

Teacher Instructions: Independent Investigation

Grade Level: 6 - 8

Task: Independent Investigation

Standard: Data Analysis, Statistics, and Probability

Design Your Own Independent Math Investigation!

Question: Must have at least 2 components of which comparisons can be made.

Collect Data: May take place as a survey, an observation, or a collection of information from a data base or already compiled resource.

Organize Data: create a chart, table, graph, diagram, or model to organize your information.

Analyze Data: Find mode, median, or mean (which ever are most appropriate for your situation).

Draw Conclusions Based on your Data Analysis: Make conclusions, recommendations, observations, "I noticed..." statements.

Research: Find research that will support or compliment your conclusions. Discuss the reliability of your data based on the research you find.

Context – From the Task Author: This task was given to students after completing many teacher-structured investigations throughout the year. I wanted students to investigate topics that were of particular interest to them, which they would take ownership of and develop enthusiasm for.

What the task accomplishes...

- This task enabled me to assess whether students could apply their skills in statistics, which they had accumulated throughout the year:
 - Systematically collecting, organizing and describing data.
 - Constructing and interpreting tables, charts, and graphs.
 - Making inferences and convincing arguments that are based on data analysis.
 - Developing an appreciation for statistical methods as powerful means for decision making.
 - Showing students that they could structure an investigation to find answers to their own questions was very empowering.

What students will do...

- Students will choose a topic that is of particular interest to them. I had to model how I wanted students to choose two questions about which they could make comparisons.
- Many students chose to compare whether a person's sex made a difference in their responses. Others tried correlate age or grade.
 - Some topics my students came up with included surveys about:
 - Eating habits (comparing what kids bring for snacks to the sugar content of the snacks).

- Recess habits (whether boys or girls tended to socialize more during recess versus participate in a structured activity).
 - Sports (whether girls or boys preferred more aggressive sports).
- I wanted students to include a research piece so they could be more reflective in their responses in regard to reliability.
 - This piece more easily addresses some topics than others and I had to be flexible in my expectations. For instance, a student wanted to see if there was a correlation between students' favorite states, and the states in which students were born. This student's research component was to use an almanac to find the populations of each state obtained in their survey and make comparisons.
 - Other research was more applicable and meaningful. For instance, one student surveyed kindergartners as to the number of numbers and letters they knew and compared the results to the students' sex. The student was then able to compare male and female SAT scores on the verbal and mathematics tests to see if these results correlated with results found with kindergarten age children. The student also compared the amount of time the teacher spent teaching these topics.

Time Required: 1-2 weeks of math classes. Students will become very invested in their topics and may tend to want to spend a great deal of time on this project.

Interdisciplinary Links: This task lends itself more to addressing individual student's preferences than particular curriculum areas. Athletic students chose to research sport topics, one student investigated pick-up trucks, and another art supplies. The list of topics is practically endless, but should be of the student's choosing and appeal to student likes and interests.

Teaching Tips...

- Before choosing topics, I brainstormed with students a list of possibilities to broaden their ideas and encourage them to choose topics that would have meaning to them. I also modeled the choosing a topic and developing interrelated questions.
- Some of my students tried to survey people using telecommunications, but did not get enough responses given time constraints. This would have been a fabulous telecommunications project had we began it early enough. The student who chose to survey students' favorite art supplies, started with the question, "Which are the most popular art schools attended by working artists, and what did the artists enjoy most about the school?" She put her question on an electronic bulletin board and waited for responses. Unfortunately they didn't come fast enough, but given more time she may have come up with some very interesting findings.

Suggested Materials: Databases for research and comparisons (books such as From Home Runs to Housing Costs Data Resource for Teaching Statistics, Dale Seymour Publications); calculators; graph paper; markers; ditto masters for surveys; and telecommunication capabilities

Possible Solution...

- ✓ Solutions will vary.

Benchmark Descriptors:

- The benchmark descriptors and rubric are designed to help the teacher analyze student thinking and understanding at each of the four performance levels.
- The descriptors are generalizations of what student work could look like.
- It is not possible to anticipate every answer a student can give, so in scoring student work the teacher must use these generalizations to come to their own conclusions as to where a student is performing on the assessment.
- It is recommended that teachers create their own task specific rubric by listing the specific math skills that would make up each section of the four performance levels.

