Meeting 3 Winter 2018

Give me instructions!

January 24th

Contents

1) Break and Keep
2) Fraction Stories
3) NAMC Survey

www.math.uci.edu/mathceo

2018 UCI MATH CEO COMMUNITY EDUCATIONAL OUTREACH. UNIVERSITY OF CALIFORNIA AT IRVINE
About MATH CEO

UC Irvine Math CEO program is committed to offering free enrichment activities in mathematics for middle school students in underserved communities, and creating free educational material to be used in classrooms around the world. An essential goal of our program is to encourage students in low income, minority communities in Southern California to pursue a college degree in Mathematics, Science or related fields through a solid foundation and adequate planning.

Our Goals

**Inspire** and support the interest in mathematics of middle school students from nearby communities who might not otherwise have access to math enrichment activities.

**Impart** the mathematical foundations and critical thinking skills required for students to successfully pursue a college education and a career in STEM areas.

**Instill** the desire in these young achievers and their families for a college education and share college access information and financial aid opportunities.
Give me Instructions! (Meeting 3, Jan 24)

- Identify the Leader mentor
- Write names of any new mentors and students (find form inside folder, write new names if needed)
- Place check-marks in the Meeting 3 column (same form inside folder)
- Tell math goals to students in each activity
- Call students by name
- Keep students silence while doing the Quiz and the NAMC Survey
- Keep your table neat and clean at all times
- Get help if there are behavior problems before they escalate

- Quiz PROBLEM 1 (pink) (end of Activity 2): 7 min + 3 min correction
- Student Survey (pink) (start survey at 3:35 PM)
- Fill Meeting Report (blue) (if you are the Leader)
- Put back into folder: Student Surveys (pink), Meeting Report (blue)
Dear Mentor

In this video we explore different activities that involve instructions, whether in the form of direct sequences of step to produce fractions, or as story templates that determine different fractions and must be filled up with values. Students will also take a short (10 minute) survey about different relevant educational aspects, that we will collect to send to the National Association of Math Circles (NAMC). For more, visit their website.

To see explanatory videos, please visit this link.

**Math Goals**

- **>1**
  - Given a fraction, kids can determine visually if that fraction is larger to 1/2, and also if it is larger to 1.

- **Vs.**
  - Kids can compare two fractions that have a denominator of at most 6, by visual methods.

- **+-**
  - Kids can add or subtract fractions visually

**Kids can translate a fractional value in a real-world context using addition, subtraction, multiplication and division.**

**Kids can test different values of fractional expressions given informally in words, by giving different numerical values to the variables of the expression.**

**Kids understand the notion of a “sequence of instructions” and can produce a numerical result by following one.**
**INSTRUCTOR MANUAL**
Green color  
(No student Booklet)

**MEETING REPORT**
Blue color  
One per table

Online meeting report

**STUDENT SURVEYS**
(PERINCLUDES QUIZZES)
Pink Color  
One per student

**WHITEBOARDS**
One per student

**DRY ERASE MARKERS**
A pouch with several

---

**AGENDA**

**2:10 pm**  
Introduction

**2:15 pm**  
Career Invitation  
Computer Engineer

**2:25 pm**  
1) Break and Keep  
Making sense of fractions visually

**2:50 pm**  
2) Fraction Stories  
A game of proportionality and areas

**3:15 pm**  
Quiz: Problem 1

**3:25 pm**  
3) NAMC Survey  
Survey for the National Association of Math Circles

**3:35 pm**  
Student Survey

**3:40 pm**  
End of the meeting
MATERIALS

INSTRUCTOR MANUAL
Green color
(No student Booklet)

MEETING REPORT
Blue color
One per table
Online meeting report

STUDENT SURVEYS (INCLUDES QUIZZES)
Pink Color
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AGENDA

2:10 pm Introduction

2:15 pm 1) Break and Keep
Making sense of fractions visually

2:40 pm Career Invitation

2:50 pm 2) Fraction Stories
A game of proportionality and areas

3:15 pm Quiz: Problem 1

3:25 pm 3) NAMC Survey
Survey for the National Association of Math Circles

3:35 pm Student Survey
3:40 pm End of the meeting
INDIVIDUAL ASSESSMENT

- Right after Activity 2 (Fraction Stories), there is time for an individual Quiz (PROBLEM 1 IN THE SURVEY). Give students **5 minutes to do both parts A and B** and have them answer individually (in their surveys). After collecting answers, grade them and quickly correct them with the kids.

