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AUTHOR Schauble, Leona; Peel, Tina
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ABSTRACT

Problem solving is a main topic in mathematics education, and considerable headway has been made in identifying the processes involved in solving well-formed problems like algebra word problems, mathematical algorithms, and logical puzzles like the Tower of Hanoi. The "Mathnet" format of the SQUARE ONE TV program, however, requires viewers to reason deductively from a set of premises to a conclusion involving problems that people might grapple with every day, using critical thinking and informal reasoning. A study examined the effects of exposure to three "Mathnet" segments on the informal reasoning, the understanding of mathematical concepts, and ideas and attitudes of third, fourth, fifth, and sixth-grade students. Eighty-six public school children composing four intact classes of the four grade levels viewed the segments during a 3-week period. Data was collected each day from a sample of 3-5 children responding to written items in "Mathnet Logbooks" and participating in group discussions. Results indicate that: (1) "Mathnet" motivated children to engage in problem solving; (2) children in the study displayed more sophisticated kinds of reasoning, readily generating alternative hypotheses resolving discrepancies between the evidence and their theories; (3) children identified instances of mathematics applications in the segments and related calculations performed, but showed incomplete understanding of identified concepts; (4) children appreciated calculator and computer efficiency, but sometimes considered their use as "cheating"; and (5) children could identify activities which required mathematics, but frequently limited such activities to those using numbers. (MDH)

The "Mathnet" Format on Square One:

Children's Informal Problem Solving, Understanding of Mathematical Concepts, and Ideas and Attitudes About Mathematics

Leona Schauble

Tina Peel

With the assistance of:

Carol Sauerhaft

Linda Kreutzer

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We thank the children and staff of Lawrence Public School #2 in Inwood, Long Island, New York, for their participation in the study.

CTW Researchers Carol Sauerhaft and Linda Kreutzer were the engine that made the study run. They worked on every detail from preparing the logbooks to arranging the site to performing the interviews.

EXECUTIVE SUMMARY

The "Mathnet" Format on Square One

Introduction and Method

The study explored "Mathnet" as a context for supporting children's informal problem solving, understanding of mathematical concepts, and ideas and attitudes about mathematics.

The study participants were one class each of third-, fourth-, fifth-, and sixth-graders from a public school in Long Island with a welfare and working-class enrollment. The sample of 86 children was 56 percent boys and 44 percent girls, and was 57 percent white, 27 percent Black, 13 percent Hispanic, and 1 percent Asian. About 75 percent of the children had never watched "Mathnet," whereas about 15 percent had watched it five times or more.

The study lasted for three weeks. During this time each class viewed three entire "Mathnet" stores, titled "Passing Parade," "Missing Baseball," and "Missing Monkey." Order of presentation of segments was rotated across classes. At the end of each day's viewing, 3-5 children were designated the "Mathnet Panel" for the day and participated in a 45-minute in-depth session that included responding to written items in "Mathnet Logbooks" and participating in group discussions. Viewing groups were held constant over the three weeks, and each panel participated once a week, a total of three times. The written and interview items were designed to learn about the thinking processes children

engage in while they watch "Mathnet."

Summary of Results

Informal Problem-Solving

1. "Mathnet" motivated and supported children to engage in informal problem solving. Skills practiced included identifying the problem, generating hypotheses, and interpreting evidence that bears on those hypotheses.

2. The problem solving stimulated by "Mathnet" is not the deductive, logical kind of activity that researchers usually mean when they refer to mathematics problem solving. It is more like the kind of activity described in research on critical thinking and informal reasoning. In everyday reasoning people need to generate the premises and goals of an argument as well as its conclusions, and it is typically not possible to specify the conclusion only from the information given in the problem.

3. Children in the study displayed more sophisticated kinds of reasoning than typically seen in studies of children's reasoning about the simple covariation or lack of covariation between antecedents and outcomes. We speculate that the story structure of "Mathnet" supported reasoning by helping children articulate hypotheses they did and did not believe, and by enabling them to note and interpret evidence that both supported and disconfirmed their own theory.

4. When asked to cite evidence for a theory they believed, children readily mentioned clues from the stories. When pressed to support a theory they did not believe, children were likely to generate alternative hypotheses that resolved

the discrepancy between the evidence and their theory.

5. The three "Mathnet" stories tested varied in their ability to support these informal reasoning skills in children. In particular, "Missing Monkey" presents lines of evidence that support two plausible theories, and includes likeable characters who serve as advocates for both points of view. It is not until the final moments of the story that the seemingly discrepant clues are resolved under one explanation. This structure was very powerful in helping children to acknowledge and to reason about alternative hypotheses.

Viewers' Understanding of Mathematical Concepts

1. Children in our study recalled many instances of mathematics on the show and displayed relatively good understanding of their purpose in relation to the goals of the characters.

2. Children were very interested in the models and diagrams in the episodes but sometimes showed incomplete understanding of them. For example, they could identify the computer model of the baseball field presented on "Missing Baseball," but they misunderstood which angle they should be attending to, to predict the bounce of the baseball. They knew that the circle on the map in "Missing Monkey" represented the gorilla's range of motion, but they did not understand why a circle, instead of a square or an oval, was used to represent this idea. The paper provides examples of good and incomplete comprehension of maps and diagrams, and offers some suggestions for future production of segments involving

maps and diagrams.

3. Children could give examples of calculations performed in the segments, and could explain what purpose the calculations served. They did not follow the calculations themselves. The paper recommends against presenting long sequences of calculations, and recommends instead focusing on one simple mathematical concept at a time and explaining it carefully.

Ideas and/Attitudes about Mathematics

1. Children already knew or learned from "Mathnet" that calculators and computers permit one to do math quickly, easily, and without mistakes. However, some children felt using calculators was "cheating," or might prevent one from learning math. The matter-of-fact use of calculators on the show stimulated some interesting discussions among children about whether one ought to use them.

2. Children have good attitudes about computers but sometimes confuse computers with their applications. For example, many children thought a data base is a computer.

3. Children had interesting and insightful discussions about whether one ought to give up on a problem-solving strategy that does not seem to be working out. The paper recommends that "Mathnet" occasionally show characters explicitly evaluating their progress toward solving a problem, and perhaps considering new paths.

4. Children could supply all kinds of examples of the kinds of mathematical activity presented in "Mathnet." These included calculating, measuring, converting units, using maps and models, using mathematical tools, and using mathematical

concepts to solve problems.

5. Occasionally children used inappropriate criteria for deciding that an activity was mathematics. The younger children frequently insisted that anything with numbers is mathematics. Some of the older children seemed to be confused about the range of problems presented, and concluded that all problems considered by mathematicians must be mathematics. The paper recommends that the staff consider directly addressing some of these issues related to children's meta-knowledge about mathematics.

CONTENTS

INTRODUCTION

The "Mathnet" Format

This study investigates three main issues in the "Mathnet" format included in each Square One program. "Mathnet" is a tongue-in-cheek Dragnet-type spoof that is extremely popular with the Square One audience. It features Kate Monday and George Frankly, members of the Mathnet Squad who are purportedly summoned by citizens of Los Angeles when there are problems to be solved. The problems themselves are humorous and even outlandish, for example, locating a kidnapped rock star or solving a series of strange thefts committed by a gorilla. A daily "Mathnet" segment lasts from five to thirteen minutes (average of about nine minutes), and a series of five of these episodes makes up each weekly dramatic narrative. In each weekly serial, a thematic problem is introduced (Where is the missing baseball? Is a gorilla really committing those robberies?), elaborated, explored, and solved by the Squad and their helpers, who accumulate and evaluate relevant clues and evidence. The thematic problems are typically not mathematical or other formal problems (although they provide the context for the presentation of mathematical problems); rather, they involve the resolution of motivational and dramatic incidents. The characters make frequent use of mathematics and mathematical tools as they attempt to solve the problems.

Main Issues of the Study

The three main issues addressed by the study are:

- How do viewers generate, coordinate, and evaluate hypotheses and evidence concerning the "Mathnet" problems?
- How well do viewers understand the mathematical concepts that stud the series?
- What ideas and attitudes about mathematics do children express in the context of the series?

The Generation and Evaluation of Hypotheses and Evidence

One of Square One's main topics is problem solving. With the simulation tools developed by cognitive science, researchers have made considerable headway in identifying the processes involved in solving well-formed problems like algebra word problems (Mayer, Larkin & Kadane, 1983), mathematical algorithms (VanLehn, 1983), and logical puzzles like the Tower of Hanoi (Anzai & Simon, 1979). However, the problems posed on "Mathnet" are not typically abstract, logical puzzles. Instead of requiring the viewer to reason deductively from a set of given premises to a conclusion, they require that the viewer bring to bear the entire repertoire of his general knowledge to participate in generating the premises, as well as the conclusion, of the problem. Researchers like Simon (1980) make the distinction between logical problems and rich, complex problems like these, which are in form less like mathematical problems and more like the problems people grapple with in everyday reasoning tasks. There are currently several lines of research that explore the kinds of difficulties people encounter in informal everday problem solving of this kind.

Current research on critical thinking (Chipman & Segal, 1985; Glaser, 1984; Johnson-Laird, 1985; Kuhn, 1987), children's problem solving (Karmiloff-Smith & Inhelder, 1975), adult judgment

(Nisbett & Ross, 1980; Kahneman, Slovic & Tversky, 1982), and informal reasoning (Kuhn, 1986; Perkins, 1982, 1984; Perkins, Allen & Haffner, 1983) converges on the conclusion that one focal difficulty for people is that, in everyday reasoning tasks of only moderate complexity, they often fail to even consider points of view other than their own. In addition, they frequently have difficulty differentiating between their hypotheses and the evidence that supports them, as well as having trouble generating counterarguments and supporting evidence for them. Finally, people tend to evaluate identical patterns of evidence differently, depending upon whether the evidence confirms or disconfirms their own beliefs (Amsel, 1986; Jennings Amabile & Ross, 1982; Kuhn, Amsel & O'Loughlin, in press). As Perkins (1984) summarizes the problem:

> Sins of omission constitute the greatest weakness of informal reasoning. An argument typically fails not because a person cannot think of an argument or because the argument a person generates has no logical bearing, but rather because a number of other lines of argument, some of them independent of the given argument and some qualifying it, need consideration, too (p. 13).

Many educational researchers feel that the best way to improve critical reasoning skills is not to try to teach them directly as principles or rules, but to provide opportunity for their practice in a variety of domains (Glaser, 1984; Kuhn, 1987).

Because of its detective theme, and because it sustains uncertainty and suspense over a week's worth of episodes, "Mathnet" seems an ideal stimulus for encouraging viewers to

practice problem-solving strategies related to the generation and evaluation of alternative hypotheses and related evidence. Over a three-week period, we repeatedly invited children to engage in this type of thinking, using three "Mathnet" stories as the stimulus. As we shall explain in the Method section, the children viewed "Mathnet" and participated in carefully designed interviews. Because the interviews were very much part of the intervention, the study does not evaluate whether viewing "Mathnet" alone encourages good informal reasoning. Rather, our objective was to learn which "Mathnet" episodes do better or worse at supporting informal reasoning, and to make some inferences about why.

Viewers' Understanding of Mathematical Concepts

By design, the "Mathnet" plots provide several occasions when characters use mathematics and mathematical tools for achieving their goals. For example, Ginny draws a circle on a map to delineate how far a helicopter might have flown in any direction; George calculates how many viewers can be accommodated along a parade route; Kate uses the concept of angle of ascent to select among possible routes taken by a van during a kidnapping. The intent is to portray people using mathematics in a practical way in their everyday lives, and not to work through the mathematics of any particular case in great detail. However, it is difficult on an *ad hoc* basis to be confident about the best trade-off between presentation and explication of the mathematics. If difficult mathematical ideas are presented only in passing, we risk the possibility that they may be assimilated to, or perhaps even reinforce, children's existing misconceptions. On the other

hand, focusing too much on low-level calculations or explanation may obscure instead of illuminating the relation between the mathematical practice and its function in the plot. Thus, the study attempts to identify occasions when our viewers show good understanding of these embedded mathematical ideas, as well as to identify instances when children misunderstood. Again, the objective is to increase our confidence in future production about those concepts that will require more and less careful explanation.

Ideas and Attitudes About Mathematics

The third major objective of the study is to use "Mathnet" as a lens through which to observe children's attitudes about certain mathematical practices. The "Mathnet" adventures provide a natural context for asking children whether it might be a good idea for George to use a calculator on that problem, whether it is ever preferable to do problems "in your head," or whether Kate and George ought to have given up or persisted on a particular fruitless problem-solving strategy.

In addition, we wanted to know how viewing "Mathnet" would shape children's ideas about what mathematics is. On several occasions over the three weeks of the study, we used a context or situation in the plot to ask viewers about various practices: were they or were they not mathematics? We were interested in identifying the kinds of criteria for children's judgments about practices that are and are not mathematics. These items in the study will help us decide whether we are giving children the kind of picture of mathematics we would most like them to have.

The remainder of this paper will have the following

structure: The Method section, which follows immediately, will describe the subjects, design, items, and procedure of the study. The Results section will present results with short discussion for each of the 15 "Mathnet" segments. The Discussion section will review the implications of the results for each of the three major themes of the study: generation and evaluation of hypotheses and evidence, understanding of mathematical concepts, and ideas and attitudes about mathematics.

METHOD

Subjects

Socioeconomic Background, Ethnicity, and Gender

A total of 86 children from Lawrence Public School #2 in Inwood, Long Island, participated in the study. The school included students from socioeconomic backgrounds that ranged from welfare level (approximately 30 percent) through lower-middle class (approximately 70 percent). The school's racial composition was described by the principal as 68.5 percent white, 30 percent black, and 1.5 percent "other."

Our sample in the school was one intact class each from the third, fourth, and fifth grades, selected by the principal as "average ability" students. The sixth grade sample, however, was an amalgamation of two of the school's sixth grade math groups. Both these groups were functioning below grade level in mathematics, ranging from slightly below to more than two years below grade level. These below grade-level students were selected for logistical, not conceptual reasons. Occasionally our data show performance by the sixth-graders that is inferior to the performance of younger grades. We suspect that these results are due to this group being a low math-ability group.

As Table 1 indicates, the ethnic composition of our sample includes a much higher proportion of Hispanic students than were reported in the total school population.

Table 1

Ethnic Composition of the Sample in Percentages (N=86)

	Grade 3	4	5	6	Total
White	57%	64%	71%	45%	59%
Black	17%	23%	24%	45%	27%
Hispanic	26%	9%	5%	10%	13%
Other	-	5%	-	-	1%

The total sample was approximately 56 percent boys and 44 percent girls. Table 2 indicates the numbers of boys and girls in each of the classes.

Table 2

Frequencies of Boys and Girls by Grade

	Grade 3	4	5	6	Total
	(N=23)	(N=22)	(N=21)	(N=20)	(N=86)
Bovs	47.8%	50.0%	57.1%	70.0%	55.8%
Girls	52.2%	50.0%	42.9%	30.0%	44.2%

Viewing History and Assignment to Viewing Groups

The week before the study began, teachers administered questionnaires concerning the children's familiarity with Square One. The questionnaires asked children to indicate whether they had ever viewed the program, to estimate how many times they had watched it, and to check the "Mathnet" episodes they had seen.

As Table 3 indicates, this was not a sample that had a lot of previous exposure to Square One, mostly because at the time the questionnaires were administered, the program had been on the air for only three weeks. Viewership was higher among the fifth and sixth grades than among the third and fourth, and girls accounted for a slightly greater percentage of the viewers than boys.

Table 3

Percentages of Children in the Sample (N=86)

Indicating They Have Ever Watched Square One

	Grade				
	3	4	5	6	Total
Yes	15%	9%	38%	33%	23.5%
No	85%	91%	62%	67%	76.5%

Of those children who reported having watched the show, about one-third reported that they had watched it only one or two times, whereas two-thirds reported having watched it five times or

more. On a separate list, we asked children to check off the "Mathnet" episodes they had watched, and we included some distractors so that we would have a check on the accuracy of the children's self-reporting. The patterns of their responses lead us to believe that about 13 of the total 86 children were likely to have watched at least five times or more, meaning they were likely to have seen the "Mathnet" segments we would be using as the stimulus. These children were carefully spread across viewing groups, so that they did not cluster into one group. Their names were flagged on the subject roster, so that interviewers would be warned to encourage other children to respond first when group discussion might be adversely affected by prior viewing.

Children were assigned to viewing groups of from 3 to 5 children, depending on the total number of children in each classroom. There were five viewing groups in each of the four classes. Most of the groups were same-gender groups, but one of the groups from each class was a mixed-gender group. A deliberate attempt was made to spread frequent viewers across the viewing groups. Viewing groups were kept constant across the study.

Design

This study was an observational repeated measures design. Each class of children viewed three entire "Mathnet" stories over the course of a three-week period. Each day a viewing group of children was removed from the classroom at the conclusion of viewing to participate as the "Mathnet Panel" for the day. The Mathnet Panel filled out activity logbooks with items related to the day's program, and participated in group interviews about the

episode. Each viewing group served as the Mathnet Panel once a week, a total of three times during the three-week study.

The three "Mathnet" stories were chosen because they were the first three aired, and thus were not going to be on the air during the weeks that the study was running. In addition, each of these episodes (entitled "Missing Baseball," "Passing Parade," and "Missing Monkey") shares the theme of a search for something or someone who is missing. Therefore, we thought we could design items comparable enough to permit making some conclusions about more and less effective production treatments of similar issues.

The study is not an evaluation of the series, designed to tell us what concepts children learned or failed to learn. Instead, it is an observational study that attempts to specify in more detail the <u>processes</u> of thinking that children engage in while they watch "Mathnet." Rather than conclusively documenting the successes and failures of the format, the data provide clearer notions about <u>why</u> a particular approach succeeds or fails, yielding diagnostic information that is useful for future rounds of production. However, necessarily, the very interviewing that provides this diagnostic information becomes part of the intervention. Consequently, it is unrealistic to expect that this study is necessarily an accurate account of the kinds of thinking that children engage in when interviewers are <u>not</u> asking them carefully directed questions about what they are watching (although it may well be a fair test of children's thinking when <u>Square One</u> is used in a school setting by a skillful teacher). Rather, it is a best-test case, a way of ascertaining what is possible, a picture which we will have to revise based on our best

knowledge about what is typical. Given unlimited time and money, this kind of fine-grained assessment would be nicely complemented with more traditional pre/post snapshots in a more naturalistic viewing context.

To cancel out possible effects of viewing order, order of the three "Mathnet" sequels was rotated across grades, as indicated in Table 4.

Table 4

Order of Viewing by Grade

Segment	Grade 3	Grade 4	Grade 5	Grade 6
Passing Parade	Week 3	Week 1	Week 3	Week 1
Missing Baseball	Week 2	Week 2	Week 2	Week 2
Missing Monkey	Week 1	Week 3	Week 1	Week 3

In addition, because we tended to have different kinds of items in the early part of a weekly sequel (focusing on hypothesis generation) than at the end of a sequel (focusing on what we have seen that is mathematics), we rotated the viewing groups so that children in any given "Mathnet Panel" would serve once at the beginning, once at the middle, and once at the end of the weekly sequel. Arbitrarily, each of the 5 viewing groups in each grade was was labelled as Group A, Group B, C, D, or E. The pattern of selection of groups is indicated in Table 5.

Table 5

Order of Selection of Viewing Groups

	Monday	Tuesday	Wednesday	Thursday	Friday
Week					
1	A	B	C	D	E
2	D	E	A	B	C
3	B	C	D	E	A

Procedure

On the first day of the study, the two (female) interviewers entered each classroom and explained the purpose and procedures of the study to the children (see "Introduction to the Study," Appendix A). Then children sat in their regularly assigned seats while that day's "Mathnet" episode was shown on a half-inch VCR deck with a large color monitor. Immediately following the end of the daily viewing, the interviewers called out the names of that day's Mathnet Panel. Those children went with the interviewers to a separate small room with a round table. Children sat around the table while the interviewers conducted and audiotaped the interviews. The in-class viewing and Mathnet Panel typically lasted approximately a total of one hour.

There were two kinds of items in each Mathnet Panel session. Children were asked to respond individually in writing to certain items, which were presented in a special Mathnet Logbook prepared for each of the 15 segments. While they filled

out their logbooks, children listened to the interviewer read the question or task description aloud. Then they worked alone until finished. We included Logbook items when we wanted to keep account of the responses of individual children, unaffected by the answers of others. Logbook items included written questions and activities. At certain points, the interviewer would pose a question for discussion by the group of children. This was typically done when we wanted some idea about the range of topics the children might be able to generate, or when we had a difficult or controversial problem where our interest was in observing the range of solutions and opinions and children's attempts to argue their point of view with others. These discussions were audiotaped; the audiotapes are on file at CTW offices for interested researchers. A complete set of items and Mathnet Logbooks is appended to this report (Appendix B). The items are designed not to assess children's competence at some criterial level, but to diagnose what knowledge, ideas, and perceptions children do have in relation to the concepts of interest.

RESULTS

This section discusses results pertaining to each of the five segments in the three "Mathnet" sequels, a total of fifteen segments in all. Those who are unfamiliar with those segments will find short descriptions of them in Appendix C, Segment Descriptions. For each of the segments, under "Bulletins" we first present a brief summary of the most important findings; then we present an item-by-item analysis. Each item is labelled as (LOG), an item answered by children in writing in their logbooks, (DISCUSSION), or group interview, or in some cases (LOG AND DISCUSSION), when a question was introduced in the logbooks and followed up in group discussions.

Because sample sizes for any one item are small (ranging from 14-17 children) the analyses do not make use of sophisticated statistical techniques, but are reported in frequencies and percentages.

Passing Parade

Episode One

Bulletins:

* The segment began with a lot of detailed calculation and "math business" concerning the upcoming parade. For the most part, children at all grades followed the point of the mathematics although they did not necessarily follow the steps of the calculations.

* Children expressed some prejudices against the use of calculators to solve math problems.

* Younger children seemed to have some difficulty assimilating the abrupt switch of problem that occurred at the end of the segment,

when George received the phone call reporting Steve Stringbean's kidnapping.

Item by Item Analysis:

1. (LOG AND DISCUSSION): What is the problem that the Mathnet Squad must solve?

Of the 13 children in the viewing groups that responded to this question, only 2 (both fifth-graders) spontaneously mentioned in their logbooks the specifically mathematical help which George and Kate gave. However, in the followup discussions, the third-graders also mentioned specific math from the show ("He told the Mathnet people to do how many horses we need, how many officers"). Many of the children gave general, vague responses ("They know better math," "Keep things from going wrong"), and the sixth-graders were preoccupied with the recognition that the most important thing was to find Steve Stringbean, ignoring the fact that Steve was not missing when the Chief asked for the Mathnetters' help.

2. (DISCUSSION): Why did Kate and George look at a map to figure out how much time the parade would take?

The sixth-graders (and one third-grader as well) seemed to recognize the conceptual problem involved in using a map for telling time ("A map isn't good for telling how much time something takes; it tells you where to go"). Most of the other children blithely transformed the question into their own understanding of what a map does, without making the conscious

translation between distance and time ("You can look how far it will be and how many miles it would be to go somewhere"). However, in each of the third, fourth, and fifth grade discussion groups, at least one child overtly mentioned the distance-to-time transformation: ("If it takes 1 hour to go 2 miles, then he could look at a map, then he could see how long it would take, like measure with a ruler and see how long the parade was"). This seems to be an idea that viewers pick up on; throughout the study children often discussed the relation between map distance and miles and time of travel.

3. (LOG): Why did George and Kate think that there might not be enough time for the parade?

This proved a difficult question. Many of the children focused on the need for Steve Stringbean to catch his plane (all of the third-grade responses centered around this idea, and so did several of the older children's). About 38 percent of the children wrote responses that mentioned the "back of the parade" problem. If we ever deal with this concept again, we might try to think of some form of diagram or model that could clarify the issue beyond simply describing the problem.

4. (LOG AND DISCUSSION): Why did the Chief want to know how many people might come to the parade?

We posed this question because we were interested in knowing whether children saw the functional reason for all this mathematical calculation. Most of the children appropriately mentioned the goals of managing the traffic and a need to figure

out how many police officers should be on duty. A couple of children simply misunderstood the question, thinking we were referring to the number of participants in the parade.

5a. (DISCUSSION) What is this (map Kate and George used to figure out how many spectators might line the parade route)?

In response to this question, most children merely mentioned a map, which is used to indicate streets, routes, and distances. One-third of the responses (some children in every grade except the fourth) referred in addition to the fact that the map had been used to figure out how many people might come to the parade ("See all those blocks? One person could go in each block. That's two feet each, so how many people in a block").

5b. (DISCUSSION): George used a calculator to learn how many feet there are in 3.2 miles. Why didn't he just do his multiplication on the blackboard?

Children in all grades agreed that a calculator would be faster. In addition, the younger children pointed out that "that was a hard example," and the older children pointed out that it is easier to avoid errors when you use a calculator.

5c. (DISCUSSION): You can do math many ways: you can use your head, pencil and paper, and a calculator. Is it sometimes better to do a problem with a calculator?

Children were split about 50/50, half pointing out that the calculator is faster and easier and half claiming "You don't learn anything if you use a calculator," or "Using a calculator is

like cheating on a test or something." The argument is perhaps best summarized in this snippet of exchange between two third-graders:

> "You shouldn't use a calculator. You learn better by multiplying it out."
>
> "I don't think that's the point of it all. You already know enough division, multiplication, times. In police activity you would need calculators 'cause it takes time to think it up in your head. You can't take time while they're probably going to commit a crime; you won't catch them. If you already know this math, you can learn more, but not while you're trying to solve a crime."

It is interesting that this calculator prejudice still waxes so strong, although it is probably the case that the attitude varies from school to school. In any case, it seems like an important idea to continue to address.

5d. (DISCUSSION): Is it sometimes better to do problems in your head instead of with a calculator?

All the children generally agreed that easy problems should be done in your head because it's faster.

6. (LOG): The Chief did not have enough police officers for the parade. How did the Mathnetters solve the problem?

A few children, in particular the third-graders, gave very literal, low-level answers: "They helped by subtracting." But about 40 percent said in some form or another that "they solved it by putting some on horses and some on foot." This may not be a bad performance in relation to a complicated, quickly presented bit of calculation.

7. (LOG): What is the most important problem of the parade?

The focus of this Mathnet episode is working out problems related to the management of the parade details. However, at the

very end of the segment, George takes a phone call that brings the news that Steve Stringbean has been kidnapped. About 70 percent of the children realized that the fundamental problem the Mathnetters had to deal with had shifted. However, about 30 percent were still focusing on how to keep him from missing his plane; younger children mentioned this problem more frequently than older ones did.

Episode Two

Bulletins:

* By episode two, all of the children understand that the main problem is to find Steve Stringbean, not to worry about details of the parade.

* All the children except two younger ones understood the bottle angle (pun intended).

* The notion of Rimshot counting off the turns is difficult, but it seemed a very interesting idea to the kids. They continued to mention it in subsequent episodes.

* The younger children are not as quick as the older ones to grab onto the implications of changes in the plot. The fifth- and sixth- graders are quite quick to attribute meaning to new clues. For example, this episode ended with Rimshot finding the bottle in the hideout. The younger children failed to cite that clue when they were asked how Rimshot knew Steve had been in the hideout. It's as if the implications of new information sink in more slowly with the third- and fourth- graders.

Item-by-Item Analysis:

1. (LOG AND DISCUSSION): What is the most important problem of

the parade?

At the completion of episode one, 30 percent of the children were still talking about the necessity of getting Steve to his plane on time. Although this is still mentioned by one-quarter of the children (total N of 14), all except 2 of the third-graders now realize that the main problem is that Steve is missing.

2a. (DISCUSSION): How could Rimshot tell when the truck began to go up a hill?

Children in all age groups mentioned the celery tonic bottle as the main clue ("He had some bottle, and it was tipping. When it tips, that means it's going up a hill"). However, in addition, several children insisted Rimshot could have felt the van going up a hill. This is certainly plausible, perhaps more immediately plausible than noting the angle of the celery tonic. In three of the four groups, children also mentioned Rimshot's counting, perhaps mistakenly thinking that this had something to do with knowing that they were going up a hill. As we shall see when we discuss question 3, that is probably because their understanding of the counting strategy was a little shakey.

2b. (LOG): Draw a line to show how the surface of the celery tonic would look in the bottle when Steve's van was NOT on a hill.

All of the children performed this task correctly. Most drew a level line parallel with the bottom of the bottle. A different strategy, also counted as correct, was used by two fifth-graders, who drew a U-shaped inverted curve. The top of the

U was parallel with the bottom of the bottle.

2b. (LOG): Draw a line to show how the surface of the celery tonic looked in the bottle when Steve's van was going up the hill.

Children did very well on this task. Only one third-grader and one fourth-grader were scored wrong. The third-grader drew the line parallel to the bottom of the bottle, but at a lower level than the surface he drew in the first bottle. The fourth-grader drew a line parallel to the bottom, but erased it and changed it after peeking at the angled line drawn by another child. Clearly he knew the other response was the better one.

A strategy we did not anticipate, but which we counted as correct, was used by one fifth-grader and one-sixth grader. These children drew a vertical line from the top to the bottom of the bottle. We counted them correct in spite of the fact that it would have to be a VERY STEEP hill.

3. (LOG): Why was Rimshot counting with his eyes closed?

Almost all of the children realized that Rimshot was counting so that he would know where to go. However, the younger children tended to give answers like, "so he could concentrate" (possibly trying to explain why Rimshot's eyes were closed instead of explaining why he was counting--a fair interpretation of the question), and the older ones had the notion that counting was a way of estimating elapsed duration that the van had been driving. Only a couple of the children specifically mentioned knowing when to turn. Even though this concept seems to have been rather

imperfectly understood, the children seemed quite taken by the idea that simple counting could provide you with this kind of information. As we shall see when we review later episodes, it was a frequently-mentioned example of using mathematics to solve problems.

4. (LOG): How did Rimshot find out for sure that Steve Stringbean had been in the hideout?