Novice

- ✓ A solution that addresses a question created only as a single component.
- ✓ A solution that makes no mathematical conclusions.
- ✓ A solution that misunderstands the task: Creating your own question to investigate which has 2 components of which comparisons can be made.
- ✓ A solution that does not attempt to display information in a meaningful way.
- ✓ A solution that makes no attempt to compare research with investigation results.
- ✓ A solution that has no reasoning or has incorrect reasoning.
- ✓ A solution that has so many mathematical errors that an accurate conclusion could not be drawn.
- ✓ A solution which has week or random collection of information.

Apprentice

- ✓ A solution that attempts to addresses a two-dimensional question.
- ✓ A solution which attempts to make a basic mathematical analysis and/or conclusion.
- ✓ A solution which attempts to display information in a meaningful way.
- ✓ A solution that attempts to compare research with investigation results.
- ✓ A solution that has some correct reasoning.
- ✓ A solution which may have a few mathematical errors.
- ✓ A solution which has a basic method for the collection of information.

Practitioner

- ✓ A solution which addresses a 2 dimensional question.
- ✓ A solution which makes a sound mathematical analysis and conclusion.
- ✓ A solution which displays information in a meaningful way.
- ✓ A solution that compares research with investigation results.
- ✓ A solution that exhibits clear, correct reasoning.
- ✓ A solution free of mathematical errors.
- ✓ A solution with a methodical and reasoned system for data collection.

Expert

- ✓ A solution that addresses a 2 dimensional question and makes a mathematical connection among the 2.
- ✓ A solution that makes a sophisticated mathematical analysis and conclusion.
- ✓ A solution that displays information in a sophisticated fashion (may combine 2 types of information one representation).
- ✓ A solution that compares research with investigation results in a sophisticated manner.

- ✓ A solution that clearly explains reasoning and decision making.
- ✓ A solution in which a sophisticated method of data collection is used (utilizing resources other than simply questioning peers orally, perhaps using a spreadsheet or data base, a written survey, or random sampling).

APS Mathematical Standards...

- ❖ The math standards stated for this task are aligned to the APS Draft Standards 2000.

Strand – Data Analysis, Statistics, and Probability

Students will identify patterns and special features of data and events of chance through experiences with meaningful mathematical problems while focusing on comparing, predicting, representing data, and making decisions to communicate mathematical understanding.

Benchmark (6 – 8): The student will design a data question with two variables and collect, represent and analyze the data. The student will use a variety of graphical representations to display data and understand measures of center and spread. The student will make conjectures and compute simple probability outcomes using a variety of tools.

Performance Standards:

Sixth Grade:

- **Collect** data using a variety of appropriate instruments (e.g., surveys, observations, and interviews).
- **Organize** data using appropriate tools (e.g., frequency tables, stem-and-leaf plots).
- **Conduct** a more complex data analysis project:
 - ❖ **identify** a question
 - ❖ **develop** a hypothesis
 - ❖ **collect** and record data
 - ❖ **represent** data using appropriate grade level statistical tools, and
 - ❖ **describe** and **interpret** data.
- **Draw** conclusions from data using measures of central tendency (e.g., mode, median, mean).
- **Select and develop** appropriate display(s) of data.
- **Develop** and **evaluate** inferences, predictions, and arguments that are based on data.

Eighth Grade:

- **Interpret** relationships between 2 variables using scatter plots and/or multiple line representations.
- **Represent** data using a variety of statistical tools (e.g., circle graphs, box, and whisker plots, and Venn diagrams).
- **Analyze** graphical displays of data for misuse, distortions, or misleading representations.
- **Use** data samples to make predictions about larger populations.
- **Conduct** a more complex data analysis project:
 - ❖ **identify** a question,
 - ❖ **develop** a hypothesis,

- ❖ **collect** and **record** data,
- ❖ **represent** data using appropriate grade level statistical tools, and
- ❖ **describe** and **analyze** data.
- ❖ **analyze** data using measures of central tendency (e.g. mean, median, mode).
- ❖ **interpret** data and **make conclusions** from data.

Strand - Global Mathematical Processes:

Students will understand and use mathematical process.

