



# Alignment

Powerful Tool for Focusing  
Instruction, Curricula, and  
Assessment



# Major Questions

- What is alignment?
- How is alignment measured?
- How are state standards and assessments aligned?
- What are the implications of alignment results?



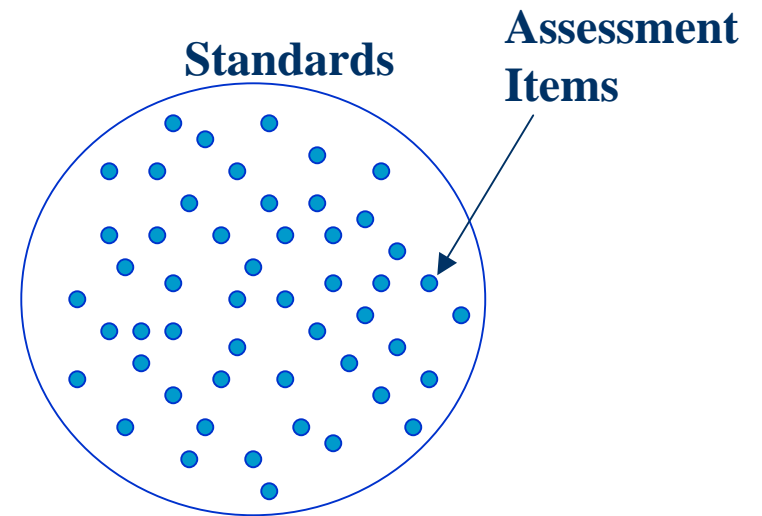
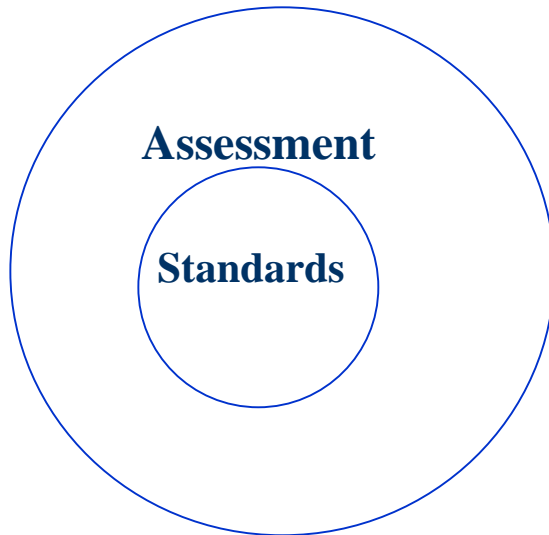
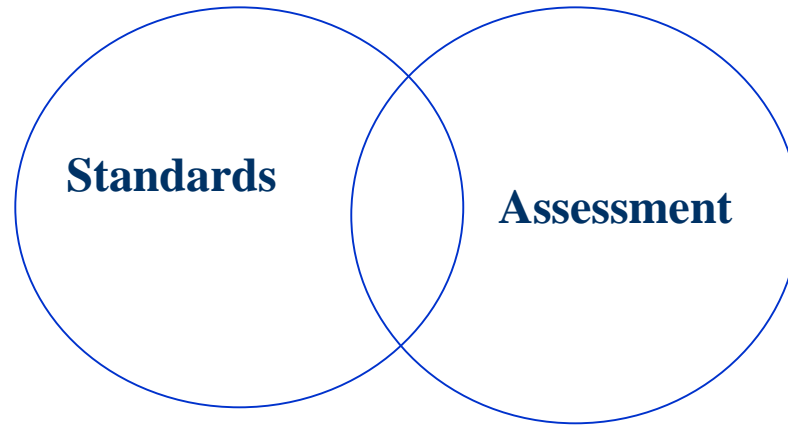
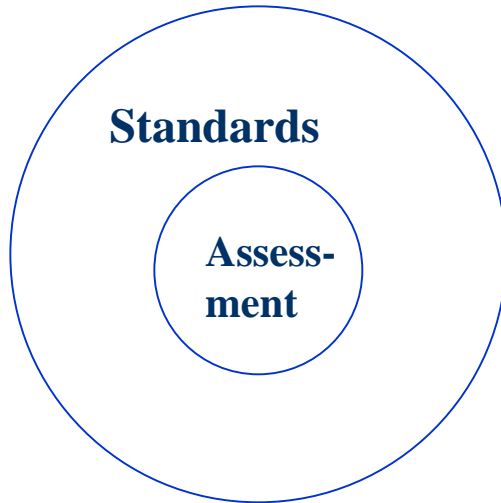
# What Is *Alignment*?



# Alignment

The degree to which expectations and assessments are in agreement and serve in conjunction with one another to guide the system toward students learning what is expected.