**TIPS**

- Build the habit of having students complete the quiz in complete silence and without any help of peers of mentors. This may take a few meetings, but make perfectly clear that we will work with these expectations. Do not ignore this.

BEHAVIOR EXPECTATIONS

If a kid is behaving improperly or disrupting students, or does not follow directions at all, talk to them. If problem persists or is really serious, please let Brandi, Alessandra, Li-Sheng or an Assistant know immediately.
## UCI MATH CEO MEETINGS: BASIC GUIDELINES FOR VOLUNTEERS

<p>| | |</p>
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| 1 | **KNOW YOUR STUDENTS**
   | Call students by their names most of the time: make sure they know your name, talk briefly about their day before you start the math activities. |
| 2 | **ASK FOR EXPLANATIONS**
   | Ask students how they got their answers. Say things like “How do you know?”, “Why?”, “Draw a picture”, “Convince me!”, “Can you explain to Juan?” etc. |
| 3 | **MOVE & MONITOR**
   | Move around your table; monitor all students; use an adequate tone of voice; encourage kids to work in teams. |
| 4 | **CHECK WORK**
   | Verify that the students write the answers to the problems and that they are correct and complete. |
| 5 | **AT THE END**
   | Ask students to fill out the survey individually (no help), and to help pick up trash from the table and floor. |

### TEACHING TIPS

This icon refers to specific tips which you will find embedded in the booklet activities: procedures, questions to ask to the students, recommended methodologies, and so on.

**Can you explain the concept in your own words?**

**Example:** After you introduce a new concept, it is a good idea to ask students to rephrase the concept, explain it in their own words. You can choose particular students, for example those who are disengaged.

**Can someone read the instructions out loud?**

**Example:** It is convenient to ask one student to read out instructions for a problem or definitions of a concept. This keeps your group focused on the task and improves their reading skills if you give feedback on reading.

This icon means that the students should work individually in the corresponding problem, before discussing. Be flexible and adapt to your situation.

**Activity to be done in pairs**

Note: if not specified, the booklet problem can be done as a group activity involving a discussion.
When we represent fractions with pictures, why do we care to break into equal shapes? Explain.

If I break a shape in 6 equal units and keep 2 of them, what fraction is being represented? Can you draw a picture?

If I break a square in 2 equal shapes, I break each of these in 2 equal new shapes, and I select 3 of these new shapes, what fraction I am representing?
1) BREAK AND KEEP

Material
Brown package (Unit Templates, Instructions A-L)

Introduction
In this activity, students use different sequences of instructions that generate different fractions. The types of instructions are restricted and must be given by students in a very precise fashion, as if they were writing a computer program in which a defined language needs to be followed. Also, the order in which the instructions are given will matter.

The goals of this activity are that students understand the visual representations of fractions and how they can relate to each other. Another goal is that kids understand at a very general level the notion of a sequence of instructions (similar to computer programs).

Start by explaining that in this activity we will start with a “unit” shape and start breaking them and keeping some of the pieces, doing this several times and in a certain order. We are simulating giving instructions to a robot, so we need to be very precise. Also, the robot will execute the instructions in the order that we choose, so we want to pick the order right.

The two possible instructions are (1) Break and (2) Keep. Break is used to break the unit (or each piece we have) into several equal new pieces, while Keep selects certain number of pieces and discards the rest (think of trashing them for good). At every moment we should know how many pieces we have, and how big they are.

To begin, go over the following two examples so that students understand the general idea of the activity:
Example #1: Creating 1/4

Tell your students that you will show them how to create the fraction one fourth, 1/4, by giving instructions. You can ask all students to pretend that they are the robots and will follow your instructions.

First instruction: draw the unit, as a circle.
Students will draw a big circle in their whiteboards or paper. Stress that the circle is the unit.

Second instruction: “Break in 2”. Explain that you want them to break the unit into two equal pieces.
Students will break the circle in 2 equal semicircles.