Benchmark (K - 12): The student will use problem solving, reasoning and proof, communication, connections, and representation as appropriate in all mathematical experiences.

Performance Standards:

Grades Kindergarten through twelve:

- **Develops** resourcefulness and perseverance in problem solving in mathematics and other disciplines.
- **Recognizes** when to use previously learned strategies to solve new problems.
- **Develops and uses** strategies for solving given problems.
- **Monitors and reflects** on the process of mathematical problem solving.
- **Makes and investigates** mathematical conjectures and use them successfully in developing and evaluating mathematical arguments and proofs.
- **Uses** the concept of counterexample to test the legitimacy of an argument.
- **Develops** a logical sequence of arguments leading to a valid conclusion or solution to a problem (statement/reasons, proof, informal proof, and algebraic steps).
- **Works** in teams to share ideas, to develop and coordinate group approaches to problems, and to share from each other in communicating findings.
- **Relates** applications to mathematical language in various modalities.
- **Communicates** mathematical thinking coherently and clearly to others.
- **Analyzes and evaluates** mathematical thinking and strategies of others.
- **Identifies** and **connects** functions with real-world applications.
- **Identifies** how seemingly different mathematical situations may be essentially the same (e.g. the intersection of two lines is the same as the solution to a system of linear equations).
- **Investigates** and **explains** the mathematics required for various careers.
- **Recognizes** and **applies** mathematics in contexts outside the mathematics course.
- **Develops** a repertoire of mathematical representation that can be used purposefully, and appropriately interchangeably (e.g. pictures, written symbols, oral language, real-world situations, and manipulative models).
- **Selects, applies, and translates** among mathematical representations to solve problems.
- **Uses** representations to model and interpret physical, social, and mathematical phenomena.

Scoring Note: Student work is from a fifth grade class. When scoring your student's work base their performance level on appropriate grade level standards.

