

EQUITY AND EXCELLENCE: FRACTIONS ON THE NUMBER LINE FOR ALL STUDENTS



2017 NEW MEXICO STEM SYMPOSIUM

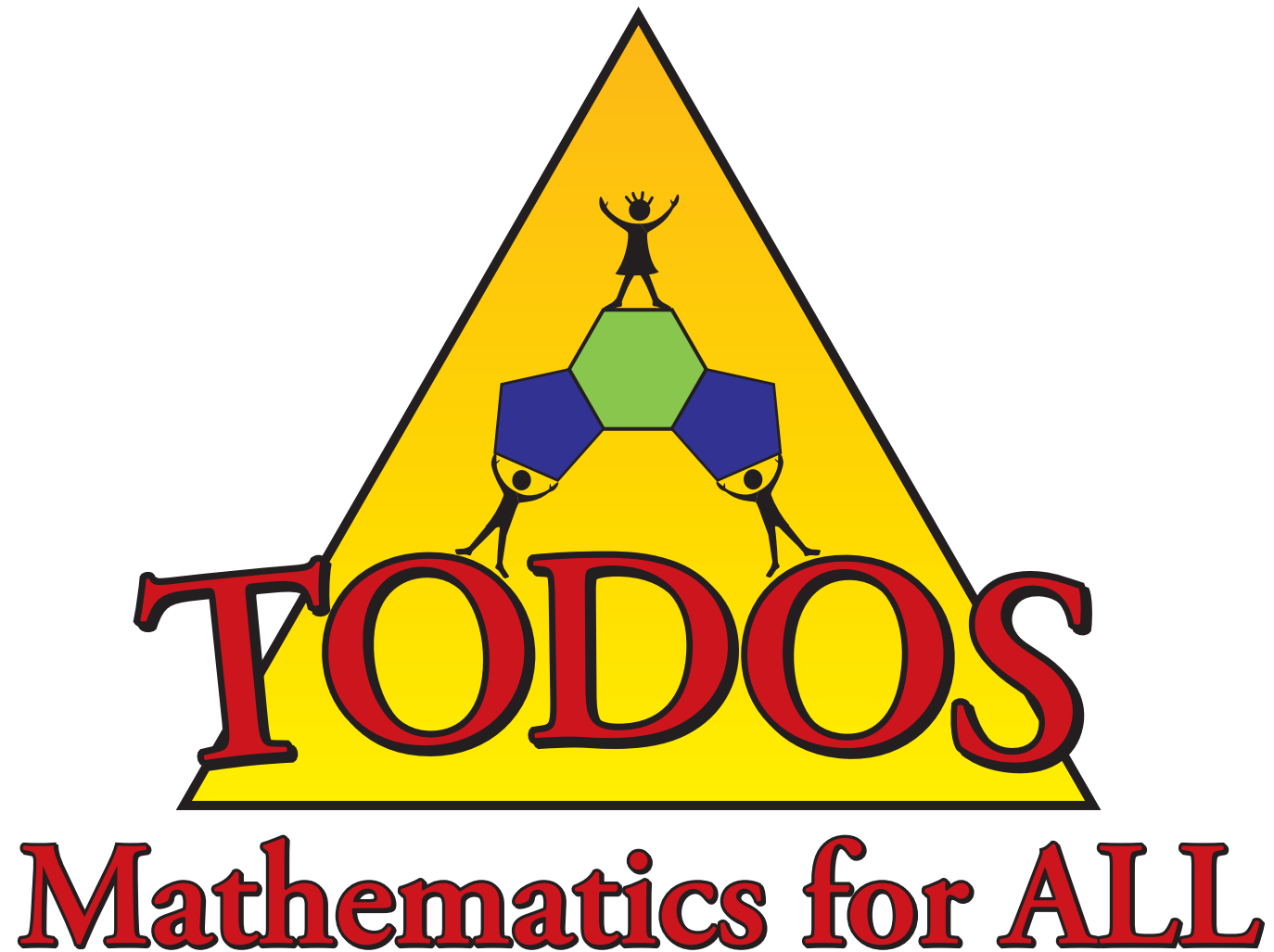
JUNE 1, 2017

PRESENTED BY

DR. SUSIE W. HÅKANSSON

MEMBER SERVICES CHAIR AND PAST PRESIDENT

TODOS: MATHEMATICS FOR ALL



DESCRIPTION

- We want ALL students, particularly English learners, to develop mathematical proficiency in fractions. In order for this to occur, we must focus on fraction sense using the number line—a conceptual understanding of fractions. We must also focus on the needs of English learners to provide the access to the content.

OUTLINE OF SESSION

- Language of Mathematics
- Why the Number Line?
- Fraction Activities for Attendees
- Adapting Fraction Activities for Students
- Best Practices for English Learners
- Equity and Excellence
- Reflection and Summary
- TODOS: Mathematics for ALL

LANGUAGE OF MATHEMATICS

- Does not mean a list of vocabulary or technical words with precise meanings
- Rather it is the communicative competence necessary and sufficient for competent participation in mathematical discourse practices

Judit Moschkovich, Understanding Language

LANGUAGE OF MATHEMATICS

- Focus on students' mathematical reasoning, not accuracy, in using language.
- Shift to a focus on mathematical discourse practices; move away from simplified views of language.
- Recognize and support students to engage with the complexity of language in mathematics classrooms.
- Treat everyday language and experiences as resources, not as obstacles.
- Uncover the mathematics in what students say and do.