All the older children mentioned the tonic bottle as evidence that Steve had been in the hideout. However, the third- and fourth-graders were apparently still thinking about earlier clues: they mentioned the fact that Rimshot looked out the window of the van when it stopped, that he counted the beats, and that he noticed the tire tracks. Only two of the younger children, one in the third and one in fourth grade, mentioned the celery tonic bottle in the shack. Just as the younger children were slower to realize that the fundamental problem had changed when Steve got kidnapped, they also seemed slower to ascribe meaning to the new clue of the tonic bottle.

5. (DISCUSSION): Do you think it was a good idea for the Chief to send mathematicians to look for Steve Stringbean?

We were interested here in children's notions concerning what mathematicians and mathematics might have to do with the problem at hand. In fact, the third-graders felt that using mathematicians in this situation might not be a good idea. They expressed concern that Kate and George might get hurt, because "they don't have real guns, only calculators." It seems the third-graders took the "Mathematicians, freeze!" spoof quite literally.

The fourth-graders, on the other hand, agreed that the mathematicians had been helpful. "They helped with the counting," "figured out with the bottle," and "knew how many miles they went." One child explained, "They think better than real police." However, the fourth-graders also agreed that a real detective would not make the "silly" mistake of "trying to use the calculator to shoot the guys."

The fifth-graders pointed out that the Chief might have sent a swat team, police, or a helicopter, but concluded, "They're better off with Mathnet. They could find him easier with their calculators, their compasses." The sixth grade also voted thumbs up for the Mathnet squad: "Yes, because they knew math and can keep track of clues." "They solved a lot of mysteries. They try to solve a mystery using math." "Yes, mathematicians solve problems."

Episode Three

Bulletins:

* When asked, "What did you see and hear today that might make you think (a particular hypothesis is true)?", children indiscriminately offered up alternative hypotheses and evidence as part of the same explanatory package. That is, they were quite willing to give hypothetical information that they COULD NOT have seen and heard. Children in all four of the age groups quite readily generated supporting information of this kind.

* Children had no difficulties generating evidence or alternative hypotheses in support of a theory they did NOT hold (a skill that is usually difficult for people of all ages). This was true of all age groups.

* Not surprisingly, children were more likely to offer alternative hypotheses to support ideas they did not believe and more likely to offer evidence that actually was portrayed on the show in support of ideas that they did believe.

Item-by-Item Analysis:

1a. (LOG): Do you think "75 Trombones" might have been written by Steve Stringbean?

Most of the children responded no (12 nos, 4 yeses). They pointed out that Steve Stringbean writes rock music, not marches. One child advanced the hypothesis that perhaps the kidnappers had written the music and left it behind to confuse the Mathnet Squad. The children who thought Steve did write the music suggested that perhaps Steve was trying to send a clue to the Mathnet Squad.

Item by Item Analysis:

1b. (LOG AND DISCUSSION): What did we see and hear today that makes you think perhaps Steve did write the music?

Remember that in light of children's responses to the previous question, most of them are being asked to produce evidence that COUNTERS their stated opinion. Children did quite well in response to this request. They produced both evidence and alternative hypotheses that might account for Steve writing the music. Children produced slightly more ideas in the group discussion condition than in their logbooks. The mean number of different ideas offered in support of Steve writing the music was 3 per age group in the logbook condition and 3.75 in the group discussion conditon. There was no strong trend for any of the age groups to offer a larger variety of ideas than the others.

Table 6

Frequencies of Ideas Generated in Support of

the Premise That Steve Wrote the Music

Grade	Logbooks:	Group Discussion:
3	3	2
4	3	5
5	2	4
6	4	4
	$\bar{X}=3$	$\bar{X}=3.75$

In response to question 1b, which asks that children supply evidence that COUNTERS their beliefs, children offered both alternative hypotheses and evidence. The ideas generated and the frequency with which they were mentioned are presented in Table 7.

Table 7

Alternative Hypotheses and Evidence Generated

In Response to the Premise that Steve Wrote the Music

Ideas	Frequency of Responses (N=38) Logs	Discussion	Percentage Total Responses
H: Kidnappers forced him to write it	4	6	26.3%
E: He sang off-key	6	4	26.3%
H: He left it as a clue	4	2	15.8%
E: They found it where he had been	4	2	15.8%
E: He writes music	1	3	10.5%
Other:	0	2	5.3%

* H = Alternative Hypothesis
E = Evidence

Note: Percentages are rounded

One of the two most common responses to this question was to generate the alternative hypothesis that if Steve did write the music, perhaps the kidnappers forced him to write it to throw off the Mathnet Squad. This is a reasonably sophisticated notion that takes excellent account of the events in the story. That is, the Mathnet Squad went to Easy Street, which turned out to be a blind alley. The other most common response was to point out that if Steve would sing off-key on the phone, something he usually does not do, why wouldn't he write a march, in spite of the fact that he usually does not write marches? Some children speculated that perhaps Steve wrote "75 Trombones" to leave a clue for the Mathnet Squad. Other ideas:

- The Mathnet Squad found the music in the shack, where Steve had been held, which makes it reasonable to suppose he wrote it.
- Perhaps Steve was nervous or bored and wrote the music to assuage his mood.

One child showed the pattern that is quite frequent in other studies of reasoning; that is, he offered evidence AGAINST the notion that he was asked to support because he could not accept it, even hypothetically. This child insisted that Steve could not have written the music because he does not write marches. We were surprised to find so little of this kind of thinking, which is common among sixth-graders in studies of informal reasoning (for example, Kuhn, Amsel & O'Loughlin, in press; O'Loughlin, 1987)

1c. (LOG AND DISCUSSION): What did we see and hear that makes us think perhaps Steve did NOT write the music?

In response to this question, children generated less various kinds of supporting information than they generated in relation to the previous question, in spite of the fact that most of them had indicated they believed that Steve did not write the music. The difference is accounted for by the fact that many fewer kinds of alternative hypotheses were generated, especially in the group discussion, than for question 1b. The fourth-graders generated the widest range of ideas, with the sixth-graders sticking exclusively to the argument that Steve could not have written "75 Trombones" because he does not write march music.

Table 8

Frequencies of Ideas Generated in Support of the Premise That Steve Did Not Write the Music

Grade:	Logbooks:	Group Discussion:
3	3	2
4	5	2
5	3	2
6	4	4
	$\bar{X}$=3	$\bar{X}$=1.75

As in the previous question, children offered both alternative hypotheses and actual evidence based on the program to support the possibility that Steve might not have written the music. Here, where the children are for the most part supporting their preferred belief, the predominant type of information offered was evidence.

Table 9

Alternative Hypotheses and Evidence Generated In Response to the Premise that Steve Did Not Write the Music

Ideas	Frequency of Responses (N=20) Logs:	Discussions:	Percentage of Total Responses
E: Steve writes rock music, not marches	8	7	75%
H: It was written by the kidnappers	3	0	15%
E: Rimshot said he did not write it	2	0	10%

* E = Evidence
H = Alternative Hypothesis

In response to this question, also, one child was not able to reason hypothetically about an idea he did not believe; this child produced evidence AGAINST the premise; namely that Steve might have written the music after all because it might be music he intended for the parade.

1d. (DISCUSSION): Why was the music left behind?

The children's responses to this question were split between the notion that the music might have been a clue from Steve (7 children) and those (6 children) who believed it might be a false clue from the kidnappers meant to divert Mathnet. An additional 3 children felt the music might have been left behind purely by accident. The interesting point here is that, after thinking about and discussing the issue, more children are

apparently seriously entertaining the possibility that Steve might have written the music. It has been noted in the social psychology literature that producing an explanation for a hypothetical phenomenon often convinces people that the phenomenon is likely to have occurred (Ross, Lepper, Strack & Steinmetz, 1977).

2a. (LOG:) How did George find out so fast about the cars?

Nearly all the children (14 of the 16) mentioned the role of the computer. However, their understanding that the computer had helped was clearer than their notion of a data base. Children wrote various comments about the "data box" and the "beta computer."

2b. (LOG): Why did George use the computer?

Children's responses to this question were quite plausible, with 9 saying the computer is faster than doing the search by hand, 5 indicating that the computer had that kind of information, and 2 pointing out that it would be impossible to count all those cars. Children either picked up or already knew about the advantages of using computers, even though this information was presented rather quickly.

3. (DISCUSSION): Why did Steve sing on the phone?

Children had a wide range of plausible hypothetical answers to this question, as well. All age groups were equally likely to generate a wide range of responses. In descending order of frequency, they were (N=24):

- To give a clue (54.2%)
- The kidnappers wanted him to (20.8%)
- He's a singer (8.3%)

- To let them know it was him (8.3%)

- To get the beat, so they could find him by counting (as Rimshot did) (8.3%).

Episode Four

Bulletins:

* Children were able to report a wide range of "mathematics" that thev have seen thus far in the episode, but they did not distinguish clearly between mathematical and general problem solving.

* At least in the items we presented, children didn't necessarily grasp the difficult distinction between good problem-solving strategies that sometimes don't work out versus out-and-out mistakes.

* Children have plausible arguments about when it is reasonable to give up on a strategy that is not proving successful.

Item-by-Item Analysis:

1a. (LOG): Do you think the Mathnet Squad has been using mathematics?

Not surprisingly, all the children (N=16) voted ves. It's hard to imagine them saying no in this context.

1b. (LOG): Why do you think so?

Children's answers fell into three classes. They cited the "math business" about the parade at the beginning of episode one ("How many police officers needed for the parade" - 1 response; "How long the parade would be" - 2 responses; "Using the map" - 4 responses; "Numbers on the backboard" - 1 response); mathematical or other problem-solving solutions to finding Steve

Stringbean (tire tracks - 1 response; bottle - 1 response); and general, vague, tautologcal responses ("They figure things out" - 1 response; "They said yes when the reporters asked them if they had used math" - 4 responses. So we have here a wide range of reasons for deciding that the Mathnet Squad had used mathematics, but about one-third of them are reasonably trivial, which may be a reflection of children's understanding and may be an artifact of the logbook demand to write replies.

1c. (DISCUSSION): What did you see and hear this week that might be mathematics:

As might be expected in a verbal discussion, children generated a wider range of "mathematics" under the discussion condition than in their logbooks. There were no grade differences in the range of activities the children remembered. These also included "parade math" (how many police - 1 response; how long parade would be - 5 responses; how many police on horseback - 1 response; number of square feet at parade - 1 response); finding Steve Stringbean (bottle - 4 responses; figuring out clue on telephone - 4 responses; counting while driving - 4 responses; tire tracks - 2 responses; figuring out how many old cars in L.A. - 1 response); and vague or irrelevant responses (mention of specific mathematical algorithm - 1 response; figuring out how to track the kidnappers down - 2 responses). Note that children are not clearly distinguishing between general problem-solving behavior and mathematical problem-solving behavior.

2a. (DISCUSSION): What is a blind alley?

Children's explanations of this metaphorical idea were pretty much on the mark. However, as you might predict, a couple

of the younger children missed the boat ("Where you can't be seen - not where a lot of people hang around" was one fourth-grader's definition).

2b. (DISCUSSION): Going down a blind alley means you <u>think</u> you have a good idea for solving a problem, but it turns out to be wrong. Has anybody ever had that happen to them?

Children's descriptions of their own personal "blind alleys" indicate that perhaps they did not grasp the concept very deeply. We got two classes of responses: some children described ventures that didn't turn out well (a cake that didn't cook; a refrigerator defrosting attempt that got soap in all the food) and some described just plain errors (mistakes in figuring out the math homework). No one described a situation in which initial indications of success were followed by clear signs of failure).

2c. (DISCUSSION): Has the Mathnet Squad gone down any blind alleys on this problem?

Children named several "blind alleys;" just as interesting, they offered no inappropriate answers. Their suggestions included going to Easy Street, expecting to find Steve at the hideout, believing that the notes in Steve's singing would spell out a word, and thinking that the tire tr[illegible]s were motorcycle tracks.

3. (DISCUSSION): Would you ever say it might be a better idea to give up on a problem?

The series of questions posed in Q3 attempts to get at children's ideas about the difficult notion that sometimes one ought to evaluate one's progress toward a goal as a means of deciding whether to persevere in a strategy. Children's ideas

here ranged in a fascinating manner from the stereotyped ("Try, try, try, and try again") to the pragmatic ("You should give up when you think you had enough of looking for it"). Children mentioned some rather sophisticated ideas here, like the notion that it is hard to know whether to persevere when you can't evaluate your progess ("They shouldn't have given up on the burnt down building, because maybe the man was only lying...you don't know) and the recognition that the value of the goal should help determine how long you try ("If it's your best friend, you don't want to lose him...you should keep trying until you find him" versus "If I lost a piece of gum, I'd give it up"). Although some children insisted that you should never give up, the consensus was "When it comes to the point that you're wrong you should give up that idea and go on to another one." Of course, there is no normative context-free answer to the question we posed, but the quality of children's arguments about it was fascinating.

Episode Five

Bulletins:

* Third- and fourth-graders are not as skilled at making inferential leaps as older children and adults are. Therefore, we have to be careful not to take this ability for granted when a mathematical concept or a problem solution hinges on it. For example, the young children had trouble figuring out how one could get an address from a phone number. Similarly, in episode one, they had trouble understanding how a map could be used to predict duration of the parade.

* Children in our target audience have some confusions about the

activities that can legitimately be classified as mathematics. Their definitions are at the one time too flexible (any kind of problem-solving is mathematics) and too rigid (mathematics is numbers). Perhaps we should consider explicitly addressing this issue.

Item-by-Item Analysis:

1. (LOG): How did the phone number help Kate and George figure out where Steve Stringbean was?

Nine of the 16 children's responses appropriately noted that if you had a phone number, you could get the corresponding address from the phone company. However, of the 7 children who made irrelevant responses, 6 of them were third- and fourth-graders. It is probable that these young kids have difficulty making quick inferential leaps, such as those that involve uses of tools to get uncharacteristic information: phone numbers to get addresses or maps to figure out duration of the parade. When we want to hinge a mathematical concept or a key problem solution on these inferences, it might be necessary to take children through the chain of reasoning just a bit slower than we often do.

2. (LOG): When did Kate know for sure that Mr. Lousa was the kidnapper?

The majority of the children (62.5 percent) recognized that the giveaway was when Lousa began to sing "75 Trombones." This escaped 37.5 percent of the children, who believed Kate figured it out when Lousa admitted Steve was in the next room. There were no age differences in children's ability to grasp this point.

3a. (LOG): What things did people do on the show this week that were mathematics?

In response to this question, children recalled a very wide variety of activities. As Table 10 illustrates, the fourth- and fifth-graders generated a wider range of things than did the third- and sixth-graders. It is not clear whether the lackluster performance by the sixth-graders was due to being older and possibly being bored by the task, or whether it was due to the fact that this particular group was a low math-ability group, and thus at the beginning of our study these children were less enthusiastic about participating.

Table 10

Sum of Unique Instances of Mathematics

Recalled by Each Age Group

Grade	Total Unique Instances
3	7
4	11
5	16
6	4

In addition, as Table 11 indicates, the average number of ideas generated per child was greater for the fourth- and fifth-graders than for the third- and sixth-graders. There was wide variability in the fourth- and fifth-grade groups.

Table 11

Average Number of Ideas Per Child

Generated by Each Age Group

Grade	Average Ideas	Range
3	1.75	1-3
4	4.00	2-6
5	6.00	2-12
6	2.00	1-3

There were five classes of responses that describe the children's recollections of the mathematics on the program. They include "parade math" (the calculating around the parade management in episode one), "Stringbean math" (legitimate mathematical activities connected with finding Steve Stringbean), "Stringbean problem-solving" (general problem-solving activities connected with finding Steve Stringbean), general reference to algorithms or measuring, and mention of the use of mathematical tools. Table 12 presents the percentage of the total responses (total of 55) that fell into each of these classes.

Table 12

Percentages of Children's Responses That

Fall Into Each of Five Classes of Mathematical Activity

Class of Mathematical Activity	Percentage of Total Responses (N=55)
Parade math	43.6%
Stringbean problem-solving	40.0%
General reference to algorithms or measuring	7.3%
Mention of mathematical tools	7.3%
Stringbean math	1.8%

As the results for episode one report, children variously understood the mathematical concepts introduced in talking about the parade; however, children recalled this mathematical activity and it was the most frequently mentioned class of mathematical activity. On the other hand, children could recall very little mathematical activity related to solving the Stringbean kidnap; in fact, this accounted for the lowest percentage of responses. Instead, when pressed to remember "things that were mathematics," children reported general problem-solving behavior. This result, and similar results across the three weeks of the study, indicate that the children believed that all problem-solving performed by mathematicians is mathematics.

3b. (DISCUSSION): Why is (activity on list) mathematics?

Here children gave justifications for their designation of various activities as mathematics. The classes of justifications the children offered indicated that they _prima facie_ considered the following to be mathematics: measuring or counting (for example, Rimshot counting in the van), things with numbers (telephones, the serial number on the van), problem-solving (any kind of figuring out), mathematical units (kilometers, hours, miles), algorithms (subtracting, fractions), and math tools (calculators, computers). Note the concern with numbers and problem-solving, both of which mav or may not involve mathematics.

Missing Baseball

Episode One

Bulletins:

* The children show fine comprehension of the problem.

* Children showed good recognition of the computer model and also good understanding of its purpose.

* However, children didn't really grasp the information about angles. Most children thought the angle being described was the angle formed by the trajectory of the ball, rather than the angle of incidence and the angle of reflection. This makes sense, because the trajectory angle looks like the most central angle and also looks most like those illustrated in school textbooks. About one-third of the children suggested that the computer might have been wrong about the bounce of the ball, whereas the entire point of this model is that, with the information given about the ball's direction, the outcome is determined by the "angle of incidence equals the gle of reflection" principle.

Item-by-Item Analysis:

1. (LOG): What is Howie's problem?

With one exception, all of the 15 children knew that Howie was in big trouble for losing the baseball. The remaining child, a fourth-grader, said there was some "problem about the baseball game," but did not say any more.

2a. (LOG): Which picture looks most like the one you saw on the computer?

Children performed quite spectacularly on this task, with 13 of the 15 underlining picture #3. One fourth-grader underlined

picture #1 and one fourth-grader underlined picture #2. It's interesting that 2 of the 3 fourth-graders got this one wrong, whereas none of the 5 thi' '-graders did!

2b. (LOG): What is the picture?

Again, fine comprehension, with 14 of the kids explaining that the picture helped show where the ball hit and bounced, whereas only 1 (fifth-grader) said more generally that it was a baseball field.

2c. (LOG): What is the picture for?

All children explained that the picture was to help find the ball.

2d. (DISCUSSION): What makes you say it was picture (1, 2, or 3) we saw on the computer?

Children's answers to this question indicate an understanding that may be less profound than answers to previous questions might lead us to expect. Five of the responses (including responses from the 2 children who were incorrect) focused on the need to choose the picture that looked as if it shows the ball bouncing toward the house (since the house is not portrayed in these diagrams, then presumably children remembered the house being at different locations). Four of the children simply claimed memory: picture #3 looked most like the one they had seen on the television. Two children mentioned angles, but they were talking about the wrong angle. Of the 17 responses offered to this question (it was a group discussion, so some children offered more than one), only 1 cited the correct notion of an angle (sixth-grader: "'Cause it looks the same angle as the line going to hit it") and three others (all from third-graders!)

cite some accurate qualitative reason about why picture #3 had to be the correct choice (for example, pointing out that picture #2 must be wrong because a baseball can't go through the metal sign). In this case, as in others (for example the compass circle on the map in "Missing Monkey"), children sometimes talk as if diagrams determine rather than describe phenomena. An interesting study in its own right would focus on children's understanding of models and diagrams.

5. (DISCUSSION): What could have happened to Howie's baseball?

A very wide range of responses was offered to this question. Children were imaginative about possible things that might have happened to the baseball. However, when the show invited them to wonder about an event without giving any clear evidence or hints about what that event might have been, they simply generated possibilities without spending much time evaluating them. For example, 4 of the responses on the list below indicate that those children either missed the point or did not think clearly about what was possible (e.g., they suggested that perhaps the ball had bounced in a different direction, or maybe the computer made a mistake about the angle). Here is the list of the children's thoughts. As the list reflects, the discussion focused on generating hypotheses, not on discussing evidence or evaluating the plausibility of the hypotheses. There were no clear age patterns favoring particular ideas or kinds of ideas.

Howie's baseball might have:

- bounced in a different direction (2 responses)
- went into the woods/weeds/a ditch (3 responses)

- been kept bv the boy who played left field (2 responses)
- fallen on the side of the house (2 responses)
- been kept by the lady (1 response)
- been taken by God (!) (1 response)
- landed on the roof (2 responses)
- got stuck in the muffler of a passing car (1 response)
- gone into the lady's house (3 responses)
- fallen into the hole in the porch (1 response)
- ricocheted off a passing car (1 response)
- been hit over the sign, is now beyond it (1 response)
- been kept by Howie (1 response)
- might have been hit at a different angle (1 response)
- be somewhere else because the computer made a mistake about the direction (2 responses)

Episode Two

Bulletins:

* The children showed good understanding of the problem and of the solutions that were raised but dismissed within the plot (e.g., house was not burned down, taken away on truck, or dismantled).
* Children can generate possible accounts of what might have happened to the house, but the story doesn't give them enough support to evaluate those solutions. That is, no one hypothesis is better than another, given the context. Thus, when we asked them to decide what had happened to Mrs. MacGregor's house, children engaged in free, unconstrained generation of hvpotheses, but they produced very little evidence in support of any of their hvpotheses and did not have a principaled commitment to anv of

them.

<u>Item-by-Item Analysis:</u>

1. (LOG): What is Mrs. MacGregor's problem?

All children recognized that the major problem of the story now is that Mrs. MacGregor's house has been stolen.

2. (LOG): Why do you suppose all those people might have wanted to buy or rent Mrs. MacGregor's house?

Responses to this question illustrate children's willingness to wonder what happened to the house, but also illustrate how little information the story gives them to work with in coming up with possible explanations. Some of the children offered more than one explanation, and a total of 24 explanations were generated in the logbooks. Of these, 10 were quite plausible, given the fact that this is a detective story: 5 of the children suggested that the house was stolen because someone wanted the baseball in the house, and 5 thought that perhaps something valuable was hidden away in the house. However, the other 14 suggestions, though plausible in the context of children's knowledge about houses and what houses are for, are less plausible as motives for this particular story. These remaining 14 suggestions were of three classes. Eleven of them concerned some property of the house itself that might make someone want to steal it: it is neat or clean, or a nice color; it has a lot of rooms; perhaps it is a magic house. Two third-graders suggested that perhaps the house was stolen by someone who had no house to live in -- perhaps they were poor and lived in a hotel. One of the children suggested that since the house was near the ballfield, perhaps it was stolen by someone who

liked to watch baseball (this in spite of the fact that it obviously is no longer near the field!). None of the sixth-graders offered any of these less plausible explanations, but children from all the other three age groups did.

2. (DISCUSSION): Why were all those people interested in Mrs. MacGregor's house?

The responses in the group discussions paralleled the suggestions in the logbooks, except that children offered better elaborated stories concerning motives, for example descriptions of poor people who have no home and needed the house. Apparently children found the argument about a nice yard compelling, because in the group discussion, we had four children suggesting that someone stole the house because it has a nice yard! Once again, sixth-graders' suggestions were confined to the more plausible alternatives (perhaps someone wanted the ball, which might be valuable, or there might have been money or something else hidden in the house).

3a. (LOG): Why was Mrs. MacGregor's house not blown up?

Children's responses were good reflections of the dialogue about this possibility in the program, and all were plausible. Ten said that there would have been debris laying around; 4 pointed out that an explosion would have been heard by the neighbors, and 1 response indicated that there would not have been time to clean up after the explosion.

3b. (LOG): Why was Mrs. MacGregor's house probably not taken apart?

All these responses were plausible as well: 7 said there was not enough time; 4 pointed out that there were no house parts

laying around; 3 mentioned that someone would have seen; 1 child pointed out that you could not live in a house if you took it apart, so why would anyone want to?; and 1 child claimed there was no way to take it apart.

3c. (LOG): Why was Mrs. MacGregor's house probably not taken away on a truck?

Nine responses indicated that a truck would have left tracks (the reason offered in the story); 3 were concerned that a truck would be too small; 2 said someone would have seen or heard a truck; 1 child said you can't take a house out of the ground. Two of the third-graders concluded that it WAS taken away on a truck, because that was the most plausible solution.

4. (DISCUSSION): What might have happened to Mrs. MacGregor's house?

Children proposed a wide range of ideas, some quite creative and some just downright silly and fun. The point is that, given what they knew from the story, there was no reason to judge one idea as any better or worse than another. Their list included:

- House was pulled apart, and a truckload of dirt used to cover up the debris (5 responses).

- House was taken by truck (3 responses).

- House was grabbed by "one of those things that look like a jaw" (perhaps a steamshovel? - 1 response).

- Bulldozer plowed down house and then smoothed the ground (1 response).

- The house was painted over so no one would recognize it and moved (1 response).

- The house was turned invisible - either bv a magician or by invisible paint (4 resnonses).

- An airplane or a helicopter took the house (7 responses - about 5 of these children had watched "Missing Baseball" at home).

- Someone buried it (2 responses).

- The ground opened, and it went under (1 response).

- Someone hid it behind the trees (1 response).

- It got crushed in a garbage truck (1 response).

- Someone set it on fire (1 response).

- Someone put acid on it and disintegrated it (1 response).

Episode Three

Bulletins:

* Children often confuse computers with their applications. It would be good to be more explicit about the distinction, for example, pointing out that a data base is a program that runs on the computer or is one program that a computer can run.

* Children's reasoning is more selective when they are given information to reason with. In this episode, as opposed to the last, they cite many pieces of evidence in support of their ideas concerning what has happened to Mrs. MacGregor's house. Evaluation of evidence is supported when two or more interpretations of the same evidence seem possible, or when there is different evidence for more than one point of view.

Item-by-Item Analysis:

1. (LOG): What is a data base?

About one third (5 out of 15) of the responses were reasonable, if vague, descriptions of a data base (a place where they store information; it gives you information; something that helps you find something; something that has records; a list of names and addresses). However, another third of the responses (6) thought that a data base is a computer. Three others indicated that a data base is part of a computer (a disk, a printout, a number code). Only 1 response was totally irrelevant (one of the fourth-graders thought that a data base is a hideout).

2. (LOG AND DISCUSSION): What made Kate so sure that Clarence Sampson stole Mrs. MacGregor's house?

Children produced a good array of evidence in response to this question. Only 4 of the 23 responses (many children gave more than one) were untrue or irrelevant. The evidence offered was:

- Clarence Sampson rented the helicopter (9 responses)
- The glasses were his (8 responses)
- Mrs. MacGregor saw a man hanging around who had glasses (2 responses)

and the four less adequate answers:

- She called and found out
- He wanted the ball
- The Army man said it was him
- I think he did it

In contrast to episode one, children now have something to reason with when they think about what happened to the house.

3a. (LOG): How do you think Mrs. MacGregor's house was stolen?

All the children indicated it was stolen by a helicopter.

3b. (LOG AND DISCUSSION): How do you know?

Once again, children appropriately cited evidence rather than generating alternative hypotheses. Responses that referred to evidence are marked by E; those that are alternative hypotheses are preceded by H:

E: The trees had no leaves (8 responses).

E: He rented the helicopter; the helicopter is capable of lifting a house. (8 responses).

E: He lied about his address (1 response).

E: The TV reception was snowy (1 response).

E: This is the only solution left (1 response).

H: Maybe the guy who rented the helicopter to Clarence Sampson stole the house (1 response).

H: Maybe the lady stole her own house, because she was mean (1 response).

Episode Four

Bulletins:

* Children can offer plenty of kinds of evidence in support of the notion that Clarence Sampson stole Mrs. MacGregor's house.

* Although children know that Ginny marked the possible route of the helicopter by drawing a circle, not a square or an oval, they are not clear on why. Perhaps if we use this technique in the future we may want to include some intermediate explanation, for example, plotting a series of points indicating that the helicopter may have gone in this direction as far as this, or in this direction as far as this, and showing that the points in aggregate approximate a circle.

* Most of the children understood how the Mathnet Squad figured out the proper direction of the helicopter; about one-third of the children did not.

Item-by-Item Analysis:

1a. (LOG): Do you think Clarence Sampson stole Mrs. MacGregor's house with a helicopter?

All the children except one checked "probably yes." One third-grader explained, "He's not old enough...he doesn't know how to fly." It wasn't clear whether this child might have confused Howie with Clarence Sampson.

1b. (LOG): Why do you think that?

Slightly over half the children's responses focused on legitimate clues to Clarence Sampson's guilt or to the use of a helicopter: the TV reception complaints (3 responses): the fact that Clarence had a helicopter and knew how to fly it (2 responses); the fact that he stole gold with a helicopter before (1 response); mention of the clue from the glasses (1 response); and the fact that he gave a wrong address (1 response). The remainder of the responses are either vague, inconclusive, or off the mark: he stole Mrs. MacGregor's house because he wanted to sell it (1); he wanted the baseball (2); a truck can't carry away a house (so it must have been a helicopter - 2); "the way he acted" (1).

1c. (LOG): What have we seen and heard this week that might make us think Clarence Sampson stole the house?

This wording of the question seemed better suited to getting children to recall evidence from the story. Their responses included: Bad TV reception or people heard helicopter

(7); clue with glasses (4); trees with no leaves (3); Clarence Sampson stole gold before with helicopter (3); he rented a helicopter (1); he gave a phony address (1); there is a helicopter that can lift a house (2); the ball was stolen (1). Of these suggestions, only the last, offered by a third-grader, is irrelevant.

2a. (LOG): What shape did Ginny make on the map?

All children correctly chose the circle.

2b. (LOG): Why did Ginny make that shape?

Children's responses were of four types. The first is functional; that is, there is some mention of the purpose Ginny had in mind when she made the circle. This included goals like finding Clarence Sampson or finding the house. All the third-graders' responses fell into this category, which accounted for 6 responses in total.

The second category refers to the fact that it's easiest to make a circle. One child pointed out that compasses make circles, and they used a compass; the other child explained that it is easier to circle the area, and a third explained that the circle is the easiest shape to remember.

