Major initiative of the U.S. Department of Education

Builds on research reviews by IES, especially Practice Guides, and expert panels

Builds a bridge from research to action by translating research into examples and practical tools to support classroom practice and school/district policy
Current Topics

**Mathematics and Science**
- National Math Panel: Critical Foundations for Algebra
- National Math Panel: Major Topics of School Algebra
- Encouraging Girls in Math and Science
- Response to Intervention in Elementary - Middle Mathematics

**Data-Driven Improvement**
- Turning Around Chronically Low-performing Schools
- Using Data under ARRA
- Using Student Achievement Data

**Literacy**
- Preschool Language and Literacy
- Teaching Literacy in English to K-5 English Learners
- Adolescent Literacy
- Response to Intervention in Primary Grades Reading

**Quality Teaching**
- How to Organize your Teaching

**Comprehensive Support**
- Dropout Prevention
- Reducing Behavior Problems in Elementary School Classrooms

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Doing What Works
dww.ed.gov
New Topics

- Developing Effective Fractions Instruction in Grades K – 8
- Improving K – 3 Reading Comprehension
- Increased Learning Time: Beyond the Regular School Day
- Helping Students Navigate the Path to College

IES Practice Guides

Developing Effective Fractions Instruction for Kindergarten through 8th Grade

Improving Reading Comprehension in Kindergarten through 3rd Grade

Structuring Out-of School Time to Improve Academic Achievement

Helping Students Navigate the Path to College: What High Schools Can Do

Doing What Works  
dww.ed.gov
Topic Coming Soon

Improving Mathematical Problem Solving in Grades 4 – 8

IES Practice Guide

Improving Mathematical Problem Solving in Grades 4 through 8

Doing What Works
Literacy
Improve literacy instruction for your students.
- Preschool Language and Literacy
- Improving K-3 Reading Comprehension
- Teaching Literacy in English to K-5 English Learners
- Response to Intervention in Primary Grade Reading
- Adolescent Literacy

Math and Science
Learn how to implement recommendations from the National Math Panel or target equity issues.
- Encouraging Girls in Math and Science
- National Math Panel: Critical Foundations for Algebra
- National Math Panel: Major Topics of School Algebra
- Developing Effective Fractions Instruction for K-8
- Response to Intervention in Elementary-Middle Math

Comprehensive Support
Build a broader array of academic and social supports to increase student success.
- Dropout Prevention
- Reducing Behavior Problems in Elementary School Classrooms
- Increased Learning Time: Beyond the Regular School Day
- Helping Students Navigate the Path to College

Early Childhood
Start students out right through essential practices in the preschool years.
- Preschool Language and Literacy
Developing Effective Fractions Instruction for K-8

Includes these recommended practices
- Initial Fraction Concepts
- Fractions as Numbers
- Operations With Fractions
- Ratio, Rate, Proportion

Explore these recommended practices:
- **Initial Fraction Concepts**
  Build basic fraction concepts from students' informal understandings of sharing and proportion.
- **Fractions as Numbers**
  Use number lines to develop student understanding of fractions as numbers.
- **Operations With Fractions**
  Help students understand why computational procedures with fractions make sense.
- **Ratio, Rate, Proportion**
  Develop proportional relationship concepts before teaching challenging computational procedures.

Multimedia Overview

**Developing Effective Fractions Instruction for K-8**

The National Mathematics Advisory Panel and the Common Core State Standards emphasize the importance of rational numbers. Watch this multimedia overview to learn why and to receive an introduction to the recommendations on effective fractions instruction in elementary and middle school, including the needed support and training for teachers. (6:31 min)

Overview Media & Materials  State and District Examples  State and District Tools  Related Links

Visual Diagram

**Fractions Instruction**

This diagram serves as a visual overview of the recommended instructional practices for teaching fractions in elementary and middle school, along with information on the knowledge teachers need to teach fractions effectively. Use this diagram to initiate discussions with teachers about how students' understanding of fractions develops.

[Download Diagram PDF](#) 871 KB

Expert Interview

**The Importance of Fractions Instruction**

Access the Practice Guide on the What Works Clearinghouse website.
Developing Effective Fractions Instruction for K–8

The Developing Effective Fractions Instruction for Kindergarten Through 8th Grade Practice Guide emphasizes that competence with fractions is essential for algebra and other more advanced areas of mathematics. The Guide provides recommendations for improving students’ learning of fractions.

FRACTIONS PROFESSIONAL DEVELOPMENT AGENDA
- Fraction representations
- Computational procedures
- Assessment of fraction concepts
- Student misconceptions

OPERATIONS WITH FRACTIONS
Help students understand why computational procedures with fractions make sense.