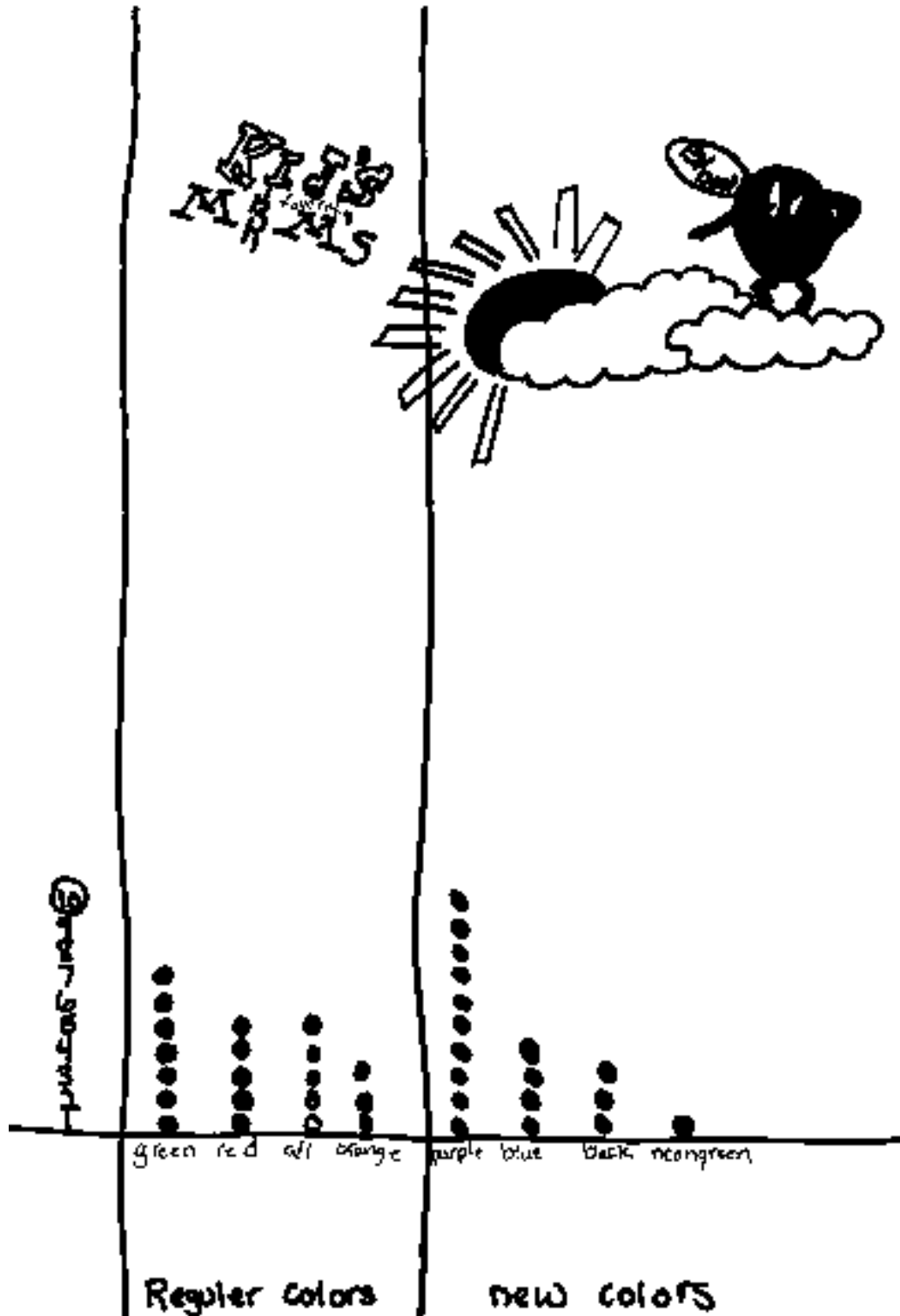
Benchmark Papers

NOVICE

Sam and I went around the 4th and 5th grade class asking kids what their favorite color M&M's are, and if they could choose a new color, what it would be? The kids in our class' favorite original color M&M's was 37% of the people liked green, 26% of the people liked red, 26% of the people liked all of the colors, and 16% liked orange. On new colors there were 56% liked purple, 26% black, 16% liked blue, and 5% liked neon green.

I think this test isn't reliable because we only asked our class (except for one person who was absent), but it was pretty reliable for Vermont. In the United States and Mexico 54% liked blue, but 53% liked purple. If that's so, purple should have won and they should have made purple too because the percentages are only one apart.

On original colors we compared them to the amount the company makes of each color. They make 18% green, and 37% of the students in our class liked green. They make 28% red and 26% of the people in our class like red, and they make 18% orange and 16% of the people e in our class like orange.



Novice, cont'd

APPRENTICE

I wanted to find out what was the most popular cereal in Mrs. Hasson's Grade 4-5 class, and what was the least popular.

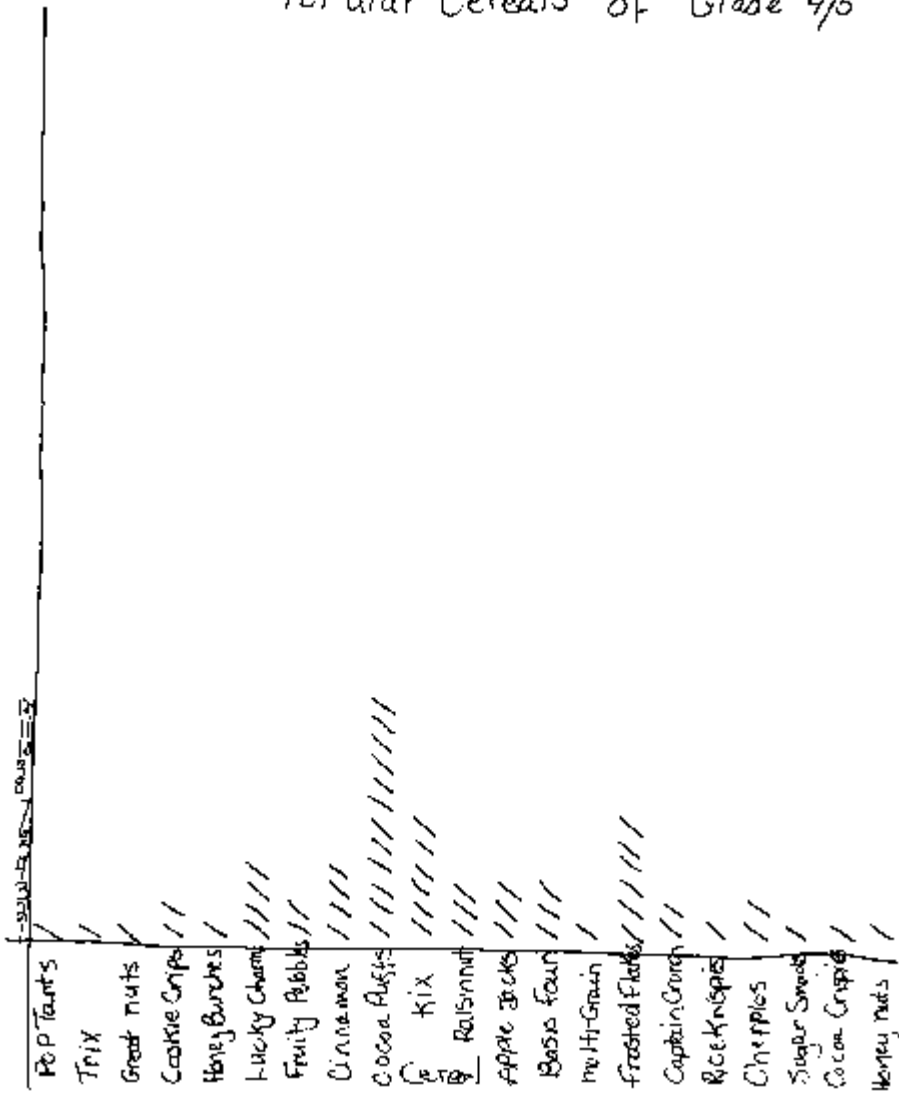
I went and asked the kids in Mrs. Hasson's grade 4-5 to name their top 3 favorite cereals. I collected my data this way because I wanted to have accurate data and I got immediate answers.