The third category provides a sort of tautological non-explanation: she drew the circle because that's where the house was (1 response).

Finally, 4 of the children tried (not very successfully) to explain why a circle was the shape of choice, and a lot of these had to do with size. One said that a circle defines the correct amount of area, but was unable to explain why. One child said a circle is smaller and thus circumscribes an area where it

will be easier to find the house than if one of the other shapes was chosen. (In the group discussion that follows, one child said a circle is preferable because it encompasses more area and would thus be more likely to enclose the house!) Note the implication that this child expects the diagram to determine where the house will be. Two other children simply said that a circle is "better" than the other shapes, or the "best shape."

2c. (DISCUSSION): Why did Ginny make a circle instead of a square?

Children struggled more directly with the "why a circle" question in this discussion. Their answers are similar to those in the previous question. For some reason the oval and the square are not right, compasses make circles, the area of a circle is the best area. One child simply admitted she had no idea. Only one fifth-grader provided a good explanation: "She made a circle 'cause it's the same all the ways. 'Cause it's equal, equal from all the distances."

Since we have used this concept before, we may use it again, and we may want to think of breaking the idea down into smaller components. For example, before the compass is even introduced, Ginny might have walked the viewers through a thought experiment about what it might mean for the helicopter to flv a given range from a central point. This might include using a ruler to plot several possible destination points, and then showing how they describe a circle. In addition, it might be worthwhile trying to think of some imaginative ways of attacking this confusion about diagrams that leads some children to believe that the shape tells the helicopter where to go instead of

understanding that it simply describes where the helicopter might go.

3. (LOG): How did the Mathnetters find out which direction the helicopter had gone?

Nine of the 13 responses correctly noted that they followed the TV reception complaints. Two of the third-graders explained that the Mathnetters "went down the line," or "knew to go down," without acknowledging that the direction had to be inferred on the basis of information. One sixth-grader said the Squad chose that direction "because the other way is water," and one sixth-grader explained the process Debbie used to choose the radius of the circle but said nothing about direction.

4. (LOG): How did Howie help to find Mrs. MacGregor's house?

Only one of the children failed to correctly describe Howie's role in finding the house.

Episode Five

Bulletins:

* We reiterate our conclusion for episode five of "Passing Parade": children have difficulty knowing what is mathematics and what is not. "Missing Baseball" perhaps presents a wider range of legitimately mathematical activity in service of the main problem than did "Missing Baseball," but the point remains the same: children believe that any problem-solving done by mathematicians is mathematics.

Item-by-Item Analysis:

1a. (LOG): What things did they do on the show that were mathematics?

Table 13 presents the number of instances of mathematical activity described by each of the age groups. Each older group named more things than the preceding age group. Note that our usually ho-hum six graders really caught on fire here!

Table 13

Sum of Unique Instances of Mathematics Recalled by Each Age Group

Grade	Total Unique Instances
3	6
4	4
5	10
6	17

As Table 14 indicates, the average number of ideas generated per child was greater for the fifth- and sixth-graders than for the third- and fourth-graders. There was wide variability in the sixth-grade group, with one child producing only 2 ideas and another producing 12.

Table 14

Average Number of Ideas per Child

Generated by Each Age Group

Grade	Average Ideas	Range
3	1.5	1-3
4	2.2	2-3
5	3.0	2-4
6	6.0	2-9

There nine general classes of responses that describe the children's recollections of the mathematics in the program. They include "find-house problem-solving," general problem solving strategies and activities related to solving the problem of the missing house; "model," reference to generating the computer model of the baseball field to figure out the bounce of the ball; "find-house mathematics," reference to legitimately mathematical activities connected to finding the house; general reference to numbers, with the implication that numbers are inherently mathematical; reference to algorithms or measurement units, such as multiplying or length and width; description of use of mathematical tools, like the computer and the compass; irrelevant responses; and "map," reference to the map representation of the helicopter's possible travel area. Table 15 presents the percentage of the total 48 responses that each of these categories comprises.

Table 15

Percentages of Children's Responses That Fall Into Each of Nine Classes of Mathematical Activity

Class of Mathematical Activity	Percentage of Total Responses (N=48)
Find house problem-solving	27.1%
Computer model of baseball field	20.8%
Find house mathematics	16.7%
General reference to numbers	10.4%
General reference to algorithms or measurement units	8.3%
Reference to use of mathematical tools	6.25%
Irrelevant	6.25%
Reference to map model of helicopter travel	4.2%

"Missing Baseball" appears to include more legitimately mathematical activity related to solving the main problem than did "Passing Parade," and this is reflected in the children's recall of these items. Nevertheless, note that general problem solving is the highest-frequency category. Children also continue to say that anything with numbers in it is mathematics, although some children had arguments about that issue in the group discussion reported in our next question.

1b. (Discussion): Why is (activity on list) mathematics?

The criteria children reported for selecting an activity

as mathematics are similar to those used in "Passing Parade." They include use of a computer or map model, use of math tools, anything with numbers, problem solving, mention of mathematical or measurement units, measuring or counting, estimating or calculating. In connection with children's insistence that numbers are mathematics, note the following interesting argument recorded between a group of fifth-graders:

> "Getting arrested on a 484 is mathematics, because 484 is a number."
> "No! Because it's just getting arrested!".
> "They're not adding or dividing or multiplying it."

Perhaps we might want to think of some way of raising some of these debates explicitly on the show.

Missing Monkey

Episode One

Bulletins:

* Children show good comprehension of the problem.

* Of the three Mathnet sequels in the study, "Missing Monkey" perhaps best supports serious consideration of two hypotheses, each with its own array of evidence that seems to support it. The fact that there were two plausible explanations for the robberies spurred animated and serious arguments among the children in the group discussions. Children proved quite capable of providing evidence for their opinion-of-choice, and they took seriously the assignment to figure out who was responsible for the robberies. This was in marked contrast to their responses to "Missing Baseball," where they gamely tried to imagine what might have happened to Mrs. MacGregor's house but simply did not have as many clues with which to reason.

Item-by-Item Analysis:

1a. (LOG AND DISCUSSION): What is the problem the Mathnet Squad must solve?

Some children gave more than one reply to this question, but all children appropriately identified the problem as either (1) finding Grunt or (and) (2) solving the robberies. Group discussion brought out arguments concerning whether the robber is or is not a real gorilla.

2a. (LOG): Do you think a real monkey is robbing those stores?

The younger children (third- and fourth-graders) predominantly felt the robber was a real monkey, whereas the older

children (fourth- and fifth-graders) said it was not. Table 16 presents children's replies by grade.

Table 16

Do You Think A Real Monkey Is Robbing the Stores?

Frequencies of Yes/No Replies by Grade

Grade	Yes	No
3	3	1
4	3	0
5	0	4
6	0	2

Apparently the younger children were more willing to accept the rather fantastic notion that a monkey could be robbing stores.

2b. (LOG): Why?

The third- and fourth-graders (who believed a monkey WAS the robber) focused on the fact that a monkey escape had just been reported at the zoo. On the other hand, those children who checked "no" focused on a wider range of explanations, including: monkeys don't use money (4 responses); a monkey can't be trained to rob stores (1 response), monkeys don't run fast, so if the robber were a monkey he would have been caught by now (1 response). In addition, one child offered an alternative hypothesis: the robber is someone wearing a costume.

2c. (LOG AND DISCUSSION): What did we see and hear today that might make us think it is a real live monkey?

Children offered lots of evidence supporting this hypothesis. As Table 17 illustrates, other than slight depressions in the recall frequencies for third- and sixth-graders, there were no notable age differences in the number of new ideas generated by each age group.

Table 17

Frequencies of Ideas Generated in Support of the Premise That the Robber Is a Real Monkey

Grade	Logbooks	Discussion
3	3	3
4	4	5
5	3	5
6	3	2
	$\bar{X}$=3.25	$\bar{X}$=3.75

In support of the hypothetical theory that the robber is a real monkey, children offered 8 different kinds of evidence. The plot was rich in clues supporting both plausible points of view, and we found no aimless theory-generation in the protocols. Table 18 presents the kinds of clues the children reported.

Table 18

Evidence Generated In Response to the Premise

That the Robber Is a Real Monkey

	Frequency of Responses (N=44)		Percentage
Ideas	Logs	Discussion	Total Responses
Stole bananas	7	7	31.8%
Monkey missing from zoo	9	5	31.8%
Size, arm length	3	3	13.6%
People saw monkey	1	1	4.5%
Shape on wall	1	1	4.5%
Pounded chest, jumped	1	1	4.5%
Strong enough to run through wall	1	1	4.5%
Able to escape quickly	1	1	4.5%

The most commonly-cited pieces of evidence were that the robber stole bananas, and that a monkey has been reported missing from the zoo. Several children argued that the size and arm length of the robber do not really match those of a man. There were a couple of responses each concerning other clues: the shape on the wall looked like a monkey; the store owner said the robber jumped and pounded himself on the chest, clearly monkey behavior; only a monkey would be strong enough to run through the wall; a monkey can run quickly and thus could make a fast escape.

However, in spite of the fact that children in all age groups readily offered evidence in support of the premise, the

older children were very compelled here by their own theory that the monkey could not have been the robber. Even though the task was to provide evidence to SUPPORT the notion that the monkey was the robber, many children offered arguments AGAINST that idea. These arguments were slipped casually into the discussion without the children acknowledging that they were taking the other point of view. This is the kind of argument you often find children giving when they are asked to cite evidence which supports a theory they do not believe (O'Loughlin, 1987). In fact, the fifth-graders produced 9 such pieces of counterevidence, for example: pointing out that a monkey doesn't know how to operate a cash register; claiming that if a monkey stole the bananas he would have eaten them right there on the spot; asking what a monkey would want with money; noting that there were no pieces of wall on the floor near the monkey-shaped hole (implying that the hole was a fake); pointing out that although the robber was hairy, that might be a costume.

3a. (LOG): Do you think a man in a monkey suit is robbing those stores?

Responses to this question indicate that the younger children still predominantly believe that the culprit is a monkey, whereas the older children continue to feel confident that it is a man in a monkey suit. Responses are presented in Table 19.

Table 19

Do You Think a Man in a Monkey Suit is Robbing The Stores?

Frequencies of Yes/No Replies by Grade

Grade	Yes	No
3	2	2
4	0	3
5	3	1
6	2	0

You may note that this table is not simply the inverse of Table 16. That is because two third-graders checked "yes" to both questions, and one fifth-grader checked "no" to both. The explanations of these "double-responders" imply that these children found both arguments compelling, and perhaps had difficulty choosing between them or changed their mind after considering both.

3b. (LOG): Why?

Those children who claimed that the robber is NOT a man in a monkey suit virtually reiterated the reasons they just offered for believing that the robber IS a monkey. (He stole bananas - 3 responses; jumped up and down - 2; monkey escaped from zoo - 2; man not big or strong enough - 2; looked like a monkey - 2; went through the wall - 1; arm length longer than a man's - 1).

The children who felt it was a man in a monkey suit tried to point out why robbery better fits human motives (stole money - 5 responses; man can like bananas - 1; stole stuff a monkey

doesn't eat - 1) and capabilities (monkey can't operate cash register -2- or use shopping cart - 1; man would know where to find the vegetables - 1; a monkey isn't that smart - 1).

3c. (LOG AND DISCUSSION): What did we see and hear today that might make us think the robber is a man in a monkey suit?

There were virtually no age differences in the number of clues children cited in support of this idea. Table 20 presents the frequencies of new ideas by age.

Table 20

Frequency of Ideas Generated in Support of the Premise That the Robber is a Man in a Monkey Suit

Grade	Logbooks	Discussion
3	4	4
4	3	4
5	4	5
6	4	3
	$\bar{X}$=3.75	$\bar{X}$=4.00

Interestingly, no children offered evidence counter to this premise. That is, the third- and fourth-graders did NOT mention clues that would tend to make us think the robber is a monkey. The spunky and contentious fifth-graders, who did so in response to question 2c. agreed with the premise here and thus did not feel the need to argue against it. The children's ideas were nearly all in the form of evidence cited. However, one

alternative hypothesis was raised, namely, that the sore managers might have stolen the monkey.

Table 21

Alternative Hypotheses and Evidence Generated In Response to the Premise That the Robber Is Man in a Monkey Suit

	Frequency of Responses (N=38)		Percentage
Ideas	Logs	Discussions	Total Responses
E: Monkey wouldn't steal money or salad food	6	6	31.6%
E: Wouldn't steal from cash register, use shopping cart	4	3	18.4%
E: Not that smart	2	2	10.5%
E: Wall shape didn't look like monkey	1	3	10.5%
E: Monkey wouldn't need food	1	2	7.9%
E: Too tall to be monkey	2	2	10.5%
H: Store manager took monkey	1	3	10.5%

E=Evidence
H=Alternative Hypothesis

Most of the children argued that a monkey would have no need for money or what some children called "salad food." Apparently, children this age do not necessarily expect monkeys to eat lettuce and other vegetables. They also pointed out that monkeys would not be able to steal from a cash register or use a

shopping cart; that monkeys just aren't that smart; that the shape on the wall did not really look like a monkey; that a monkey from the zoo would not want that much food (apparently they also don't know that monkeys eat a lot); that six feet is too tall for a monkey (monkey confused with gorilla?). Note here how the children's limited knowledge about monkeys made it difficult for them to know how to evaluate some of the information from the story. (A point of clarification: we are not trying to argue here that the show <u>should</u> have specified this information; indeed our strong impression is that learning more about gorillas was one of the strongly motivating things about this story for the third-graders. We are only pointing out that sometimes children of different ages reason differently because they do not have the same knowledge.)

4. (DISCUSSION): Who do you think is robbing the stores?

Only four children (all third- and fourth-graders) reported still believing that the robber is a monkey. Perhaps after considering the alternate point of view, they changed their minds. The other children had more or less specific hypotheses: it's a man (3 responses); the boy stamping prices in the store (1 response); one or more of the store managers (5 responses); the zookeeper, possibly in cahoots with the store managers (2 responses); or "a lady" (1 response). A snippet of an argument among the third-graders illustrates that the younger children are less critical in their evaluation of the possibilities:

> "I don't think it's a real monkey...it's a man. A monkey wouldn't steal money."
> "Yes, it would!" objects someone.
> "But what would it need it for?"

"Bananas!" choruses the rest of the group triumphantly.

5. (DISCUSSION): Why is it important for George and Kate to learn who is robbing the stores?

Children pointed out the need to stop the robberies or arrest the culprit, to bring the monkey back to the zoo, and to get the money back. However, when prompted to consider the issue, they realized that perhaps catching a monkey and catching a man might be different kinds of challenges. The younger children, for the most part, felt that it would be more difficult to catch a monkey than to catch a man, because a monkey can run fast, hide in trees, blend in with the environment, and climb the Empire State Building(!). The older children felt a man would be harder to catch: he could have a weapon, could use a private plane to go almost anywhere, might hole up in a hideout. Some of the fifth-graders said that you'd simply have to look in different places: "If it's a monkey, you should look in trees or zoos. If it's a man, you look in a hideout. Or houses and garages and stuff."

Episode Two

Bulletins:

* Children showed good qualitative understanding of the circle graph used as Grunt's food chart.
* Most of the children just did not seem to understand the idea that the combination lock would be difficult for Grunt or for a person to open if he did not know the combination. Of those children who knew it would be difficult to figure out the

combination, even fewer noted that the difficulty is due to the fact that there are many possible combinations. Four of the 15 children (nearly one-third) believed that if a person fiddled around with the lock, he could figure out how to open it.

* Once again we have children showing good understanding of the advantages of using a calculator for certain kinds of problems, but irregardless, showing some prejudice about whether their use is a good idea.

* Children have difficulty with the notion that a circle plots points equidistant from the center. Some children expressed what we have taken to calling "diagram determinism," the notion that the diagram determines rather than describes a phenomenon.

* When asked whether activities on a list were mathematics, children sometimes used inappropriate criteria for deciding; in particular, several of them used the criteria we saw applied in "Passing Parade" and "Missing Baseball": anything with numbers is mathematics.

Item-by-Item Analysis

1a. (LOG): What is this (Grunt's feeding chart)?

Ten of the 15 children said it was Grunt's food chart, and another 3 referred to its function (it shows what Grunt eats). Two of the children attempted to provide more technical descriptions. One said, "It's a fractor table," and the other called it "a round graph of percent that Grunt eats."

1b. (LOG): What is it for?

The most sophisticated kind of answer to this question (given by 8 children, none of them third-graders) referred to quantity or percent: it tells "how much to give Grunt to eat,"

for example. Adequate but less complete answers were that the chart was "for foods the gorilla eats" (4 responses), "for what he likes best," (2 responses), or simply "for Grunt" (1 response, from a third-grader).

1c. (LOG): What food does Grunt eat the most?

All children correctly chose fruit and vegetables.

1d. (LOG): How do you know?

Seven of the children's answers (nearly half) referred to percentages and quantities, for example, 60 percent being more than 30 percent and 10 percent. In addition, four children offered the less specific reply that fruit and vegetables took up a "bigger place" or "more room." Two children indicated that "it says so on the circle." Other responses were that those are the foods Grunt stole from the stores (1) and that the zookeeper and Jane said that's what Grunt eats (1). Overall, the children showed excellent understanding of the circle graph and its meaning.

1e. (LOG): Why does Kate want to know what Grunt eats?

Children's answers showed that, for the most part, they understood the purpose for thinking about Grunt's diet. Nine pointed out that this information helps make sense out of the fact that these were the foods stolen. In addition, another 2 children thought that knowing what foods Grunt eats might help the Mathnet Squad to figure out where he will strike next. Four younger children (2 third-graders and 2 fourth-graders) gave other, unrelated answers (such as, "In case he's hungry").

2a and 2b. (DISCUSSION): Could Grunt figure out how to open the lock? Why?

The majority of children's responses to this question were no. However, as Table 22 shows, only 5 of the 24 total responses made reference to the mathematical point of the segment: the fact that Grunt doesn't know the combination or that there are too many combinations for him to figure out.

Table 22

Responses to Question 2a: Could Grunt Open the Lock?

Percentages of Total Responses Represented by Each Reply

Idea	Percentage of Total Responses (N=24)
NO:	79.1
His fingers don't work that way	33.3%
He can't see the numbers	12.5%
*He doesn't know the combination	12.5%
*Too many possible combinations	8.3%
Monkeys can't read numbers	8.3%
Fingers don't fit though gate	4.2%
YES:	20.9 %
Could pull open or break with teeth	8.3%
It was opened so he opened it	4.2%
Combination on back of lock	4.2%
Learned by imitating someone else	4.2%

* Answers that could be referring to the discussion about combinations on the show.

It seems that the discussion about combinations was too fast or too difficult (possibly both) for the children to handle. Perhaps the message should have been simplified or summarized, e.g., "There are many numbers on this lock that can go together in

many, many different ways. It would be nearly impossible for anyone to guess the combination."

Many of the children mentioned the fact that a gorilla's thumb and index fingers do not meet. This is rather surprising, given how quickly that information was discussed on the show, and it was one of the things that made us feel that children were highly motivated by this story in part because they really enjoyed learning more about monkeys.

2c and 2d. (DISCUSSION): Could a person figure out the lock? How?

Only two of the replies to this question were nos. Both mentioned the possibility that it might be hard to figure out the combination. The other 14 replies were yeses, but a large number of those (6) were qualified yeses: a person could figure it out if he knew the combination. Somewhat more disturbing are the 8 -- fully half-- of the children's responses that indicate they totally missed the point about the number of possible combinations. Four of the children said a person could figure out the lock by picking it, and 4 suggested that you could open it by randomly fiddling with it. These answers were given by fourth-, fifth-, and sixth-graders, not by the youngest children.

2e. (DISCUSSION); So how did Grunt get out of his cage?

Children suggested a range of possiblities, including: someone (the robber) opened the cage (5 responses), he broke it himself (3 responses), Jane let him out (2 responses), the zookeeper opened the lock (2 responses), another gorilla (3 responses), he jumped over the fence (1 response), the store managers took him (1 response), the cage was left open by mistake

after feeding Grunt (1 response).

2f. (DISCUSSION) Why did George use a calculator?

Children's answers to this question show that they have good understanding of the advantages of using a calculator. They said: he couldn't figure out the problem in his head because it was too hard (or calculator was easier - 9 responses), he didn't want to make a mistake (3 responses), a calculator is faster (6 responses). Once again, however, children tended to mention some prejudices about the use of calculators:

- "It gives you all the answers and then you wouldn't know how to do it for a test or something" (fourth-grader).

- "I don't think that's good, because once you don't do the hard ones, the easy ones, you forget it. I think you shouldn't use calculators at all, unless it's really, really, really hard" (fifth-grader).

- "If they know how to do the example in their head and it's hard, they should, no matter how hard" (sixth-grader).

It is difficult to know how widely held these anti-calculator attitudes are, but it's probably safe to say they are common enough to continue to feature use of calculators on the show. Perhaps it would be interesting sometime for Kate and George to have a discussion about the kinds of problems that are best done with calculators versus the kinds of problems that are best done in your head.

3a. (LOG): What are these (Xs)?

All children either described the Xs as crime locations or places where Grunt might be. Depending on whether you think Grunt is the criminal, these two explanations are interchangeable.

3b. (LOG): What shape did Debbie make on the map?

All children chose the circle, with the exception of one fifth-grader who underlined the square but then erased it, saying, "Oh, yeah, I just remembered it was a circle."

3c. (LOG): Why did Debbie make that shape?

Most of the children gave a functional reply to this question; that is, they said what the circle was for, namely, to find Grunt or to show where he was. Three fifth-graders gave responses that indicated they knew the size of the circle was relevant: it showed about how far Grunt could go. Two children said that all the places that were robbed were in the same area, so Debbie drew a circle around them.

3d. (DISCUSSION): Why did she make a circle instead of a square or an oval?

This concept is difficult for children. One child suggested that "all the robberies were like, in a circle, and so she put a circle around it" (fifth-grader). Several suggested that a circle was chosen because Debbie was using a compass, and compasses only make circles: "She had to use the compass. If she had a ruler, she woulda made a square" (fifth-grader). In addition, some of the children's responses illustrated "diagram determinism:" that is, it appears from their answers that they expect the circle to constrain, rather than describe, Grunt's activity: "An oval would be really tight and he'd probably go out of the oval. The square has sides and he wouldn't know which way to go; he'd probably run right out of it. With a circle he'll probably find another place to rob" (third-grader) Only one child, a sixth-grader, seemed to have fully grasped the idea:

"When she made a circle, it could be an inch all the way around it, but over here on the square it's too short here, see, two inches here and one inch across. An oval is too short on the sides, too long on top." Suggestions for breaking this idea down into more digestible components are included in "Missing Baseball."

4. (DISCUSSION): Was (item on list) used for doing mathematics?

Table 23 presents children's responses to this question in relation to several objects, some used in the series and some not.

Table 23

Was X Used for Doing Mathematics?

Children's Replies by Grade

	YES:				NO:			
Object Grade	3	4	5	6	3	4	5	6
Ruler	2	4	3	3	2	0	1	0
Gorilla cage	3	4	4	3	1	0	0	0
Compass	3	4	4	3	1	0	0	0
Hamburger	0	0	0	0	4	4	4	3
Telephone	0	1	1	2	4	3	3	1
Map	3	3	4	3	1	1	0	0
Lock	1	2	4	2	3	2	0	1
Doll	1	2	4	2	3	2	0	1
Calculator	4	4	4	3	0	0	0	0
Blackboard	4	4	4	3	0	0	0	0
Pizza	2	0	0	0	2	4	4	3

Total N = 4 third-graders
4 fourth-graders
4 fifth-graders
3 sixth-graders

Notable confusions were the ruler, the telephone, the lock, and the doll. When we asked children about the criteria for deciding which objects were used for mathematics, it appeared that the criterion causing much of the confusion for "telephone" was "numbers": many children are applying the rule that if an object has to do with numbers, it by definition has to do with mathematics. For example, one fifth-grader's explanation for

choosing the telephone was, "Without numbers there wouldn't be mathematics, and without mathematics, there couldn't be a telephone." There are also some confusions concerning the idea that "figuring things out" is inherently mathematical, although there are not nearly as many of those confusions expressed here as in "Passing Parade." For example, children argued over whether a telephone might be used for mathematics since clues come over it, and since that's how the Mathnet Squad first learned about the robberies. Some children suggested that Grunt's doll was used for mathematics because it provided a clue for the Mathnet Squad to evaluate when deciding whether Grunt left the zoo on his own accord. Explanations for "ruler" mentioned numbers but also appropriately mentioned measurement. We do not have on tape responses from many of the children who said the ruler was <u>not</u> used for mathematics. Because of time pressures, the interviewers were not able to probe all responses; unfortunately, responses for "lock" were among those not probed. Thus we do not know what was contributing to the variance in responses for that item.

<u>Episode Three</u>

<u>Bulletins:</u>

* Children produced <u>more</u> ideas in support of the premise that Grunt was not the robber than they produced in support of the premise that Grunt was the robber. In addition, when asked to provide evidence that Grunt was the robber they also slipped in (unconsciously, we believe) evidence that would prove the opposite. When asked to provide evidence that Grunt was not the robber, children provided a nice mix of clues from the show and alternative hypotheses that might account for these clues. Most

of the children by now believe that Grunt is not the robber, but the fact that there is so much "live" evidence against him keeps children guessing and thinking. This is a very powerful stimulus for using informal reasoning skills.

* Children were somewhat confused about measuring the prints in the pizza shop. About a third of the children thought Jane was measuring the size of the footprints.

* Children showed good understanding that the X on the map representing the Huntington robbery meant that Grunt could not have committed that robbery (unless he did not commit the ones within the circle). Children have a good grasp on the idea that the circle represents Grunt's range of motion. As discussed in the previous episode they don't understand WHY a circle, but they know what the circle means.

* Children have lots of elaborated notions about how the Huntington Beach robbery might have taken place. They are thinking actively about plausible (and some implausible!) scenarios.

Item-by-Item Analysis:

1a. (LOG AND DISCUSSION): What did we see and hear today that makes us think Grunt might be the robber?

As Table 24 indicates, the third-graders generated relatively few ideas. Otherwise, there are no notable differences by grade in the number of pieces of supporting evidence recalled for this premise. Although the fifth-grade performance looks relatively good, in fact, that Mathnet Panel had one more child than the other panels did.

Table 24

Frequencies of Ideas Generated by Each Grade in Support of the Premise that Grunt Is the Robber

Grade	Logbooks	Discussion
3	2	2
4	3	3
5	5	4
6	3	3
	$\overline{X}$=3.25	$\overline{X}$=3.0

Children seemed to focus on the most recentlv revealed piece of evidence, so that 15 responses (34.9 percent of the total responses) referred to the fact that Grunt likes pizza. In addition, children remembered that the other stolen foods were foods that Grunt likes (13 responses, 30.2 percent of the total). Four responses (9.3 percent of total) were clues that, correctlv interpreted, are actually evidence <u>against</u> Grunt being the robber. These involved the footprints in the pizza shop and the fact that monev was taken. I think these clues were slipped in because children believe Grunt is not guilty and have a hard time bracketing their own beliefs.

In addition, 6 responses (13.9 percent of the total) were offered by children who were consciously arguing against, not for the premise. Most of these responses were alternative hypotheses, not evidence. These involved placing the blame for the robberies with others: some other animal (1 response), NOT Grunt (1),

someone in a costume (1), two gorillas (1). In addition, 2 children pointed out that the footprints were NOT Grunt's.

Table 25 presents the evidence and alternative hypotheses generated by children asked to support the premise that Grunt is the robber.

Table 25

Evidence and Alternative Hypotheses Generated In Response to the Premise that Grunt Is the Robber

	Frequency of Response (N=43)		Percentage
Ideas	Logs	Discussion	Total Responses
For the premise:			
E Grunt likes pizza	8	7	34.9%
E Likes other foods stolen	7	6	30.2%
E Footprints in shop	1	2	6.9%
E Money was taken	1	1	4.6%
E Grunt missing from zoo	1	1	4.6%
E Gorilla robbed stores	1	0	2.3%
E All robberies located in one area	1	0	2.3%
Against the premise:			
E Footprints NOT Grunt's	0	2	4.6%
H Some other animal=robber	0	1	2.3%
H Grunt NOT the robber	0	1	2.3%
H Man in costume = robber	0	1	2.3%
H 2 gorillas involved	0	1	2.3%

E = Evidence
H = Alternative Hypothesis

2a. (LOG AND DISCUSSION): What did we see and hear today that makes us think Grunt is NOT the robber?

Children produced more different kinds of evidence in relation to the premise that Grunt was NOT the robber than in

support of the premise that he was. The mean number of ideas was 4.75 in the logs (as compared to 3.25 for the premise that Grunt is the robber) and a whopping 7.0 in the discussions (compared with 3.00 for the opposite premise). As Table 26 indicates, the larger number of ideas for this premise is mostly accounted for by the group discussions among the younger children. Sixth-graders produced relatively few ideas in relation to either premise, and produced the same number (3) in support of each.

Table 26

Frequencies of Ideas Generated by Each Grade

In Support of the Premise That Grunt is NOT the Robber

Grade	Logbooks	Discussion
3	4	7
4	6	12
5	6	6
6	3	3
	$\bar{X}$=4.75	$\bar{X}$=7.0

Once again, newer pieces of evidence received more attention. The clues that it was NOT Grunt's footprints in the pizza shop (14 responses, 20.9 percent of the total 66) and that Grunt can't run fast and needs to rest a lot (12 responses, 17.9 percent of the total) led the list of children's arguments. It seems as if most children are now convinced that Grunt is not the robber, although they can cite the evidence that seems to

incriminate him. Although children included a lot of alternative hypotheses in the discussion (9 responses, 13.4 percent of the total), none of these implicated Grunt as the robber.

Table 27 presents the children's ideas and indicates the percentage of the total responses that each comprised.