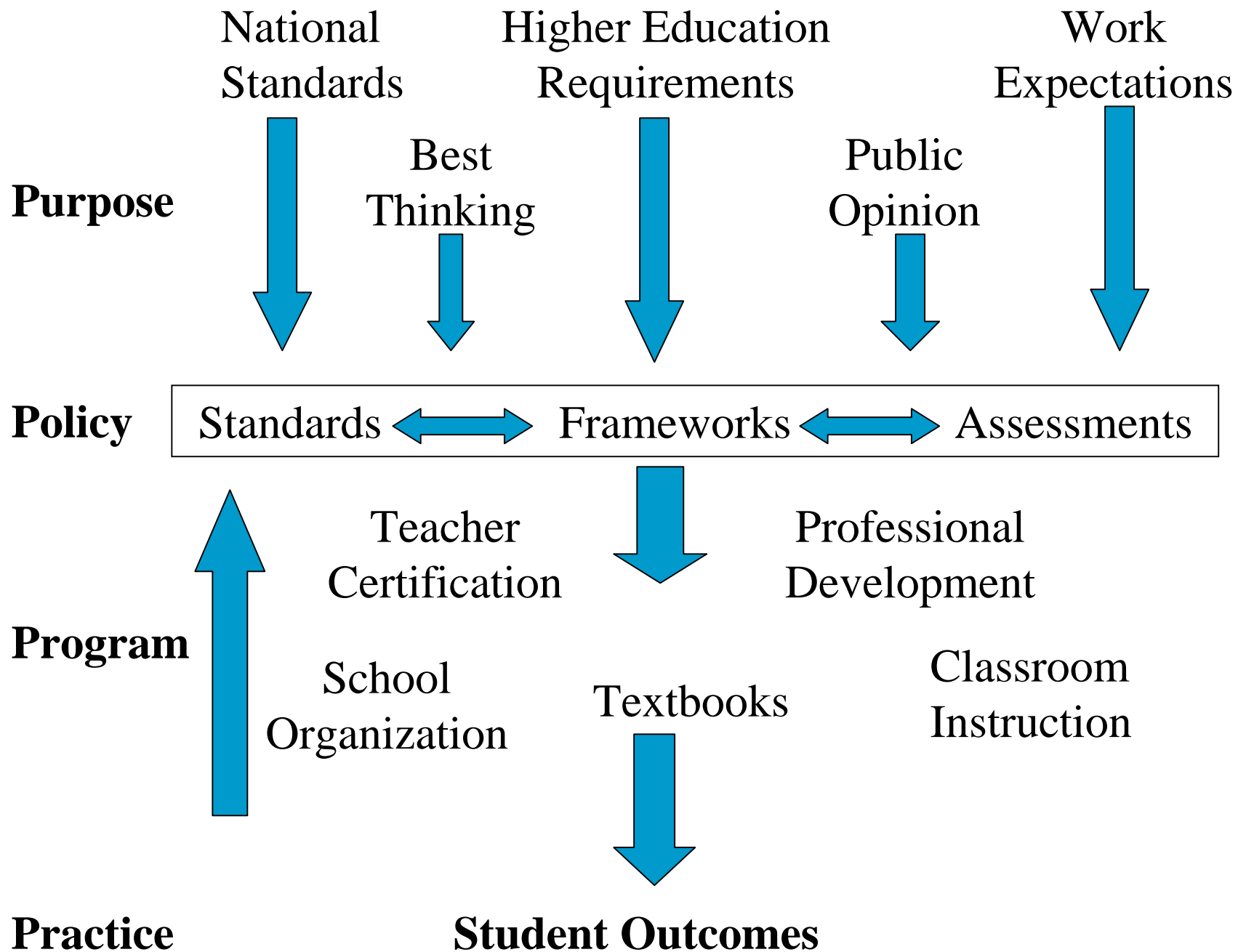
# Degree of Alignment





# Alignment Is Important

- Federal statutes require alignment
- Education systems are easily fragmented





# Alignment Is Important

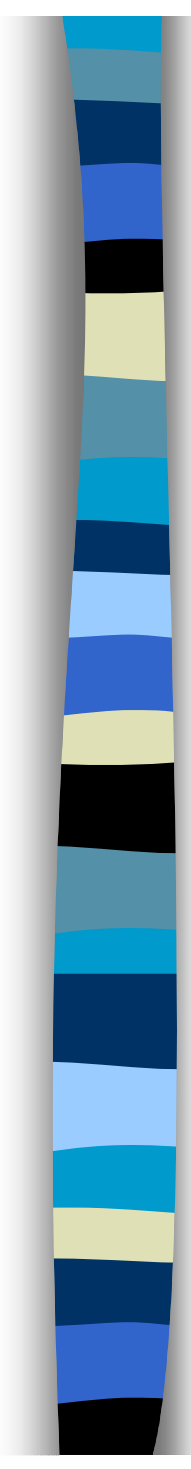
- Federal statutes require alignment
- Education systems are easily fragmented
- Teachers and students receive mixed messages
- Learning expectations can be lowered for some students





# Curriculum Types

- Intended
- Implemented
- Assessed
- Achieved



Alignment has been an issue  
for as many as forty years,  
dating back to behavioral  
objectives and  
mastery-learning.



How is alignment  
measured?



## Three Methods:

- Common Framework
- Expert Consensus
- Common Criteria

# Content-by-Process Framework

Topics	Categories of Cognitive Demand			
<b>Measurement &amp; Calculation in Science</b>	Coverage	Memorize Facts/etc.	Understand Concepts	Perform Procedures
<b>The International System</b>	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
<b>Mass &amp; Weight</b>	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
<b>Length</b>	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
<b>Volume</b>	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
<b>Time</b>	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3
<b>Temperature</b>	0 1 2 3	0 1 2 3	0 1 2 3	0 1 2 3



# Categories of Cognitive Demand

- Memorize
- Understand Concepts
- Perform Procedures
- Generate Questions/Hypotheses
- Collect Data
- Analyze & Interpret Information
- Use Information to Make Connections

# Achieve Matrix

## Grade 3 Mathematics

### Data Analysis and Probability

Obj. #	Text of Objective	A	B	Content Centrality	Type of Performance Centrality	Source of Challenge
<b>Organize, describe and make predictions from existing data</b>						
<b>10.A. 1a</b>	Organize and display data using pictures, tallies, tables, charts, or bar graphs.	81				
<b>10A. 1b</b>	Answer questions and make predictions based on given data.	5				
		20				
		41				
		53				
		66				
		69				



# Grade 8 Standards from Three States

## **State A:**

The student will use proportions to solve scale-model problems with fractions and decimals.

## **State B:**

Students compute with rational numbers expressed in a variety of forms; they solve problems involving ratios, proportions, and percentages. Use ratio and proportion to solve problems.

## **State C:**

Apply proportional thinking in a variety of problem situations that include, but are not limited to: 1) ratios and proportions, and 2) percents, including those greater than 100 and less than one.



# Achieve Alignment Criteria

## Item-Standard Match

- Content Centrality
- Performance Centrality
- Source of Challenge

## Instrument-Standard Match

- Level of Challenge
- Balance
- Range



# Five General Criteria

1. Content Focus
2. Articulation Across Grades and Ages
3. Equity and Fairness
4. Pedagogical Implications
5. System Applicability



# Specific Criteria

## Content Focus

- A. Categorical Concurrence
- B. Depth-of-Knowledge Consistency
- C. Range-of-Knowledge Correspondence
- D. Structure-of-Knowledge Comparability
- E. Balance of Representation
- F. Dispositional Consonance

# Indiana Mathematics Standards

## Grade 8

<b>Obj. #</b>	<b>Text of Objective</b>	<b>DOK</b>	<b>Item # 1</b>	<b>Item # 2</b>
<b>5A</b>	Express any decimal in scientific notation			
<b>5B</b>	Order a set of rational numbers			
	Fractions, Percents, Integers, & Irrationals			
	Reinforce an understanding of fractions, and develop an understanding of percent, integers, and irrationals			
<b>6A</b>	Use models to compare two or more integers and/or irrational numbers			
<b>6B</b>	Recognize the relationships between fraction, percent, ratio, and proportion			



# Depth of Knowledge

## Level 1 Recall

Recall of a fact, information, or procedure.

## Level 2 Skill/Concept

Use information or conceptual knowledge, two or more steps, etc.

## Level 3 Strategic Thinking

Requires reasoning, developing plan or a sequence of steps, some complexity, more than one possible answer.

## Level 4 Extended Thinking

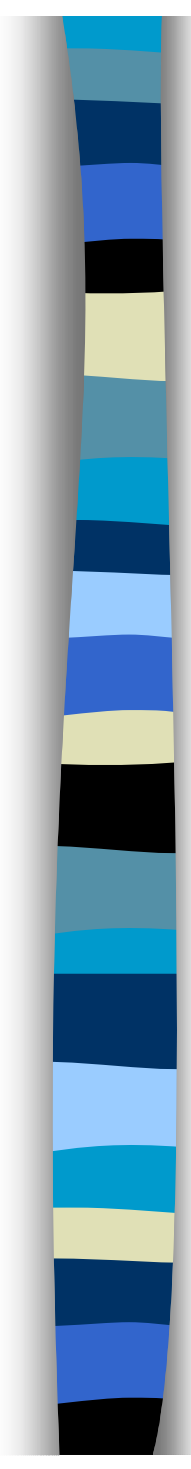
Requires an investigation, time to think and process multiple conditions of the problem.