Judit Moschkovich

WHY THE NUMBER LINE?

- It serves as a visual/physical model to represent the counting numbers and constitutes an effective tool to develop estimation techniques, as well as a helping instrument when solving word problems.
- It constitutes a unifying and coherent representation for the different sets of numbers (N , Z , Q , R), which the other models cannot do.

WHY THE NUMBER LINE?

- It is an appropriate model to make sense of each set of numbers as an expansion of other and to build the operations in a coherent mathematical way.
- It enables to present the fractions as numbers and to explore the notion of equivalent fractions in a meaningful way.

BASIC ASSUMPTIONS



FRACTIONS ON THE NUMBER LINE



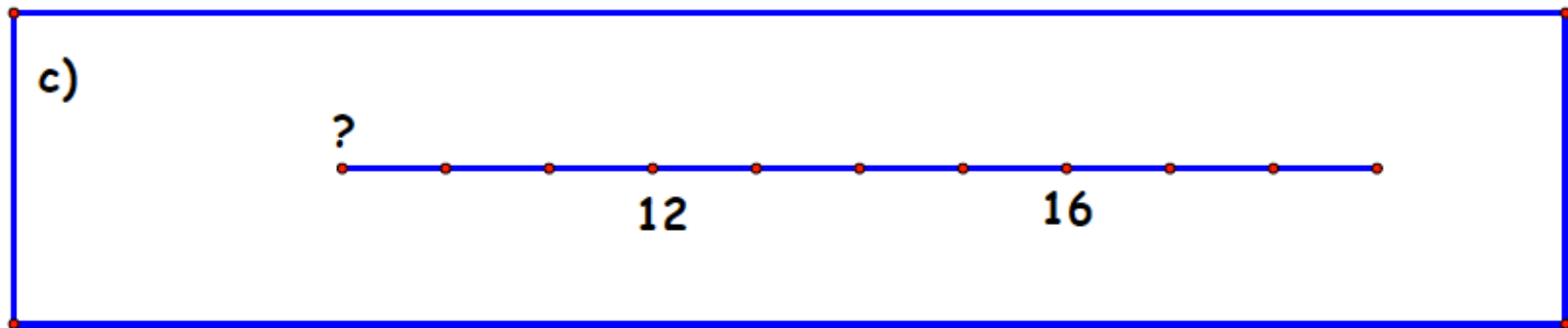
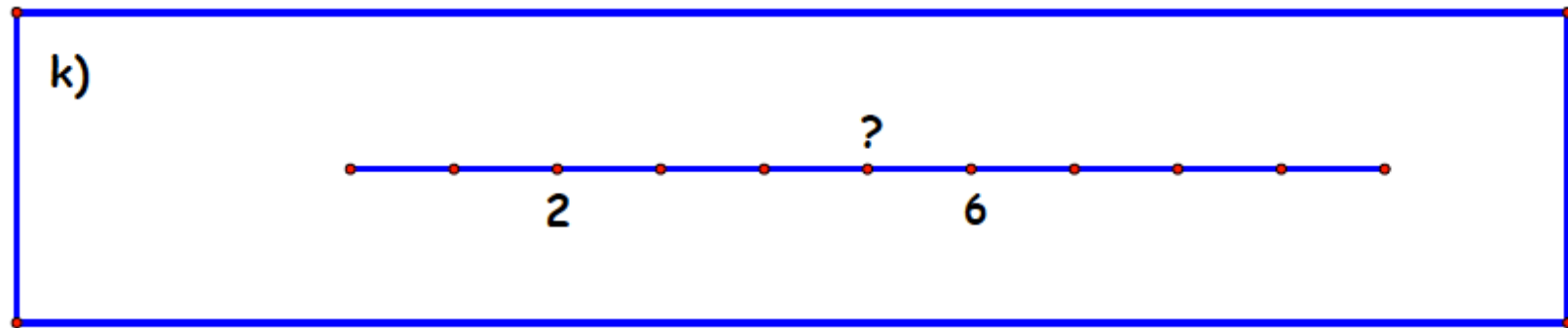
FRACTIONS ON THE NUMBER LINE