Table 27

Evidence and Alternative Hypotheses Generated In Response to the Premise that Grunt is NOT the Robber

Idea	Frequency of Response (N=66) Logs	Discussion	Percentage of Total Responses
E Footprints NOT Grunt's	8	6	20.9%
E Grunt slow, needs rest	6	6	17.9%
E Doesn't like anchovies	4	3	10.4%
E Jane says he wouldn't do these things	4	2	8.9%
E Can't be 2 places	2	3	7.5%
E Can't use money	2	1	4.3%
H Some other monkey=robber	2	2	5.9%
E Grunt too shy	1	3	5.9%
E Couldn't open cage	0	3	4.3%
E Left doll behind	0	2	2.9%
H Someone kidnapped him	0	1	1.5%
H Person in costume=robber	0	2	2.9%
H Man controls monkey	0	1	1.5%
H Someone let Grunt out	0	2	2.9%

E = Evidence
H = Alternative Hypothesis

Children's responses show a mix of two strategies: (1) support the premise by citing evidence in its favor, and (2) support the premise by generating hypotheses that can account for

it. Although hypothesis generation is not evidence and thus strictly speaking does not satisfy the question posed, the children engaged in a nice blend of accurately bringing known clues to bear and letting their imaginations loose to think how the robberies might have occurred.

3a. (LOG): Why might Grunt steal from a pizza shop?

The children produced 18 responses to this question (some provided more than 1). Of those responses, 72 percent appropriately focused on the fact that Grunt likes pizza. Three of the responses, or about 16 percent, provided information that does NOT support the idea that Grunt robbed the shop (pointing out that Grunt did not like anchovies, erroneously saying Grunt did not like pizza). Other responses were on the order of "He was hungry."

3b. (LOG AND DISCUSSION): Why did Jane measure the distance between the footprints?

Over a third of the responses indicated that children understood there was some discrepancy between the expected and actual distances between the footprints. An additional third correctly pointed out that Grunt walks on four feet (although this is not why Jane measured the prints, strictly speaking). However, one-third of the children thought Jane was concerned with the size of the footprints ("Length of the foot looked too big").

4a. (DISCUSSION): What does (the position of this X on the map) tell us about the Huntington Beach robbery?

All the children except for 1 th grader understood that the X indicated that Grunt could not have committed that robbery. Most of the children focused on the fact that Grunt could not have

travelled fast enough to get there; others mentioned that he was seen picking oranges at the same time. Children understand what the circle on the map is FOR, and even what it represents, in spite of the fact that they do not understand the mathematical and conceptual reason for employing a circle instead of any other shape.

4b. (DISCUSSION): How did the Huntington Beach robbery happen?

Invited to let loose with their imaginations, the children did. Many thought that a man in a monkey suit must have committed this robbery, although some of them felt that Grunt might have come along in the car, with or against his will. This led to all kinds of amusing arguments about how that might have been arranged:

> "Say the zookeeper can't pay the rent he has to pay for the zoo and Grunt tries to help him. He doesn't realize he's just going to get in more trouble."
>
> "Yeah, but they woulda saw the guy putting on the monkey suit. And it would be really funny to see a man driving a gorilla around in a car."
>
> "When he put it on, he got out of the car."

Some children suggested that Grunt stole a car and drove to the robbery -- others suggested that perhaps he took a bus, or even a boat! Another popular theory is that there might be two monkeys operating and that Grunt may or may not be doing any of the robbing himself. Someone said that perhaps Grunt "did the Huntington Beach robbery but not the ones in the circle."

Episode Four

Bulletins:

* Children have mixed opinions about Janos. Although most of them

thought that he gorilla-napped Grunt only to serve as a cover for his own criminal activity, some of them attributed more poignant motives to him: he wanted Grunt back again so it would be like old times. so he could play with him.

* Children now realize that both lines of seemingly conflicting evidence can be resolved under one explanation.

Item-by-Item Analysis:

1. (LOG): Why did Debbie check other zoos?

Almost all of the children appropriately indicated that she checked the zoos in case there were two gorillas loose. One child suggested that perhaps she was checking to make sure they didn't have Grunt.

2a. (LOG AND DISCUSSION): Why do Kate and George think that Janos took Grunt?

Children interpreted this question in two different ways. Most children replied by offering evidence that tied Janos to Grunt: he knew Grunt from the circus (most common response), rented an ape costume, had a gorilla cage behind his house, could have opened Grunt's cage. walks on two feet, would have use for money. Alternatively, children talked about possible motives: he wanted to use Grunt as an alibi for his own robberies, wanted to get Grunt back for his circus act, was jealous of Grunt's superior strength, wanted to get money. There were no clear age patterns on any of these responses. Older children were not more likely than younger children to reply with evidence rather than motives.

2b. (LOG AND DISCUSSION): Can you think of any reasons why Janos would take Grunt from the zoo?

Most of the children replied that Janos wanted to use

Grunt as a cover for his own robberies. However, several (predominantly third-graders) suggested that Janos wanted Grunt back. As one child put it, "He could have missed Grunt, thought about the times they was juggling or whatever." Similarly, many children suggested that perhaps he was trying to "get the act back so they would be ready for the circus to come." Additional motives included: to get the free food, to get money, to sell Grunt back to the zoo. Any of these are plausible, since we don't know anything about Janos.

3. (DISCUSSION): Do you think Grunt was shy or bold?

None of the children had any difficulty indicating that Grunt was shy, and that when his actions seemed bold, they were really the actions of Janos. As one fifth-grader explained, "Grunt, he was shy, scared of people and he always carried a doll with him. You know he was shy if he carried a doll."

4. (DISCUSSION): Are all the Mathnet problems solved now?

About one-third of the children thought all the problems were solved, but the rest had other ideas: the Mathnet Squad was not yet sure that Janos was the robber; it might be another monkey, perhaps even a mechanical monkey; even if it was Janos they still had to catch him; they had to solve the problem of how to keep Grunt safely locked up.

Episode Five

Bulletins:

* In this sequel, the third-graders recalled more instances of mathematics in the program than did the children in all other grades!

* It was not the case that large numbers of the children's responses were about general problem-solving. By and large they were legitimately mathematical activities. That may be because this episode has more intrinsic mathematics than does, for example, "Passing Parade."

* The criteria children are using for what is mathematics are similar to those mentioned in the earlier two episodes. Many children continue to claim that "math is made out of numbers." so anything with numbers is mathematical. These interviews, as opposed to those for "Passing Parade" and "Missing Baseball," showed more awareness that plain old "figuring out" is not necessarily mathematics.

Item-by-Item Analysis:

1. (LOG AND DISCUSSION): What things did they do on the show this week that were mathematics?

Table 28 presents the number of instances of mathematical activity described by each of the age groups. The fourth-graders did unusually poorly here; in fact, one of the interviewers noted that the children were having a hard time remembering episodes with mathematics. We really do not have an explanation, and we tend to attribute this result to the fact that the small Mathnet Panel sizes occasionally produce results that we cannot account for. It was the third-graders who did uncharacteristically well; in spite of the fact that that group had one outlier child who generated 6 ideas and pulled up the average, all the children recalled more instances of mathematics than children that age did in the other two sequels.

Table 28

Sum of Unique Instances of Mathematics

Recalled by Each Age Group

Grade	Total Unique Instances
3	11
4	6
5	7
6	10

As Table 29 indicates, the average number of ideas generated by each child was greater for the third-graders than for any other group! However, the differences among ages are small, except that the fourth-graders recalled unusually few examples.

Table 29

Average Number of Ideas per Child

Generated by Each Age Group

Grade	Average Ideas	Range
3	3.6	2-6
4	1.5	0-3
5	2.25	2-3
6	3.0	2-4

One child in the fourth-grade group had been absent a

great deal. That child recalled no ideas at all, which helps to explain the depressed frequency for the fourth grade.

There were five general classes of responses that describe the children's recollections of the mathematics in the program. Thev include calculations, use of the map/model, measurements, general reference to algorithms or measurement units, and general problem solving. Table 30 presents the percentage of the total 48 responses that each of these categories comprises.

Table 30

Percentages of Children's Responses That Fall Into Each of Five Classes of Mathematical Activity

Class of Mathematical Activity	Percentage of Total Responses N=48)
Calculations:	
- Concerning location of Grunt or robberies	35.4%
- Of lock combinations	10.4%
- Of pounds or cost of bananas	10.4%
Use of Map model	14.6%
Measurements of Grunt's footprints, size, or weight	8.3%
General reference to algorithms or mathematical units out of context	10.4%
General problem solving, figuring out:	
- Who rented the gorilla costume	4.2%
- How ape escaped from store	2.0%
- How many monkeys there were	4.2%

Note how few responses there are (relative to those for "Passing Parade" and "Missing Baseball") in the general problem solving category. Apparently this story contained plenty of instances of legitimately mathematical activity, and when they are there to be recalled, children prefer to mention them.

The criteria children named in the group discussion included the following (by now familiar) list of ideas:

- Algorithms are mathematics. The third grade group in particular tended to describe mathematical activity as adding up or "timesing."

- "Mathematics," as one child explained, "is measuring." Finding out how much or how long or how many is a frequently used criteria.

- Numbers. As one child explained, "Math is made out of numbers." As in the other sequels, children argue that telephones are mathematics because they have numbers on them. As a fourth-grader explained, "Yes. On the telephone it has numbers and you dial it."

- The "What If" game. This may be part of children's tendancy to be confused about whether any problem solving performed by mathematicians is mathematics. One child said, "They're thinking of ideas, what the animal could have done, or the person." A child in a different grade disagreed: "They're talking about what if Grunt did things, and that doesn't mix in to mathematics." Another child explained, "There's lots of problems to figure out that are not math." We have not heard many children be this critical about calling an activity mathematics. This issue may be a legitimate one for the show to address directly.

- There is also some confusion about whether talking about mathematics is mathematics. Again, the phone was implicated as mathematics because people talk about math on it. Playing "What If" was mathematics to one child because George discussed the lock combination while playing.

- Using certain tools is always described as mathematics (map, scale, compass).

- Calculating (how many miles Grunt could run per given period of time, how much cost per pound of bananas, etc.).

DISCUSSION

This section discusses the results of the study in regard to the three main issues raised in the Introduction: informal reasoning, viewers' understanding of mathematical concepts, and ideas and attitudes about mathematics.

Informal Reasoning

When they watched "Mathnet," children in our study recognized the main story problems, generated hypotheses, and reasoned about evidence that bears on those hypotheses. Thus we conclude that "Mathnet" motivates the practice of these skills in informal reasoning. Although we observed this behavior in the children's performance, it might have been generated by the show, or it might have been generated by the research procedure. Within this design we do not have a formal means of separating out the two sources of influence. However, even though this study provided the subjects with considerable guidance in informal reasoning by asking them carefully directed questions, posing problems, and raising alternative viewpoints, there is reason to suspect that children engage in these activities even without intervention. Children in our sample spun tales, argued, and wove scenarios about the "Mathnet" mysteries--whether or not they happened to be chosen for that day's Mathnet Panel. They did this while they were viewing the episodes, as well as in the school hallways and at lunch. Since each child served on a panel only three times, it is unlikely that we and the teachers were merely witnessing training effects from the research procedure.

As mentioned in the Introduction to this paper, studies of causal reasoning, scientific thinking, and decision-making usually

reveal that humans make characteristic patterns of errors when they evaluate evidence that bears on a favored theory. For example, they are more likely to notice and cite evidence that confirms a favored theory than they are to attend to and interpret evidence that disconfirms a theory they believe. In addition, they evaluate such evidence as being more conclusive and better founded. They are more likely to ignore evidence for a theory they do not believe than they are to overlook similar evidence that supports their own theory. Children in our study made these errors, too, but showed more sophistication in generating and evaluating different theories than is usually seen among children in the informal reasoning research. We speculate that the story structure of "Mathnet" provides certain structural supports for noting and entertaining an alternative point of view. Children's implicit knowledge of story structure elements like paths, causal connections, goals, constraints, solutions, and outcomes (e.g., Mandler, 1984), may enable reasoning of a more sophisticated kind than children engage in when they reason about the simple covariation of antecedents and outcomes. When children (or adults, for that matter) reason, they do not merely tabulate and record clues and evidence; rather, they try to fit what they are learning into a larger explanatory scheme. The "Mathnet" stories may provide that explanatory scheme by introducing characters who articulate and argue for different points of view and by exemplifying the familiar mystery format, where every viewer understands that the obvious conclusion may not be the correct one.

The <u>kind</u> of problem solving that the format stimulates is

not inherently mathematical (although, of course, it is used as a context for raising and thinking about mathematical issues). That is, these problems are not abstract, deductive reasoning exercises. Instead, the problems have a closer resemblance to the kind of problems described in the critical thinking and informal reasoning literatures, which require children to use the evidence at hand as well as their general knowledge to frame the problem, decide what the goal is, and then decide when it has been achieved. The Square One staff might legitimately debate whether a series on mathematics ought to feature a format whose structure is not primarily mathematical. However, the series motivates and supports children in practicing reasoning skills that are both valuable and difficult. If we accept the premise that this kind of activity deserves to be an objective of Square One, then it may be useful to think about "Mathnet" in relation to a model of problem solving that suits complex, everyday reasoning problems.

Doing so might provide a framework for helping to understand another finding of the study: our three sequels did not equally succeed in supporting informal reasoning. We can explain this point best by discussing our subjects' performance in relation to the reasoning skills we have been considering.

Identifying the Problem:

In "Passing Parade," the third-graders had some difficulty when the main problem abruptly switched from working out details of the parade to finding Steve Stringbean. As we reported in the results for episode one, they did not automatically make the kind of quick inferential leap that allowed the fifth- and sixth-graders to understand that catching the plane and working

out the parade details were no longer relevant objectives.

"Missing Baseball" contains a comparable shift of problem definition. The Mathnet Squad is first called in to locate the missing baseball, but then the main focus shifts to the subgoal of finding Mrs. MacGregor's missing house. In this story, the third-graders had no difficulty following the switch, perhaps because it was very graphically portrayed (Mrs. MacGregor on an empty lot with tent and signs) as opposed to simply being verbally described by George on the telephone, as was the case in "Passing Parade."

In contrast, in "Missing Monkey," children were speculating about who the robber might be even before we asked them. In fact, there are two main problems in "Missing Monkey," finding Grunt and solving the robberies. Depending on whether he believes Grunt is the robber, a child might parse that as one or two problems. When we asked them about the problem, some children provided one of these replies and some provided both; in any case, no child was confused about what the problem was.

Generating Hypotheses

Children have no difficulty generating alternative hypotheses to account for events in the "Mathnet" stories, and there seem to be only small differences in the number of hypotheses generated by the younger children as opposed to the older children. However, there are two methodological limitations to our study that make generalizations about age effects difficult. First, the small size of our Mathnet Panels makes the data susceptible to being skewed by outliers, children who make substantially more or fewer replies than others in the group.

Second, because of scheduling constraints, our sixth grade group was composed of two below-grade math classes. These children exhibited considerably less enthusiasm and participation than children in the other grades. Clearly they were not predisposed to volunteer information or to chance offering answers in extacurricular mathematics activities. This problem, combined with the fact that clear age trends have been found in other Square One research, influence us to take certain of our age-related findings (and certain failures to find age effects) with a grain of salt. For example, a reasonably common pattern in our data was an inverted U-curve in frequency of hypotheses generated, with the fourth- and fifth-graders generating more hypotheses than the third- and sixth-graders. However, because of the nature of our sixth-grade sample, we do not conclude that "Mathnet" better stimulated hypothesis-generation among fourth- and fifth-graders.

We did get some age differences on the kinds of hypotheses generated, but these depended on the "Mathnet" segment. When the story encouraged unconstrained generation of hypotheses (in effect, guesses), none of the age groups showed a tendancy to evaluate their hypotheses for plausibility. Thus we have sixth-graders speculating that perhaps Grunt took a bus to the Huntington Beach robbery and that perhaps the earth opened up and swallowed Mrs. MacGregor's house. On the other hand, when the storyline supports the probability that there is more than one plausible hypothesis, we see the older children relying more on their richer knowledge about the world to help them choose among the alternatives. For example, the reader may recall that at the

beginning of "Missing Monkey," the third- and fourth-graders were quite willing to entertain the possibility that a robber-monkey might be on the loose, and they offered evidence from the story to support that idea. On the other hand, the fourth- and fifth-graders felt quite sure that the robber could not be a monkey, and in support of that belief, they cited their knowledge about what monkeys are likely to do and capable of doing. Similarly, when asked whether they believed Steve Stringbean might have written the sheet music found in the hideout in "Passing Parade," the older children were more likely to generate plausible hypotheses about why he might have written it, such as the notion that the kidnappers might have made him leave it behind on purpose to throw off the Mathnet Squad. The younger children tended to stick to inconclusive information that did not take into account the direction of the plot or the characters' motives, for example, "He's a musician, and he writes music."

The point here is that the structure of the "Mathnet" story has a lot to do with the quality of children's reasoning. When little is known and every possibility is equally plausible (as in the question about what happened to Mrs. MacGregor's house), children simply generate alternatives without thinking much about them. When the story encourages thinking about characters' motives or the plausibility of alternatives, the fourth- and fifth-grade children produce more plausible (but not necessarily a greater number of) hypotheses than the third-graders. Fourth- and fifth-graders often outperformed sixth-graders, both on number and quality of hypotheses generated, but we attribute that finding to the nature of our sample and not

to genuine age differences.

Identifying Evidence for Various Hypotheses:

In the reasoning literature, children frequently more readily note evidence justifying a theory they believe is true than they cite evidence to justify a theory they do not believe. This does not show up clearly in our data, because the story format affords a way of resolving the discrepancy that most reasoning tasks do not. When we asked our children to provide evidence supporting a premise they did not believe, they would frequently instead generate alternative hypotheses that might account for the outcome. For example, most of our subjects did not believe that Steve Stringbean wrote "75 Trombones" because he writes rock music, not marches. When we asked them, "What did we see and hear today that might make us think Steve wrote the music," they generated hypothetical explanations that served to resolve the contradiction between the premise and their theory, for example, he wrote it because the kidnappers forced him to. Not surprisingly, children were more likely to generate these alternative hypotheses when they were asked to support a premise they did not accept, and more likely to recount evidence from the story when we asked them to support a premise they believed was true.

Finally, when we asked them to provide evidence for a premise they did not believe, the older children, but not the younger ones, frequently would unconsciously introduce into their argument evidence for the opposite theory. For example, asked to provide evidence why Grunt might be the robber, a fifth-grader (who did not believe a monkey could rob a store) began by writing

down the facts that bananas were stolen and a monkey is missing from the zoo, but then continued by noting that "a monkey can't drive a shopping cart." Young children did not usually make this kind of "cognitive Freudian slip," and the older children only did it when arguing against a point of view that they felt strongly about. For example, it occurred very frequently in "Missing Monkey," where the older children strongly doubted that a monkey would rob a store, and much less frequently in "Passing Parade," where thev could think of several legitimate reasons why Steve Stringbean might write "75 Trombones."

The three "Mathnet" sequels we tested exemplified two different structures. Two of them ("Passing Parade" and "Missing Baseball") started off by posing an intriguing problem (Who kidnapped Steve Stringbean? What happened to the baseball/house?) and implicitly inviting the viewer to wonder about it. But note that at the beginning of these segments, the viewer has little material to wonder with, because there are very few readily interpretable clues to think about. As the week progresses, the evidence mounts until it begins to cluster around and support a particular hypothesis. At some point that hypothesis becomes more certain and then the solution is known. Thus there is one line of evidence that over the week funnels progressively closer to the solution.

Now contrast the structure of "Missing Monkey." A problem is posed, but there are reasons right from the beginning to suspect that the obvious interpretation cannot be correct. Soon another character is introduced who actively lobbies for an alternative interpretation of the data. Over the week, both

hypotheses remain plausible because both continue to be buttressed by new evidence. It is not until the last suspenseful moment that the mystery is resolved and both lines of evidence become subsumed under one explanation. We would like to argue that the "Missing Monkey" structure is more supportive of informal reasoning precisely because it embodies the alternative perspectives that children have trouble generating and taking seriously. In fact, anecdotal reports from our interviewers are that "Missing Monkey" was easily the most popular of the sequels, with "Passing Parade" second (perhaps because it invites consideration of characters' motives) and "Missing Baseball" third. (However, NOTE that our study was not designed to address appeal, and the Square One appeal research indicates that "Missing Monkey" is most popular, followed by "Missing Baseball" and then "Passing Parade"). Of course, we are not arguing that the "Missing Monkey" structure be adopted as a formula that all "Mathnet" sequels should try to follow. Rather, we are trying to point out that "Missing Monkey" is one structure among a number of possible others that, through the good instincts of the producers, happens to support the very skills that kids find most difficult. Thinking about "Mathnet" in terms of these skills may help us develop more such effective structures. We might also consider making the generation and evaluation of hypotheses a more explicit part of the show. It might be useful for viewers to occasionally hear characters discuss whose idea is better and why, and to be introduced directly to the words and concepts of "hypothesis" and "evidence."

Viewers' Understanding of Mathematical Concepts

Our general impression was that the children enjoyed the

mathematics in the stories. In fact, they seemed rather taken with the notion that the detectives could solve problems with mathematics, and they made frequent mention of the mathematical concepts introduced on the show.

We mention these facts to encourage taking time to carefully explain mathematical concepts. The children seemed to be genuinely interested in the mathematical ideas, not champing to get on with the story. We feel that a bit more time spent on explaining the mathematics might be useful, because children often fail to make the inferences that would permit them access to concepts that are not fully and explicitly presented. Our impression was that, for our sample, some of the mathematics went by very fast, often with sparse explanation of intermediate processes.

The children recalled a considerable amount of the mathematics on the show, and they showed reasonably good understanding of its purpose. These achievements, especially the second, are not trivial. But occasionally the children showed poor or incomplete understanding of the mathematics involved. Here are a few examples of incomplete understanding of the mathematical concepts, as well as some notable successes.

Diagrams and Models:

Children seemed fascinated with the diagrams and models presented on the show: the computer model of the baseball field, the map with Grunt's range of motion circled, the circle graph that represented Grunt's feeding chart. However, there were cases where they would probably have learned more from a fuller explanation. For example, children readily identified a

photograph of the map that George and Kate used for the parade planning. However, few of them (about a third) remembered that the map was used to calculate how many spectators might come to the parade, and fewer yet had any notion of what those little blocks lining the sidewalks were supposed to represent. Perhaps if George or Kate had merely remarked, "See--one small block, which represents two square feet for each person," that might have provided the hook we needed.

As we mentioned in the Results section, children knew what the baseball field model was for and nearly all of them identified the correct model when asked to choose it from two distractors. However, they did not really understand what angle they were supposed to be attending to (indeed, it's possible the younger children don't know what an angle is). Perhaps as a consequence, many of them missed the point, explaining in a later question that the ball might have bounced in a different direction, or that perhaps the computer was wrong. Again, a fuller, more explicit explanation would have been helpful; for example, if Ginny generated a few possible paths for the ball, and then asked George to trace (with a pencil) the possible ricochets before the computer confirmed them. Perhaps also Ginny could have spent a little more time pointing out which two angles are equal and showing how they look when they are equal and not equal.

In the Results section, we also discussed children's incomplete understanding of using a circle to indicate the area that delineates the possible range of motion of the helicopter and the gorilla. Once again, children recognized the correct diagram and knew what it was used for but did not understand why a circle

was better than a square or an oval. As we reported, some children even believed that the shape was a circle <u>because</u> the characters chose to use a compass to draw it. Others gave answers that looked as if they expected the shape to <u>determine</u> where the gorilla (or helicopter) could be as opposed to <u>describing</u> where it could be. The few children who gave good answers to the "why a circle and not some other shape?" question were all in fifth or sixth grade. We suggested that Ginny might have talked through how a circle describes the points equidistant from a central point. She might have used a ruler to plot several points an equal distance from Mrs. MacGregor's yard, and showed how they approximate a circle. Then she could explain that the same thing is accomplished by setting the compass radius. She might finish by asking Howie how far each of several points on the circle is from Mrs. MacGregor's yard, and how he knows.

Children showed good understanding of the circle graph representing Grunt's feeding chart. Even some of the third-graders, who did not mention percentages, talked about the "greater space" that fruits and vegetables took up on the chart. Circle graphs are introduced early in school mathematics, and children were able to take this familiar concept and interpret it in the context of the story.

Thus, children do not always get a deep understanding of the models and diagrams we use on the show. However, they get some information from them, notably, they understand their function. We DO NOT argue for long explanations that often only bore and obfuscate the strength of what we have (that is, children's understanding that these diagrams have a real <u>purpose</u>

in relation to characters' goals). What we are suggesting in most of these examples is a sentence or two more, to fill in a missing step.

Calculations:

The calculation on the show is frequently recalled and identified by viewers as mathematical activity. In addition, we do a good job of showing calculation for a purpose, and not as the rote exercise many children encounter. On the whole, children note and understand the functions that these calculations serve. Children characteristically do not follow the calculations themselves. For example, children can explain that George calculated how many police officers should be on horseback, but they cannot explain what calculations he performed or why.

Although the children in our study showed considerable patience for watching extended sequences of calculations (for example, episode one of "Passing Parade"), we were NOT in this study requiring them to watch these segments in the context of a full half-hour program. It is difficult to know how interested and capable viewers would be of actually following along with these calculations in the context of a full show. In any case, the show does not presently support viewers in doing so, because the calculations are often done rather quickly. Consequently, we recommend against presenting extended sequences of calculations, because they may be more confusing than illuminating. It is probably better to keep presentation of actual calculations brief, to avoid giving in to the pressure to make the shows more mathematical by packing them with many calculations, and instead, when we do show calculation, to concentrate on illustrating or

clarifying one simple point.

In addition, on occasion calculations may simply not be the best way of presenting an idea. For example, when George calculated the number of combinations on Grunt's lock, the idea was both too fast and too difficult for the children to understand. Why should one multiply 36 times 36? Even if a child knew enough to ask the question, he wouldn't be likely to know the answer. Here we might have gone with a simple verbal summary of the problem, for example: "There are 36 numbers on this lock and they can go together in many, many ways. It is not very likely that anyone could guess the combination, even if he tried for a long, long time."

Mathematical Tricks:

Children really loved the math tricks, like Rimshot's counting in the van and the angle on the celery tonic bottle. The reader may recall that Rimshot counted as the van drove so that the beats would provide a cue for remembering when the kidnappers made a turn. The children in our sample came close to fully understanding what Rimshot was trying to do. Had Rimshot said something like, "When I get to 38, turn!" we think they would have grasped the idea that counting was a cue to turns and not just to elapsed driving time. The "bottle trick" involved watching the angle made by the liquid surface in a bottle to estimate the height of a hill that the van was climbing. The children did very well when we asked them to draw what the surface looked like, and seemed quite interested in the idea that you could use mathematics (like estimating angles) to solve problems.

Ideas and Attitudes About Mathematics:

Children either already knew or learned from the series that calculators and computers permit a person to do math quickly, easily, and without mistakes. However, when asked, children expressed some prejudices about calculators: they make you lazy, you don't learn anything if you use them, and other similar ideas, which they may well have heard from their parents or teachers. The series sparked some good discussions about whether using calculators is OK or "cheating." We feel these discussions were facilitated by the fact that the "Mathnet" characters use calculators so routinely and matter-of-factly. It might also be good sometime to explicitly raise the question whether it is ever better to use a calculator to solve a problem, and whether it is ever better to do a problem in your head.

Interestingly, children did not generalize these prejudices to computers. They seemed to have very positive attitudes about computers. However, subjects did sometimes confuse computers with their applications, so that some children thought data bases _are_ computers. Maybe we can find a way of helping children make that distinction (it is a difficult one even for adults).

Children expressed some interesting ideas about whether one ought to ever give up on a problem solution that isn't working out. Some children insisted one should never give up; others felt if a strategy isn't working out, you should try another method. A couple of children even indicated that how long you persist ought to depend upon the importance of your goal--a very sophisticated understanding. These conversations occurred when children

considered the "blind alleys" the "Mathnet" crew went down while they were trying to find Steve Stringbean. The seriousness of their discussion suggests that this might be an interesting issue to raise more explicitly on the show. At the least it would be good to occasionally show characters explicitly evaluating their progress toward solving a problem, and perhaps considering a new path. We portray these strategies in the program from time to time, but it might be worthwhile to describe them more directly in the context of the stories, thus raising them to the level of children's metacognition about their own reasoning.

Children in our sample were able to supply all sorts of examples of the kinds of mathematical activities presented in "Mathnet." These included calculating, measuring, converting units, using maps and models, and using mathematical tools like compasses, calculators, and computers. However, because the Mathnet characters are mathematicians, and because they tackle all types of problems, our viewers occasionally got confused about which activities were mathematics and which were not. Several children responded as if all problems addressed by mathematicians are, by definition, mathematics. We think it would be useful to raise on the show the issue that not all problems are mathematical problems, and to clarify the distinction, lest we muddy it. Similarly, children (especially the third-graders) sometimes insisted that anything involving numbers must be mathematical, so that, for example, getting arrested on a 484 is mathematics. Conversely, activities that do not involve numbers are not mathematics. Thus, children's criteria for deciding what is mathematics are sometimes too general and sometimes too

inflexible. Trying to address some of these areas of children's meta-knowledge about mathematics might well be on the agenda for future production.

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Appendix A

General Introduction to the Study

MATHNET STUDY
February, 1987

General Introduction to the Study

Have you ever watched television and wished you could make a difference in the programs you see? Well, for the next three weeks, you will get that chance. I'm Leona, and this is Carol and Linda. We're from the Children's Television Workshop, where people have been working on a new program for people your age, called Square One Television.

Over the next three weeks we'll be spending a little time each day here in class to watch a short episode from Square One. The episodes are called Mathnet, and they are stories about problems solved by the Mathnet Squad.

Each day, the entire class will watch about 10 minutes of the story. Then, after watching, four students will serve as our Mathnet Panel for the day. Every person will get a few turns to be on a panel. When it's your turn to be on the Mathnet Panel, you will work with me or with Carol to fill out the Mathnet Log (hold up sample). When we watch the story together, make sure to pay careful attention, because you won't know until after it's over whether you are on the panel that day. As you will see, being on the panel is kind of fun. It's nothing like taking a test and has nothing at all to do with your grades in school. There are lots of different answers to the questions we will think about together. The whole idea is to do some careful thinking - - like a detective - - about the problems you will see in the Mathnet stories.

Any questions? (Respond to students' questions).