# EXAMPLE OF STANDARDS AND DEPTH-OF-KNOWLEDGE LEVELS CONTENT AREA: GEOMETRY

	Mathematics Standard	Depth-of- Knowledge Level
State D Grade 8	<b>VI. Geometric and Spatial Sense</b>	
VI.2	Explore transformations of geometric figures.	4
State B Grade 8	<b>II. Geometry</b>	
II.4	Graph on a coordinate plane similar figures, reflections, and translations.	2
State A Grade 6	<b>IV. Geometry and Spatial Sense</b>	
IV.D.	Investigate and predict the results of transformations of shapes, figures, and models including slides, flips, and turns.	
IV.D.1	Identify and describe the results of translations (slides), reflections (flips), rotations (turns), or glide reflections.	2

# EXAMPLE OF STANDARDS AND DEPTH-OF-KNOWLEDGE LEVELS CONTENT AREA: PROBABILITY AND STATISTICS

	Mathematics Standard	Depth-of- Knowledge Level
State D Grade 8	VII. Data Analysis, Probability & Statistics	
VII.3	Formulate, predict, and defend positions taken that are based on data collected.	4
State B Grade 8	VI. Probability and Statistics	
VI.1	Collect data involving 2 variables and display on a scatter plot; interpret results.	3



Which of the following numbers, when rounded to the nearest thousand, becomes 27,000?

(a) 26,099

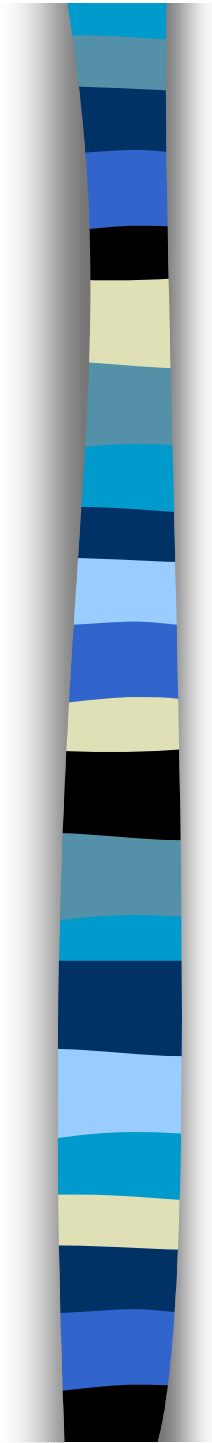
(b) 26,490

(c) 27,381

(d) 27,550

(e) 27,640

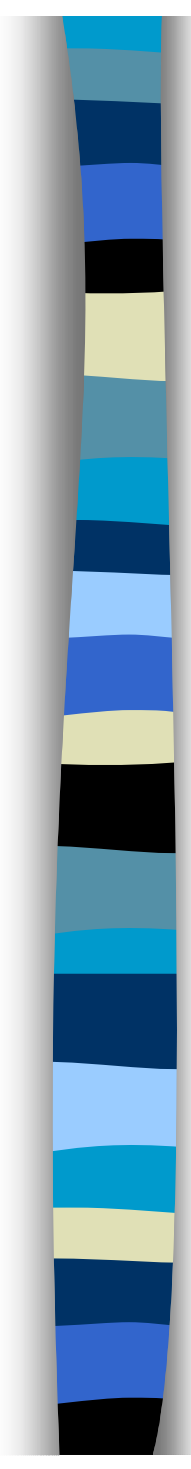




121  
13  
32  
+ 34

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- 1) 190
- 2) 200
- 3) 290
- 4) N



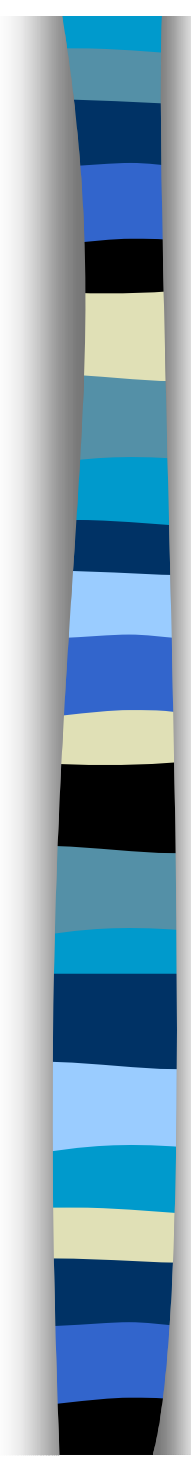
A car odometer registered 41,256.9 miles when a highway sign warned of a detour 1,200 feet ahead. What will the odometer read when the car reaches the detour? (5,280 feet = 1 mile)

- (a) 42,456.9
- (b) 41,279.9
- (c) 41,261.3
- (d) 41,259.2
- (e) 41,257.1

Did you use the calculator on this question?

Yes

No



This question refers to pieces  $N$ ,  $P$ , and  $Q$ .

In Mr. Bell's classes, the students voted for their favorite shape for a symbol. Here are the results.

	Class 1	Class 2	Class 3
Shape $N$	9	14	11
Shape $P$	1	9	17
Shape $Q$	22	7	2

Using the information in the chart, Mr. Bell must select one of the shapes to be the symbol. Which one should he select and why?

The shape Mr. Bell should select: \_\_\_\_\_

Explain:

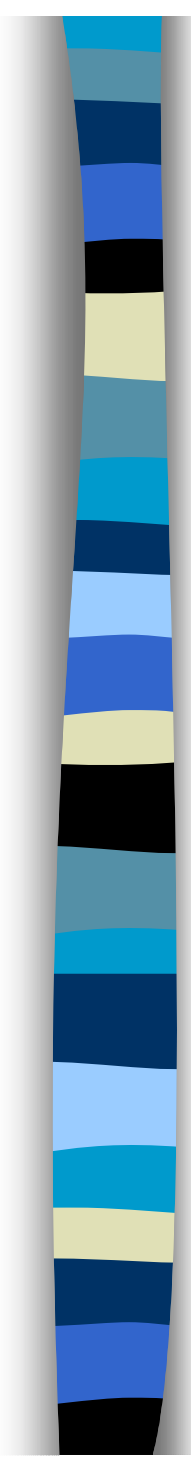


## New Cubes

Your school is planning a casino night to raise funds to construct a wall aquarium in your school. As a mathematics student, you are given the job of developing a dice game for this event.

A regular pair of “number dice” consists of two cubes, each with its faces numbered 1 through 6. Often, dice games are played by rolling the two dice and then finding the sum of the two numbers turned upward.

1. Show that, with a regular pair of number dice, the probability of rolling a sum of 7 is greater than the probability of rolling any other sum.



You decide to call your casino game “New Cubes.” To make it interesting, you decide to construct new dice that have different numbers on their faces than regular dice. Here is how you will construct them:

- Only the single digits 0 through 9 can be used.
  - Any digit can be used more than once.
  - When the dice are rolled every sum from 4 to 14 must be possible and no other sums can occur.
  - The two dice do not have to be identical.
2. What numbers would you put on the 6 faces of each of the two dice so that the above conditions are met?