REAL-LIFE CONTEXTS

MODELS

INITIAL FRACTION CONCEPTS
Build basic fraction concepts from students’ informal understandings of sharing and proportionality.

ORDERING

EQUAL SHARING

LANDMARKS
1 \( \frac{1}{2} \), \( \frac{2}{3} \), ...

FRACIONS AS NUMBERS
Use number lines to develop student understanding of fractions as numbers.

DOING WHAT WORKS / U.S. Department of Education
http://www.ed.gov
This diagram depicts the progression of learning about fractions in elementary and middle school with recommended teaching practices from the IES Practice Guide, *Developing Effective Fractions Instruction for Kindergarten Through 8th Grade*. For the purposes of this website, five recommended practices were consolidated into four. The practice related to professional development was incorporated into the other practices.

In the diagram, progressively higher platforms depict the learning trajectory of fractions from the primary grades through middle school. The "ribbon" that connects the platforms identifies important pedagogical concepts (e.g., equivalencies, representations) that are relevant to all stages of learning about fractions. To underscore the importance of improving teachers' mathematics content knowledge and strategies for teaching fractions, the diagram depicts teachers in a professional development setting.

**Fractions as Numbers**

Understanding that fractions are numbers with magnitudes that can be ordered or considered equivalent is fundamental to grasping operations with fractions. Teachers can develop students' understanding of fractions as numbers by using number lines to illustrate magnitudes, the relationship between whole numbers and fractions, and the relationships among fractions, decimals, and percents.

**Ratio, Rate, Proportion**

Proportional thinking—understanding multiplicative relationships between quantities—is essential for more advanced work in mathematics. Teachers should develop students' understanding of proportional reasoning before teaching the cross-multiplication algorithm as a procedure for solving proportions. Teachers can make connections among problem contexts involving ratios, rates, and proportions, and discuss which ones can be solved most easily with cross-multiplication.

**Initial Fraction Concepts**

Children have developed an intuitive understanding of basic fraction concepts, such as dividing a whole object into equal pieces or sharing a set of objects among a group of people, by as early as preschool. Teachers can structure activities that create connections between informal knowledge of sharing and formal fraction concepts of ordering and equivalent relationships.

**Operations With Fractions**

In order for students to become proficient with operations, they need a strong understanding of how computational procedures work with fractions. Teachers should focus on building conceptual understanding and developing procedural knowledge, emphasizing the connections. Teaching for understanding requires teachers to have deep knowledge of computational procedures.

**Professional Development**

Professional development programs should place a high priority on improving teachers' understanding of fractions and how to teach them. Teachers benefit from preparation for using pictorial and concrete representations of fractions and fraction operations. It is important that teachers understand students' understandings and misunderstandings of fractions.

The DWW website includes other mathematics topics, some of which include media and materials relevant to teaching fractions. See also these topics: National Math Panel: Critical Foundations for Algebra; National Math Panel: Major Topics of School Algebra; Response to Intervention in Elementary-Middle Math; and Encouraging Girls in Math and Science.
Fractions as Numbers

Use number lines to develop student understanding of fractions as numbers.

Understanding that fractions are numbers with magnitudes that can be ordered or considered equivalent is fundamental to grasping operations with fractions. Teachers can develop students’ understanding of fractions as numbers by using number lines to illustrate magnitudes, the relation between whole numbers and fractions, and the relations among fractions, decimals, and percents.

Multimedia Overview
Recognizing Fractions as Numbers

Watch this multimedia overview explaining why number lines are recommended as a central representational tool to teach students about fractions and how teachers can help students understand fractions as numbers, relationships between fractions, and fractions as units of measure. (5:40 min)

TRANSCRIPT & DETAILS | PDF | 499 KB
For Each Practice:

- Research base/Instructional presentations
- Expert interviews
- School site videos and slideshows
- Interviews and sample materials from schools
- Ideas for action
- Tools and templates to implement practices

Doing What Works

dww.ed.gov
Develop understanding of proportional relationships before teaching computational procedures.

Expert Interview
Learning to Think Proportionally
W. James (Jim) Lewis, Ph.D.
University of Nebraska-Lincoln

Dr. James Lewis discusses what it means to think proportionally and offers examples from everyday contexts. He describes the conceptual progression toward working with cross-multiplication and demonstrates using ratio tables as a tool for solving problems. (7:11 min)

Download Video | QuickTime | 54 MB
Transcript & Details | PDF | 1 MB
Developing Effective Fractions Instruction for K-8

Operations With Fractions

Practice Summary

Learn What Works

See How It Works

Do What Works

Site Profiles

Eliza Hart Spalding School of Math and Technology (ID)
Tollgate Elementary School of Expeditionary Learning (CO)

Site Selection Criteria

Presentations

Subtracting a Fraction From a Whole
Watch this presentation to learn about reinforcing conceptual understanding and building procedural knowledge of fractions.