Let's begin by watching today's show. Remember, think carefully about the story - - you may be on today's Mathnet Panel!

Introduction to the Mathnet Panel

(To be given at the beginning of the first meeting with each new group of children)

Let's talk about what we will do here on the Mathnet Panel. Today we will be thinking together about some questions that I will ask about the story we saw (have been watching this week). Most of these questions do not have one right answer. In fact, sometimes we will ask you to think about a problem in as many different ways as you can. Sometimes we will be asking your opinion about which is the best way to think about a problem. However, we are not interested in correct answers; we're interested in how you think about problems like these.

This is called the Mathnet Log Book. When scientists or detectives are trying to solve a problem, they often keep a lab book or a log book to write down ideas, facts, and clues. Our job today will be to think carefully about the story we saw, so that we can fill out this log book. Each person will work alone on the questions. I will read out the question, and each person should write down his/her best thoughts about it in the log book. Then, we will talk together about the question.

Now, we don't want you to worry about spelling or handwriting. Spelling and handwriting don't count here. It's your ideas that matter.

We will be using this tape recorder from time to time so we don't have to write down what you say.

Appendix B

Mathnet Study Items

and Children's Logbooks

THE CASE OF THE PASSING PARADE

MONDAY
Episode 1
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN EACH PERSON WILL TAKE SOME TIME TO WRITE DOWN HER/HIS ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all the children have their books open to the correct page. Hand out pencils as required.

HERE COMES THE FIRST QUESTION.

P1,Q1

QUESTION ONE: WHY DID THE CHIEF NEED THE MATHNETTERS' HELP? NOW REMEMBER, WHENEVER YOU ARE NOT SURE OF AN ANSWER, JUST WRITE YOUR BEST IDEA. WHY DID THE POLICE CHIEF COME TO THE MATHNET SQUAD FOR HELP? WRITE YOU ANSWER ON THE LINES.

Wait until all children have finished writing. Then:

Turn Tape Recorder on.

Oral Review, Q1

LET'S JUST TURN OUR BOOKS OVER FOR A MOMENT, SO WE CAN DISCUSS THIS QUESTION TOGETHER. WHY DID THE CHIEF NEED THE MATHNETTERS TO HELP HIM?

(P) Probe: WHAT WAS THE CHIEF'S PROBLEM? WHAT DID THE CHIEF HAVE TO DO? HOW DID THE CHIEF THINK THE MATHNET SQUAD MIGHT HELP?

WHAT JOBS DID HE HAVE FOR KATE AND GEORGE?

<u>Oral Only, Q2</u>

2.

<u>Hold up Polaroid shot of Kate and George standing in front of the wide-scale parade route.</u>

REMEMBER WHEN KATE AND GEORGE WERE TRYING TO FIGURE OUT HOW MUCH TIME THE PARADE WOULD TAKE? WHY DID THEY LOOK AT A MAP TO FIGURE OUT HOW MUCH TIME THE PARADE WOULD TAKE?

(P) Probe: IS A MAP GOOD FOR TELLING HOW MUCH TIME SOMETHING WILL TAKE? WHAT DOES A MAP TELL YOU? HOW CAN A MAP HELP YOU FIGURE OUT HOW MUCH TIME A PARADE WILL TAKE?

<u>Tape Recorder Off</u>.

<u>Q3,P2</u>

LET'S OPEN OUR BOOKS AGAIN TO GO ON. OPEN YOUR BOOK TO PAGE TWO.

3. GEORGE AND KATE DECIDED THAT THE FRONT OF THE PARADE WOULD FINISH IN PLENTY OF TIME IF THE PARADE STARTED AT 5:00. SO WHY DID THEY THINKTHE PARADE WOULD HAVE TO BEGIN EARLIEk, MAYBE AS EARLY AS 4:30? WHY DID THEY THINK THERE MIGHT NOT BE ENOUGH TIME FOR THE PARADE? WRITE YOUR ANSWER ON THE LINES.

<u>Q4,P3</u>

NEXT QUESTION:

4. WHY DID THE CHIEF WANT TO KNOW HOW MANY PEOPLE MIGHT COME TO THE PARADE? WRITE YOUR ANSWER ON THE LINES.

Oral Review, Q4

ONCE AGAIN, LET'S TURN OUR BOOKS OVER.

Tape Recorder On.

WHY DID THE CHIEF WANT TO KNOW HOW MANY PEOPLE MIGHT COME TO THE PARADE? WHY WAS IT IMPORTANT FOR HIM TO KNOW THAT?

(P) Probe: ANYBODY HAVE AN IDEA? WHY DO YOU THINK IT MIGHT BE IMPORTANT? ANYTHING ELSE? WHO WORKS FOR THE POLICE CHIEF?

Q5, Oral Only (Keep tape recorder on.)

Show close up view of the map.

5a. WHAT IS THIS? (Pause.) WHAT IS IT FOR? WHY DID KATE AND GEORGE LOOK AT THIS? WHAT WERE THEY TRYING TO FIGURE OUT?

Show Polaroid shot of George with calculator.

5b. GEORGE USED A CALCULATOR TO LEARN HOW MANY FEET THERE ARE IN 3.2 MILES. WHY DIDN'T HE JUST DO HIS MULTIPLICATION ON THE BLACKBOARD?

5c. YOU CAN DO MATH MANY WAYS, YOU CAN USE YOUR HEAD, PENCIL AND PAPER, OR A CALCULATOR. IS IT SOMETIMES BETTER TO DO A PROBLEM WITH A CALCULATOR? YOU MIGHT THINK YES, AND YOU MIGHT THINK NO. LET'S VOTE: (cont. next page):

HOW MANY PEOPLE SAY NO? WHY DO YOU SAY NO? WHY IS IT NOT SUCH A GOOD IDEA TO DO PROBLEMS WITH A CALCULATOR?

HOW MANY PEOPLE SAY YES? WHY DO YOU SAY YES? WHY IS IT SOMETIMES BETTER TO DO A PROBLEM WITH A CALCULATOR? WHAT KIND OF PROBLEMS SHOULD YOU DO WITH A CALCULATOR?

5d. IS IT SOMETIMES BETTER TO DO PROBLEMS IN YOUR HEAD INSTEAD OF WITH A CALCULATOR? YOU MIGHT THINK YES AND YOU MIGHT THINK NO. LET'S VOTE: HOW MANY PEOPLE SAY NO? WHY DO YOU SAY NO? WHY DO YOU THINK YOU SHOULD NEVER DO PROBLEMS IN YOUR HEAD?

HOW MANY PEOPLE SAY YES? WHY DO YOU SAY YES? WHY IS IT SOMETIMES BETTER TO DO PROBLEMS IN YOUR HEAD? WHAT KIND OF PROBLEMS SHOULD YOU DO IN YOUR HEAD?

Tape Recorder Off.

Q6,P4

OKAY, LET'S OPEN OUR BOOKS AGAIN, TO PAGE FOUR.

4. THE CHIEF DID NOT HAVE ENOUGH POLICE OFFICERS FOR THE PARADE. HOW DID THE MATHNETTERS SOLVE THE PROBLEM? HOW DID KATE AND GEORGE HELP? WRITE YOUR ANSWER ON THE LINES.

Q7,P5

PLEASE TURN THE PAGE NOW.

HERE'S THE FINAL QUESTION FOR TODAY.

7. WHAT IS THE MOST IMPORTANT PROBLEM OF THE PARADE? WHAT IS THE MOST IMPORTANT PROBLEM KATE AND GEORGE MUST SOLVE? WRITE YOUR ANSWER ON THE LINES.

Finish up by thanking children and reminding them that they will be chosen again for a mathnet panel, so pay attention! You never know when you might be chosen.

TUESDAY
Episode 2
Instructions to Interviewer

WELCOME, MATHNET PANEL! LET'S OPEN OUR LOGBOOKS TO PAGE ONE. REMEMBER, I WILL READ EACH QUESTION ALOUD FIRST. THEN YOU WILL HAVE TIME TO WRITE IN YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all children have their log books open to page one. Hand out pencils as required.

HERE'S THE FIRST QUESTION TODAY.

Q1,P1

1. WHAT IS THE MOST IMPORTANT PROBLEM WITH THE PARADE? REMEMBER, IF YOU ARE NOT SURE OF AN ANSWER, JUST WRITE YOUR BEST IDEA. WHAT IS THE MOST IMPORTANT PROBLEM KATE AND GEORGE MUST SOLVE? WRITE YOUR ANSWER ON THE LINES.

Oral Review, Q1

Tape Recorder On.

NOW LET'S TURN OVER OUR BOOKS FOR JUST A MOMENT, SO THAT WE CAN DISCUSS THIS QUESTION TOGETHER.

WHAT IS THE MOST IMPORTANT PROBLEM GEORGE AND KATE MUST SOLVE?

Ask each child in turn: WHAT DO YOU THINK IS THE MOST

IMPORTANT PROBLEM OF THE PARADE?

After each child's response, ask the group: WHAT DO WE THINK? WHY IS THIS AN IMPORTANT PROBLEM? IS IT THE MOST IMPORTANT PROBLEM? ANY OTHER IDEAS?

Q2a, Oral Only (Tape Recorder stays On.)

2a. HERE'S OUR NEXT QUESTION: WHEN STEVE STRINGBEAN WAS KIDNAPPED, RIMSHOT WAS HIDING IN THE VAN. HE COULD NOT SEE OUT THE WINDOW. SO HOW COULD RIMSHOT TELL WHEN THE TRUCK BEGAN TO GO UP A HILL? HOW DID HE KNOW?

If necessary, remind: REMEMBER, HE COULD NOT SEE OUT THE WINDOW. HOW DID HE KNOW THE TRUCK WAS GOING UP A HILL?

Ask children in turn, if they are not on the right track: WAS THERE SOMETHING INSIDE THE CAR THAT HE COULD SEE THAT GAVE HIM A CLUE? WHAT WAS IT?

CAN YOU THINK ON ANY OTHER WAY RINSHOT MIGHT HAVE FIGURED OUT THAT THE CAR WAS GOING UP A HILL? DOES ANYBODY ELSE HAVE AN IDEA HOW HE MIGHT KNOW?

Tape Recorder Off.

Q2b,P2

These questions are read orally. (But not taped)

2b. I'M GOING TO GIVE YOU BOTTLE #1 (Hand out.)
SUPPOSE THE VAN WAS NOT ON A HILL. DRAW A LINE TO SHOW HOW

THE SURFACE OF THE CELERY TONIC WOULD LOOK IN THE BOTTLE WHEN STEVE'S VAN WAS NOT ON A HILL. HOW WOULD THE CELERY TONIC LOOK? NOW TURN BOTTLE #1 OVER.

I WILL GIVE YOU BOTTLE NUMBER TWO. SUPPOSE THE VAN STARTED GOING UP A HILL. DRAW A LINE TO SHOW HOW THE SURFACE OF THE CELERY TONIC LOOKED IN THE BOTTLE WHEN STEVE'S VAN WAS GOING UP THE HILL.

Tape Bottles in Book.

Q3, Oral Only

Tape Recorder On.

Show Polaroid shot of Kate, George, and Rimshot driving in the van. Rimshot has his eyes shut.

3. KATE, GEORGE, AND RIMSHOT DROVE IN THE VAN TO TRY TO FIND STEVE. WHY WAS RIMSHOT COUNTING WITH HIS EYES CLOSED? HE COUNTED 27-2-3-4, 28-2-3-4. WHY WAS HE COUNTING?

(P) Probe: WHAT WAS HE TRYING TO DO?

HOW DID GEORGE KNOW WHICH WAY TO DRIVE THE VAN?

HOW DID GEORGE KNOW WHEN TO TURN?

Tape Recorder Off.

Q4, P3

LET'S OPEN OUR BOOKS TO PAGE THREE.

4. KATE, GEORGE, AND RIMSHOT DROVE THE VAN TO A HOUSE, A HIDEOUT. HOW DID RIMSHOT FIND OUT FOR SURE THAT STRINGBEAN HAD BEEN IN THE HIDEOUT?

DID RIMSHOT SEE ANYTHING THAT HELPED HIM KNOW THAT STRINBEAN HAD

BEEN INSIDE? WRITE YOUR ANSWER ON THE LINES.

Tape Recorder On.

Q5, Oral Only

DO YOU THINK IT WAS A GOOD IDEA FOR THE CHIEF TO SEND MATHEMATICIANS TO LOOK FOR STEVE STRINGBEAN? LET'S VOTE: HOW MANY PEOPLE THINK IT WAS PROBABLY A GOOD IDEA TO SEND MATHEMATICIANS?

TELL ME WHY?

HOW MANY PEOPLE THINK IT WAS PROBABLY A BAD IDEA TO SEND MATHEMATICIANS? TELL ME WHY NOT? IS THERE ANY OTHER KIND OF PERSON THAT YOU THINK THE CHIEF SHOULD HAVE PUT ON THE CASE? WHY?

WEDNESDAY
Episode 3
Instructions-to-Interviewer

HI, MATHNET PANEL! LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST, THEN I WILL GIVE YOU TIME TO WRITE YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all children have their log books open to page one. Hand out pencils as required.

HERE'S THE FIRST QUESTION.

Q1,P1

1a. AT THE HIDEOUT, GEORGE AND KATE FOUND SOME SHEET MUSIC, LIKE THIS.

Hold up sample of sheet music with title, 75 Trombones.

THE NAME OF THE MUSIC WAS 75 TROMBONES. DO YOU THINK THE MUSIC MIGHT HAVE BEEN WRITTEN BY STEVE STRINGBEAN? IF YOU THINK IT WAS, CHECK PROBABLY YES. IF YOU THINK IT WAS NOT, CHECK PROBABLY NO.

WHY DO YOU THINK STEVE DID OR DID NOT WRITE THE MUSIC? WRITE YOUR ANSWER ON THE LINES.

1b. NOW LET'S FORGET FOR A MOMENT WHAT WE THINK ABOUT THE MUSIC. LET'S SUPPOSE THE MUSIC WAS WRITTEN BY STEVE STRINGBEAN. WHAT DID WE SEE AND HEAR TODAY THAT MAKES YOU THINK PERHAPS STEVE DID WRITE THE MUSIC? WRITE AS MANY FACTS AS YOU CAN REMEMBER TO SHOW THAT MAYBE STEVE WROTE THE MUSIC. WRITE YOU ANSWERS ON THE LINES.

Tape Recorder On.

Q1b, Oral Review

LET'S TURN OUR BOOKS OVER FOR A MOMENT, SO WE CAN DISCUSS THIS QUESTION TOGETHER. WHAT DID WE SEE AND HEAR TODAY THAT MAKES US THINK PERHAPS STEVE DID WRITE THE MUSIC? LET'S MAKE A LIST OF FACTS.

(P) Probe: ANYBODY ELSE HAVE ANYTHING TO ADD? CAN WE THINK OF ANOTHER FACT?

Tape Recorder Off.

Q1c,P2

1c. NOW TURN THE PAGE, PLEASE. REMEMBER, FORGET WHAT YOU THINK ABOUT THE MUSIC. LET'S SUPPOSE THE MUSIC WAS NOT WRITTEN BY STEVE STRINGBEAN. WHAT DID WE SEE AND HEAR TODAY THAT MAKES YOU THINK PERHAPS STEVE DID NOT WRITE THE MUSIC? WRITE AS MANY FACTS AS YOU CAN REMEMBER TO SHOW THAT MAYBE STEVE DID NOT WRITE THAT MUSIC.

Tape Recorder On.

Q1c, Oral Review

LET'S TURN OUR BOOKS OVER AGAIN TO DISCUSS THIS IDEA. WHAT DID WE SEE AND HEAR TODAY THAT MAKES YOU THINK PERHAPS STEVE DID NOT WRITE THE MUSIC? LET'S MAKE A LIST OF FACTS.

(P) Probe: ANYBODY ELSE HAVE ANYTHING TO ADD? CAN WE THINK OF

ANOTHER FACT?

Q1d, P2

WHY DO YOU THINK THE MUSIC WAS LEFT BEHIND IN THE HIDEOUT? LET'S MAKE A LIST . IDEAS. WHAT ARE GOOD POSSIBILITIES? WHY WAS THE MUSIC PROBABLY LEFT BEHIND?

(P) Ask each child in turn and generate a list as long as possible. Probe: ANY MORE REASONS? WHO CAN COME UP WITH ANOTHER POSSIBILITY?

Tape Recorder off.

Q2a, P3

NOW LET'S TURN TO PAGE THREE IN OUR LOGBOOKS.

2a. GEORGE FOUND OUT HOW MANY ANTIQUE CARS THERE ARE IN LOS ANGELES. HOW COULD HE FIND THAT OUT SO FAST? WRITE YOUR ANSWER ON THE LINES.

Q2b, P4

2b. WHY DID GEORGE USE A COMPUTER TO FIND OUT ABOUT THE CARS? WRITE YOUR ANSWER ON THE LINES.

Q3, Oral Only

Tape Recorder On.

WHY DO YOU THINK STEVE STRINGBEAN WAS SINGING ON THE PHONE? HE SANG, "PLEASE DO WHAT THESE PEOPLE SAY." BUT WHY DID HE SING? WHY DIDN'T HE JUST TALK? LET'S THINK OF AS MANY IDEAS AS WE CAN. WHY WOULD STEVE STRINGBEAN SING TO KATE ON THE PHONE?

Encourage each child to generate one or more ideas.

About each, say: THAT'S A GOOD IDEA. WHY WOULD STEVE DO THAT?

4. Why did the Chief want to know how many people might come to the parade?

He wanted to know because: ______________________________

____

____

____

____

____

____

6. How did the Mathnetters solve the Chief's problem?

They solved the problem by: ______________________________

____

____

____

____

____

____

____

7. What is the most important problem of the parade?

The most important problem is: ______________________________

TUESDAY

1. What is the most important problem of the parade?

The most important problem is: ______________________________

2b.

Bottle 1
Van is not on hill

Bottle 2
Van going up hill

4. How did Rimshot know Steve Stringbean had been in the hideout?

He knew because: ____

WEDNESDAY

1a. Do you think the music might have been written by Steve Stringbean?

_____ probably yes   _____ probably no

Why? ____

1b. What did we see and hear today that might make you think that Steve did write the music?

Maybe Steve wrote the music, because: ______________________

1c. What did we see and hear today that might make you think that Steve did not write the music?

Maybe Steve did not write the music, because: ______________

THURSDAY
Episode 4
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST. THEN I WILL GIVE YOU SOME TIME TO WRITE YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all children have their log books open to page one. Hand out pencils as required.

Q1,P1

HERE'S THE FIRST QUESTION.

Hold up Polaroid photo of press session.

1a. THE REPORTERS ASKED KATE AND GEORGE IF THEY HAD BEEN USING MATHEMATICS TO SOLVE THE CASE. DO YOU THINK THE MATHNET SQUAD HAS BEEN USING MATHEMATICS? IF YOU THINK YES, CHECK YES. IF YOU THINK NO, CHECK NO.

1b. WHY DO YOU THINK THAT? WRITE YOUR ANSWER ON THE LINES.

Q1c, Oral Only

Tape Recorder on.

1c. LET'S TRY TO MAKE A LIST TOGETHER. WHAT DID YOU SEE AND HEAR THIS WEEK THAT YOU THINK MIGHT BE MATHEMATICS?

About each response, as it is offered (you are asking the child who proposed the idea, but also the group), <u>continue to ask</u>:

TELL ME WHY X IS MATHEMATICS. DOES ANYBODY DISAGREE? DOES ANYBODY THINK X IS NOT MATHEMATICS? WHY DO YOU THINK X IS NOT MATHEMTICS? (But don't spend too much time.)

<u>Q2, Oral Only</u> (<u>Keep Tape Recorder on.</u>)

2a. THE CHIEF TOLD THE REPORTERS THAT WHEN YOU ARE SOLVING PROBLEMS, YOU OFTEN GO DOWN BLIND ALLEYS. DOES ANYBODY KNOW WHAT HE MEANS? WHAT IS A BLIND ALLEY?

(P) Probe: TAKE A SHOT AT IT! ANYBODY GOT AN IDEA? WAHT MIGHT IT MEAN: TO GO DOWN A BLIND ALLEY WHEN YOU'RE SOLVING A PROBLEM? WHAT DOES BLIND MEAN? WHAT DOES ALLEY MEAN?

2b. GOING DOWN A BLIND ALLEY MEANS YOU <u>THINK</u> YOU HAVE A GOOD IDEA ABOUT HOW TO SOLVE YOUR PROBLEM, BUT IT TURNS OUT TO BE WRONG. HAS ANYBODY EVER HAD THAT HAPPEN TO THEM? WHEN?

2c. HAVE THE MATHNETTERS GONE DOWN ANY BLIND ALLEYS ON THIS PROBLEM?

(P) Probe: CAN YOU REMEMBER A TIME WHEN THEY <u>THOUGHT</u> THEY HAD A GOOD IDEA ABOUT SOLVING THE PROBLEM, BUT THEY WERE WRONG?

(P) WHAT HAPPENED WHEN THEY WENT TO EASY STREET?

(P) DID THEY FIND STEVE STRINGBEAN?

Q3. Oral Only (Keep Tape Recorder on.)

The question is cued by a set of three Polaroid photos, in the manner of a cartoon strip. The question is set up by means of a story, illustrated by the three photos which are held up on posterboard, laid out to look like a cartoon.

First part of story refers to picture of Kate on phone, while George and Rimshot listen in background:

Hold up the 3 photos on posterboard. Point to first photo.

WHEN STEVE TALKED TO KATE ON THE PHONE, HE SANG, "PLEASE DO WHAT THESE PEOPLE SAY." RIMSHOT WAS SURE STEVE WAS TRYING TO SEND A SECRET MESSAGE.

SO RIMSHOT, KATE, AND GEORGE TRIED TO FIGURE OUT THE MESSAGE.

Point to second photo, of Mathnetters in front of empty lot.

FIRST THEY THOUGHT STEVE WAS TRYING TO SEND A CLUE ABOUT HIS ADDRESS, SO THEY WENT TO EASY STREET. IT TURNED OUT THAT THEY WERE WRONG. IT TURNED OUT TO BE A BLIND ALLEY.

Point to third photo, of George, presumably right after he discovers that FFFGEF is not a word.

THEN THEY THOUGHT THE MUSIC MIGHT SPELL OUT A SECRET WORD. BUT THE MUSICAL NOTES DID NOT SPELL OUT ANY WORD AT ALL, SO IT TURNED OUT THAT THEY WERE WRONG AGAIN. ANOTHER BLIND ALLEY!

RIMSHOT WAS STILL CERTAIN THAT STEVE WAS TRYING TO SEND A MESSAGE. HE DID NOT WANT TO GIVE UP. GEORGE THOUGHT STEVE WAS PROBABLY NOT TRYING TO SEND A MESSAGE. GEORGE THOUGHT THEY SHOULD THINK ABOUT THE PROBLEM IN A DIFFERENT WAY.

WHAT DO YOU THINK OF RIMSHOT? HE WOULD NOT GIVE UP. WHY DID THAT TURN OUT TO BE A GOOD THING FOR THIS PROBLEM?

WOULD YOU SAY IT MIGHT EVER BE BETTER TO GIVE UP ON AN IDEA ABOUT A PROBLEM?

SUPPOSE YOU HAVE AN IDEA ABOUT HOW TO SOLVE A PROBLEM, BUT NO MATTER HOW YOU THINK ABOUT IT, THE IDEA JUST DOESN'T SEEM TO WORK. SHOULD YOU GIVE UP? SHOULD YOU KEEP TRYING?

DO YOU REMEMBER WHEN KATE, GEORGE, AND RIMSHOT WENT TO EASY STREET? THEY THOUGHT STEVE STRINGBEAN MIGHT BE THERE. WAS HE? WERE THEY RIGHT TO GIVE UP THAT IDEA? WERE THEY WRONG TO GIVE UP THAT IDEA?

WHEN SHOULD YOU GIVE UP YOUR IDEA AND TRY TO THINK ABOUT YOUR PROBLEM IN A DIFFERENT WAY?

FRIDAY
Episode 5
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN I WILL GIVE YOU TIME TO WRITE IN YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their log books open to page one. Hand out pencils as required.

HERE'S THE FIRST QUESTION.

Q1,P1

1. THANKS TO RIMSHOT, GEORGE AND KATE LEARNED THE KIDNAPPERS' TELEPHONE NUMBER. HOW DID THE PHONE NUMBER HELP THEM FIGURE OUT WHERE STEVE STRINGBEAN WAS? WHAT GOOD IS A TELEPHONE NUMBER FOR FINDING OUT WHERE SOMEBODY IS? WRITE YOUR ANSWER ON THE LINES.

Give kids time to write. Then...

GOOD. NOW TURN THE PAGE, PLEASE.

Q2,P2

2. Show Polaroid of Kate, George, and Rimshot speaking to Mr. Lousa. (If possible, this should be a shot with Lousa at piano,

but I'm not sure there is one with all of them in the shot. If there's one of just Kate and Lousa, that would be OK for our purposes.)

BEFORE THEY FOUND STEVE STRINGBEAN, KATE, GEORGE, AND RIMSHOT WERE TALKING TO MR. LOUSA IN HIS HOUSE. WHEN DID KATE KNOW FOR SURE THAT MR. LOUSA WAS THE KIDNAPPER? WHAT WAS IT THAT MADE HER CERTAIN? WRITE YOUR ANSWER ON THE LINES.

Q3,P3

3a. ALL THIS WEEK WE WATCHED PEOPLE DOING MANY DIFFERENT KINDS OF THINGS. SOME OF THESE THINGS WERE MATHEMATICS. SOME WERE NOT MATHEMATICS. NOW THINK BACK AND USE YOUR MEMORY. WHAT THINGS DID THEY DO ON THE SHOW THAT WERE MATHEMATICS? WRITE DOWN AS MANY THINGS AS YOU CAN. TRY TO MAKE AS LONG A LIST AS YOU CAN. WHAT THINGS DID PEOPLE DO THIS WEEK THAT ARE MATHEMATICS? WRITE YOUR ANSWERS ON THE LINES.

If a child lays down his pencil before the others seem ready, probe:

(P) TRY TO THINK OF ONE OR TWO MORE THINGS YOU SAW THIS WEEK THAT YOU WOULD SAY WERE MATHEMATICS.

When the children have written all they can be urged to write, continue with oral portion.

Tape Recorder on.

3b, Oral Only

3b. LET'S TALK TOGETHER ABOUT OUR LISTS, OKAY, (CHILD X), READ ME THE FIRST THING ON YOUR LIST. WHAT DID YOU SEE THIS WEEK THAT YOU THINK MIGHT BE MATHEMATICS?

OKAY, EVERYONE. LET'S THINK ABOUT X. WHY IS X MATHEMATICS? GOOD. DOES ANYBODY ELSE HAVE AN IDEA ABOUT WHY X IS MATHEMATICS?

DOES ANYBODY DISAGREE? DOES ANYONE THINK X IS NOT MATHEMATICS? WHY NOT?

Go on to next item in list. Go through children's lists. If time remains, go down the list supplied below. Ask children to vote on each item.

LET'S TALK ABOUT SOME OTHER THINGS WE SAW. IS X MATHEMATICS? LET'S VOTE: WHO SAYS YES, IT IS? WHY DO YOU SAY X MIGHT BE MATHEMATICS? (OR, WHAT MAKES X MATHEMATICS?). WHO SAYS NO? WHY DO YOU SAY X IS PROBABLY NOT MATHEMATICS?

Concentrate on getting the "whys and wherefores" in these responses, not on the bare judgments of math/nonmath.

The list:

RIDING IN STEVE STRINGBEAN'S VAN

(cont. next page)

COUNTING OUT BEATS BETWEEN TURNS ON THE ROAD

USING THE COMPUTER AT THE MATHNET OFFICE

PLAYING 75 TROMBONES ON THE PIANO

ASKING FOR $104,020 IN RANSOM

MAKING HUNCHES ABOUT A PROBLEM

FIGURING OUT HOW MANY PEOPLE MIGHT COME TO A PARADE

USING A CALCULATOR TO TELL SOME CROOKS TO "FREEZE!"

WORKING OUT THE PARADE TIME ON THE BLACKBOARD

SEARCHING THE DATA BASE AT THE TELEPHONE COMPANY

THE CASE OF THE MISSING BASEBALL

MONDAY
Episode 1
Instructions to the Interviewer

LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN YOU WILL TAKE SOME TIME TO WRITE DOWN YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all children have their books open to the correct page. Hand out pencils as required.

OKAY, GET READY: HERE'S THE FIRST QUESTION.

Q1,P1

1. WHAT IS HOWIE'S PROBLEM? NOW REMEMBER, WHENEVER YOU DON'T FEEL SURE OF THE ANSWER, JUST WRITE DOWN YOUR BEST IDEA. WHAT IS HOWIE'S PROBLEM? WRITE YOUR ANSWER ON THE LINES.

Wait until the children have finished writing. Then:

OKAY, LET'S TURN TO PAGE TWO IN OUR BOOKS.

Q2,P2

2a. DO YOU SEE THE THREE PICTURES? WHICH PICTURE LOOKS MOST LIKE THE ONE YOU SAW ON THE COMPUTER? WAS IT PICTURE NUMBER 1, PICTURE NUMBER 2, OR PICTURE NUMBER 3? LOOK CAREFULLY AT EACH PICTURE BEFORE YOU DECIDE. WHICH PICTURE IS LIKE THE ONE YOU SAW ON THE COMPUTER? DRAW A CIRCLE AROUND THE PICTURE YOU SAW.

2b. WHAT IS THIS PICTURE? WRITE YOUR ANSWER ON THE LINES. WHAT DOES THIS PICTURE STAND FOR?

2c. WHAT IS THE PICTURE FOR? WHAT DID THE MATHNETTERS USE THE PICTURE FOR? WRITE YOUR ANSWER ON THE LINES.

Q2d, Oral Only

Note: In this case, we don't ask children to turn books over because we want them to refer to the sketches.

Tape Recorder On.

2d. OK, LET'S SEE WHAT PEOPLE THINK. HOW MANY PEOPLE CIRCLED PICTURE #1? RAISE YOUR HANDS. HOW MANY SAY PICTURE #2? HOW MANY SAY PICTURE #3?