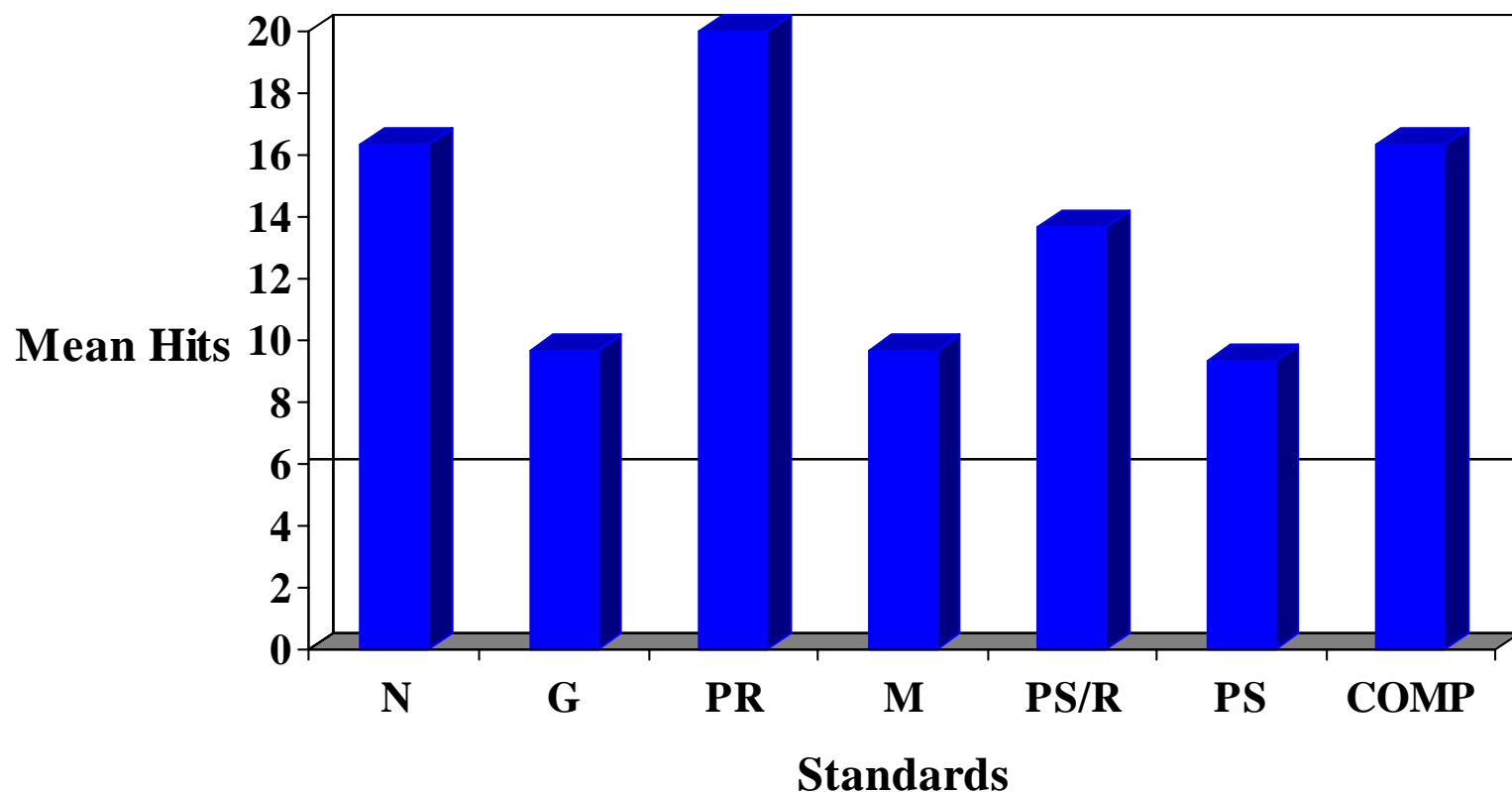
Die 1: \_\_\_\_\_

Die 2: \_\_\_\_\_

3. Which sum(s) do you think would turn up most frequently if your New Cubes were rolled 1000 times?  
Explain why.

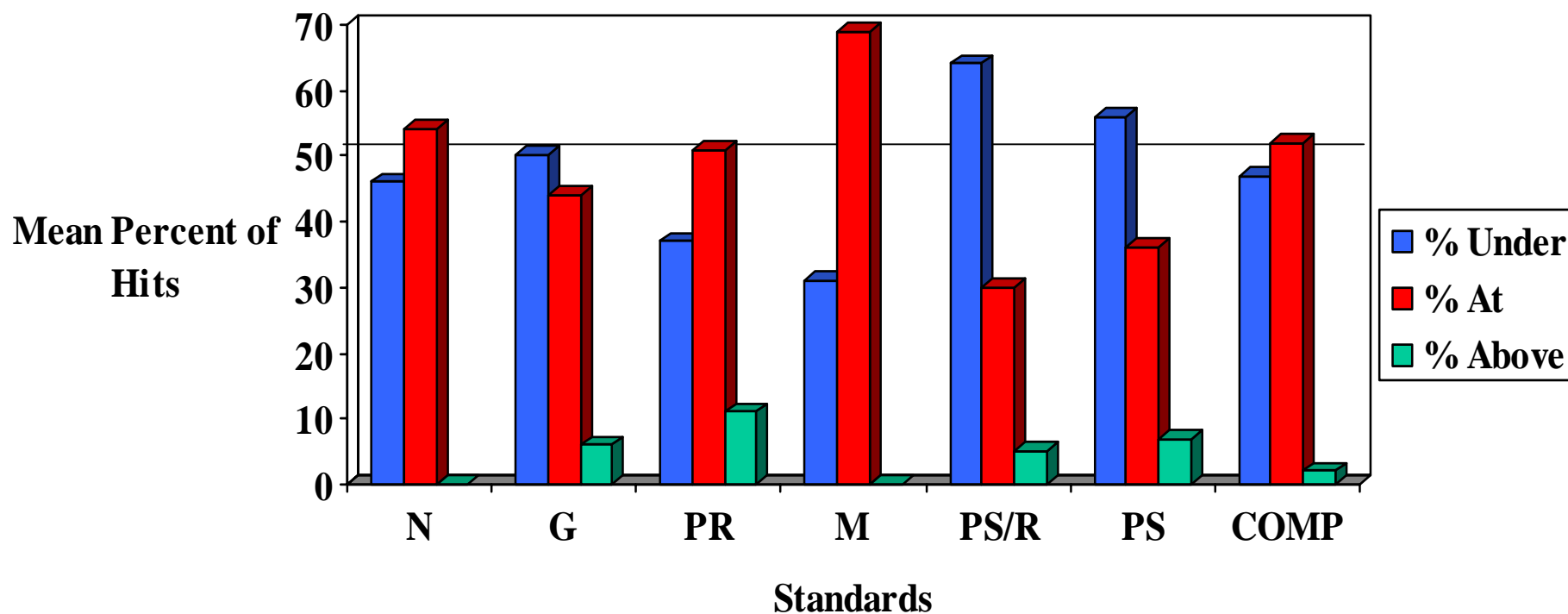
# Categorical Concurrency

## State B Grade 8 Mathematics



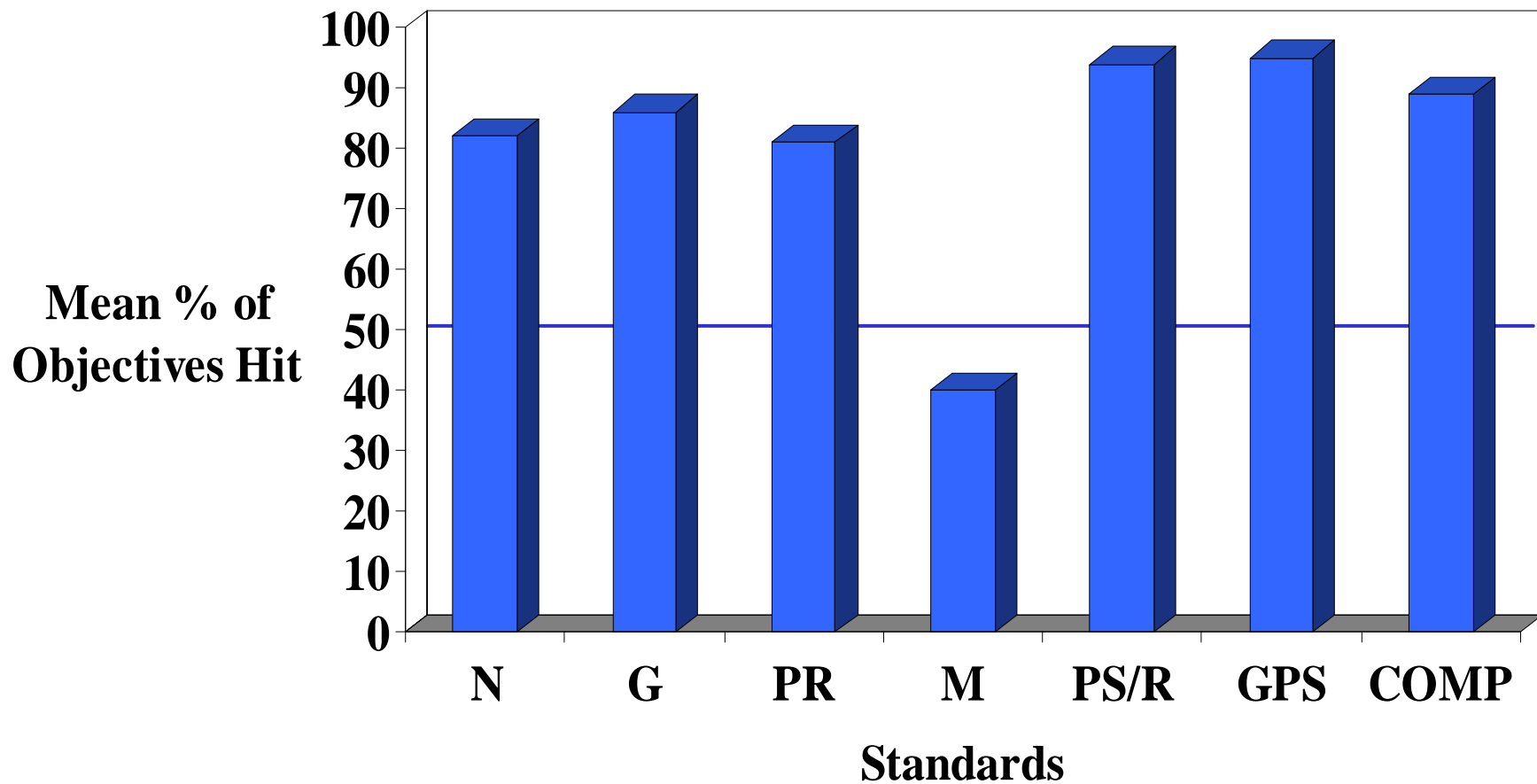
# Depth-of-Knowledge Consistency

## State B Grade 8 Mathematics



# Range-of-Knowledge Correspondence

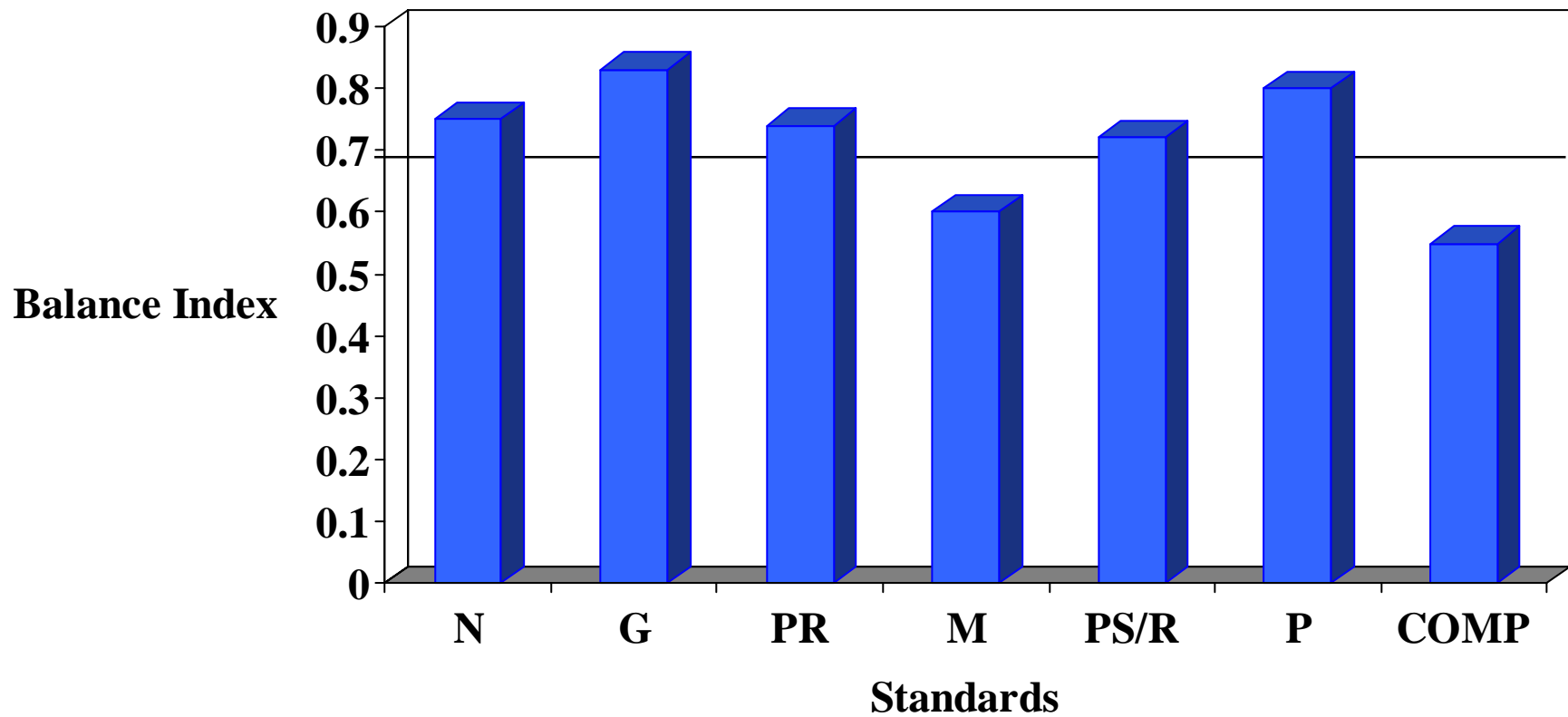
## State B Grade 8 Mathematics





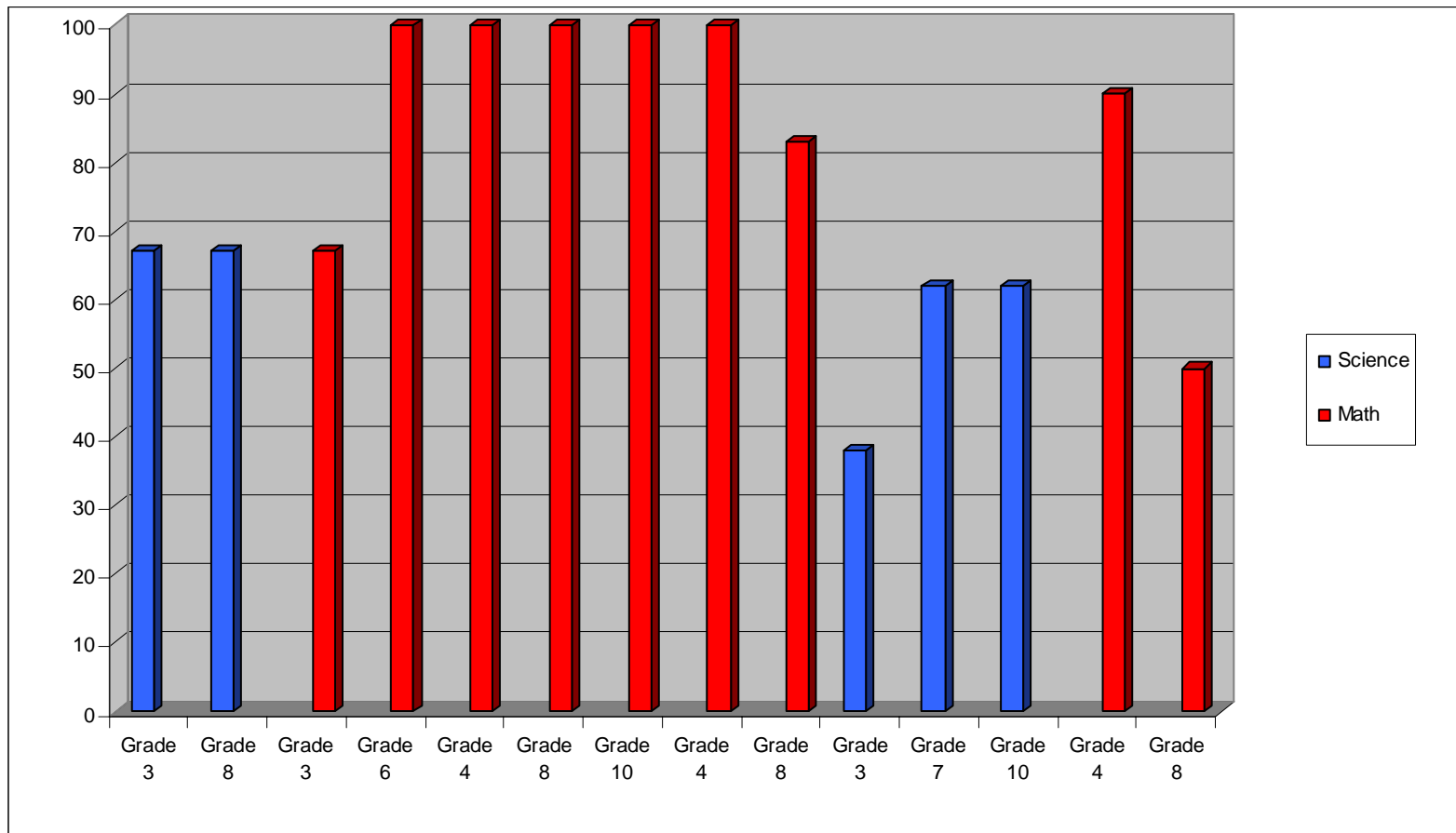
# Balance Index

## State B Grade 8 Mathematics



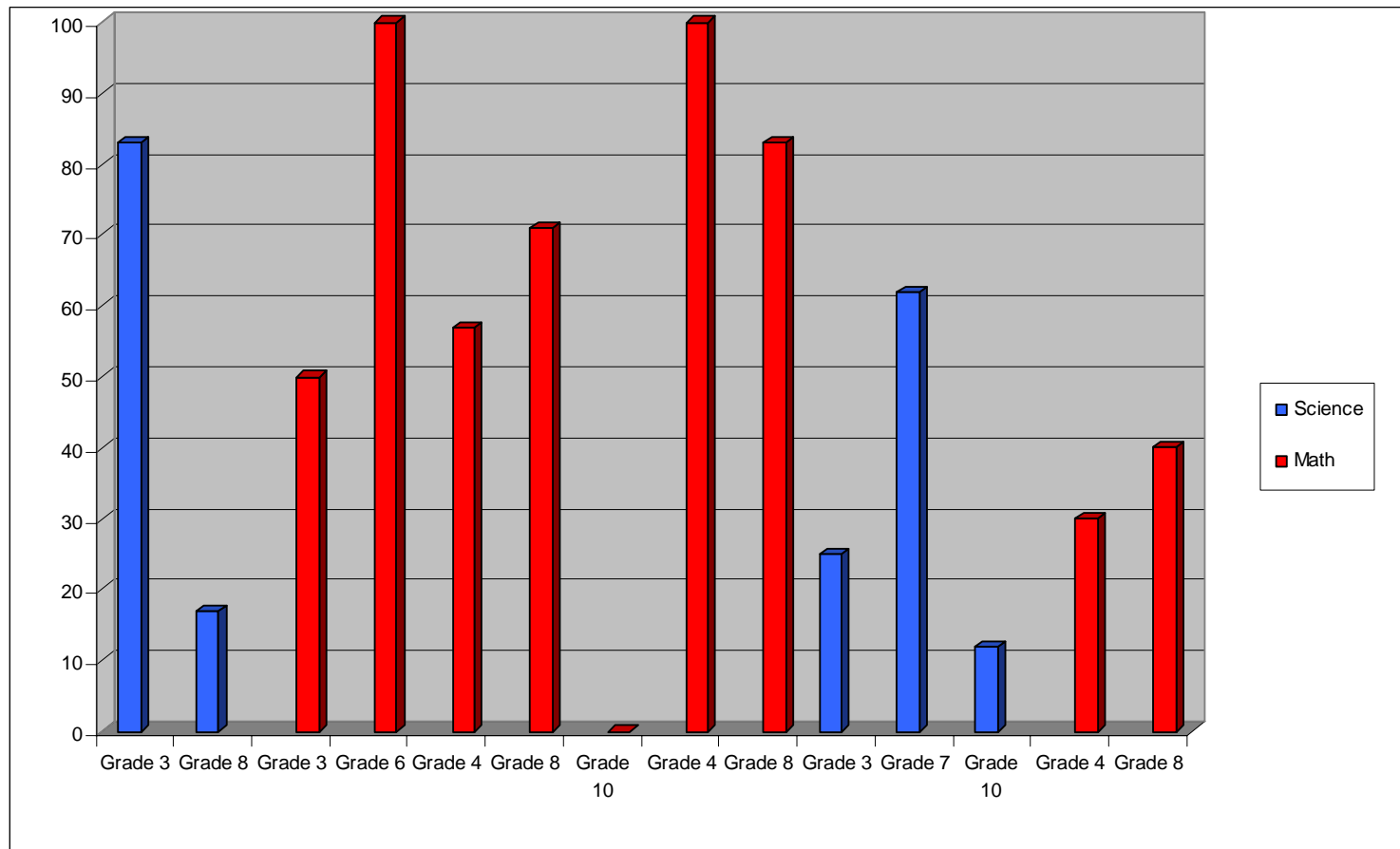
# Four State Study

## Percent of Standards with Acceptable Alignment Category



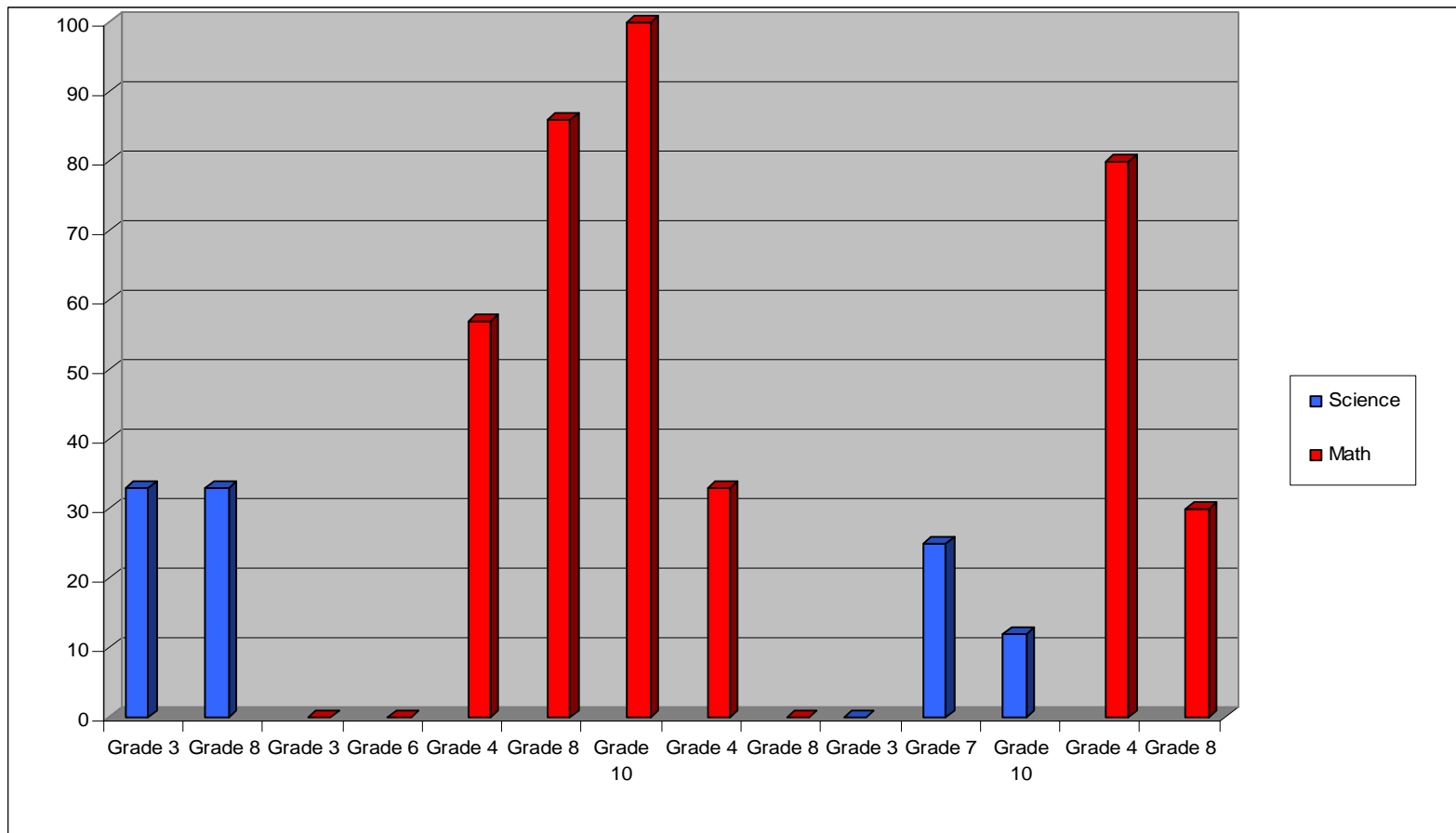
# Four State Study

## Percent of Standards with Acceptable Alignment Depth of Knowledge



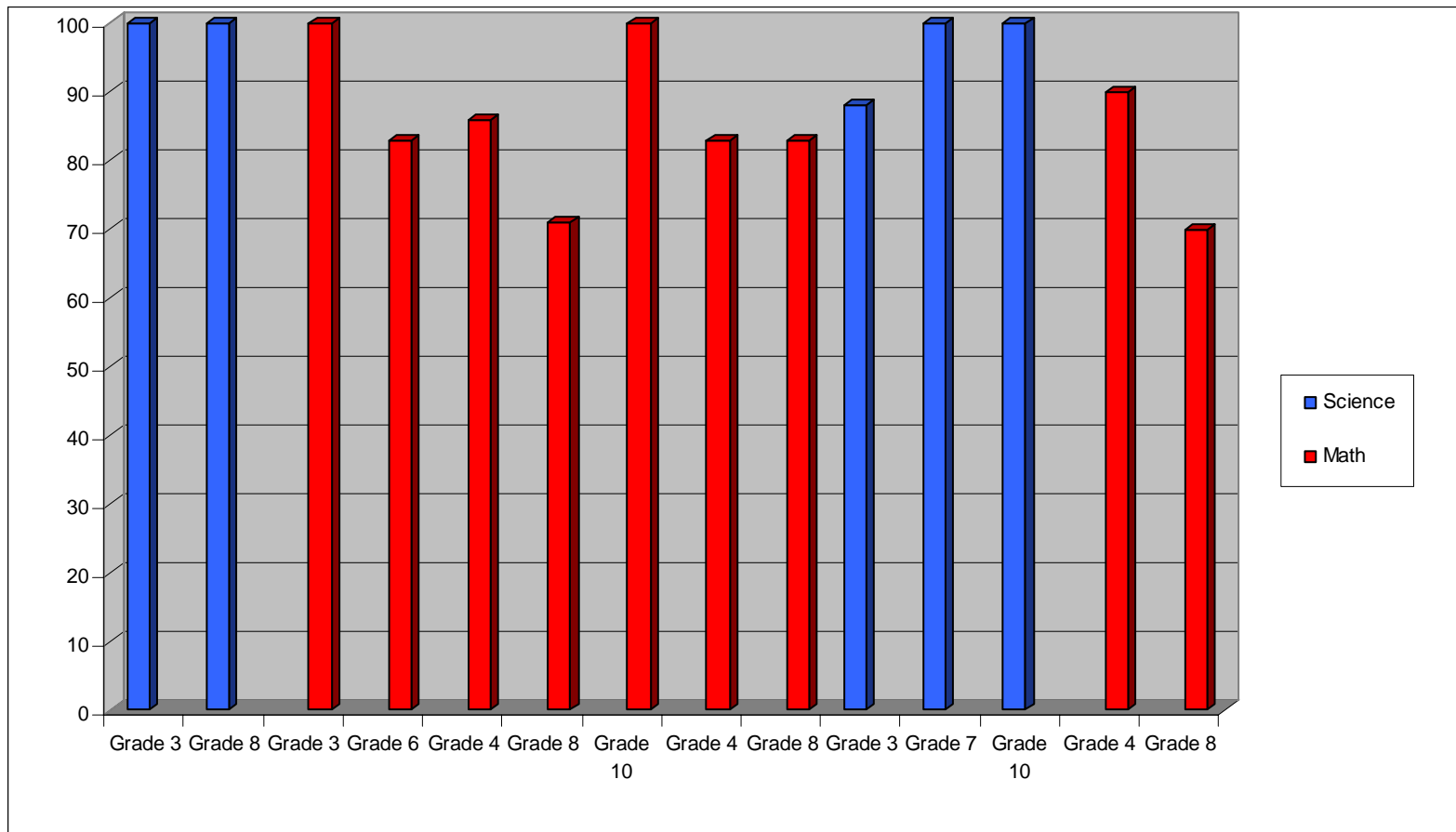
# Four State Study

## Percent of Standards with Acceptable Alignment Range



# Four State Study

## Percent of Standards with Acceptable Alignment Balance



Average Measure Intraclass Correlation of Depth-of-Knowledge  