Cocoa puffs was the most popular cereal of the kids. It had 12. Kix and Frosted Flakes were tied with 6. The mode was Cocoa Puffs.

The least favorite cereals were Pop-Tarts, Trix, Grape-Nuts, Honeybunches, Multi-Grain, Cheerios, Rice Krispies, Sugar Smacks, Cocoa Krispies, and Honey Nuts.

I noticed by looking at my data that kids my age like cereal with a lot of sugar in it. According to a book "Used Numbers" two of the three most popular cereals of kids in Mrs. Hasson's grade 4-5 are high in sugar; Cocoa Puffs has 9 grams of sugar and Frosted Flaked has 11 grams. One of the popular cereals, Kix, has low sugar with only 3 grams. One reason kids come to school hyper in the morning is because their cereal is high in sugar.

Popular Cereals of Grade 4/5



Apprentice, cont'd

	1	2	3
Jahil	grape	grape	apple grapes
afis	concess	fruits	captain & crunch
Dos	grape	grape	rasan bran
Kelly	grape	grape	flaky pebbles
marcus	grape	grape	grape
Scott	grape	grape	grape
Erio	grape	grape	grape
Sam	grape	grape	kix com pops
Ch	grape	grape	frutisles
Co T	Rob	scor	green pops
Star	kix	kix	cheleuts
mill	kix	kix	grape
Pat	grape	grape	grape
Jr	grape	grape	grape
Leve	grape	grape	grape
Kristen	grape	grape	grape
Just	grape	grape	grape
Bob	grape	grape	grape
Elyse	grape	grape	grape
Emma	grape	grape	grape
EV	grape	grape	grape

Apprentice, cont'd

PRACTITIONER

We just finished a problem that we got to make up by ourselves. Our question was what percentage of kids at Robinson School know what the state bird is, and can more girls or boys answer correctly?