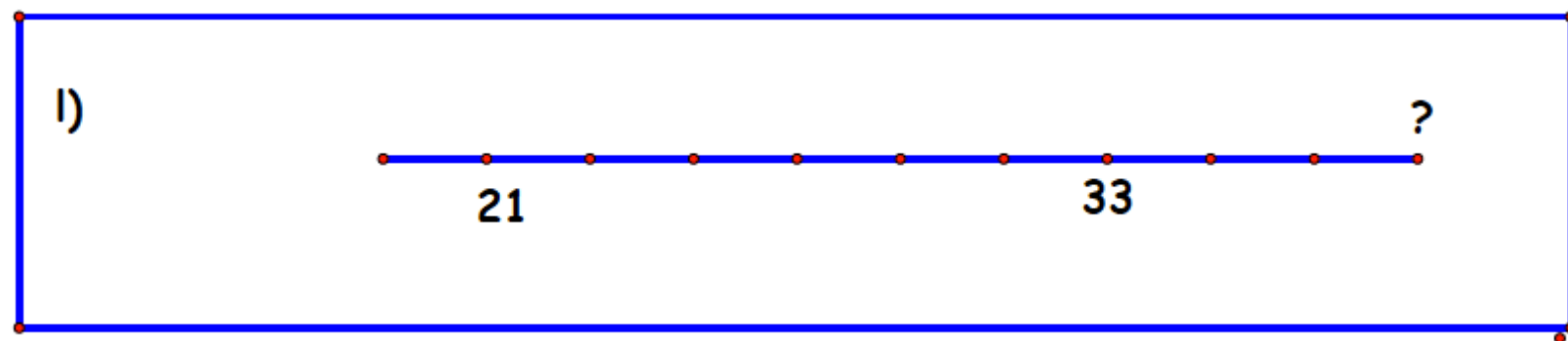
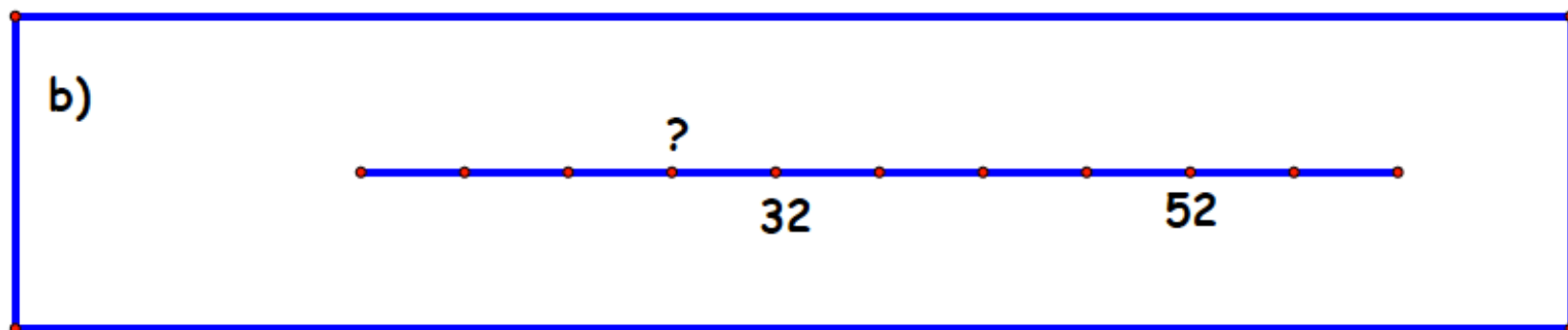
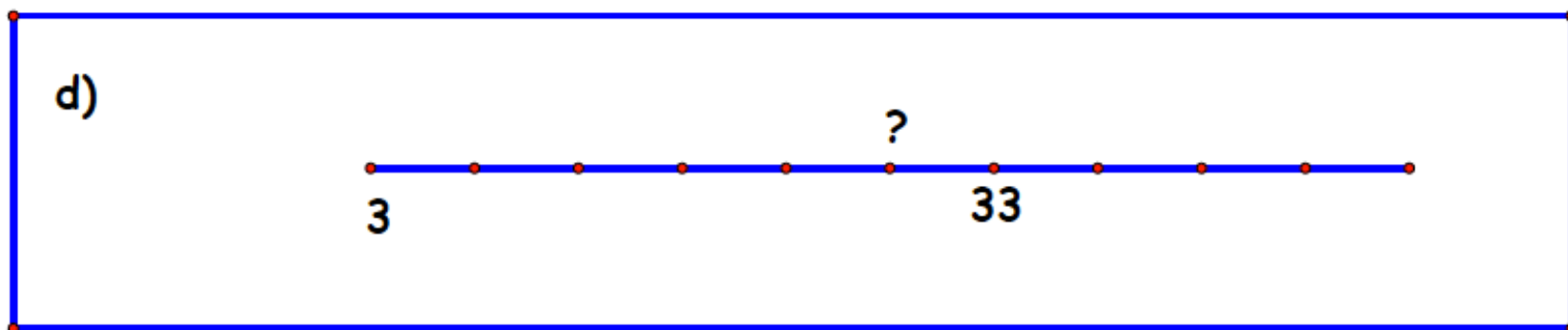


WHOLE NUMBERS

- Use the structure of the number line and benchmarks to determine value of the “?” of each number line strip.