If any children chose #1:

OKAY, ______, YOU SAID WE SAW PICTURE #1. HOW CAN YOU TELL? WHAT MAKES YOU SAY IT WAS PICTURE #1 WE SAW ON THE COMPUTER?

If anybody chose #2:

AND ______ SAID IT WAS PICTURE #2. WHAT DO YOU THINK, ______? HOW CAN YOU TELL? WHAT MAKES YOU SAY IT WAS PICTURE #2 WE SAW ON THE COMPUTER?

Picture #3:

AND ______ THOUGHT IT WAS PICTURE #3. HOW CAN YOU TELL, ______?

WHAT MAKES YOU SAY IT WAS PICTURE #3 WE SAW ON THE COMPUTER?

Q3, Oral Only (Keep Tape Recorder On.)

LET'S GO ON TO THE NEXT QUESTION. WHAT COULD HAVE HAPPENED TO HOWIE'S BASEBALL? LET'S SEE HOW MANY IDEAS WE CAN THINK OF. WHAT COULD HAVE HAPPENED TO HOWIE'S BASEBALL? WHO CAN THINK OF AN IDEA? (_____, DO YOU HAVE AN IDEA?)

Everytime a child offers an idea, say:

WHAT DID WE SEE AND HEAR TODAY THAT MIGHT MAKE US THINK THIS

____

____?

Go on down the list, prompting children to think of as many ideas as possible. Don't forget to ask for justification for each idea. Stop the questionning when children can't think of any more possibilities, or when it becomes evident that the ideas are getting ridiculously far-fetched.

TUESDAY
Episode 2
Instructions to Interviewer

WELCOME, MATHNET PANEL. LET'S BEGIN BY OPENING OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN YOU WILL TAKE SOME TIME TO WRITE DOWN YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their books open to the correct page. Hand out pencils as required.

ALRIGHT, EVERYBODY, HERE'S THE FIRST QUESTION.

Q1,P1

1. WHAT IS MRS. MACGREGOR'S PROBLEM? WHAT IS MRS. MACGREGOR'S PROBLEM? WRITE YOUR ANSWER ON THE LINES.

When children are finished writing:

OKAY, LET'S TURN OUR BOOKS TO PAGE TWO.

Q2,P2

2. MRS MACGREGOR SAID THAT LOTS OF PEOPLE HAD BEEN HANGING AROUND HER HOUSE, ASKING TO BUY IT, RENT IT, OR RENT A ROOM IN IT. DO YOU HAVE ANY IDEAS WHY ALL THOSE PEOPLE WERE SO INTERESTED IN MRS. MACGREGOR'S HOUSE? THERE IS NO ONE RIGHT ANSWER TO THIS QUESTION, WE JUST WANT YOU TO PUT DOWN YOUR BEST IDEA. WHY DO YOU SUPPOSE ALL THOSE PEOPLE MIGHT HAVE WANTED TO BUY OR RENT MRS. MACGREGOR'S

HOUSE? WRITE YOUR ANSWER ON THE LINES.

Q2, Oral Review

Tape Recorder On.

OKAY, LET'S TALK ABOUT OUR IDEAS. WHO HAS AN IDEA ABOUT WHY ALL THOSE PEOPLE WERE INTERESTED IN MRS. MACGREGOR'S HOUSE?
(Probe, if necessary: _____, WHAT'S YOUR IDEA? WHAT DO YOU THINK?)

Repeat child's idea: MAYBE ______________________. If it is unclear what relation this idea might have to an interest in Mrs. MacGregor's house, say MMM-HMMM. AND HOW DOES THIS EXPLAIN WHY THOSE PEOPLE WERE INTERESTED IN MRS. MACGREGOR'S HOUSE?
GREAT. ANYBODY ELSE HAVE AN IDEA?

Make sure to elicit at least one idea from each child.

Tape Recorder Off.

Q3, P3

OKAY, LET'S TURN TO PAGE THREE IN OUR LOG BOOKS.

3a. KATE AND GEORGE TRIED TO DECIDE WHAT HAPPENED TO MRS. MACGREGOR'S HOUSE. FIRST THEY WONDERED WHETHER SOMEBODY HAD BLOWN IT UP. BUT THEY DECIDED PROBABLY NOT. WHY WAS MRS. MACGREGOR'S HOUSE PROBABLY NOT BLOWN UP? WRITE YOUR ANSWER ON THE LINES.

3b. THEN KATE AND GEORGE WONDERED WHETHER SOMEBODY HAD DISMANTLED MRS. MACGREGOR'S HOUSE, THAT IS, TAKEN IT APART. BUT THEY DECIDED PROBABLY NOT. WHY WAS MRS. MACGREGOR'S HOUSE PROBABLY NOT TAKEN APART? WRITE YOUR ANSWER ON THE LINES.

3c. KATE AND GEORGE WONDERED WHETHER SOMEBODY HAD TAKEN MRS. MACGREGOR'S HOUSE AWAY ON A TRUCK. BUT THEY DECIDED PROBABLY NOT. WHY WAS MRS. MACGREGOR'S HOUSE PROBABLY NOT TAKEN AWAY ON A TRUCK? WRITE YOUR ANSWER ON THE LINES.

Q4, Oral Only

OKAY, LET'S TURN OUR BOOKS OVER FOR A MOMENT SO WE CAN DISCUSS THE NEXT QUESTION TOGETHER.

Tape Recorder On.

4. WHAT DO YOU THINK MIGHT HAVE HAPPENED TO MRS. MACGREGOR'S HOUSE? LET'S TRY TO THINK OF AS MANY IDEAS AS WE CAN. WHAT DO YOU THINK MIGHT HAVE HAPPENED TO MRS. MACGREGOR'S HOUSE?

Prompt children to produce as many ideas as possible:

(P) WHO HAS AN IDEA? LET'S THINK OF SOME POSSIBILITIES. GOOD IDEA; CAN ANYBODY ELSE THINK OF AN IDEA?

WEDNESDAY
Episode 3
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S TURN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN YOU WILL TAKE SOME TIME TO WRITE DOWN YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all the children have their books open to the correct page. Hand out pencils as required.

OKAY, GET READY, HERE COMES THE FIRST QUESTION.

Q1,P1

1. GINNY USED A DATA BASE TO FIND OUT WHO MIGHT OWN THE GLASSES FOUND ON MRS. MACGREGOR'S LAWN. WHAT IS A DATA BASE? NOW REMEMBER, DON'T WORRY IF YOU ARE NOT SURE ABOUT YOUR ANSWER. JUST WRITE DOWN YOUR BEST IDEA. WHAT DO YOU THINK A DATA BASE MIGHT B ? WRITE YOUR ANSWER ON THE LINES.

PLEASE TURN TO PAGE TWO. HERE'S THE NEXT QUESTION.

Q2,P2

2. KATE SAID TO GEORGE, "WE'VE GOT OUR MAN." SHE WAS SURE THAT IT WAS CLARENCE SAMPSON WHO STOLE MRS. MACGREGOR'S HOUSE. HOW COULD SHE BE SO SURE? WHAT THINGS HAVE WE SEEN AND HEARD THIS WEEK THAT MIGHT MAKE US THINK CLARENCE SAMPSON STOLE MRS. MACGREGOR'S HOUSE? WRITE YOUR ANSWER ON THE LINES.

Q2, Oral Review

Tape Recorder On.

2. OKAY, WAHT DID EVERYONE WRITE? WHAT THINGS HAVE WE SEEN AND HEARD THIS WEEK THT MIGHT MAKE US THINK CLARENCE SAMPSON STOLE MRS. MACGREGOR'S HOUSE? WHO HAS AN IDEA? WHAT DO YOU THINK? ANYBODY ELSE HAVE AN IDEA?

Probe until you have elicited at least one idea from each child. If one of the following pieces of evidence is omitted, probe as follows:

(P) WHO OWNED THE GLASSES THAT MRS. MACGREGOR FOUND ON HER LAWN? HOW DO YOU KNOW?

? WHO RENTED A POWERFUL HELICOPTER RIGHT BEFORE THE HOUSE WAS STOLEN?

Tape Recorder Off.

LET'S GO ON. TURN TO PAGE THREE IN YOUR BOOKS.

Q3,P3

3a. HOW DO YOU THINK MRS. MACGREGOR'S HOUSE WAS STOLEN? WRITE YOUR ANSWER ON THE LINES.

3b. HOW DO YOU KNOW? WHAT DID WE SEE AND HEAR THIS WEEK THAT

HELPED US FIGURE OUT HOW MRS. MACGREGOR'S HOUSE WAS STOLEN? WRITE YOUR ANSWER ON THE LINES.

Q3b, Oral Review

Tape Recorder On.

LET'S SEE IF WE CAN MAKE A LIST OF PEOPLE'S ANSWERS. WHAT DID WE SEE AND HEAR THIS WEEK THAT HELPED US FIGURE OUT HOW MRS. MACGREGOR'S HOUSE WAS STOLEN? ANYBODY HAVE AN IDEA? __________, WHAT'S YOUR IDEA?

THURSDAY
Episode 4
Instructions to Interviewer

ALRIGHT, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN YOU WILL HAVE SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their books open to the correct page. Hand out pencils as required.

Q1,P1

1a. KATE THINKS CLARENCE SAMPSON STOLE MRS. MACGREGOR'S HOUSE WITH A POWERFUL HELICOPTER. DO YOU THINK THAT'S WHAT HAPPENED? IF YOU THINK IT IS, CHECK PROBABLY YES. IF YOU THINK THAT DID NOT HAPPEN, CHECK PROBABLY NO.

1b. WHY DO YOU THINK THAT? WRITE YOUR ANSWER ON THE LINES.

1c. WHAT HAVE WE SEEN AND HEARD THIS WEEK THAT MIGHT MAKE US THINK CLARENCE SAMPSON STOLE THE HOUSE? WRITE YOUR ANSWERS ON THE LINES.

Q1c, Oral Review

Tape Recorder On.

1c. OKAY, LET'S MAKE A LIST OF THE EVIDENCE. WHAT HAVE WE SEEN

AND HEARD THIS WEEK THAT MIGHT MAKE US THINK CLARENCE SAMPSON STOLE THE HOUSE WITH A HELICOPTER? DOES ANYBODY REMEMBER ANYTHING?

(P) Probe: ______, CAN YOU REMEMBER ANYTHING YOU SAW OR HEARD THAT MADE YOU THINK THAT?

(P) GOOD, ANYBODY ELSE HAVE AN IDEA?

Elicit at least one idea from each child. (They can agree with each other if they can't think of new evidence).

P2,Q2

2a. OKAY, LET'S TURN OUR BOOKS TO PAGE TWO.

DO YOU SEE THE THREE SHAPES ON THE MAPS? THERE IS A CIRCLE, AN OVAL, AND A SQUARE. WHICH SHAPE DID GINNY MAKE ON THE MAP? DRAW A LINE UNDER THE SHAPE THAT GINNY MADE.

2b. WHY DID GINNY MAKE THAT SHAPE? WRITE YOUR ANSWER ON THE LINES.

Q2c, Oral [illegible]

Tape Recorder On.

2c. MAYBE YOU REMEMBERED THAT GINNY MADE A CIRCLE ON THE MAP. WHY DID GINNY MAKE A CIRCLE INSTEAD OF A SQUARE?

Let the group try to generate the answer, rather than concentrating on getting a vote from each child.

Ⓟ Probes: WHAT WAS THE CIRCLE FOR? WHY WOULD A CIRCLE BE BETTER THAN A SQUARE OR AN OVAL? TAKE A SHOT AT IT: WHY WOULD SHE MAKE A CIRCLE INSTEAD OF A SQUARE?

Tape Recorder off.

NOW LET'S GO BACK TO OUR BOOKS. PAGE THREE.

Show Polaroid of map with circle and directional vector drawn in.

Q3,P3

3. HOW DID THE MATHNETTERS FIND OUT WHICH DIRECTION THE HELICOPTER HAD GONE? WRITE YOUR ANSWER ON THE LINES.

Q4,P4

OUR FINAL QUESTION FOR TODAY IS ON PAGE FOUR.

Show kids the same picture again.

4. HOW DID HOWIE HELP FIND MRS. MACGREGOR'S HOUSE? WHAT DID HE DO TO HELP? WRITE YOUR ANSWERS ON THE LINES.

FRIDAY
Episode 5
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST. THEN I WILL GIVE YOU PLENTY OF TIME TO WRITE IN YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all children have their logbooks open to correct page. Hand out pencils as required.

HERE'S THE FIRST QUESTION.

Q1,P1

1a. ALL THIS WEEK WE HAVE WATCHED PEOPLE DOING MANY DIFFERENT KINDS OF THINGS. SOME OF THESE THINGS WERE MATHEMATICS. SOME WERE NOT MATHEMATICS. NOW THINK BACK, AND USE YOUR MEMORY. WHAT THINGS DID THEY DO ON THE SHOW THAT WERE MATHEMATICS? WRITE DOWN AS MANY THINGS AS YOU CAN. TRY TO MAKE AS LONG A LIST AS YOU CAN. WHAT THINGS DID PEOPLE DO THIS WEEK THAT ARE MATHEMATICS? WRITE YOUR ANSWERS ON THE LINES.

If a child lays down his pencil before the others seem ready, prompt:

(P) TRY TO THINK OF ONE OR TWO MORE THINGS YOU SAW THIS WEEK THAT YOU WOULD SAY WERE MATHEMATICS.

When children have written all they can be urged to write,

continue with oral portion.

Tape Recorder On.

1b, Oral Only

LET'S TALK TOGETHER ABOUT OUR LISTS. OKAY, (CHILD X), READ THE FIRST THING ON YOUR LIST. WHAT DID YOU SEE THIS WEEK THAT YOU THINK MIGHT BE MATHEMATICS?

OKAY, EVERYONE. LET'S THINK ABOUT X. WHY IS X MATHEMATICS? GOOD.

DOES ANYBODY DISAGREE? DOES ANYBODY THINK X IS NOT MATHEMATICS? WHY NOT?

ANY OTHER IDEAS? DOES ANYBODY ELSE HAVE AN IDEA ABOUT WHY X IS MATHEMATICS?

Go on to next item in list. Go through children's lists. If time remains, go down the list supplied below. (next page). Ask children to vote on each item.

LET'S TALK ABOUT SOME OF THE OTHER THINGS WE SAW. IS X MATHEMATICS? ~~LET'S VOTE!~~ WHO SAYS YES, IT IS? WHY DO YOU SAY X MIGHT BE MATHEMATICS? (OR, WHAT MAKES X MATHEMATICS?) WHO SAYS NO? WHY DO YOU SAY X IS PROBABLY NOT MATHEMATICS?

Concentrate on getting the whys and wherefores in these responses, not on the bare judgments of math/nonmath.

THE LIST:

DECIDING HOW FAR THE HELICOPTER MIGHT HAVE FLOWN

LOOKING FOR 727 BLUFF DRIVE

USING THE COMPUTER TO SEE WHO BOUGHT GLASSES LIKE THE ONES THE MATHNETTERS FOUND

PLAYING THIRD BASE ON HOWIE'S TEAM

RUNNING A MAKE ON CLARENCE SAMPSON

GETTING ARRESTED ON A 484

FIGURING OUT THE ANGLE THAT THE BASEBALL MIGHT HAVE BOUNCED

FINDING OUT IF A HELICOPTER CAN LIFT A HOUSE

DRAWING A CIRCLE WITH A COMPASS

THINKING THAT THE FIREPLACE MIGHT BE MADE OF GOLD BRICKS

MISSING MONKEY

MONDAY
Episode 1
Instructions to Interviewer

P1,Q1

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO THE FIRST PAGE. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST. THEN I WILL GIVE YOU SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their log books open to page one.

Hand out pencils as required.

HERE COMES THE FIRST QUESTION. QUESTION 1: WHAT IS THE PROBLEM THAT THE MATHNET SQUAD MUST SOLVE? THE MATHNET PROBLEM IS.... WRITE YOUR ANSWER ON THESE LINES.

If children seem confused, you can add the following probe:

WHAT IS THE PROBLEM KATE AND GEORGE ARE THINKING ABOUT?

Wait until children seem finished writing, but don't let it go longer than three or four minutes.

OKAY, LET'S TURN OUR BOOKS OVER FOR A MINUTE. Turn on tape recorder. WHAT IS THE PROBLEM THAT THE MATHNET SQUAD MUST SOLVE? WHO HAS IDEA?

(Probes: WOULD ANYBODY LIKE TO SAY WHAT HE/SHE THINKS? OTHER IDEAS? WHO THINKS HE/SHE KNOWS WHAT PROBLEM KATE AND GEORGE

MUST WORK OUT? WHAT DO THEY HAVE TO DO?) If no response, directly ask individuals.

Try to elicit a response from each of the children in turn. Take care throughout the interviewing NOT to always begin with the same child.

Turn tape recorder off.

P2,Q2

2a. QUESTION TWO: DO YOU THINK A REAL MONKEY IS ROBBING THOSE STORES? IF YOU THINK IT PROBABLY IS A REAL MONKEY, CHECK PROBABLY YES. IF YOU THINK IT PROBABLY IS NOT A REAL MONKEY, CHECK PROBABLY NO.

2b. NOW, WHY DO YOU THINK IT IS OR IS NOT A REAL MONKEY? WRITE YOUR ANSWER ON THE LINES WHERE IT SAYS "WHY?"

If necessary, help individual children find their place.

2c. NOW, FOR THIS NEXT QUESTION, I'M GOING TO ASK YOU TO FORGET FOR A MINUTE WHAT YOU THINK ABOUT THE ROBBERIES. LET'S THINK ABOUT WHETHER IT MIGHT HAVE BEEN A REAL MONKEY. WHAT DID WE SEE AND HEAR TODAY THAT MIGHT MAKE US THINK IT IS A REAL LIVE MONKEY? WRITE DOWN AS MANY FACTS AS YOU CAN REMEMBER THAT MAKE US THINK THE ROBBER IS A REAL MONKEY. TAKE YOUR TIME AND TRY TO REMEMBER AS MUCH AS YOU CAN.

Give the children plenty of time to write. If necessary, try to wait out a period when children may put down their pencils. If individuals do, probe with: CAN YOU REMEMBER ANY MORE FACTS THAT MIGHT MEAN THE ROBBER IS A REAL MONKEY?

When the children seem through (but don't let it go on way too lo... -- no longer than five minutes or so, Tops). Then say:

VERY GOOD. REMEMBER, WE ARE NOT TRYING TO SEE IF YOU KNOW THE RIGHT ANSWERS, BECAUSE THERE AREN'T ANY RIGHT ANSWERS. WE ONLY WANT TO KNOW YOUR IDEAS.

TURN YOUR BOOKS OVER NOW.

(Oral Review, 2c): Turn tape recorder on.

WHAT FACTS DID YOU REMEMBER THAT MIGHT MAKE US THINK THE ROBBER IS A MONKEY?

Probe with:

(P) CAN ANYBODY THINK OF ANOTHER FACT?

If child seems to provide a meaningless fact, or a fact supporting a different hypothesis, ask:

(P) COULD YOU EXPLAIN HOW THIS MAKES US THINK THE ROBBER MIGHT BE A MONEY?

Don't forget to prompt each child to say his or her piece.

Turn tape recorder off.

P3,Q3

OKAY, LET'S OPEN OUR BOOKS TO THE NEXT PAGE, PAGE THREE. QUESTION THREE:

3a. DO YOU THINK A MAN IN A MONKEY SUIT IS ROBBING THESE STORES? IF

YOU THINK IT PROBABLY IS A MAN IN A MONKEY SUIT, CHECK PROBABLY YES. IF YOU THINK IT PROBABLY IS NOT A MAN IN A MONKEY SUIT, CHECK PROBABLY NO.

3B. NOW WHY DO YOU THINK IT IS OR IS NOT A MAN IN A MONKEY SUIT? WRITE YOUR ANSWER ON THE LINES WHERE IT SAYS WHY.

3c. NOW, FOR THIS NEXT QUESTION, I'M GOING TO ASK YOU TO FORGET FOR A MINUTE WHAT YOU THINK ABOUT THE ROBBERIES. LET'S THINK ABOUT WHETHER IT MIGHT HAVE BEEN A MAN IN A MONKEY SUIT. WHAT DID WE SEE AND HEAR TODAY THAT MIGHT MAKE US THINK IT IS A MAN IN A MONKEY SUIT? WRITE DOWN AS MANY FACTS AS YOU CAN REMEMBER THAT MAKE US THINK THE ROBBER IS A MAN IN A MONKEY SUIT. TAKE YOUR TIME AND TRY TO REMEMBER AS MUCH AS YOU CAN.

(P) If children put down their pencils, probe with: CAN YOU REMEMBER ANY MORE FACTS THAT MIGHT MEAN THE ROBBER IS A MAN IN A MONKEY SUIT

(Oral Review, Q. 3c):

Turn on tape recorder.

OKAY, LET'S TURN OUR BOOKS OVER SO THAT WE CAN DISCUSS THE QUESTION. WHAT FACTS DID YOU REMEMBER THAT MIGHT MAKE US THINK THE ROBBER IS A MAN IN A MONKEY SUIT?

(P) Probe with: CAN ANYBODY THINK OF ANOTHER FACT?

That's a good one! DOES ANYBODY KNOW ANOTHER?

(P) If a child comes up with a meaningless fact, or one that seems to support a different hypotheses, say: CAN YOU EXPLAIN HOW THAT

MAKES US THINK THAT THE ROBBER IS A MAN IN A MONKEY SUIT?

Q4 - Oral only. (Tape Recorder remains on.)

OKAY, LET'S CLOSE OUR LOG BOOKS AND THINK ABOUT THIS NEXT QUESTION. REMEMBER THE STORY AND EVERYTHING WE SAW AND HEARD. NOW, TELL ME, WHO DO YOU THINK IS ROBBING THE STORES?

Elicit responses from each child in turn. After each response, probe:

(P) WHY DO YOU THINK ______ MIGHT BE THE ROBBER?

(P) (Probe:) WHAT ARE YOUR REASONS FOR THINKING ______ IS THE ROBBER?

Wait until you have queried each of the children in turn. If the only responses you get are monkey/man in monkey suit responses, ask the following question:

(P) DOES ANYBODY THINK IT COULD BE ANYBODY OR ANYTHING ELSE?

(P) (If yes:) WHO? WHAT? WHY DO YOU THINK SO?

Q5 - Oral only. (Tape recorder remains on.)

WHY IS IT IMPORTANT FOR GEORGE AND KATE TO LEARN WHO IS ROBBING THE STORES? WHY DO THEY WANT TO KNOW?

(P) Prompt: CAN ANYBODY THINK OF ANOTHER REASON?

If no child comes up with a feasible answer about why this would be important to know, you may probe with:

(P) DOES IT MAKE A DIFFERENCE WHETHER THEY ARE TRYING TO CATCH A MONKEY OR A MAN? WHY/WHY NOT? WHO IS HARDER TO CATCH, A MAN OR A MONKEY? WHY?

Closing:

OKAY, I THINK THAT'S ALL FOR TODAY. WE WILL PICK YOU A COUPLE MORE TIMES TO BE ON THE MATHNET PANEL AGAIN, SO WHEN WE WATCH MATHNET I CLASS, KEEP YOUR EYES AND EARS OPEN, AND YOUR BRAIN WORKING!

TUESDAY
Episode 2
Instructions to Interviewer

OKAY, MATHNET PANEL, OPEN YOUR LOG BOOKS TO THE FIRST PAGE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN I WILL GIVE YOU SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their log books open to page one. Hand out pencils as required.

HERE'S THE FIRST QUESTION.

P1,Q1

1a. Hold up circle chart. WHAT IS THIS? WRITE YOUR ANSWER ON THE LINES. IF YOU'RE NOT SURE, THAT'S FINE. JUST WRITE YOUR BEST IDEA. WHAT DO WE CALL THIS?

Probe:

(P) IS THERE A NAME FOR THIS?

1b. SECOND QUESTION: WHAT IS IT FOR? WHAT IS THE CIRCLE FOR? WRITE YOUR ANSWER ON THE LINES. WHAT DOES THIS SHOW?

1c. LOOK CAREFULLY AT THE CIRCLE. WHAT FOOD DOES GRUNT EAT THE MOST? IS IT FRUITS AND VEGETABLES? GRAINS? DAIRY PRODUCTS? PUT A LINE UNDER THE CORRECT ANSWER.

1d. NEXT QUESTION: HOW DO YOU KNOW THAT'S THE FOOD THAT GRUNT EATS THE MOST? HOW DO YOU KNOW? WRITE YOUR ANSWER ON THE LINES. NOW TURN THE PAGE IN YOUR BOOK.

1a. WHY DOES KATE WANT TO KNOW WHAT GRUNT EATS? WHY IS IT IMPORTANT FOR HER TO KNOW WHAT GRUNT EATS? WRITE YOUR ANSWER ON THE LINES.

Q2 - Oral only. Turn on tape recorder.

2a. Hold up an actual combination padlock. Let children hold. THE LOCK ON GRUNT'S CAGE IS CALLED A COMBINATION LOCK. WHAT DO YOU THINK? COULD GRUNT FIGURE OUT HOW TO OPEN IT ALL BY HIMSELF?

Ⓟ Probe: WOULD YOU SAY GRUNT COULD FIGURE OUT HOW TO OPEN THE LOCK? WOULD YOU SAY PROBABLY YES? WOULD YOU SAY PROBABLY NO? Try to get each child to take a stab at an answer. Any other reasons?

2b. WHY DO YOU THINK SO?

Elicit justifications for both answers, if the children give both.

2c. WHAT DO YOU THINK? COULD A PERSON WHO DOES NOT KNOW THE COMBINATION FIGURE OUT HOW TO OPEN THE LOCK? WHAT DO YOU THINK? COULD A HUMAN FIGURE IT OUT?

Ⓟ Probe:

WOULD YOU SAY A PERSON COULD FIGURE OUT THE LOCK? WOULD YOU SAY PROBABLY YES? WOULD YOU SAY PROBABLY NO? WOULD YOU SAY YOU COULD FIGURE OUT THE LOCK?

2d. WHY DO YOU THINK SO?

Elicit justifications for both answers, if children give both.

2e. SO HOW DID GRUNT GET OUT OF HIS CAGE? ANYONE HAVE AN IDEA? HOW DID THE LOCK GET OPENED?

FRIDAY
Episode 5
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN I WILL GIVE YOU TIME TO WRITE IN YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their log books open to page one. Hand out pencils as required.

HERE'S THE FIRST QUESTION.

Q1,P1

1. THANKS TO RIMSHOT, GEORGE AND KATE LEARNED THE KIDNAPPERS' TELEPHONE NUMBER. HOW DID THE PHONE NUMBER HELP THEM FIGURE OUT WHERE STEVE STRINGBEAN WAS? WHAT GOOD IS A TELEPHONE NUMBER FOR FINDING OUT WHERE SOMEBODY IS? WRITE YOUR ANSWER ON THE LINES.

Give kids time to write. Then...

GOOD. NOW TURN THE PAGE, PLEASE.

Q2,P2

2. Show Polaroid of Kate, George, and Rimshot speaking to Mr. Lousa. (If possible, this should be a shot with Lousa at piano,

but I'm not sure there is one with all of them in the shot. If there's one of just Kate and Lousa, that would be OK for our purposes.)

BEFORE THEY FOUND STEVE STRINGBEAN, KATE, GEORGE, AND RIMSHOT WERE TALKING TO MR. LOUSA IN HIS HOUSE. WHEN DID KATE KNOW FOR SURE THAT MR. LOUSA WAS THE KIDNAPPER? WHAT WAS IT THAT MADE HER CERTAIN? WRITE YOUR ANSWER ON THE LINES.

Q3, P3

3a. ALL THIS WEEK WE WATCHED PEOPLE DOING MANY DIFFERENT KINDS OF THINGS. SOME OF THESE THINGS WERE MATHEMATICS. SOME WERE NOT MATHEMATICS. NOW THINK BACK AND USE YOUR MEMORY. WHAT THINGS DID THEY DO ON THE SHOW THAT WERE MATHEMATICS? WRITE DOWN AS MANY THINGS AS YOU CAN. TRY TO MAKE AS LONG A LIST AS YOU CAN. WHAT THINGS DID PEOPLE DO THIS WEEK THAT ARE MATHEMATICS? WRITE YOUR ANSWERS ON THE LINES.

If a child lays down his pencil before the others seem ready, probe:

(P) TRY TO THINK OF ONE OR TWO MORE THINGS YOU SAW THIS WEEK THAT YOU WOULD SAY WERE MATHEMATICS.

When the children have written all they can be urged to write, continue with oral portion.

Tape Recorder on.

3b, Oral Only

3b. LET'S TALK TOGETHER ABOUT OUR LISTS, OKAY, (CHILD X), READ ME THE FIRST THING ON YOUR LIST. WHAT DID YOU SEE THIS WEEK THAT YOU THINK MIGHT BE MATHEMATICS?

OKAY, EVERYONE. LET'S THINK ABOUT X. WHY IS X MATHEMATICS? GOOD. DOES ANYBODY ELSE HAVE AN IDEA ABOUT WHY X IS MATHEMATICS?

DOES ANYBODY DISAGREE? DOES ANYONE THINK X IS NOT MATHEMATICS? WHY NOT?

Go on to next item in list. Go through children's lists. If time remains, go down the list supplied below. Ask children to vote on each item.

LET'S TALK ABOUT SOME OTHER THINGS WE SAW. IS X MATHEMATICS? LET'S VOTE: WHO SAYS YES, IT IS? WHY DO YOU SAY X MIGHT BE MATHEMATICS? (OR, WHAT MAKES X MATHEMATICS?). WHO SAYS NO? WHY DO YOU SAY X IS PROBABLY NOT MATHEMATICS?

Concentrate on getting the "whys and wherefores" in these responses, not on the bare judgments of math/nonmath.

The list:

RIDING IN STEVE STRINGBEAN'S VAN

(cont. next page)

COUNTING OUT BEATS BETWEEN TURNS ON THE ROAD

USING THE COMPUTER AT THE MATHNET OFFICE

PLAYING 75 TROMBONES ON THE PIANO

ASKING FOR $104,020 IN RANSOM

MAKING HUNCHES ABOUT A PROBLEM

FIGURING OUT HOW MANY PEOPLE MIGHT COME TO A PARADE

USING A CALCULATOR TO TELL SOME CROOKS TO "FREEZE!"