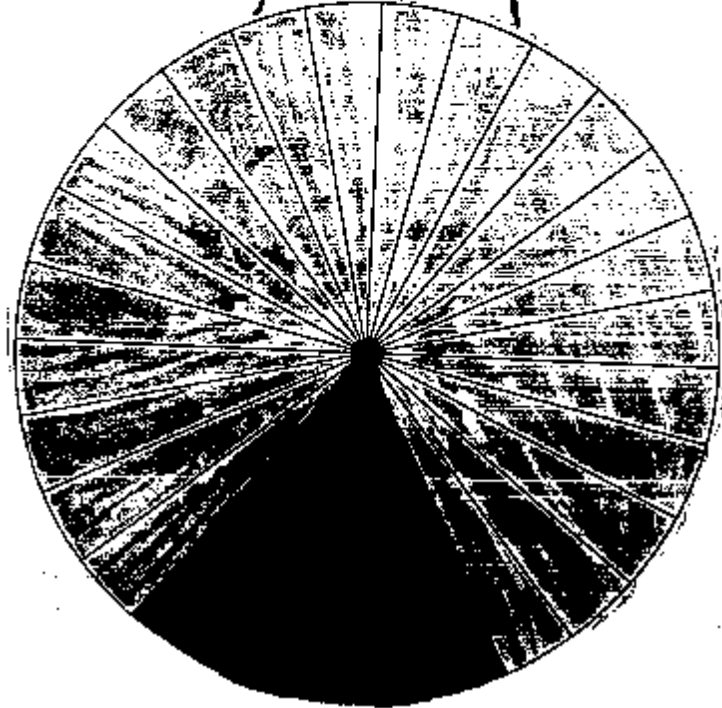
The way we surveyed people was by having 6 pictures of birds mounted on a piece of paper. We asked students to point to Vermont's state bird. Only one of them was the state bird. It turned out that only 40% of the girls surveyed knew the right answer, and only 20% of the boys knew. Not many girls or boys knew the state bird, and I think they should. My partner and I decided to compare our results to how well students in our school did on our CTBS standardized tests in social studies. Kids in our school did better on the CTBS test than they did identifying the state bird. I think kids did better on the CTBS test because there was more a variety of questions, but they should still learn Vermont's state bird, the Hermit Thrush!

DO Kids K-5 at
Robinson know the state
Bird?