Natural Numbers



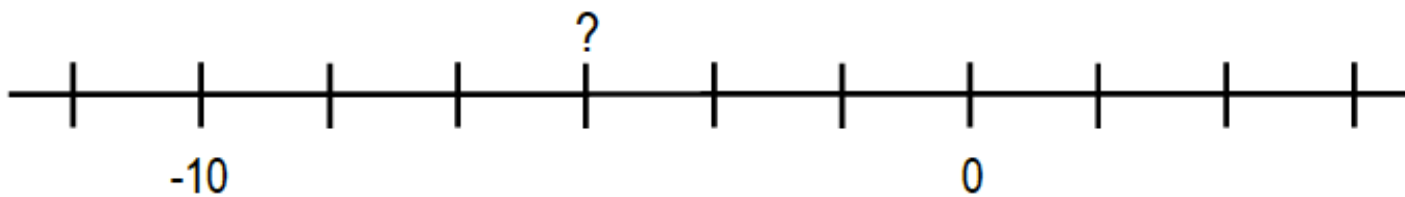


INTEGERS

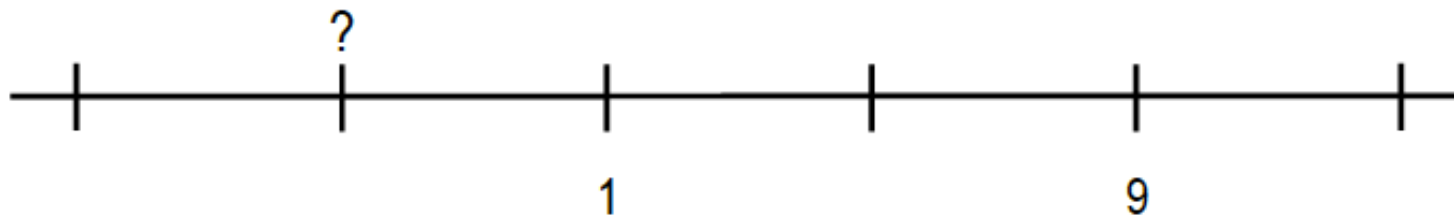
- Use the structure of the number line and benchmarks to determine value of the “?” of each number line strip.

Integers

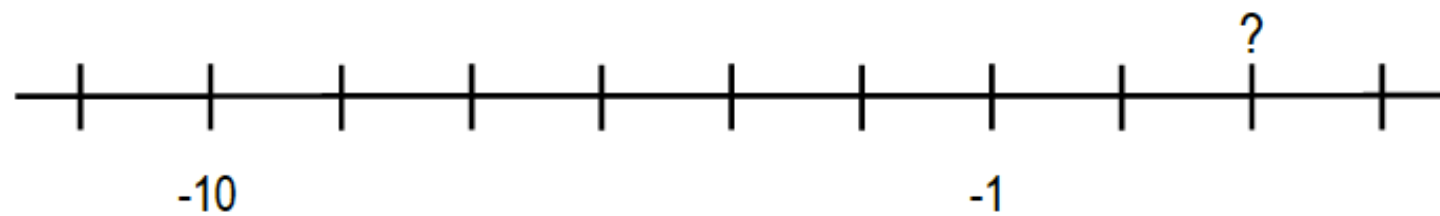
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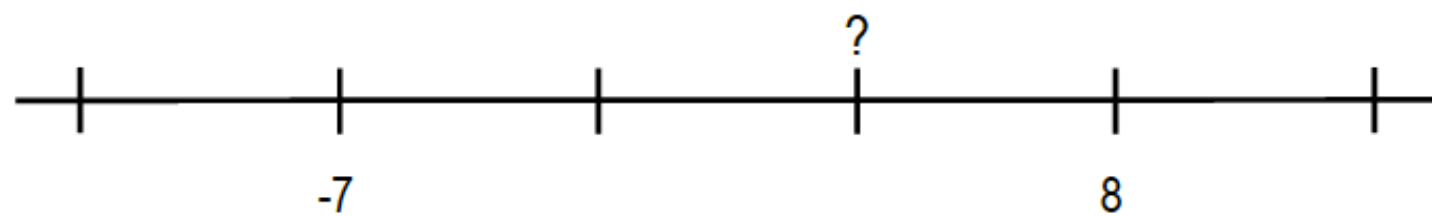
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FRACTION ACTIVITIES FOR ATTENDEES

- Introduction
- Order on the Number Line
- Fraction Sense Problems

INTRODUCTION

I have a friend who is a middle school math teacher. This year he teaches all the “Far Below Basic” and “Below Basic” students. He was frustrated as he asked his students to locate $7/8$ on the number line.

Where do you think the students put $7/8$ on the number line?

INTRODUCTION

That night he went home to his 5th grade son and asked him the same question.

By the way, last year his son got a perfect score on the standardized test.

Where do you think his son placed $\frac{7}{8}$ on the number line?

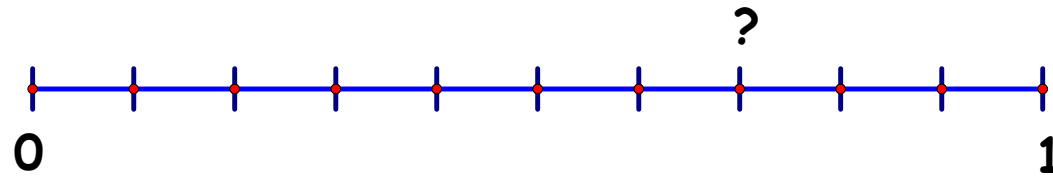
ORDER ON THE NUMBER LINE

- Use the structure of the number line and benchmarks to determine value of the “?” of each number line strip.
- Select two strips that are low in cognitive demand and two strips that are high in cognitive demand. Why did you select them?

