Questions:

Why is teaching mathematics important?
Why is learning mathematics important?
Chapter 1

Teaching Mathematics in the Era of NCTM Standards
Vision
NCTM

- Vision
- Principles
NCTM

- Vision
- Principles
- Standards
Vision

What does the ideal mathematics classroom look like?
What does NCTM say?
Principles

- Equity
Principles

- Equity
- Curriculum
Principles

- Equity
- Curriculum
- Teaching
Principles

- Equity
- Curriculum
- Teaching
- Learning
Principles

- Equity
- Curriculum
- Teaching
- Learning
- Assessment
Principles

- Equity
- Curriculum
- Teaching
- Learning
- Assessment
- Technology
Equity

Regardless of physical challenges
Equity

Regardless of physical challenges

We must let go of the belief that there are some who “just aren’t any good at math.”
Curriculum

Coherence
Curriculum

- Coherence
- “Importance”
Teaching

- Requires a deep understanding of the material
Teaching

- Requires a deep understanding of the material
- Needs to take into account all learning styles.
Teaching

- Requires a deep understanding of the material
- Needs to take into account all learning styles.
- Uses *effective* instructional strategies
Learning

- Rote memorization is not enough.
Learning

- Rote memorization is not enough.
- Students can understand mathematics deeply.
Assessment

- Supports learning (*for as well as* *to*)
Assessment

- Supports learning (*for* as well as *to*)
- Guides learning (*communicates* to the student what is most important)
Assessment

- Supports learning (*for* as well as *to*)
- Guides learning (*communicates to the student what is most important*)
- Guides Teaching (*What do they know? What don’t they know?*)
Technology

- Don’t look a gift horse in the mouth
Technology

- Don’t look a gift horse in the mouth
- Generates examples more quickly
Technology

- Don’t look a gift horse in the mouth
- Generates examples more quickly
- Allows for more time and energy to consider ideas
Content Standards

Numbers
Content Standards

- Numbers
- Algebra
Content Standards

- Numbers
- Algebra
- Geometry
Content Standards

- Numbers
- Algebra
- Geometry
- Measurement
Content Standards

- Numbers
- Algebra
- Geometry
- Measurement
- Data analysis and probability
Examples:
Numbers

- Pre-K-2: Understand and represent fractions such as $\frac{1}{4}$, and $\frac{1}{3}$
Numbers

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- Grades 3-5: Identify and use relationships between operations.
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- Grades 6-8: Develop Meaning for Percents greater than 100 and less than 1
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- Grades 9-12: Judge the reasonableness of numerical calculations.
Pre-K-2: Describe quantitative change, such as a student growing taller in one year.
Algebra

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- Grades 3-5: Investigate how the change in one variable results in the change of another.
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- Grades 3-5: Investigate how the change in one variable results in the change of another.
- Grades 6-8: Identify functions as linear or non-linear and contrast their properties from tables, graphs, or equations
- Grades 9-12: Interpret representations of functions of two variables.
Geometry

- Pre-K-2: Recognize and create shapes that have symmetry
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- Grades 3-5: Explore congruence and similarity
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- Grades 6-8: Construct geometric objects with specified properties, such as side lengths and angle measures
- Grades 9-12: Use Cartesian or Polar coordinate systems to analyze geometric situations
Measurement

- Pre-K-2: Recognize the attributes of length, volume, weight, area and time
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- Grades 3-5: Select and use benchmarks to estimate measurements
- Grades 6-8: Solve problems using scale factors, using ratios and proportions
- Grades 9-12: Analyze precision, accuracy, and approximate error in measurement situations.
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Data Analysis and Probability

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- Grades 9-12: Understand how to compute the probability of a compound event.
Process Standards

- Problem Solving
Process Standards

- Problem Solving
- Reasoning and Proof
Process Standards

- Problem Solving
- Reasoning and Proof
- Communication
Process Standards

- Problem Solving
- Reasoning and Proof
- Communication
- Connections
Process Standards

- Problem Solving
- Reasoning and Proof
- Communication
- Connections
- Representation
Problem Solving

To do is to learn.
To learn is to do.
Reasoning and Proof

Thinking Mathematically
Reasoning and Proof

- Thinking Mathematically
- Why, why, why???
In order to teach you must know
Communication

- In order to teach you must know
- In order to know, maybe you need to teach
Communication

- In order to teach you must know
- In order to know, maybe you need to teach
  - Forces Clarity
Communication

- In order to teach you must know
- In order to know, maybe you need to teach
  - Forces Clarity
  - Reveals Errors
Connections

How do the different pieces of mathematics fit together?
Connections

How do the different pieces of mathematics fit together?

• Addition and Subtraction
Connections

- How do the different pieces of mathematics fit together?
  - Addition and Subtraction
  - Fractions and Decimals
  - Multiplication and Division
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- 1 and 0
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  - Multiplication and Division
  - 1 and 0
  - Fractions and Division

- How does Mathematics fit into the wider world?
Representations

- Pictures
Representations

- Pictures
- And More!
Five Shifts in The Classroom:

- Towards classrooms as mathematics communities and away from classrooms as simply a collection of individuals
- Toward logic and mathematical evidence as verification and away from the teacher as the sole authority for right answers
- Toward mathematical reasoning and away from mere memorizing procedures
- Toward conjecturing, inventing, and problem solving and away from an emphasis on the mechanistic finding of answers
- Toward connecting mathematics, its ideas, and its applications and away from treating mathematics as a body of isolated concepts and procedures
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