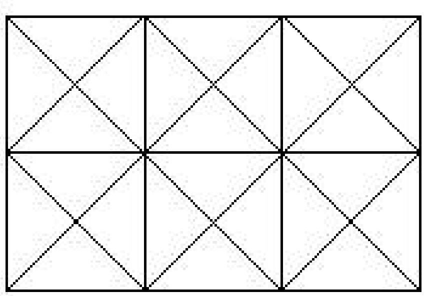
MAKE 1/3 GREEN



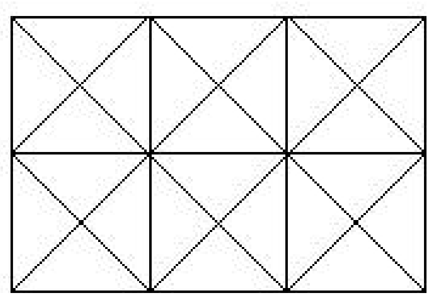
MAKE 2/6 ORANGE



MAKE 8/12 PURPLE



MAKE 6/24 PINK



BRAINBUSTER