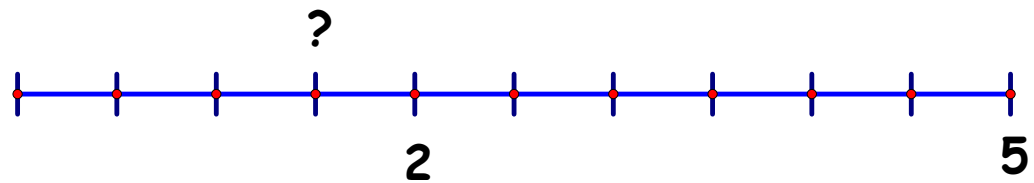
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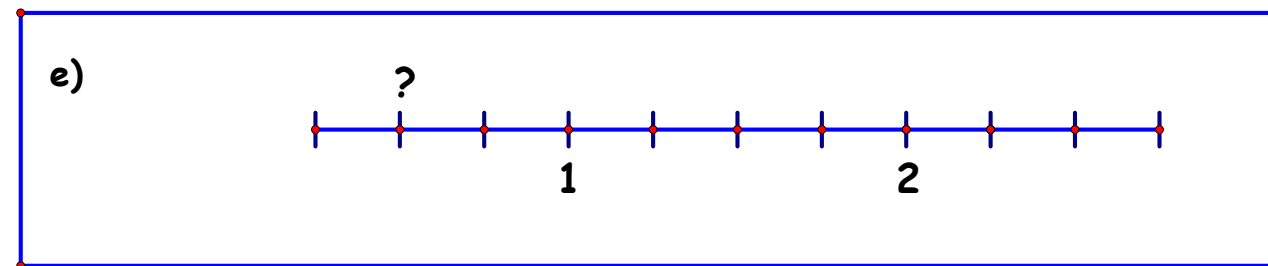
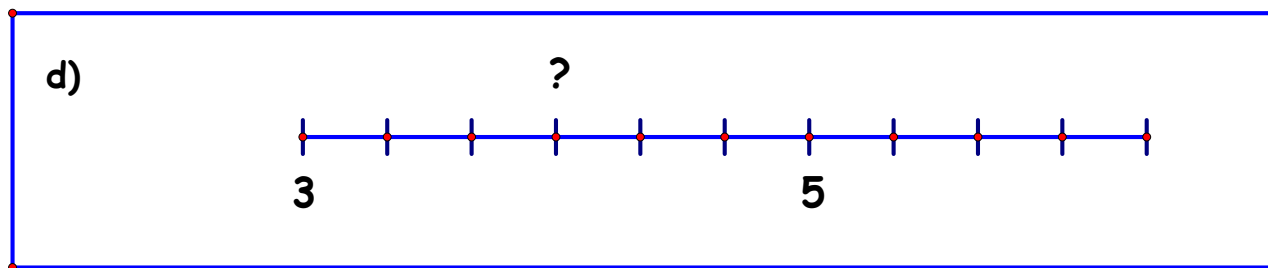
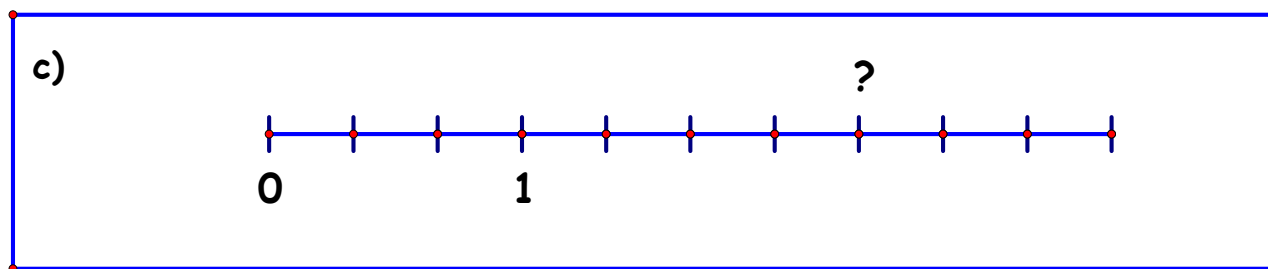
Assuming the marks are equally spaced,
what number corresponds to the point marked with the "?".