WORKING OUT THE PARADE TIME ON THE BLACKBOARD

SEARCHING THE DATA BASE AT THE TELEPHONE COMPANY

THE CASE OF THE MISSING BASEBALL

MONDAY
Episode 1
Instructions to the Interviewer

LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN YOU WILL TAKE SOME TIME TO WRITE DOWN YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all children have their books open to the correct page. Hand out pencils as required.

OKAY, GET READY: HERE'S THE FIRST QUESTION.

Q1,P1

1. WHAT IS HOWIE'S PROBLEM? NOW REMEMBER, WHENEVER YOU DON'T FEEL SURE OF THE ANSWER, JUST WRITE DOWN YOUR BEST IDEA. WHAT IS HOWIE'S PROBLEM? WRITE YOUR ANSWER ON THE LINES.

Wait until the children have finished writing. Then:

OKAY, LET'S TURN TO PAGE TWO IN OUR BOOKS.

Q2,P2

2a. DO YOU SEE THE THREE PICTURES? WHICH PICTURE LOOKS MOST LIKE THE ONE YOU SAW ON THE COMPUTER? WAS IT PICTURE NUMBER 1, PICTURE NUMBER 2, OR PICTURE NUMBER 3? LOOK CAREFULLY AT EACH PICTURE BEFORE YOU DECIDE. WHICH PICTURE IS LIKE THE ONE YOU SAW ON THE COMPUTER? DRAW A CIRCLE AROUND THE PICTURE YOU SAW.

2b. WHAT IS THIS PICTURE? WRITE YOUR ANSWER ON THE LINES. WHAT DOES THIS PICTURE STAND FOR?

2c. WHAT IS THE PICTURE FOR? WHAT DID THE MATHNETTERS USE THE PICTURE FOR? WRITE YOUR ANSWER ON THE LINES.

Q2d, Oral Only

Note: In this case, we don't ask children to turn books over because we want them to refer to the sketches.

Tape Recorder On.

2d. OK, LET'S SEE WHAT PEOPLE THINK. HOW MANY PEOPLE CIRCLED PICTURE #1? RAISE YOUR HANDS. HOW MANY SAY PICTURE #2? HOW MANY SAY PICTURE #3?

If any children chose #1:

OKAY, ______, YOU SAID WE SAW PICTURE #1. HOW CAN YOU TELL? WHAT MAKES YOU SAY IT WAS PICTURE #1 WE SAW ON THE COMPUTER?

If anybody chose #2:

AND ______ SAID IT WAS PICTURE #2. WHAT DO YOU THINK, ______? HOW CAN YOU TELL? WHAT MAKES YOU SAY IT WAS PICTURE #2 WE SAW ON THE COMPUTER?

Picture #3:

AND ______ THOUGHT IT WAS PICTURE #3. HOW CAN YOU TELL, ______?

WHAT MAKES YOU SAY IT WAS PICTURE #3 WE SAW ON THE COMPUTER?

Q3, Oral Only (Keep Tape Recorder On.)

LET'S GO ON TO THE NEXT QUESTION. WHAT COULD HAVE HAPPENED TO HOWIE'S BASEBALL? LET'S SEE HOW MANY IDEAS WE CAN THINK OF. WHAT COULD HAVE HAPPENED TO HOWIE'S BASEBALL? WHO CAN THINK OF AN IDEA? (_____, DO YOU HAVE AN IDEA?)

Everytime a child offers an idea, say:

WHAT DID WE SEE AND HEAR TODAY THAT MIGHT MAKE US THINK THAT

____

_______________________________________?

Go on down the list, prompting children to think of as many ideas as possible. Don't forget to ask for justification for each idea. Stop the questionning when children can't think of any more possibilities, or when it becomes evident that the ideas are getting ridiculously far-fetched.

TUESDAY
Episode 2
Instructions to Interviewer

WELCOME, MATHNET PANEL. LET'S BEGIN BY OPENING OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN YOU WILL TAKE SOME TIME TO WRITE DOWN YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their books open to the correct page. Hand out pencils as required.

ALRIGHT, EVERYBODY, HERE'S THE FIRST QUESTION.

Q1,P1

1. WHAT IS MRS. MACGREGOR'S PROBLEM? WHAT IS MRS. MACGREGOR'S PROBLEM? WRITE YOUR ANSWER ON THE LINES.

When children are finished writing:

OKAY, LET'S TURN OUR BOOKS TO PAGE TWO.

Q2,P2

2. MRS MACGREGOR SAID THAT LOTS OF PEOPLE HAD BEEN HANGING AROUND HER HOUSE, ASKING TO BUY IT, RENT IT, OR RENT A ROOM IN IT. DO YOU HAVE ANY IDEAS WHY ALL THOSE PEOPLE WERE SO INTERESTED IN MRS. MACGREGOR'S HOUSE? THERE IS NO ONE RIGHT ANSWER TO THIS QUESTION, WE JUST WANT YOU TO PUT DOWN YOUR BEST IDEA. WHY DO YOU SUPPOSE ALL THOSE PEOPLE MIGHT HAVE WANTED TO BUY OR RENT MRS. MACGREGOR'S

HOUSE? WRITE YOUR ANSWER ON THE LINES.

Q2, Oral Review

Tape Recorder On.

OKAY, LET'S TALK ABOUT OUR IDEAS. WHO HAS AN IDEA ABOUT WHY ALL THOSE PEOPLE WERE INTERESTED IN MRS. MACGREGOR'S HOUSE? (Probe, if necessary: _____, WHAT'S YOUR IDEA? WHAT DO YOU THINK?)

Repeat child's idea: MAYBE ______________________. If it is unclear what relation this idea might have to an interest in Mrs. MacGregor's house, say MMM-HMMM. AND HOW DOES THIS EXPLAIN WHY THOSE PEOPLE WERE INTERESTED IN MRS. MACGREGOR'S HOUSE? GREAT. ANYBODY ELSE HAVE AN IDEA?

Make sure to elicit at least one idea from each child.

Tape Recorder Off.

Q3,P3

OKAY, LET'S TURN TO PAGE THREE IN OUR LOG BOOKS.

3a. KATE AND GEORGE TRIED TO DECIDE WHAT HAPPENED TO MRS. MACGREGOR'S HOUSE. FIRST THEY WONDERED WHETHER SOMEBODY HAD BLOWN IT UP. BUT THEY DECIDED PROBABLY NOT. WHY WAS MRS. MACGREGOR'S HOUSE PROBABLY NOT BLOWN UP? WRITE YOUR ANSWER ON THE LINES.

3b. THEN KATE AND GEORGE WONDERED WHETHER SOMEBODY HAD DISMANTLED MRS. MACGREGOR'S HOUSE, THAT IS, TAKEN IT APART. BUT THEY DECIDED PROBABLY NOT. WHY WAS MRS. MACGREGOR'S HOUSE PROBABLY NOT TAKEN APART? WRITE YOUR ANSWER ON THE LINES.

3c. KATE AND GEORGE WONDERED WHETHER SOMEBODY HAD TAKEN MRS. MACGREGOR'S HOUSE AWAY ON A TRUCK. BUT THEY DECIDED PROBABLY NOT. WHY WAS MRS. MACGREGOR'S HOUSE PROBABLY NOT TAKEN AWAY ON A TRUCK? WRITE YOUR ANSWER ON THE LINES.

Q4, Oral Only

OKAY, LET'S TURN OUR BOOKS OVER FOR A MOMENT SO WE CAN DISCUSS THE NEXT QUESTION TOGETHER.

Tape Recorder On.

4. WHAT DO YOU THINK MIGHT HAVE HAPPENED TO MRS. MACGREGOR'S HOUSE? LET'S TRY TO THINK OF AS MANY IDEAS AS WE CAN. WHAT DO YOU THINK MIGHT HAVE HAPPENED TO MRS. MACGREGOR'S HOUSE?

Prompt children to produce as many ideas as possible:

(P) WHO HAS AN IDEA? LET'S THINK OF SOME POSSIBILITIES. GOOD IDEA; CAN ANYBODY ELSE THINK OF AN IDEA?

WEDNESDAY
Episode 3
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S TURN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN YOU WILL TAKE SOME TIME TO WRITE DOWN YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all the children have their books open to the correct page. Hand out pencils as required.

OKAY, GET READY, HERE COMES THE FIRST QUESTION.

Q1,P1

1. GINNY USED A DATA BASE TO FIND OUT WHO MIGHT OWN THE GLASSES FOUND ON MRS. MACGREGOR'S LAWN. WHAT IS A DATA BASE? NOW REMEMBER, DON'T WORRY IF YOU ARE NOT SURE ABOUT YOUR ANSWER. JUST WRITE DOWN YOUR BEST IDEA. WHAT DO YOU THINK A DATA BASE MIGHT BE? WRITE YOUR ANSWER ON THE LINES.

PLEASE TURN TO PAGE TWO. HERE'S THE NEXT QUESTION.

Q2,P2

2. KATE SAID TO GEORGE, "WE'VE GOT OUR MAN." SHE WAS SURE THAT IT WAS CLARENCE SAMPSON WHO STOLE MRS. MACGREGOR'S HOUSE. HOW COULD SHE BE SO SURE? WHAT THINGS HAVE WE SEEN AND HEARD THIS WEEK THAT MIGHT MAKE US THINK CLARENCE SAMPSON STOLE MRS. MACGREGOR'S HOUSE? WRITE YOUR ANSWER ON THE LINES.

Q2, Oral Review

Tape Recorder On.

2. OKAY, WAHT DID EVERYONE WRITE? WHAT THINGS HAVE WE SEEN AND HEARD THIS WEEK THT MIGHT MAKE US THINK CLARENCE SAMPSON STOLE MRS. MACGREGOR'S HOUSE? WHO HAS AN IDEA? WHAT DO YOU THINK? ANYBODY ELSE HAVE AN IDEA?

Probe until you have elicited at least one idea from each child. If one of the following pieces of evidence is omitted, probe as follows:

(P) WHO OWNED THE GLASSES THAT MRS. MACGREGOR FOUND ON HER LAWN? HOW DO YOU KNOW?

(P) WHO RENTED A POWERFUL HELICOPTER RIGHT BEFORE THE HOUSE WAS STOLEN?

Tape Recorder Off.

LET'S GO ON. TURN TO PAGE THREE IN YOUR BOOKS.

Q3,P3

3a. HOW DO YOU THINK MRS. MACGREGOR'S HOUSE WAS STOLEN? WRITE YOUR ANSWER ON THE LINES.

3b. HOW DO YOU KNOW? WHAT DID WE SEE AND HEAR THIS WEEK THAT

HELPED US FIGURE OUT HOW MRS. MACGREGOR'S HOUSE WAS STOLEN? WRITE YOUR ANSWER ON THE LINES.

Q3b, Oral Review

Tape Recorder On.

LET'S SEE IF WE CAN MAKE A LIST OF PEOPLE'S ANSWERS. WHAT DID WE SEE AND HEAR THIS WEEK THAT HELPED US FIGURE OUT HOW MRS. MACGREGOR'S HOUSE WAS STOLEN? ANYBODY HAVE AN IDEA? __________, WHAT'S YOUR IDEA?

THURSDAY
Episode 4
Instructions to Interviewer

ALRIGHT, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN YOU WILL HAVE SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their books open to the correct page. Hand out pencils as required.

Q1,P1

1a. KATE THINKS CLARENCE SAMPSON STOLE MRS. MACGREGOR'S HOUSE WITH A POWERFUL HELICOPTER. DO YOU THINK THAT'S WHAT HAPPENED? IF YOU THINK IT IS, CHECK PROBABLY YES. IF YOU THINK THAT DID NOT HAPPEN, CHECK PROBABLY NO.

1b. WHY DO YOU THINK THAT? WRITE YOUR ANSWER ON THE LINES.

1c. WHAT HAVE WE SEEN AND HEARD THIS WEEK THAT MIGHT MAKE US THINK CLARENCE SAMPSON STOLE THE HOUSE? WRITE YOUR ANSWERS ON THE LINES.

Q1c, Oral Review

Tape Recorder On.

1c. OKAY, LET'S MAKE A LIST OF THE EVIDENCE. WHAT HAVE WE SEEN

AND HEARD THIS WEEK THAT MIGHT MAKE US THINK CLARENCE SAMPSON STOLE THE HOUSE WITH A HELICOPTER? DOES ANYBODY REMEMBER ANYTHING?

(P) Probe: ______, CAN YOU REMEMBER ANYTHING YOU SAW OR HEARD THAT MADE YOU THINK THAT?

(P) GOOD, ANYBODY ELSE HAVE AN IDEA?

<u>Elicit at least one idea from each child.</u> (They can agree with each other if they can't think of new evidence).

<u>P2,Q2</u>

2a. OKAY, LET'S TURN OUR BOOKS TO PAGE TWO.

DO YOU SEE THE THREE SHAPES ON THE MAPS? THERE IS A CIRCLE, AN OVAL, AND A SQUARE. WHICH SHAPE DID GINNY MAKE ON THE MAP? DRAW A LINE UNDER THE SHAPE THAT GINNY MADE.

2b. WHY DID GINNY MAKE THAT SHAPE? WRITE YOUR ANSWER ON THE LINES.

<u>Q2c, Oral Only</u>

<u>Tape Recorder On.</u>

2c. MAYBE YOU REMEMBERED THAT GINNY MADE A CIRCLE ON THE MAP. WHY DID GINNY MAKE A CIRCLE INSTEAD OF A SQUARE?

<u>Let the group try to generate the answer,</u> rather than concentrating on getting a vote from each child.

Probes: WHAT WAS THE CIRCLE FOR? WHY WOULD A CIRCLE BE BETTER THAN A SQUARE OR AN OVAL? TAKE A SHOT AT IT: WHY WOULD SHE MAKE A CIRCLE INSTEAD OF A SQUARE?

Tape Recorder Off.

NOW LET'S GO BACK TO OUR BOOKS. PAGE THREE.

Show Polaroid of map with circle and directional vector drawn in.

Q3,P3

3. HOW DID THE MATHNETTERS FIND OUT WHICH DIRECTION THE HELICOPTER HAD GONE? WRITE YOUR ANSWER ON THE LINES.

Q4,P4

OUR FINAL QUESTION FOR TODAY IS ON PAGE FOUR.

Show kids the same picture again.

4. HOW DID HOWIE HELP FIND MRS. MACGREGOR'S HOUSE? WHAT DID HE DO TO HELP? WRITE YOUR ANSWERS ON THE LINES.

FRIDAY
Episode 5
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO PAGE ONE. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST. THEN I WILL GIVE YOU PLENTY OF TIME TO WRITE IN YOUR ANSWER. DOES ANYBODY NEED A PENCIL?

Check to make sure all children have their logbooks open to correct page. Hand out pencils as required.

HERE'S THE FIRST QUESTION.

Q1,P1

1a. ALL THIS WEEK WE HAVE WATCHED PEOPLE DOING MANY DIFFERENT KINDS OF THINGS. SOME OF THESE THINGS WERE MATHEMATICS. SOME WERE NOT MATHEMATICS. NOW THINK BACK, AND USE YOUR MEMORY. WHAT THINGS DID THEY DO ON THE SHOW THAT WERE MATHEMATICS? WRITE DOWN AS MANY THINGS AS YOU CAN. TRY TO MAKE AS LONG A LIST AS YOU CAN. WHAT THINGS DID PEOPLE DO THIS WEEK THAT ARE MATHEMATICS? WRITE YOUR ANSWERS ON THE LINES.

If a child lays down his pencil before the others seem ready, prompt:

(P) TRY TO THINK OF ONE OR TWO MORE THINGS YOU SAW THIS WEEK THAT YOU WOULD SAY WERE MATHEMATICS.

When children have written all they can be urged to write,

continue with oral portion.

Tape Recorder On.

1b, Oral Only

LET'S TALK TOGETHER ABOUT OUR LISTS. OKAY, (CHILD X), READ THE FIRST THING ON YOUR LIST. WHAT DID YOU SEE THIS WEEK THAT YOU THINK MIGHT BE MATHEMATICS?

OKAY, EVERYONE. LET'S THINK ABOUT X. WHY IS X MATHEMATICS? GOOD.

DOES ANYBODY DISAGREE? DOES ANYBODY THINK X IS NOT MATHEMATICS? WHY NOT?

ANY OTHER IDEAS? DOES ANYBODY ELSE HAVE AN IDEA ABOUT WHY X IS MATHEMATICS?

Go on to next item in list. Go through children's lists. If time remains, go down the list supplied below. (next page). Ask children to vote on each item.

LET'S TALK ABOUT SOME OF THE OTHER THINGS WE SAW. IS X MATHEMATICS? ~~LET'S VOTE:~~ WHO SAYS YES, IT IS? WHY DO YOU SAY X MIGHT BE MATHEMATICS? (OR, WHAT MAKES X MATHEMATICS?) WHO SAYS NO? WHY DO YOU SAY X IS PROBABLY NOT MATHEMATICS?

Concentrate on getting the whys and wherefores in these responses, not on the bare judgments of math/nonmath.

THE LIST:

DECIDING HOW FAR THE HELICOPTER MIGHT HAVE FLOWN

LOOKING FOR 727 BLUFF DRIVE

USING THE COMPUTER TO SEE WHO BOUGHT GLASSES LIKE THE ONES THE MATHNETTERS FOUND

PLAYING THIRD BASE ON HOWIE'S TEAM

RUNNING A MAKE ON CLARENCE SAMPSON

GETTING ARRESTED ON A 484

FIGURING OUT THE ANGLE THAT THE BASEBALL MIGHT HAVE BOUNCED

FINDING OUT IF A HELICOPTER CAN LIFT A HOUSE

DRAWING A CIRCLE WITH A COMPASS

THINKING THAT THE FIREPLACE MIGHT BE MADE OF GOLD BRICKS

MISSING MONKEY

MONDAY
Episode 1
Instructions to Interviewer

P1,Q1

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO THE FIRST PAGE. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST. THEN I WILL GI... YOU SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their log books open to page one.

Hand out pencils as required.

HERE COMES THE FIRST QUESTION. QUESTION 1: WHAT IS THE PROBLEM THAT THE MATHNET SQUAD MUST SOLVE? THE MATHNET PROBLEM IS.... WRITE YOUR ANSWER ON THESE LINES.

If children seem confused, you can add the following probe:

(P) WHAT IS THE PROBLEM KATE AND GEORGE ARE THINKING ABOUT?

Wait until children seem finished writing, but don't let it ... longer than three or four minutes.

OKAY, LET'S TURN OUR BOOKS OVER FOR A MINUTE. Turn on tape recorder. WHAT IS THE PROBLEM THAT THE MATHNET SQUAD MUST SOLVE? WHO HAS IDEA?

(P) (Probes: WOULD ANYBODY LIKE TO SAY WHAT HE/SHE THINKS? OTHER IDEAS? WHO THINKS HE/SHE KNOWS WHAT PROBLEM KATE AND GEORGE

MUST WORK OUT? WHAT DO THEY HAVE TO DO?) If no response, directly ask individuals.

Try to elicit a response from each of the children in turn. Take care throughout the interviewing NOT to always begin with the same child.

Turn tape recorder off.

P2,Q2

2a. QUESTION TWO: DO YOU THINK A REAL MONKEY IS ROBBING THOSE STORES? IF YOU THINK IT PROBABLY IS A REAL MONKEY, CHECK PROBABLY YES. IF YOU THINK IT PROBABLY IS NOT A REAL MONKEY, CHECK PROBABLY NO.

2b. NOW, WHY DO YOU THINK IT IS OR IS NOT A REAL MONKEY? WRITE YOUR ANSWER ON THE LINES WHERE IT SAYS "WHY?"
If necessary, help individual children find their place.

2c. NOW, FOR THIS NEXT QUESTION, I'M GOING TO ASK YOU TO FORGET FOR A MINUTE WHAT YOU THINK ABOUT THE ROBBERIES. LET'S THINK ABOUT WHETHER IT MIGHT HAVE BEEN A REAL MONKEY. WHAT DID WE SEE AND HEAR TODAY THAT MIGHT MAKE US THINK IT IS A REAL LIVE MONKEY? WRITE DOWN AS MANY FACTS AS YOU CAN REMEMBER THAT MAKE US THINK THE ROBBER IS A REAL MONKEY. TAKE YOUR TIME AND TRY TO REMEMBER AS MUCH AS YOU CAN.

Give the children plenty of time to write. If necessary, try to wait out a period when children may put down their pencils. If individuals do, probe with: CAN YOU REMEMBER ANY MORE FACTS THAT MIGHT MEAN THE ROBBER IS A REAL MONKEY?

When the children seem through (but don't let it go on way too l... -- no longer than five minutes or so, Tops). Then say:

VERY GOOD. REMEMBER, WE ARE NOT TRYING TO SEE IF YOU KNOW THE RIGHT ANSWERS, BECAUSE THERE AREN'T ANY RIGHT ANSWERS. WE ONLY WANT TO KNOW YOUR IDEAS.

TURN YOUR BOOKS OVER NOW.

(Oral Review, 2c): Turn tape recorder on.

WHAT FACTS DID YOU REMEMBER THAT MIGHT MAKE US THINK THE ROBBER IS A MONKEY?

Probe with:

(P) CAN ANYBODY THINK OF ANOTHER FACT?

If child seems to provide a meaningless fact, or a fact supporting a different hypothesis, ask:

(P) COULD YOU EXPLAIN HOW THIS MAKES US THINK THE ROBBER MIGHT BE A MONEY?

Don't forget to prompt each child to say his or her piece.

Turn tape recorder off.

P3,Q3

OKAY, LET'S OPEN OUR BOOKS TO THE NEXT PAGE, PAGE THREE. QUESTION THREE:

3a. DO YOU THINK A MAN IN A MONKEY SUIT IS ROBBING THESE STORES? IF

YOU THINK IT PROBABLY IS A MAN IN A MONKEY SUIT, CHECK PROBABLY YES. IF YOU THINK IT PROBABLY IS NOT A MAN IN A MONKEY SUIT, CHECK PROBABLY NO.

3B. NOW WHY DO YOU THINK IT IS OR IS NOT A MAN IN A MONKEY SUIT? WRITE YOUR ANSWER ON THE LINES WHERE IT SAYS WHY.

3c. NOW, FOR THIS NEXT QUESTION, I'M GOING TO ASK YOU TO FORGET FOR A MINUTE WHAT YOU THINK ABOUT THE ROBBERIES. LET'S THINK ABOUT WHETHER IT MIGHT HAVE BEEN A MAN IN A MONKEY SUIT. WHAT DID WE SEE AND HEAR TODAY THAT MIGHT MAKE US THINK IT IS A MAN IN A MONKEY SUIT? WRITE DOWN AS MANY FACTS AS YOU CAN REMEMBER THAT MAKE US THINK THE ROBBER IS A MAN IN A MONKEY SUIT. TAKE YOUR TIME AND TRY TO REMEMBER AS MUCH AS YOU CAN.

(P) If children put down their pencils, probe with: CAN YOU REMEMBER ANY MORE FACTS THAT MIGHT MEAN THE ROBBER IS A MAN IN A MONKEY SUIT

(Oral Review, Q. 3c):

Turn on tape recorder.

OKAY, LET'S TURN OUR BOOKS OVER SO THAT WE CAN DISCUSS THE QUESTION. WHAT FACTS DID YOU REMEMBER THAT MIGHT MAKE US THINK THE ROBBER IS A MAN IN A MONKEY SUIT?

(P) Probe with: CAN ANYBODY THINK OF ANOTHER FACT?

That's a good one! DOES ANYBODY KNOW ANOTHER?

If a child comes up with a meaningless fact, or one that seems

(P) to support a different hypotheses, say: CAN YOU EXPLAIN HOW THAT

MAKES US THINK THAT THE ROBBER IS A MAN IN A MONKEY SUIT?

Q4 - Oral only. (Tape Recorder remains on.)

OKAY, LET'S CLOSE OUR LOG BOOKS AND THINK ABOUT THIS NEXT QUESTION. REMEMBER THE STORY AND EVERYTHING WE SAW AND HEARD. NOW, TELL ME, WHO DO YOU THINK IS ROBBING THE STORES?

Elicit responses from each child in turn. After each response, probe:

(P) WHY DO YOU THINK ______ MIGHT BE THE ROBBER?

(P) (Probe:) WHAT ARE YOUR REASONS FOR THINKING ______ IS THE ROBBER?

Wait until you have queried each of the children in turn. If the only responses you get are monkey/man in monkey suit responses, ask the following question:

(P) DOES ANYBODY THINK IT COULD BE ANYBODY OR ANYTHING ELSE?

(P) (If yes:) WHO? WHAT? WHY DO YOU THINK SO?

Q5 - Oral only. (Tape recorder remains on.)

WHY IS IT IMPORTANT FOR GEORGE AND KATE TO LEARN WHO IS ROBBING THE STORES? WHY DO THEY WANT TO KNOW?

(P) Prompt: CAN ANYBODY THINK OF ANOTHER REASON?

If no child comes up with a feasible answer about why this would important to know, you may probe with:

(P) DOES IT MAKE A DIFFERENCE WHETHER THEY ARE TRYING TO CATCH A MONKEY OR A MAN? WHY/WHY NOT? WHO IS HARDER TO CATCH, A MAN OR A MONKEY? WHY?

Closing:

OKAY, I THINK THAT'S ALL FOR TODAY. WE WILL PICK YOU A COUPLE MORE TIMES TO BE ON THE MATHNET PANEL AGAIN, SO WHEN WE WATCH MATHNET IN CLASS, KEEP YOUR EYES AND EARS OPEN, AND YOUR BRAIN WORKING!

TUESDAY
Episode 2
Instructions to Interviewer

OKAY, MATHNET PANEL, OPEN YOUR LOG BOOKS TO THE FIRST PAGE. REMEMBER, FIRST I WILL READ THE QUESTION ALOUD. THEN I WILL GIVE YOU SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

Check to make sure all children have their log books open to page one. Hand out pencils as required.

HERE'S THE FIRST QUESTION.

P1,Q1

1a. Hold up circle chart. WHAT IS THIS? WRITE YOUR ANSWER ON THE LINES. IF YOU'RE NOT SURE, THAT'S FINE. JUST WRITE YOUR BEST IDEA. WHAT DO WE CALL THIS?

Probe:

(P) IS THERE A NAME FOR THIS?

1b. SECOND QUESTION: WHAT IS IT FOR? WHAT IS THE CIRCLE FOR? WRITE YOUR ANSWER ON THE LINES. WHAT DOES THIS SHOW?

1c. LOOK CAREFULLY AT THE CIRCLE. WHAT FOOD DOES GRUNT EAT THE MOST? IS IT FRUITS AND VEGETABLES? GRAINS? DAIRY PRODUCTS? PUT A LINE UNDER THE CORRECT ANSWER.

1d. NEXT QUESTION: HOW DO YOU KNOW THAT'S THE FOOD THAT GRUNT EATS THE MOST? HOW DO YOU KNOW? WRITE YOUR ANSWER ON THE LINES. NOW TURN THE PAGE IN YOUR BOOK.

1a. WHY DOES KATE WANT TO KNOW WHAT GRUNT EATS? WHY IS IT IMPORTANT FOR HER TO KNOW WHAT GRUNT EATS? WRITE YOUR ANSWER ON THE LINES.

Q2 - Oral only. Turn on tape recorder.

2a. Hold up an actual combination padlock. Let children hold. THE LOCK ON GRUNT'S CAGE IS CALLED A COMBINATION LOCK. WHAT DO YOU THINK? COULD GRUNT FIGURE OUT HOW TO OPEN IT ALL BY HIMSELF?

(P) Probe: WOULD YOU SAY GRUNT COULD FIGURE OUT HOW TO OPEN THE LOCK? WOULD YOU SAY PROBABLY YES? WOULD YOU SAY PROBABLY NO? Try to get each child to take a stab at an answer. Any other reasons?

2b. WHY DO YOU THINK SO?

Elicit justifications for both answers, if the children give both.

2c. WHAT DO YOU THINK? COULD A PERSON WHO DOES NOT KNOW THE COMBINATION FIGURE OUT HOW TO OPEN THE LOCK? WHAT DO YOU THINK? COULD A HUMAN FIGURE IT OUT?

(P) Probe:

WOULD YOU SAY A PERSON COULD FIGURE OUT THE LOCK? WOULD YOU SAY PROBABLY YES? WOULD YOU SAY PROBABLY NO? WOULD YOU SAY YOU COULD FIGURE OUT THE LOCK?

2d. WHY DO YOU THINK SO?

Elicit justifications for both answers, if children give both.

2e. SO HOW DID GRUNT GET OUT OF HIS CAGE? ANYONE HAVE AN IDEA? HOW DID THE LOCK GET OPENED?

2f. <u>Held up Polaroid shot of Kate at blackboard, with George nearby with calculator.</u>

REMEMBER WHEN KATE AND GEORGE WERE FIGURING OUT THE NUMBER OF COMBINATIONS ON GRUNT'S LOCK? WHY DID GEORGE USE A CALCULATOR?

(P) Probe: WHY DIDN'T HE JUST LET KATE DO THE MULTIPLICATION ON THE BLACKBOARD?

Note: The children's answers may betray some moral injunction against calculators, such as "We're not allowed to use them," or "He should figure it out." If so, ask WHY. Probe this issue:

(P) Probe: ARE CALCULATORS OKAY FOR THE KIND OF MATHEMATICS THAT KATE AND GEORGE HAVE TO DO? WHY/WHY NOT? IS IT BETTER SOMETIMES TO DO PROBLEMS WITH A CALCULATOR? WHAT KIND OF PROBLEMS? IS IT BETTER SOMETIMES TO DO PROBLEMS IN YOUR HEAD? WHAT KIND OF PROBLEMS?

FOR THE NEXT QUESTION, LET'S TURN THE PAGES OF OUR BOOKS, TO PAGE 3.

<u>Tape recorder off</u>.