Third instruction: “Keep 1”. Explain that of all pieces (which are 2), you want them to keep only 1, and eliminate the other one, by marking it with a red X.
Note that we now have only 1 piece (we eliminated the other one).

Fourth instruction: “Break in 2”. Explain that each piece (except those eliminated) should be broken into 2 equal new pieces.

Fifth instruction: “Keep 1”. That is, from the two pieces that we have, keep one and trash the other.

Sixth instruction: “END”. Tell students to color or shade all the pieces that were not eliminated.
Tell students that the fraction represented is 1/4 and ask them why.
Example #2:

Tell your students that you will give them some instructions like in the previous example, and they will need to tell you which fraction was created.

1st instruction: draw the unit, as a square. Students will draw a big circle in their whiteboards or paper. Stress that the square is the unit.

2nd instruction: “Break in 3”. Explain that you want them to break the unit into 3 equal pieces.

3rd instruction: “Keep 2”. Explain that of all pieces (which are 3), you want them to keep only 2, and eliminate the other one, by marking it with a red X. We now have only 2 pieces.

4th instruction: “Break in 2”. Explain that each piece (except those eliminated) should be broken into 2 equal new pieces. There are now 4 equal new pieces.

5th instruction: “Keep 1”. That is, from the 4 pieces that we have, keep one and trash the other 3.

6th instruction: “END”. Tell students to color or shade all the pieces that were not eliminated. Ask students which fraction they think was created.

The answer is: 1/6 (which can be seen by splitting the right column into, to obtain 1 out of 6 equal pieces). Help students reason this out if they seem to be struggling.
Activity
If there is still time, carry on with the following activity. Otherwise you can end. In the next meeting we will come back to a similar one.

Now ask your students to combine the following instructions any order they like to create different fractions. They don’t need to use all instructions in a sequence. Also, students cannot repeat an instruction letter in a sequence. They need to justify why they obtain each fraction that they claim to have created.

Note: students must start with a “Start” instructions (A or B) and end with the “End” instruction (L)

Instructions:
A - “Start with a Square as a unit”
B - “Start with a bar as a unit”
C - “Start with a circle as a unit”

D - “Break in 2”
E - “Break in 2”
F - “Break in 3”
G - “Break in 5”
H - “Keep 1”
I - “Keep 3”
K - “Keep 4”
L - “End”

Example:
B, D, H, F, K, L  will produce 4/6, or equivalently, 2/3:
Example:

B, D, H, F, K, L will produce 4/20, or equivalently, 2/10 or 1/5:
1) Break and Keep

Teaching Tips

- An important goal of this activity is that students can explain fractions using verbs and phrases involving actions (break, keep, discard, etc), instead of just saying what the numerator or denominators are. Encourage students to describe the fractions using this relational language, in which they describe the picture and the different relations between all parts.

- Students may start discovering some regularities the more they get in touch with the sequence of instructions. For example, when we do two consecutive “Break” instructions, the order does not matter since it will break into the same number of pieces which is the total. This is a basic fact for fraction multiplication and which is important to understand. Encourage students to talk about these discoveries, and even write them down as rules for the group to use.

- It is perfectly in this game to keep more pieces than you have, and that is why we can actually create fractions which are greater than the unit (that is, improper fractions). It is a bit weird here using the language of keep since in real life you cannot really keep more than what you have, but you can tell students that math is kind of magical and whatever that we can do using our imagination and following rules, its perfectly OK. For example, to generate the fraction 3/2, you would do: “Start with a unit”, then “Break in 2”, then “Keep 3”, then “End”.

- It is very important to always start with the instruction that sets up the unit. This rule can help students keep in mind that the unit must always be identified, as fractions can be relative and depend on which unit you begin with.
FRACTION STORIES

Our Goals:
Represent fractions visually
Compare fractions using different methods: numerically and visually

Discuss in your group. Everyone talks.

- How can I easily tell if a fraction is larger than 1? Larger to 1/2?

- What are some ways in which we can represent a fraction visually, that is, without using symbols? Give examples.

- Which fraction is larger: 2/3 or 3/5? How can we know this visually?
Can someone explain again the rules of the game?