Interviews

Grade 5 Number Talk
Follow a teacher’s lesson on adding and subtracting fractions using fraction equivalents and relationships.

Ways to Measure One and a Half Cups
Watch a teacher lead students through reasoning about fraction multiplication and division in the context of a real-world problem.

Solving a Real-World Fraction Division Problem
A fifth-grade teacher poses a fraction division problem and challenges students to find different approaches to a solution. One student uses a number line; others use build-up strategies. See their assignment in Web Shots for Spiderman Problem. (6:41 min)

Download Video | QuickTime | 60 MB

Transcript & Details | PDF | 960 KB

Sample Materials

Dumb Friends League Problem
Web Shots for Spiderman Problem
Fractions as Numbers

Fraction Game on Number Lines
Tollgate Elementary School of Expeditionary Learning (CO)

Fifth graders compete to win the Fraction Tracks game, which is designed to help them practice working with equivalent fractions. The versatile game offers many options for practicing skills. Fraction Tracks Game includes rules and a game board.

Presentations
- Fraction Game on Number Lines
  - Fifth graders compete to win the Fraction Tracks game, which is designed to help them practice working with equivalent fractions.

Interviews
- Making and Using Fraction Strips
  - Watch how a third-grade teacher introduces unit fractions by playing a game that involves “covering up” a unit with fractional parts.
- Fractions on a Number Line
  - A fourth-grade teacher describes students’ challenges in moving from a part-whole interpretation of fractions to seeing them as numbers.
- Multiple Interpretations of Fractions
  - Professor Jonathan Brendefur describes how he helps teachers understand and teach different interpretations of fractions.

Sample Materials
- Fraction Strip Game: Cover Up
- Fraction Tracks Game
- Frank’s Fresh Farm Produce

TRANSCRIPT & DETAILS | PDF | 800 KB
Initial Fraction Concepts

Tollgate Elementary School of Expeditionary Learning (CO)

Equal Sharing in Grade 1

Watch a first-grade teacher guide students through a problem set requiring fair sharing of objects and sets of objects. Using Sharing Cookies Worksheets, she provides differentiated challenges based on students’ skill level. (6:46 min)

Presentations

- **Representations of Part-Whole Relationships**
  - Listen to how a math coach works with second graders on fair sharing and fraction equivalence challenges.

- **Teaching Fractions in Grade 2**
  - Watch this presentation to see a second-grade lesson used to review fractions, decimals, and percents.

- **Using Multiple Representations to Teach Fractions**
  - Watch this slideshow to see illustrations of different ways teachers use multiple representations to teach fractions.

Interviews

- **Equal Sharing in Grade 1**
  - Watch a first-grade teacher guide students through a problem set requiring fair sharing of objects.

Sample Materials

- **Sharing Cookies Worksheets**
- **Fractions with Cuisenaire Rods**
- **Same Parts, Different Whole: Lesson Plan and Worksheets**
Develop proportional relationship concepts before teaching challenging computational procedures.

**Math Supervisor**

How can I build up teachers’ confidence in teaching about ratios, rates, and proportions?

**This idea for action includes:**

- Set up a targeted professional learning community that enables teachers to work together on lesson preparation and follow-up.
- Provide hands-on professional development opportunities where teachers work through problems and explain their reasoning.
- Facilitate teachers’ analysis of student work, including student misconceptions about ratios, rates and proportions.

Learn more ►

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**Middle School Math Teachers**

How can I provide students with more practice on real-world problems?

**This idea for action includes:**

- Work as a grade level team to design extended challenges with embedded problems that engage students.
- Adapt problems from other sources to your students’ interests.

Learn more ►
Develop proportional relationship concepts before teaching challenging computational procedures.

Math Supervisor
How can I build up teachers’ confidence in teaching about ratios, rates, and proportions?

This idea for action includes:

1. Set up a targeted professional learning community that enables teachers to work together on lesson preparation and follow-up.
2. Provide hands-on professional development opportunities where teachers work through problems and explain their reasoning.
3. Facilitate teachers’ analysis of student work, including student misconceptions about ratios, rates and proportions.