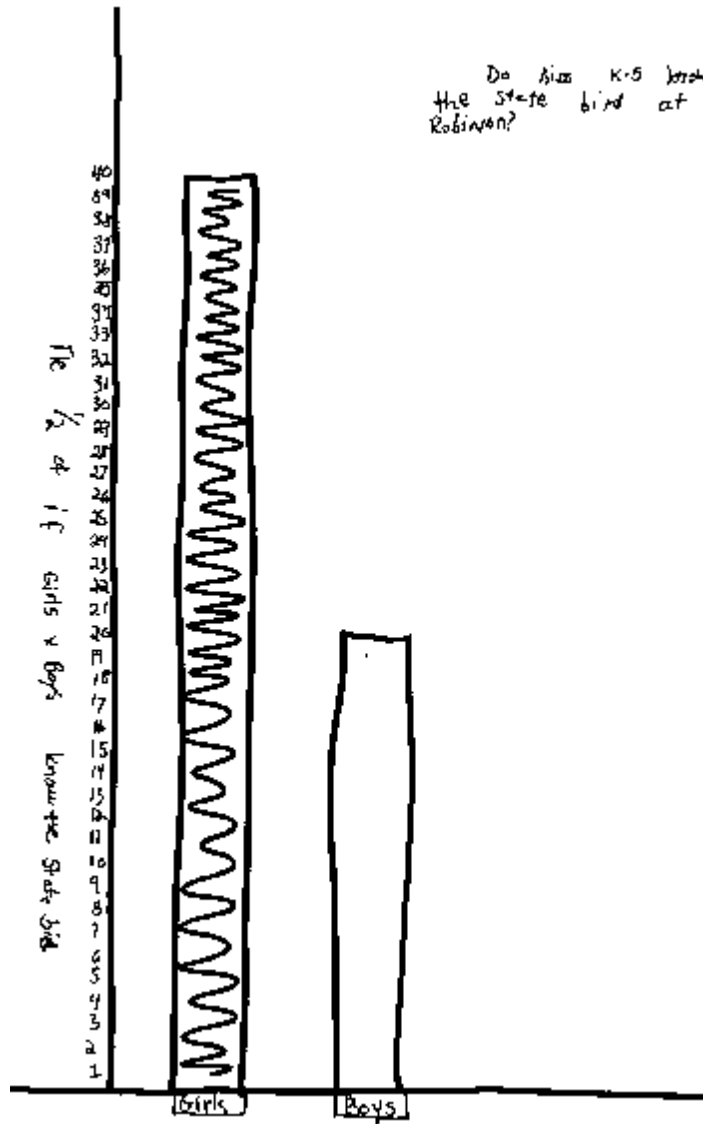
KEY

○ = No

● = Yes



Practitioner, cont'd



Practitioner, cont'd

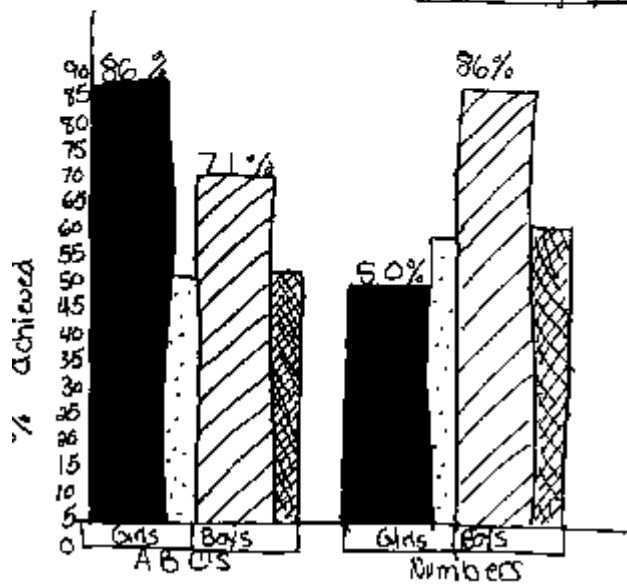
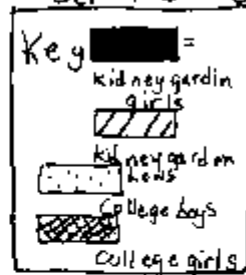
EXPERT

My question was how many kindergarten boys and girls knew their ABC's and can count up to 20 to see if boys or girls learn either faster. First I went to kindergarten and asked 21 of them to recite their ABC's, and then to count to 20. I kept track of my results by writing them down on on a chart. I think my test was fair because I asked all 21 kindergartners the same questions.

86% of the girls knew all of their ABC's, and 86% of the boys could count to 20. From my results of this survey I noticed that kindergarten boys seemed to be stronger in mathematics, and girls stronger in Language arts. Their teacher spends a little more time each day on math (15 minutes) than writing (10 minutes).

I decided to compare these results to SAT results to see if this trend continued using a book called From Home Runs to Housing Costs, and it was close. Boys did slightly better on the mathematics part of the SAT's than girls, but language arts scores of boys and girls were very close. I conclude that girls are just as smart as boys.

Comparison of boys and girls in language arts and mathematics.



Subject

Expert cont'd

Boy's		
NAME	123's	upto
lucan	13	
tommy	20	w-x
Sam	20	2
Randy	20	W
eddie	20	W
bradely	20	W
Josh	20	W
		12 = 14 + 100
		#5 ÷ total x 100
tommy		
Sam		
Randy		
bradely		
Josh		
	$6 \div 7 \times 100$	

Expert, cont'd

SAT® SCORE AVERAGES, 1969-1990

200-800

College-Bound Seniors

200-800

Year	Verbal			Mathematical		
	Men	Women	Total	Men	Women	Total
1967	465	468	466	514	467	492
1968	464	466	466	512	470	492
1969	479	466	463	513	470	493
1970	459	461	460	509	465	488
1971	454	457	455	507	466	489
1972	454	452	453	505	461	481
1973	446	443	445	502	460	481
1974	447	442	444	501	459	480
1975	437	431	434	495	449	472
1976	433	430	411	487	446	472
1977	431	427	427	487	445	470
1978	433	425	429	494	444	468
1979	431	423	427	493	443	467
1980	428	420	424	491	443	466
1981	430	418	424	492	443	466
1982	431	421	426	495	443	467
1983	430	420	420	491	443	466
1984	433	420	426	495	447	471
1985	437	425	431	499	455	475
1986	437	426	431	501	451	475
1987	435	425	430	500	453	475
1988	435	422	428	498	455	476
1989	434	421	427	500	454	476
1990	429	419	424	499	455	476
1991	426	418	422	497	453	474
1992	428	419	423	499	454	476

53.5 | 52.9

62.3 | 57

428
800

Expert, cont'd