Levels Ratings for Mathematics

State/Grade	Number of Reviewers	Number of Items	Alpha	95% CI Lower-Upper
A4	4	61	.47	.11-.68
A7	4	61	.93	.89-.95
A7 (Repl)	4	63	.77	.66-.85
A9	4	63	.81	.72-.88
B5	4	49	.79	.67-.87
B8	4	46	.58	.34-.75
C4	4	48	.88	.81-.93
C4 (Repl)	4	52	.89	.84-.93
C8	4	146	.86	.82-.89
C11	4	56	.91	.86-.94
Average			.79	

Average Measure Intraclass Correlation of Depth-of-Knowledge Levels  
Ratings for Language Arts

State/Grade	Number of Reviewers	Number of Items	Alpha	95% CI Lower-Upper
A4	5	84	.52	.34-.67
A7	3	74	.70	.56-.80
A10	3	82	.62	.45-.74
B5	6	38	.79	.66-.88
B8	6	35	.60	.36-.78
B11	6	88	.85	.79-.89
C4	6	45	.92	.88-.95
C8	6	40	.87	.80-.92
C11	6	192	.86	.83-.89
Average			.75	

**Table 1**  
**Categorical Concurrence Between Standards and Assessment as Rated by Four Reviewers**  
**Grade 4 Mathematics**  
**(Number of Assessment Items—65 Multiple Choice Items)**

Standards			Level by Objective			Hits		Categorical Concurr. Acceptable