Teachers are likely to need support in both the math content and the methods of instruction associated with teaching ratios, rates, and proportions, including ideas for building practice assignments. Teachers will benefit from a safe, supportive environment...
Help students understand why computational procedures with fractions make sense.

Practice Tools
These tools and templates help you use the materials in the "Learn What" and "See How" sections as you tackle the hard work of school improvement. Each tool is a downloadable Word document that you can edit and adapt to serve your needs.

Learning Together about Student Misconceptions
This professional development workshop is designed to create awareness about students' potential misconceptions related to fraction operations.

Walkthroughs: Teaching Fractions
Use the "look-fors" in this tool as a guide for observational walkthroughs of elementary and middle school math classes.

Planning Real World Problems for Operations
Intermediate-grade teachers can use this planning tool to develop practice problems in adding and multiplying fractions based in real-world situations.

Comprehensive Tools and Templates
These three comprehensive planning templates address the practices for Developing Effective Fractions Instruction. They can be used by a technical assistance provider (e.g.,
DEVELOPING EFFECTIVE FRACTIONS INSTRUCTION FOR K–8: PLANNING FRACTIONS INSTRUCTION USING COMMON CORE STATE STANDARDS FOR MATHEMATICS

This template can help districts/schools follow the progression of fractions as stated in the Common Core State Standards for Mathematics. Educators may compare present district standards and instructional materials to align with Common Core domains and clusters specific to topics of fractions in grades 1–8. To complete this activity, you will need to reference the IES Practice Guide, Developing Effective Fractions Instruction for Kindergarten Through 8th Grade, as well as the DWW media and sample materials that are most relevant to each of the Common Core State Standards. Titles of these media items and materials are listed in bold under each statement, followed by the corresponding DWW practice and area (in brackets) where each item can be found on the website.

<table>
<thead>
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Planning Templates:
Helping states, districts, and schools develop policies
HANDOUTS
Common Core Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
   *Mathematically proficient students:*
   - Explain the meaning of a problem and restate it in their words.
   - Analyze given information to develop possible strategies for solving the problem.
   - Identify and execute appropriate strategies to solve the problem.
   - Evaluate progress toward the solution and make revisions, if necessary.
   - Check their answers using a different method, and continually ask “Does this make sense?”

2. Reason abstractly and quantitatively.
   *Mathematically proficient students:*
   - Make sense of quantities and their relationships in problem situations.
   - Use varied representations and approaches when solving problems.
   - Know and flexibly use different properties of operations and objects.
   - Change perspectives, generate alternatives, and consider different options.

3. Construct viable arguments and critique the reasoning of others.
   *Mathematically proficient students:*
   - Understand and use prior learning in constructing arguments.
   - Habitually ask “why” and seek an answer to that question.
   - Question and problem-poser.
   - Develop questioning strategies to generate information.
   - Seek to understand alternative approaches suggested by others and, as a result, to adopt better approaches.
   - Justify their conclusions, communicate them to others, and respond to the arguments of others.
   - Compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is.

Prepared by Carolyn Marchetti, State Supervisor of Mathematics in Pennsylvania
4. Model with mathematics.

*Mathematically proficient students:*
- ✓ Apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.
- ✓ Make assumptions and approximations to simplify a complicated situation, realizing that these may need revision later.
- ✓ Identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-column (row) tables, graphs, flowcharts, and formulas.
- ✓ Analyze mathematical relationships to draw conclusions.

5. Use appropriate tools strategically.

*Mathematically proficient students:*
- ✓ Use tools when solving a mathematical problem and to deepen their understanding of concepts (e.g., pencil and paper, physical models, geometric construction and measurement devices, graph paper, calculators, computer-based algebra or geometry systems.)
- ✓ Make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. They detect possible errors by strategically using estimation and other mathematical knowledge.

6. Attend to precision.

*Mathematically proficient students:*
- ✓ Communicate their understanding of mathematics to others.
- ✓ Use clear definitions and state the meaning of the symbols they choose, including using the equal sign consistently and appropriately.
- ✓ Specify units of measure and label parts of graphs and charts.
- ✓ Strive for accuracy in computations (procedures).

7. Look for and make use of structure.

*Mathematically proficient students:*
- ✓ Look for, develop, generalize, and describe a pattern orally, symbolically, graphically, and in written form.
- ✓ Apply and discuss properties.

8. Look for and express regularity in repeated reasoning.

*Mathematically proficient students:*
- ✓ Look for mathematically sound shortcuts.
- ✓ Generalize through use of repeated applications.
Cite examples of mathematical practices presented in the media piece.

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