Multisensory Geometry: a Hands-on Approach to Reasoning, Proof and Logic

NCTM 2012 Annual Meeting and Exposition
Philadelphia PA

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Reasoning and Proof Standard for Grades 9-12

- recognize reasoning and proof as fundamental aspects of mathematics;
- make and investigate mathematical conjectures;
- develop and evaluate mathematical arguments and proofs;
- select and use various types of reasoning and methods of proof.

Mathematical Practices

Construct viable arguments and critique the reasoning 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 "

Common Core State Standards

Critique the reasoning of others:

It's all about the language

conditional

antecedent

And

disjunction

MODUS TOLLENS

conjunction

contrapositive

consequence

Or

statement

Modus Ponens

Conjecture

consequent

postulate

Our Challenge

Take abstract concepts and make them concrete in order to make them understandable and memorable

CRA Instructional Sequence

• Concrete teaches the concept

• Representational provides practice and makes memorable

• Abstract calculates with numbers and symbols

Venn Diagrams and the Inclusive "OR"

• Do you like ice cream or lima beans?

• Do you like cabbage or candy?

• Do you like dog biscuits or liver?

Venn diagrams

Concrete: construct diagrams using attributes of class (sports, where are our grandparents, clothing, etc)

Representational: Shade regions "and", "or", "not" (handout)
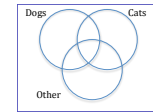
Abstract: Analyze diagrams with numerical values
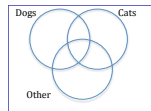

VENN DIAGRAMS
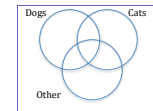
Students who have at least one dog and at least one cat
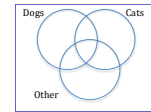
Students who do not have any pets or students who have a pet that is not a dog or a cat

Students who have a dog or cat or other pet

Students who have a pet that is not a dog or a cat

Truth Tables

Concrete/Kinesthetic: double-sided markers replace T and F (handout)

Determining Truth Values

Code the statements:
21 is divisible by 3 and 21 is not prime
Blue is a color and 7+3=10

TRUTH TABLES

Conditional Statements

- Simple statements

  statements vs. compound sentences

- Language: make it relevant
  -conditional
  – Converse
  – Inverse
  – contrapositive

Conditional statements

- One statement per index card
- Construct conditional
- Write out the compound sentence
- Code the sentences
- Write in symbols
- Repeat with converse, etc.

Modus Ponens and Modus Tollens

- Coding the statements aids in pattern recognition
- Code each statement (p,q,~q, etc) and conclusion (handout)
- Look for pattern of MP or MT

MODUS TOLLENS

p q

If you get enough money, then you can buy a new car.

$\sim q$

You cannot buy a new car.

$\sim p$

Therefore, you don't have enough money.

$$p \rightarrow q$$
$$\sim q$$
$$\therefore \;\; \sim p$$

Proofs
a real crowd pleaser

Visual Theorem Bank

Visual Theorem bank

Parallel Lines and Transversals
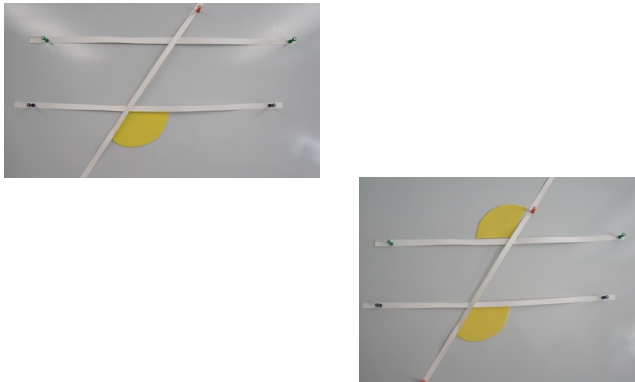
Interior   Exterior

Alternate   Corresponding

Vertical   Transversal

These terms must have meaning for the students
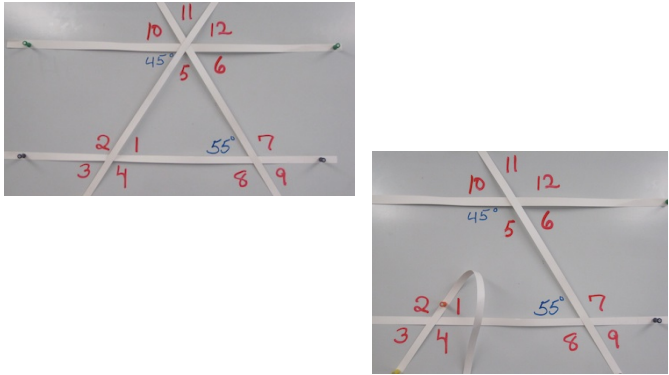
Concrete: Discovering Angle Relationships
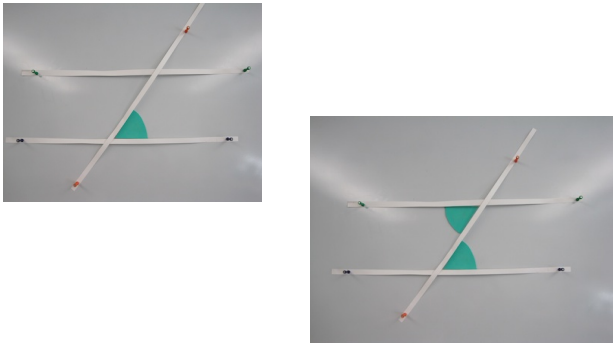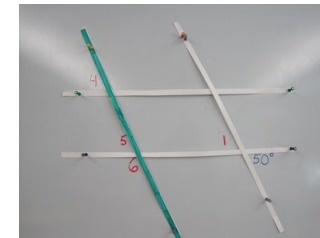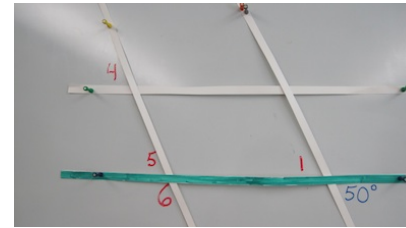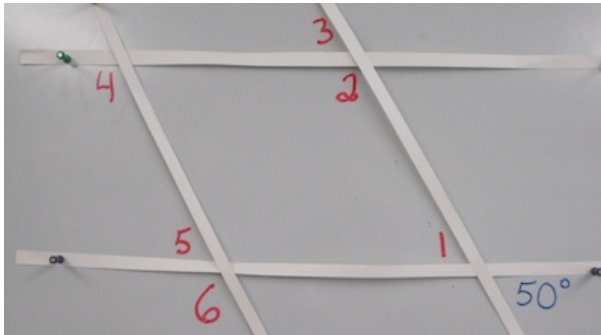

Discovering angle relationships

Discovering angle relationships

Clarifying angle relationships

Clarifying angle relationships

It really is all about the language..

Include
Vocabulary Development Activities

"Hit my Rhombus

One more Time"

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