Before we start, I’m going to show you some examples and the steps that you need to follow.

This is essentially the same activity as in Meeting 2, but we now have different stories and some include fraction addition. Students play a game in which they create stories involving several values obtained from rolling dice. Each story ends up with a fraction X which is calculated from those values. Students must place that fraction in a number line (called the ordered number road), to get points.

The goals of the game are:

- Make sense of fractions in real life situations
- Compare different fractions using several techniques
- Model problems using operations.
- Develop algebraic thinking by considering the same general situation with different values.
Before the game

Explore the different questions in the page cover of the activity, to explore previous understanding of your students regarding fractions, including what does a fraction mean, how can we know if a fraction is larger than ½ or larger than 1, and how to compare fractions using visual and non-visual methods. You can do this as a review from last meeting, in order to consolidate concepts.

The game

We now describe the game of Fraction stories.

**Set Up:** Place the board in the middle of the table and explain that players will be completing the boxes putting fractions. As one moves forward from the 0-box on, the fractions must be getting larger.

Have the dice ready and select a player to start the game

**Goal of the game**

The player with most points at the end of the game wins. Points are given to a player each time he writes a fraction in the board. The game ends when the board is full or when all players have consecutively passed during their turn (not being able to play any fraction).

**A players turn**

Players take turns until the game ends. A player’s turn has the following sequence of actions:

1) Roll 3 dice.
2) Create a story: use 2 of the dice values to create a story (from the Template), and compute the fraction X given at the end of that story.
3) Write the fraction X in the game board and score points (or pass and get 0 points if the fraction cannot be placed).

We describe each of these actions:
1) Roll 3 dice
The player rolls 3 dice, thus obtaining 3 values (which might be repeated).

Example: Paolo rolls a 2, a 4 and a 4.

2) Create a story
The player chooses two of the values obtained, and selects one of the four story templates (A-C) to assemble a story. He fills the number blanks from the story with the values chosen, and he also fills up the word blank with a phrase related to the benefits of the medication of the story. He also finds the value of X, which is the fraction at the end of the story.

Example 1: Paolo chooses one 2 and one 4 from his dice, and picks template story A, to create the following story:

Jennifer worked in Brussels. She had to distribute a total of 1 g of Vitamin D evenly among 4 patients, because they were not being exposed to enough sunlight.

X = amount of g of Vitamin D that each of Jennifer patient’s got = 1/4.

3) Write the fraction X
The player now tries to write the value of X in the game board in a blank box, such that after writing it, the number road lists all values in increasing order from 0 to infinity.

Example 2: In the first turn of the game, Paolo generated X=1/4. Since X is between 0 and 1, he could then place X in ANY of the boxes marked with a check mark:
Example 3: Suppose that after a certain number of turns, the board looks like this:

It’s Laura’s turn, and she has produced the fraction $X = \frac{4}{6}$. Since $X$ is between $\frac{1}{4}$ and $\frac{7}{8}$, there are only two possible boxes where Laura can play:

If the fraction that he player generates cannot be placed anywhere in the board (because it is between two fractions that are adjacent in the board, or because it is equivalent to a fraction that is already written in the board), then the player must pass. In this case he scores 0 points in that turn.

If the player did successfully put his fraction $X$ in the board, count the number of spaces from $X$ to the closest filled box in the board (including the “infinity” box). This “distance” (which is at least 1) is the player’s number of points scored in this turn. Points accumulate during the game.

Example 4: Suppose that Arthur just wrote the fraction $X = \frac{7}{6}$ in the board, as shown in the figure. $X$ is 3 spaces from $\frac{3}{2}$ (which is the closest fraction in the board, in terms of spaces), so Arthur scores 3 points in this turn.

Example 5: Suppose that Kevin just wrote the fraction $X = \frac{9}{3}$ in the board, as shown in the figure. He then scores 5 points, as there are 5 spaces moving from the $\frac{9}{3}$ box to the infinity box.
Your turn
Roll 3 dice. Use 2 of them to complete a story (A-D). Find the value of the fraction X, and place that fraction if you can, in a blank box of the ordered number road, respecting the order.