Title	Goals #	Objs #	Level	# of objs by Level	% w/in std by Level	Mean	S.D.	
I. Number Sense	4	17.75 <sup>1</sup>	1 2	11 7	61 39	26.75	.43	YES
II. Algebra & Functions	2	7.25	1 2	5 2	71 29	20.50	1.12	YES
III. Measurement & Geometry	3	17 <sup>2</sup>	1 2 3	15 1 1	88 6 6	15.25	.43	YES
IV. Statistics, Data Analysis & Probability	2	5	1 2 3	3 1 1	60 20 20	2.75	.43	NO
Total	11	46.75	1 2 3	34 11 2	72 24 4	65.25	.83	

<sup>1</sup>Includes one generic objective because coded items did not correspond to existing objectives.

<sup>2</sup>Includes two generic objectives because coded items did not correspond to existing objectives.



**Table 2**  
**Depth-of-Knowledge Consistency Between Standards and Assessment**  
**as Rated by Four Reviewers**  
**Grade 4 Mathematics**  
 (Number of Assessment Items—65 Multiple Choice Items)

Standards	Level of Item w.r.t. Standard						Depth-of-Knowledge Consistency Acceptable
	% Under		% At		% Above		
Title	Mean	S.D.	Mean	S.D.	Mean	S.D.	