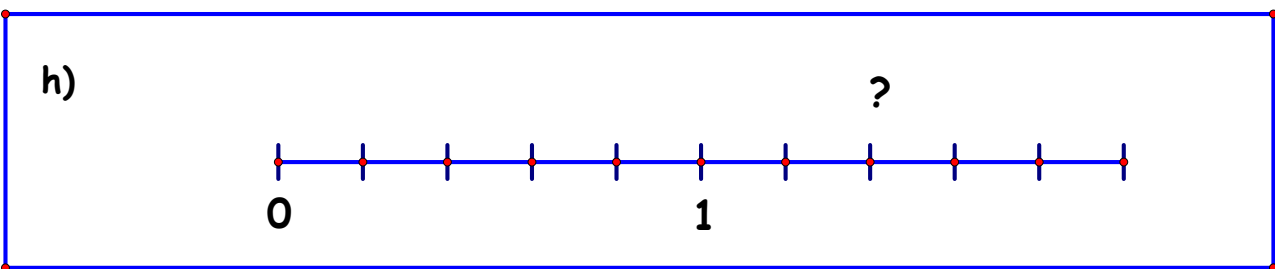
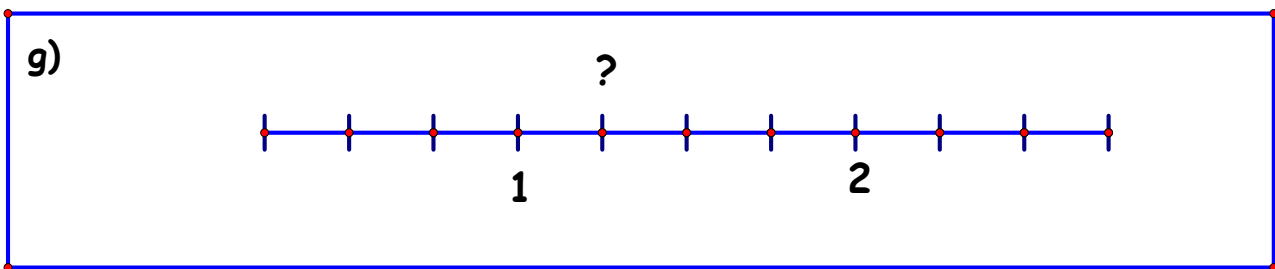
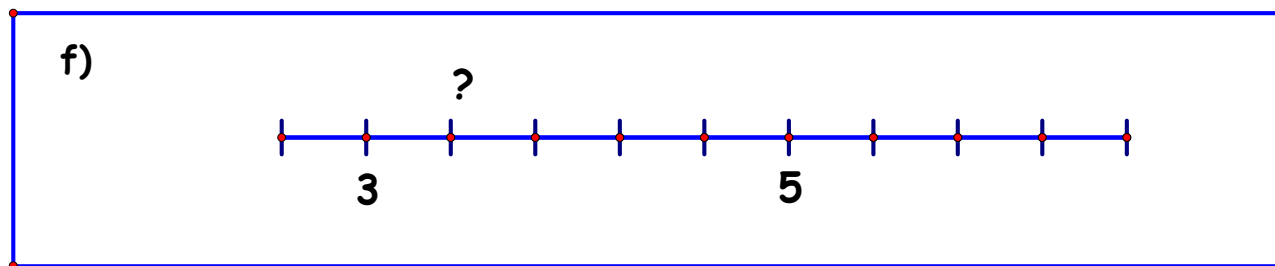
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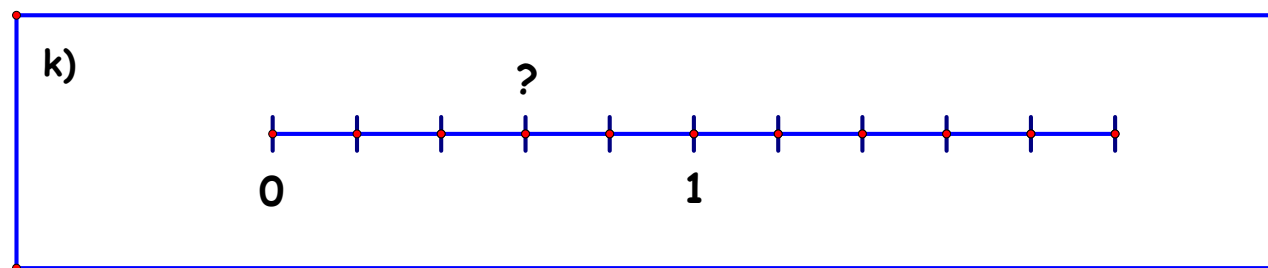
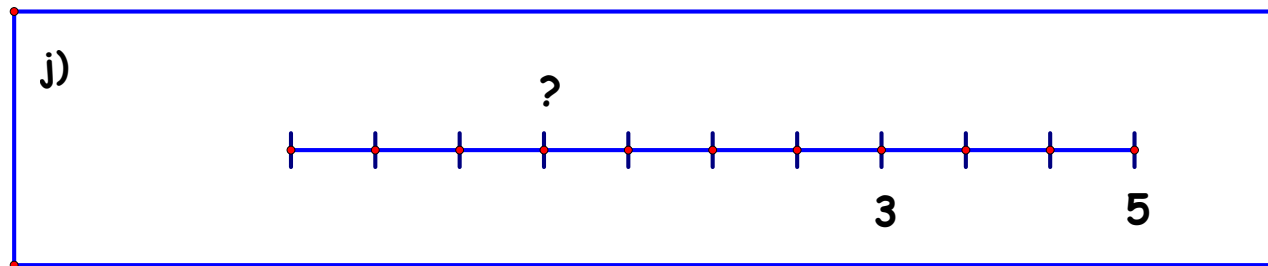
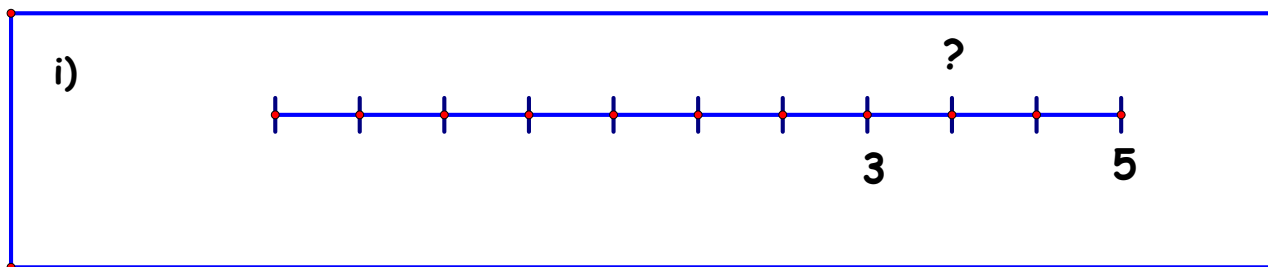