Scoring
Your score that round equals to the number of spaces going forward from the fraction X to the closest filled box, or 0 if you did not fill any space.
**Story A**

A wooden log was cut into equal pieces. The log had an original length of meters.

\[ X = \text{The length of each piece, in meters.} \]

**Story B**

Jim had 2 identical cookies. He cut the first one in equal pieces and gave one piece to Zue. He cut the second cookie in equal pieces and gave one piece to Zue.

\[ X = \text{Fraction of cookie that Zue got.} \]

**Story C**

A red bucket contained kilograms of Superpowder. Later, 1 kilogram of it was removed from the bucket and separated into piles of equal weight. One such pile was sold and the others were put back into the bucket.

\[ X = \text{Fraction of kilograms of the Superpowder left in the bucket.} \]
2) Fraction Stories

Teaching Tips

- A good habit that you can promote in your students is the following: given a fraction, always ask: is it greater than 1? Is it greater than 1/2? This is important so that students consolidate the fact that fractions are numbers just like the naturals (they extend that sets) and they can be compared. It also helps to understand the role of numerator and denominator. So what you can do in this activity is, whenever a fraction is considered, perform the 2 questions above. In the start you can answer them, “thinking out loud”, and as the activity progresses you may encourage students to reason. The goal is that students ask and answer these questions in an autonomous way.

- To make the game simpler, you can first play a trial round in which players must use only the “Story A template”, and roll 3 dice instead of 4 to decrease the possibilities and speed up turns.

- When comparing fractions, you may use the “Fraction wall”, which is a manipulative to do comparisons in a visual way.

- Students should realize that the best strategy in the game is to pick a fraction X that fits in the “largest gap” (in terms of spaces) of the board, and place that fraction in the middle (or as close to the middle as possible). You should let students figure this out during the game. You may also ask questions that lead to this such as: how do you think you should pick the fraction to obtain lots of points?

- Here are some ways in which you can make the game more interesting and open ended:
  - Equivalent fractions: if a player creates a fraction X that is equivalent to one on the board, he obtains 1 point and repeats his turn.
  - A player can create a new story using 2 or 3 dice and generate a fraction from the values of this story.
Dear mentors:
Dedicate 7 minutes for Individual Quiz, both parts A and B (Pink papers in your Mentor’s folder).

3 extra minutes for formative assessment (giving feedback so that kids learn from mistakes right away)

(A) Give an example of a fraction that is larger than 1 but smaller than 3/2.

(B) I have 200 bats in total. Some are wooden, some metallic. If the ratio WOODEN : METALLIC is of 3 : 2, how many bats are wooden?

Justify your choices. Write your work:

Answer
NAMC SURVEY

A SURVEY FOR THE NATIONAL ASSOCIATION OF MATH CIRCLES

Materials
● NAMC Surveys (Inside the Grey Package)

Instructions
● Make sure that students write their full name and it is legible

● Please give the survey in a quiet environment, where the kids are not distracted by talking or other activities going on. This makes a big difference in the quality of their responses

● Please ask our assistants in case some kids would rather answer the survey in Spanish
M3  Additional Resources

(we will have them at the meeting in your table)

- Page 29: 18 copies, Brown (1 for each table)
  **Fold and place contents from P30-32 inside**
- Pages 30-32: 60 copies, Brown paper, one sided
  3 per table + extras for both rooms

- Page 33: 18 Copies, Yellow (1 per table)
  **Fold and place contents from P34-36**
- Page 34: 60 copies, Grey Paper
  3 per table + extras for both rooms
- Page 35: 40 copies, Grey paper
  2 per table + extras for both rooms
- Page 36: 120 copies, Grey paper
  6-8 per table + extras for both rooms

- Page 37: 18 Copies, Yellow (1 per table)
  **Fold and place 6-8 NAMC Surveys inside**

- Pages 39-40: **SS** 160 copies, 2-sided, **PINK**, 8 per table

- Pages 42-43: **MR** 20 copies, 2-sided, **BLUE**, (1 per table + 2 extra)
Manipulatives for

Activity 1

BREAK AND KEEP

Brown Package
Units Templates I

Brown Paper
Your job as a team:
Create various sets of instructions to create as many different (non-equivalent fractions as you can). For each sequence of instructions make sure to:

- Use each instruction at most once.
- Write down the sequence (order matters) and double check.