I. Number Sense	26	44	73	44	2	8	YES
II. Algebra & Functions	10	29	88	29	3	8	YES
III. Measurement & Geometry	4	20	95	21	1	7	YES
IV. Statistics, Data Analysis & Probability	50	50	50	50	0	0	WEAK
Total	18	38	81	38	1	7	

Table 3A  
 Range-of-Knowledge Correspondence and Balance of Representation  
 Between Standards and Assessment as Rated by Four Reviewers  
 Grade 4 Mathematics  
 (Number of Assessment Items—65 Multiple Choice Items)

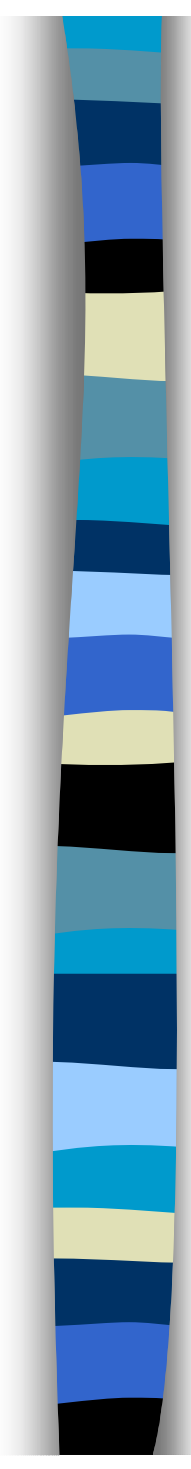
Standards	Range of Objectives				Range of Know. Accent.
	# Objs Hit		% of Total		
Title	Mean	S.D.	Mean	S.D.	
I. Number Sense	13.5	1.80	76	9	YES
II. Algebra & Functions	5.25	.43	72	2	YES
III. Meas. & Geometry	11.50	.50	68	3	YES
IV. Stat., Data Anal.& Probability	2.50	.50	50	10	WEAK
Total	8.19	4.59	67	13	

Table 3B  
 Balance of Representation Between Standards and Assessment  
 as Rated by Four Reviewers  
 Grade 4 Mathematics  
 (Number of Assessment Items—65 Multiple Choice Items)

Standards	Balance Index (1 perfect-0 no Balance)				Balance of Representation Acceptable
	% Hits in Std/Ttl Hits		Index		
Title	Mean	S.D.	Mean	S.D.	
I. Number Sense	41	1	.81	.01	YES
II. Algebra & Functions	31	1	.67	.05	WEAK
III. Meas. & Geometry	23	1	.81	.01	YES
IV. Stat., Data Analysis & Probability	4	1	.96	.07	YES
Total	25	14	.81	.12	

Table 4  
 Summary of Attainment of Acceptable Alignment Level on  
 Four Content Focus Criteria  
 Grade 4 Mathematics  
 (Number of Assessment Items—65 Multiple Choice Items)

Standards	Alignment Criteria			
	Categorical Concurrence	Depth-of- Knowledge Consistency	Range of Knowledge	Balance of Representation
I. Number Sense	YES	YES	YES	YES
II. Algebra & Functions	YES	YES	YES	WEAK
III. Measurement & Geometry	YES	YES	YES	YES
IV. Statistics, Data Analysis & Probability	NO	WEAK	WEAK	YES



What are the  
implications of  
the results?



# IMPLICATIONS

- Confirm quality of assessment items and standards
- Attend to depth-of-knowledge levels
- Write standards at a moderate level of specificity
- Use multiple measures
- Identify acceptable levels for alignment criteria