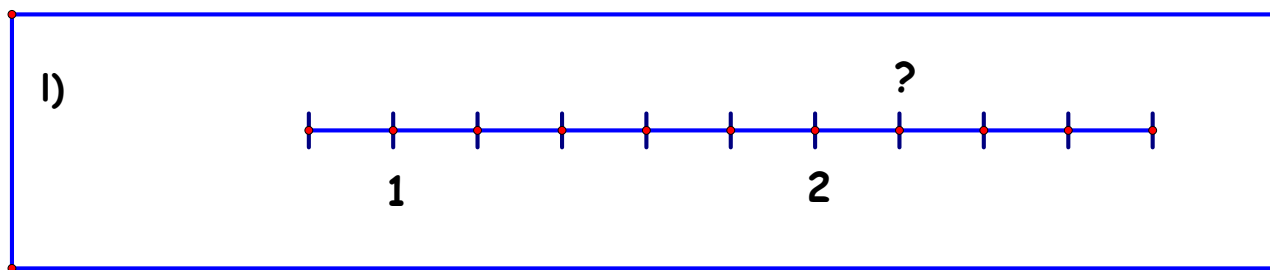
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FRACTION SENSE PROBLEMS

- Comparisons: Determine whether the following are true or false. Do not “cross multiply” and do not find a common denominator. Give a rational for your solution.

$$\frac{8}{15} > \frac{1}{2} ?$$

$$\frac{1}{6} > \frac{1}{7} ?$$

$$\frac{7}{22} > \frac{1}{3} ?$$

$$\frac{7}{8} > \frac{8}{9} ?$$

$$\frac{6}{11} > \frac{7}{15} ?$$

$$\frac{7}{9} > \frac{7}{10} ?$$

$$\frac{7}{9} > \frac{13}{12} ?$$

$$\frac{5}{11} > \frac{4}{13} ?$$

HUMAN NUMBER LINE

- Divide into groups of 9.
- Each of you will be given a card.
- One person will place himself/herself on a line to establish a point.
- Each subsequent person is to place himself/herself to the left, right, or in between the existing numbers to maintain proper order.
- This task focuses on order and not proportionality.

ADAPTING FRACTION ACTIVITIES FOR STUDENTS

- Order on the Number Line
- Fraction Sense Problems

ORDER ON THE NUMBER LINE

- Start with whole numbers regardless of the grade level.
- Select four strips for students to work on.
- Have them work independently first.
- Next work in pairs and ask them to write down the rationale they used to determine the value of the “?”.
- Share with another group or with the whole class.

FRACTION SENSE PROBLEMS

- Start with one fraction sense problem and have students justify their solution (e.g., is the following true or false? $\frac{1}{7} < \frac{1}{8}$).
- Highlight the responses that provide an appropriate justification.

FRACTION SENSE PROBLEMS

- Provide two to four fraction sense problems for students to solve in pairs or in small groups.
 - Compare unit fractions and "beyond"
 - Compare fractions near a key benchmark (e.g., $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{3}{4}$, 1)
 - Compare fractions with a common numerator but whose denominators differ by 1.
 - Go from lower cognitive demand to higher cognitive demand

BEST PRACTICES FOR ENGLISH LEARNERS

- Provide high cognitive demand tasks
- Scaffold the language by amplifying and enriching the language to access the content
- Expect students to “do” the mathematics
- Access prior knowledge and build on prior knowledge
- Understand flexibility in ways students respond

BEST PRACTICES FOR ENGLISH LEARNERS

- Encourage and expect mathematical talk
- Ask students probing questions to clarify and draw out their thinking
- Have students share and justify their reasoning and process they used to solve the problem
- Provide opportunities for students to work individually, pair share, and in small and whole groups

BEST PRACTICES FOR ENGLISH LEARNERS

- Use language as a resource for learning not only as a tool for communicating but also as a tool for thinking and reasoning mathematically
- Provide diverse avenues of action and expression
- Be aware of multiple meanings of words
- Have students Think, Ink, Pair, Share
- Increase discourse in the classroom