Make sure to create also improper fractions (those which are greater than 1), such as 3/2. Also, identify equivalent fractions that you create.
Manipulatives for Activity 2

FRACTION STORIES

Yellow Package

Fold paper

Manipulatives for
The Fraction Wall

UNIT: ONE (1)

ONE HALF (½)

ONE THIRD (1/3)

ONE FOURTH (1/4)

ONE FIFTH (1/5)

ONE SIXTH (1/6)

ONE SEVENTH (1/7)

1/8

1/9

1/10

1/11

1/12

3/12 = 2/8 = 1/4
Your turn
Roll 3 dice. Use 2 of them to complete a story (A-D). Find the value of the fraction X, and place that fraction if you can, in a blank box of the ordered number road, respecting the order.

Scoring
Your score that round equals to the number of spaces going forward from the fraction X to the closest filled box, or 0 if you did not fill any space.
**Story A**
A wooden log was cut into equal pieces. The log had an original length of meters.

\[X = \text{The length of each piece, in meters.}\]

**Story B**
Jim had 2 identical cookies. He cut the first one in equal pieces and gave one piece to Zue. He cut the second cookie in equal pieces and gave one piece to Zue.

\[X = \text{Fraction of cookie that Zue got.}\]

**Story C**
A red bucket contained kilograms of Superpowder. Later, 1 kilogram of it was removed from the bucket and separated into piles of equal weight. One such pile was sold and the others were put back into the bucket.

\[X = \text{Fraction of kilograms of the Superpowder left in the bucket.}\]
Manipulatives for Activity 3
NAMC SURVEY
Grey Package
Student Survey
(Pink paper)
160 copies
2-sided
Please answer all questions individually

**PROBLEM 1**
(Take at the end of Activity 2)

(A) Give an example of a fraction that is larger than 1 but smaller than 3/2.

(B) Al and Paul ate parts of a cookie: Al ate 1/2 of it and Paul ate 1/5 of it. Select the picture representing how much of the cookie combined they ate.

Justify your choices.
Write your work:

Answer

1 box of Quinoa

1 box of Quinoa

1 box of Quinoa

1 box of Quinoa
Questions:

1) How enjoyable were today’s tasks?  
   1= not at all enjoyable  2  3= somewhat enjoyable  4  5= very enjoyable

2) How competent did you feel on today’s tasks?  
   1= not competent at all  2  3= somewhat competent  4  5= very competent

3) How did you feel while solving today’s tasks?  
   1= not pressured at all  3  3 = somewhat pressured  4  5= very pressured

4) How important was for you to do well on today’s tasks?  
   1= not important at all  2  3= somewhat important  4  5= very important

5) How close do you feel to your mentor at Math CEO?  
   1= not close at all  2  3= somewhat close  4  5= very close

6) How close do you feel to your peers at Math CEO?  
   1= not close at all  2  3= somewhat close  4  5= very close

Feedback for your mentor: ______________

3 words to describe Math CEO ________________________________

2 THINGS WHICH I LEARNED TODAY

2 THINGS THAT I FOUND INTERESTING

I QUESTION THAT I STILL HAVE

Thanks for your responses!
Meetings Report
(Blue paper)
Dear leader mentor,

Please complete this survey about each of the students at your table. Circle the number that better reflects how you feel. We really value your input. THANK YOU for your thoughtful answers, and for your amazing contribution to Math CEO.

STUDENT'S FIRST NAME: ___________________  LAST NAME: ______________________

Compared to his/her peers, how good was this student at solving today's math activities? 1 (worse) 2 3 (average) 4 5 (a lot better)
How much innate ability or talent in math did this student show today? 1 (not at all) 2 3 (a little) 4 5 (very much)
How much effort did this student put in today's math activities? 1 (not at all) 2 3 (a little) 4 5 (very much)
How much did this student participate in today's math activities? 1 (not at all) 2 3 (a little) 4 5 (very much)
How interested was this student in today's math activities? 1 (not at all) 2 3 (a little) 4 5 (very much)

Note or comments about this student:  ________________________________________________________________________________

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