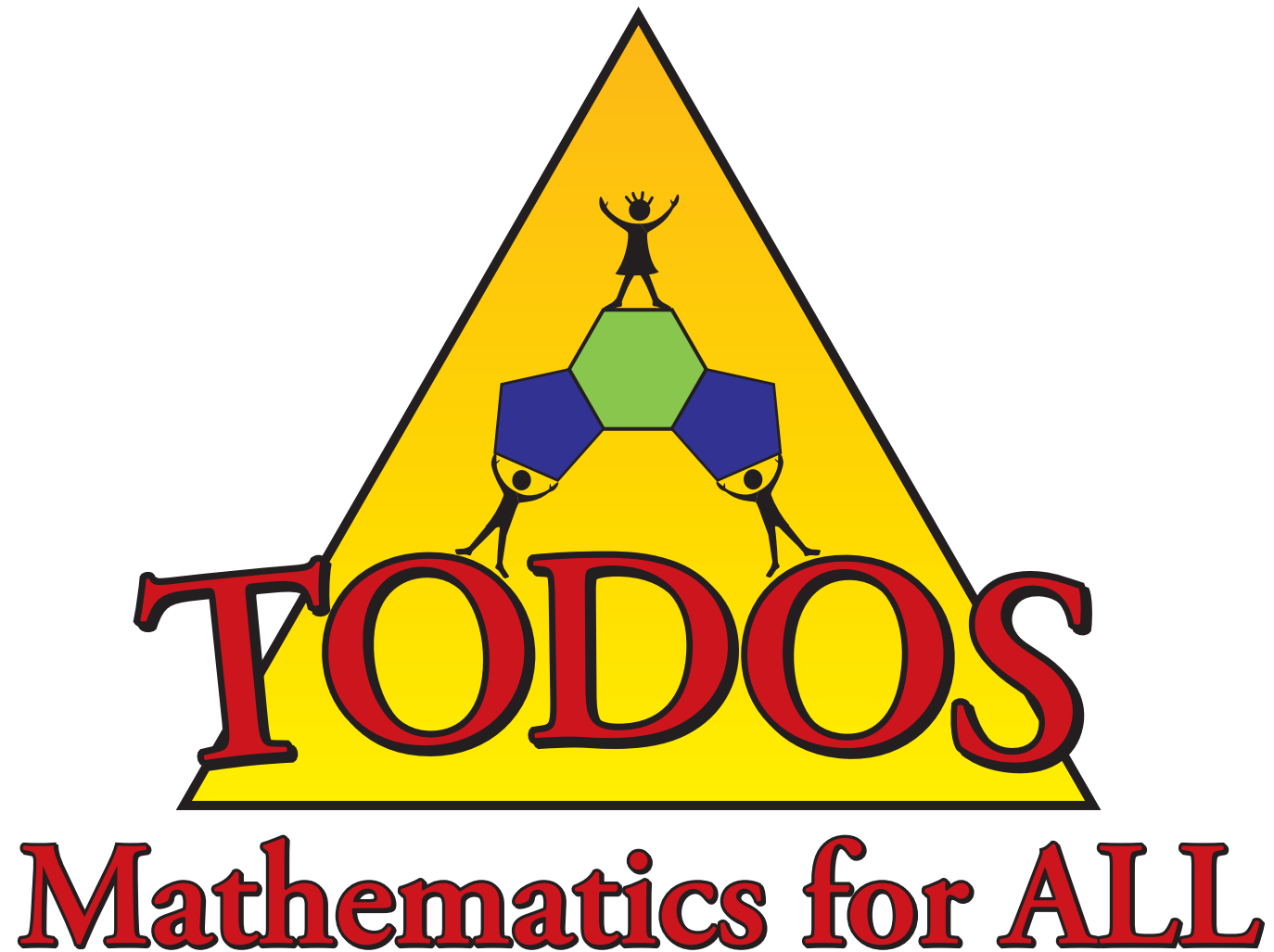
EQUITY AND EXCELLENCE

We want to provide access to ALL students. We also want ALL students to make sense of rigorous, high quality, and high cognitive demand mathematics tasks. We want them to approach the zone of proximal development, not the zone of minimal effort. We want equity AND excellence.

“Equity without excellence is meaningless. Excellence without equity is unjust. We must always ask ourselves, what can we do to incorporate both?”

REFLECTION AND SUMMARY

- How has the experiences with these activities expanded your concept of fractions?
- How will this inform your instruction in the classroom or with other teachers?
- How will you provide access to a conceptual understanding of fractions on the number line to ALL students, particularly English learners?



TODOS MISSION

- The mission of *TODOS*: Mathematics for ALL is to advocate for equity and high quality mathematics education for all students — in particular, Latina/o students.

TODOS STATEMENTS

NCSM/TODOS Joint Social Justice Position Statement

Taking a Stand for Humanity

TODOS 2018 Conference

Save the Date!

Next year!

June 21 -23, 2018



It's ALL about ALL Students
Learning Quality Mathematics:
Advocating for Equity and Social Justice

TODOS: Mathematics for ALL
Scottsdale Plaza Resort, Phoenix Metropolitan Area

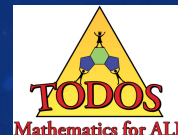
TODOS MEMBERSHIP

JOIN TODOS for only \$25 for a one-year membership, \$70 for three years!

Visit TODOS Booth

TODOS Website:

<http://www.todos-math.org>



THANK YOU FOR PARTICIPATING!

Susie W. Håkansson, Ph.D.

Member Services Chair and Past-President

TODOS: Mathematics for ALL

See me for a business card!

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<http://www.todos-math.org>