<u>P3,Q3</u>

3a. <u>Researcher holds up own copy of the map with blue Xs on it.</u>

REMEMBER WHEN DEBBIE PUT THESE BLUE Xs ON THE MAP? (<u>Point to Xs</u>). WHAT ARE THEY? WHAT ARE THEY FOR? WRITE YOUR ANSWER ON THE LINES.

3b. NEXT QUESTION. DO YOU SEE THE THREE SHAPES ON THE MAPS? THERE IS A SQUARE, A CIRCLE, AND AN OVAL. WHICH SHAPE DID DEBBIE MAKE ON THE MAP? DRAW A LINE UNDER THE SHAPE THAT DEBBIE MADE.

3c. WHY DID DEBBIE MAKE THAT SHAPE? WRITE YOUR ANSWERS ON THE LINES.

3d. Oral Only

Tape recorder on

3d. WHY DID DEBBIE MAKE A CIRCLE INSTEAD OF A SQUARE OR AN OVAL?

Elicit as many ideas as possible, if no one is coming up with a reasonable solution. Let the group try to generate the answer, rather than pushing each child for a separate response.

(P) Probe: WHAT WAS THE CIRCLE FOR? WHY WOULD A CIRCLE BE BETTER THAN A SQUARE OR AN OVAL? TAKE A SHOT AT IT - WHY WOULD SHE MAKE A CIRCLE INSTEAD OF A SQUARE?

Tape recorder remains on for next item.

P4,Q4

LET'S TURN THE PAGE AND GO ON TO THE NEXT QUESTION.

PEOPLE CAN USE TOOLS TO HELP THEM DO MATHEMATICS. WE SAW MANY THINGS ON TODAY'S SHOW. SOME OF THESE THINGS WERE USED FOR MATHEMATICS, AND SOME THINGS WERE NOT. LET'S TALK ABOUT THE THINGS WE SAW ON TODAY'S SHOW. I WILL READ OUT THE NAMES, ONE BY ONE. IF THAT THING WAS USED FOR DOING MATHEMATICS, WRITE A Y, FOR YES, IN THE SPACE. IF IT WAS NOT USED FOR DOING MATHEMATICS, WRITE A N FOR NO.

Hold up sketch. Reseacher reads off the items one by one.

HOW ABOUT A RULER? WAS A RULER USED FOR DOING MATHEMATICS? WRITE Y IF YOU THINK YES. WRITE N IF YOU THINK NO.

After all children have written an answer for each item:

NOW LET'S TALK ABOUT THE RULER. WAS A RULER USED FOR DOING MATH? LET'S VOTE.

HOW MAY WROTE Y? If there are any responses: TELL ME HOW THE RULER WAS USED FOR DOING MATHEMATICS. (or, WHAT MATHEMATICS DID THEY DO WITH THE RULER?)

LET'S VOTE AGAIN. HOW MANY WROTE N? If there are any responses: TELL ME WHY YOU SAY THE RULER WAS NOT USED FOR DOING MATHEMATICS? (Or,) WHAT DO YOU THINK ABOUT USING A RULER FOR DOING MATHEMATICS?)

Items: Go on to next item until all are discussed.

ruler

gorilla cage

compass

giant hamburger

telephone

map

combination lock

calculator

doll

blackboard

pizza

WEDNESDAY
Episode 3
Instructions to Interviewer

Q1,P1

LET'S OPEN OUR LOG BOOKS TO THE FIRST PAGE. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST. THEN I WILL GIVE YOU SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

HERE'S THE FIRST QUESTION.

Show Polaroid of Kate with thought balloon.

1. KATE THINKS GRUNT IS ROBBING THE STORES. WHAT DID WE SEE AND HEAR TODAY THAT MAKES US THINK SHE COULD BE CORRECT? WRITE AS MANY FACTS AS YOU CAN REMEMBER THAT MAKE US THINK KATE MIGHT BE RIGHT, THAT GRUNT IS THE ROBBER.

WRITE YOUR ANSWERS ON THE LINES.

Give kids time to write answer. Then.....

Turn tape recorder on.

Q1 Oral Review

OKAY, LET'S TURN OUR BOOKS OVER FOR A MOMENT AND TALK ABOUT THIS QUESTION. WHAT DID WE SEE AND HEAR TODAY THAT MAKE US THINK KATE MIGHT BE RIGHT, THAT GRUNT IS THE ROBBER? LET'S TRY TO THINK OF AS MANY FACTS AS WE CAN.

(P) Probe: CAN ANYONE REMEMBER ANYTHING THAT MADE YOU THINK GRUNT MIGHT BE THE ROBBER?

Continue probing to generate as long a list as possible. Make sure one kid does not hog the conversation and no one is silent throughout.

Turn tape recorder off.

LET'S OPEN OUR BOOKS TO PAGE TWO, AND GO ON.

Show Polaroid of Jane with thought balloon.

2. JANE THINKS GRUNT IS NOT ROBBING THE STORES. WHAT DID WE SEE AND HEAR TODAY THAT MAKE US THINK JANE MIGHT BE CORRECT? WRITE AS MANY FACTS AS YOU CAN REMEMBER TO SHOW JANE MIGHT BE RIGHT, THAT GRUNT IS NOT THE ROBBER. WRITE YOUR ANSWERS ON THE LINES.

Give kids time to write answer. Then....

Turn tape recorder on

Q2, Oral Review

NOW LET'S TURN OUR BOOKS OVER AND THINK ABOUT THIS QUESTION. WHAT DID WE SEE AND HEAR TODAY THAT MAKE US THINK JANE MIGHT BE RIGHT, THAT GRUNT IS NOT THE ROBBER? LET'S THINK OF AS MANY FACTS AS WE CAN.

(P) Probe: CAN ANYBODY REMEMBER ANYTHING THAT MADE YOU THINK THAT GRUNT WAS NOT THE ROBBER? ANYTHING ELSE?

Tape recorder off.

LET'S GO BACK TO OUR BOOKS, TO PAGE THREE.

3a. WHY MIGHT GRUNT STEAL FROM A PIZZA SHOP? WHAT DO WE KNOW ABOUT GRUNT AND PIZZA? WRITE YOUR ANSWER ON THE LINES.

HERE'S THE NEXT QUESTION:

Show Polaroid of Jane measuring the footprints.

3b. IN THE PIZZA SHOP, WHY DID JANE MEASURE THE DISTANCE BETWEEN THE FOOTPRINTS? WRITE YOUR ANSWER ON THE LINES.

Give kids time to write answer. Then....

3c. Oral only. Turn tape recorder on.

WHAT DID JANE LEARN FROM MEASURING THE DISTANCE BETWEEN THOSE FOOTPRINTS?

If the kids really do not know, don't press it. This is one of the occasions when we want the group to produce the answer, rather than taking a response from each child and considering it separately. That's because it's a straightforward recall question, although a difficult one.

Q4, Oral only. (Keep tape recorder on.)

Hold up copy of map, with the compass circle drawn in. Also on the map is the cluster of blue Xs within the circle and the one lonely X outside the circle that represents the Huntington Beach robbery.

4a. THIS X (point) IS WHERE THE HUNTINGTON BEACH ROBBERY HAPPENED. YOU CAN SEE THAT THIS X IS WAY OUTSIDE THE RED CIRCLE. WHAT DOES THAT TELL US ABOUT THE ROBBERY?

(P) Probe: ANYBODY ELSE HAVE AN IDEA?

COULD GRUNT HAVE COMMITTED THIS ROBBERY?

WHAT DOES THE CIRCLE TELL US?

4B. NOW, LET'S PUT OUR IMAGINATIONS TO WORK. WE KNOW GRUNT COULD WALK ONLY AS FAR AS THE EDGE OF THE RED CIRCLE. SO LET'S THINK OF AS MANY EXPLANATIONS AS WE CAN: HOW DID THIS ROBBERY HAPPEN? (Point to Blue X.)

Solicit as many theories as you can about the robbery. If you're really getting nothing at all, probe:

Ⓟ SUPPOSE IT WAS NOT GRUNT WHO DID THE ROBBERIES. COULD ANYBODY ELSE HAVE GONE FARTHER THAN GRUNT COULD WALK? WHO? HOW?

Ⓟ SUPPOSE IT WAS GRUNT WHO DID THE ROBBERIES. IF GRUNT COULD NOT WALK FARTHER THAN THE EDGE OF THE CIRCLE, HOW COULD HE GET ALL THE WAY OUT TO HERE? (Point)

ANYTHING ELSE?

Plenty of probing.

THURSDAY
Episode 4
Instructions to Interviewer

OKAY, MATHNET PANEL, LET'S OPEN OUR LOG BOOKS TO THE FIRST PAGE. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST. THEN I WILL GIVE YOU SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

HERE IS THE FIRST QUESTION.

1. WHY DID DEBBIE CHECK OTHER ZOOS TO MAKE SURE NO OTHER GORILLAS WERE MISSING? WHAT DO YOU THINK? WHY DO YOU SUPPOSE SHE DID THAT? WRITE YOUR ANSWER ON THE LINES.

Give kids time to write. Then....

LET'S TURN THE PAGE AND GO ON.

2a. KATE AND GEORGE THINK THAT MAYBE JANOS TOOK GRUNT. WHY DO THEY THINK THAT? WRITE DOWN EVERYTHING YOU HAVE SEEN AND HEARD THAT MAKES YOU THINK THAT MAYBE JANOS TOOK GRUNT. WRITE YOUR ANSWERS ON THE LINES.

Give kids time to write. Then....

2a. Oral Review

Tape recorder on.

OKAY, LET'S TURN OVER OUR BOOKS FOR A MINUTE. WHY DO KATE AND GEORGE THINK THAT JANOS TOOK GRUNT? LET'S MAKE A LIST (Not written) OF EVERYTHING WE KNOW.

Make sure you try to solicit ideas from each child.

(P) If you are getting nowhere, probe: DOES JANOS KNOW GRUNT? HOW? HOW DO YOU THINK GRUNT GOT OUT OF HIS CAGE? WHY DO YOU THINK THAT? WHAT DID KATE AND GEORGE FIND BEHIND JANOS' HOUSE?

Tape recorder off.

LET'S OPEN OUR BOOKS AGAIN.

2b. LET'S USE OUR IMAGINATIONS. CAN YOU THINK OF ANY REASONS WHY JANOS WOULD TAKE GRUNT FROM THE ZOO? THINK OF AS MANY REASONS AS YOU CAN. WRITE YOUR ANSWERS ON THE LINES.

Tape recorder on.

2b. Oral Review

LET'S TURN OVER OUR BOOKS AGAIN. WHAT REASONS DID PEOPLE THINK OF? WHY DID JANOS TAKE GRUNT? LET'S MAKE A GOOD LONG LIST. USE YOUR IMAGINATION.

WHAT'S ANOTHER POSSIBILITY? THAT'S A GOOD ONE, CAN ANYBODY ELSE THINK OF ANOTHER IDEA?

Q3 Oral Only (Tape recorder stays on.)

SOME PEOPLE IN THE STORY SAID THEY SAW A BOLD GORILLA WHO ROBBED STORES.

OTHER PEOPLE IN THE STORY SAID THEY SAW A SHY GORILLA WHO RAN AWAY. DO YOU THINK GRUNT WAS SHY OR BOLD?

If children answer shy, say, WHAT ABOUT THE PEOPLE WHO SAW A BOLD GORILLA? HOW DID THAT HAPPEN?

If children answer bold, say, WHAT ABOUT THE PEOPLE WHO SAW A SHY GORILLA? HOW DID THAT HAPPEN?

Q4, Oral Only (Tape recorder stays on.)

DO YOU THINK THE PROBLEM IS SOLVED? ARE ALL THE MATHNET PROBLEMS SOLVED NOW? LET'S VOTE. WHO THINKS YES?

TELL ME WHY YOU THINK THE PROBLEMS ARE ALL SOLVED.

WHO THINKS NO?

TELL ME WHY YOU THINK THE PROBLEMS ARE NOT SOLVED.

Tape recorder off.

FRIDAY
Episode 5
Instructions to Interviewer

1. OKAY, MATHNET PANEL. LET'S OPEN OUR LOG BOOKS. REMEMBER, I WILL READ THE QUESTION ALOUD FIRST. THEN I WILL GIVE YOU SOME TIME TO WRITE YOUR ANSWER. DOES ANYONE NEED A PENCIL?

HERE'S THE QUESTION:

ALL THIS WEEK WE WATCHED MANY PEOPLE DOING DIFFERENT KINDS OF THINGS. SOME OF THESE THINGS WERE MATHEMATICS, AND SOME WERE NOT. NOW THINK BACK, AND USE YOUR MEMORY. WHAT THINGS DID THEY DO THAT WERE MATHEMATICS. WRITE DOWN AS <u>MANY</u> THINGS AS YOU CAN THINK OF. TRY TO MAKE AS <u>LONG</u> A LIST AS YOU CAN. WAHT THINGS DID PEOPLE DO THIS WEEK THAT ARE MATHEMATICS? WRITE YOUR ANSWERS ON THE LINES. I WANT YOU TO MAKE A LONG LIST, SO I'LL GIVE YOU PLENTY OF TIME.

Because this is the only written question for today, make sure you give them lots of time to respond. If you see a child lay down his pencil, prompt:

(P) TRY TO THINK OF ONE OR TWO MORE THINGS THAT YOU SAW THIS WEEK THAT YOU WOULD CALL MATHEMATICS.

When it looks as if it's about over, develop the discussion with the group.

Tape recorder on.

OKAY, LET'S TALK ABOUT OUR LISTS. (CHILD X), READ ME THE FIRST THING ON YOUR LIST. WHAT DID YOU SEE THIS WEEK THAT YOU THINK MIGHT BE MATHEMATICS?

TELL ME WHY X IS MATHEMATICS. GOOD. DOES ANYBODY ELSE HAVE AN IDEA ABOUT WHY X IS MATHEMATICS? DOES ANYBODY THINK X IS NOT MATHEMATICS? WHY NOT?

Go on to next item of list. Go through lists. If time remains, ask about some of the following activities. Ask children to vote on each item.

WHAT ABOUT RIDING IN THE MATHNET CAR? IS RIDING IN THE MATHNET CAR DOING MATHEMATICS? LET'S VOTE! WHO THINKS RIDING IN THE MATHNET CAR IS MATHEMATICS? WHY DO YOU SAY IT IS MATHEMATICS? WHO THINKS RIDING IN THE MATHNET CAR IS NOT MATHEMATICS? WHY DO YOU SAY IT IS NOT MATHEMATICS?

Also on the list:

FIGURING OUT LOGICAL ANSWERS TO PROBLEMS

MULTIPLYING

PLAYING "WHAT IF"

DRAWING A CIRCLE WITH A COMPASS (Show real one.)

TAKING PHONE CALLS AT THE MATHNET OFFICE

CALLING THE MATHCHOPPER HELICOPTER IN ON THE CASE

PUNCHING IN NUMBERS ON THE CALCULATOR

SEARCHING A DATA BASE

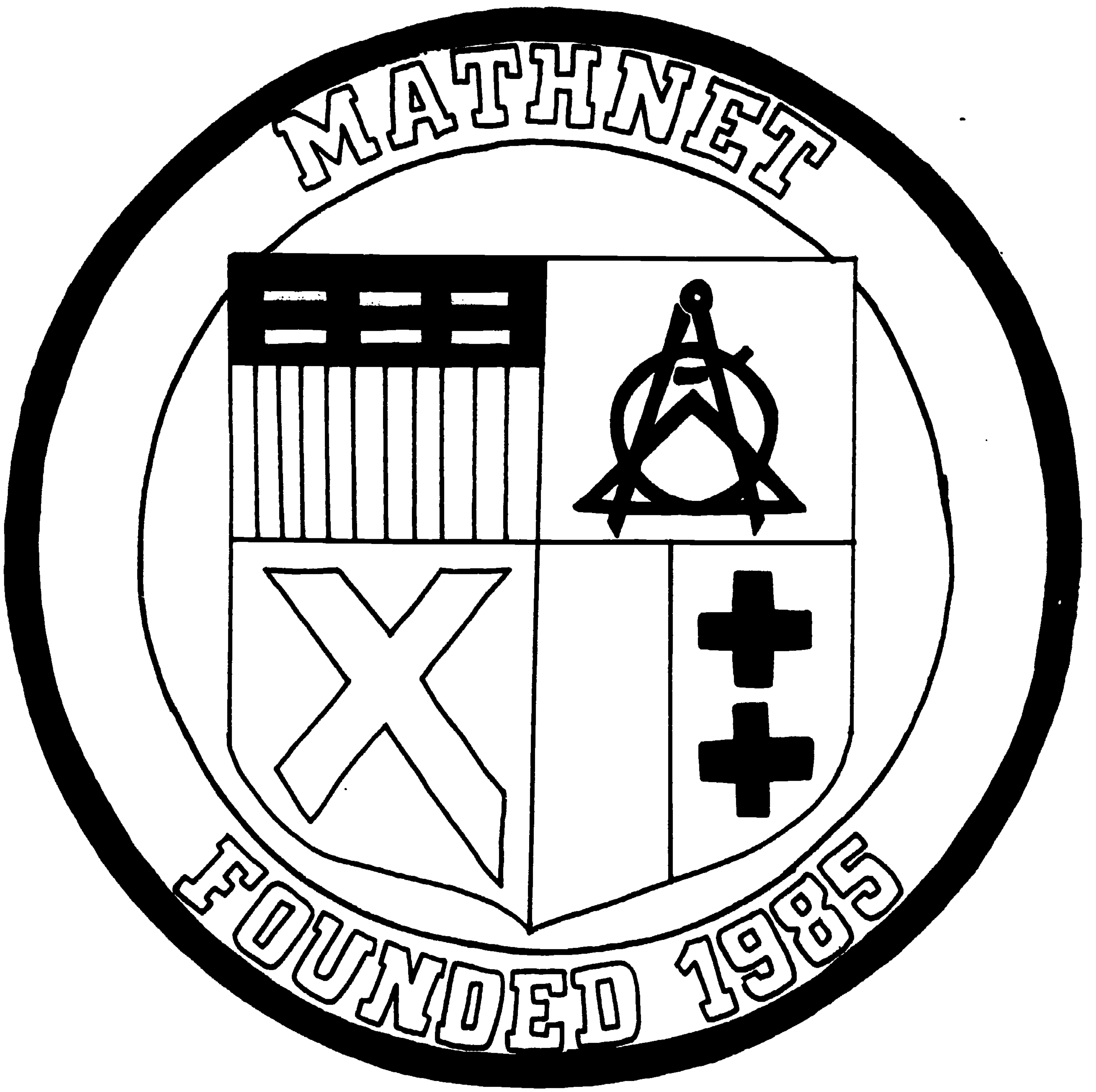
FIGURING OUT HOW MANY MILES AN INCH ON THE MAP STANDS FOR

READING GRUNT HIS RIGHTS

ESTIMATING GRUNT'S HEIGHT

MATHNET

Name: ____________________ Grade: ____ Viewing Group: ____



MONDAY

1. Why did the Chief need the Mathnetters to help him?

He needed their help because: ______

3. Why did George and Kate decide that the parade would have to begin earlier than 5:00?

They thought there might not be enough time for the parade because: ______

______

______

______

______

______

______

2a. How could George find out about the cars so fast?

He found out quickly because: ______

2b. Why did George use a computer to find out about the cars?

He used a computer because: ______

______

______

______

______

______

______

______

THURSDAY

1. Do you think the Mathnet Squad has been using mathematics?

_____ yes _____ no

Why? ____

____

____

____

____

____

____

____

FRIDAY

1. How did the phone number help the Mathnet Squad find Steve Stringbean?

It helped them because: ______________________________

____

____

____

____

____

____

____

____

2. How did Kate know for sure that Mr. Lousa was the Kidnapper?

She knew because: ______________________________

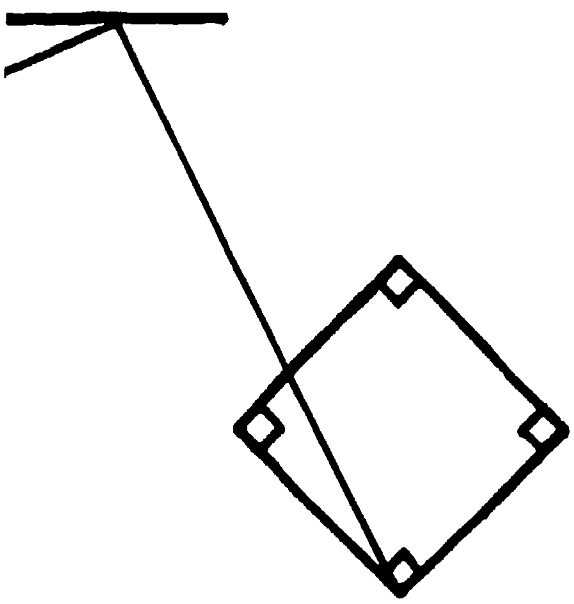
3. What things did we see this week that were mathematics?

MONDAY

1. What is Howie's problem?

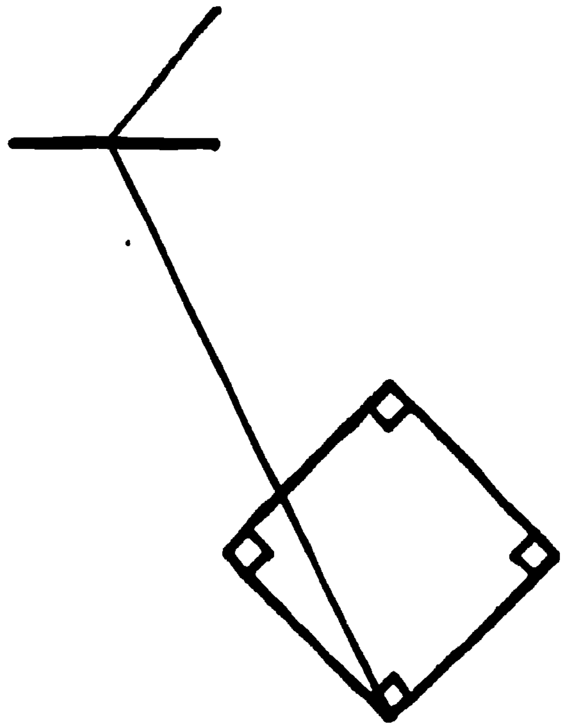
Howie's problem is that: ______________________________

2a. Which picture looks most like the one you saw on the computer? Draw a circle around the picture you saw.



picture

#1



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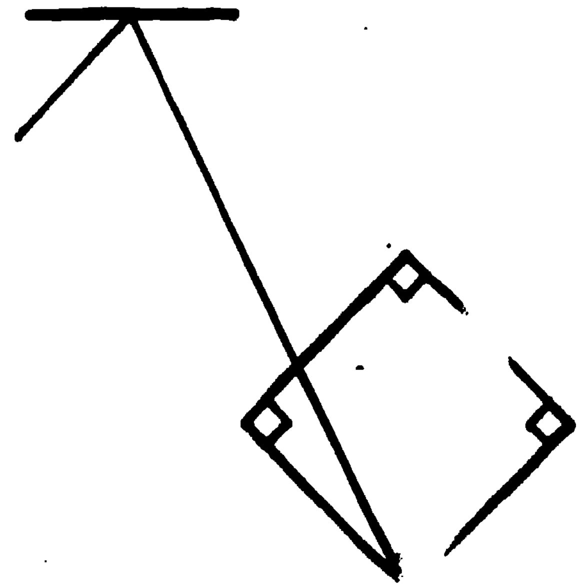
#2



picture

#3

2b. What does this picture stand for?

It stands for: ____

____

____

____

____

____

2c. What is the picture for?

<u>The Mathnetters used the picture to:</u> ____________________

____

____

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____

____

____

TUESDAY

1. What is Mrs. MacGregor's problem?

Mrs. MacGregor's problem is: ______________________________

____

____

____

____

____

____

2. Why were all those people interested in Mrs. MacGregor's house?

Maybe they were interested in her house because ____________

3a. Why was Mrs. MacGregor's house probably not blown up?

Probably it was not blown up, because: ______________________

3b. Why was Mrs. MacGregor's house probably not taken apart?

Probably it was not taken apart, because: ______________________

3c. Why was Mrs. MacGregor's house probably not taken away on a truck?

Probably it was not taken away on a truck, because: ______________________

WEDNESDAY

1. What is a data base?

   I think a data base is: ______________________________

2. What things have we seen and heard this week that might make us think that Clarence Sampson stole Mrs. MacGregor's house?

Here's why I think maybe Clarence Sampson stole Mrs. MacGregor's house: ______________________________

3a. How was Mrs. MacGregor's house stolen?

Mrs. MacGregor's house was stolen by: ____________________

3b. How do you know?

I know that because: ____________________

THURSDAY

1a. Do you think Clarence Sampson stole Mrs. MacGregor's house with a helicopter?

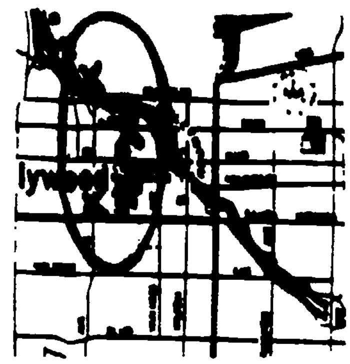
_____ probably yes _____ probably no

1b. Why? ______________________________

1c. What have we seen and heard this week that might make us think Clarence Sampson stole Mrs. MacGregor's house?

Here's what we saw and heard this week: ______________________________

2a. Which shape did Ginny make on the map? Draw a line under the shape that Ginny made.



2b. Why did Ginny make that shape?

Ginny probably made that shape because: ______________________

____

____

____

____

____

____

____

____

3. How did the Mathnetters find out which direction the helicopter had gone?

The found out because: ______________________________

____

____

____

____

____

____

____

4. How did Howie help find Mrs. MacGregor's house?

What Howie did to help was to: ______________________________

FRIDAY

1a. What things did we see this week that were mathematics?

MONDAY

1. What is the problem that the Mathnet Squad must solve?

   The Mathnet problem is: ______________________________

2a. Do you think a real monkey is robbing those stores?

_____ probably yes   _____ probably no

2b. Why? ____

____

____

____

2c. What did we see and hear today that might make us think it is a real live monkey?

<u>The robber might be a monkey because</u>: ____________

____

____

____

____

____

____

____

____

3a. Do you think a man in a monkey suit is robbing those stores?

____ probably yes ____ probably no

3b. Why? ____________________

____

____

____

3c. What did we see and hear today that might make us think that it is a man in a monkey suit?

It might be a man in a monkey suit because: ____________________

____

____

____

____

____

____

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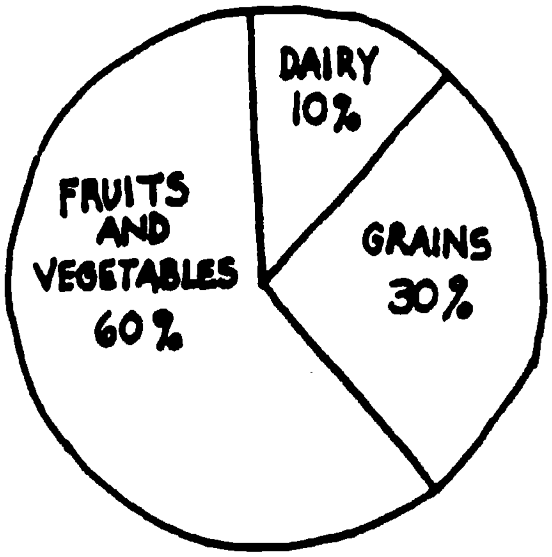

TUESDAY

1a. What is this?

It is: ______________________________

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____

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1b. What is it for?

It is for: ______________________________

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____

1c. What kind of food does Grunt eat the most?

Mostly, Grunt eats:

fruits and vegetables   grains   dairy products

Put a line under the food that Grunt eats the most.

1d. How do you know?

I know because: ______________________________

____

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1e. Why does Kate want to know what Grunt eats?

Kate wants to know because: ______________________

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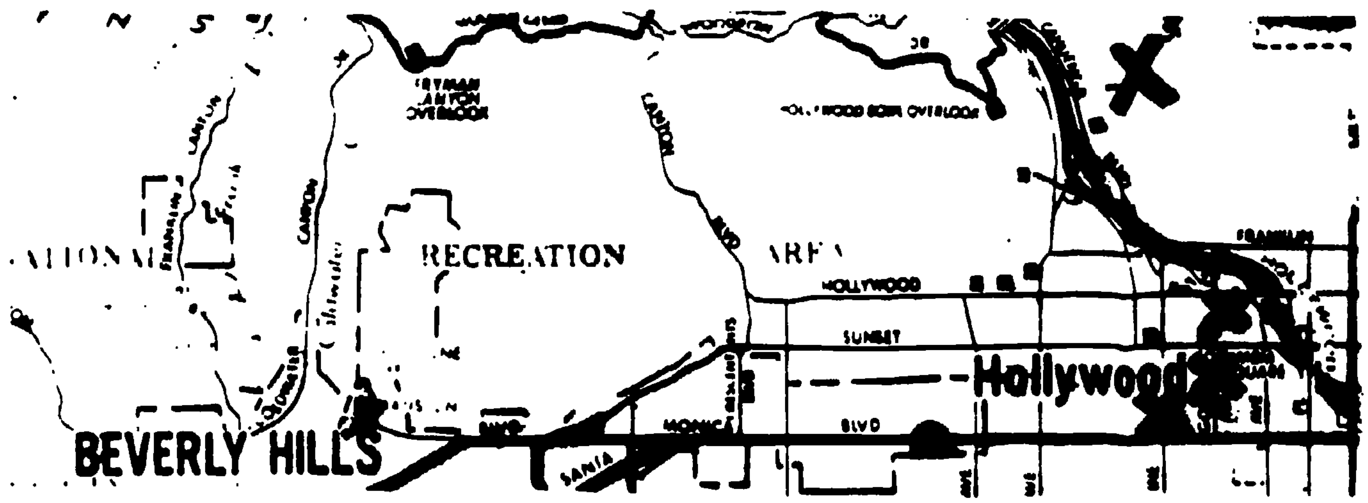

3a. Remember when Debbie put these blue Xs on the map? What are they?

The Xs are: ______________________________

____

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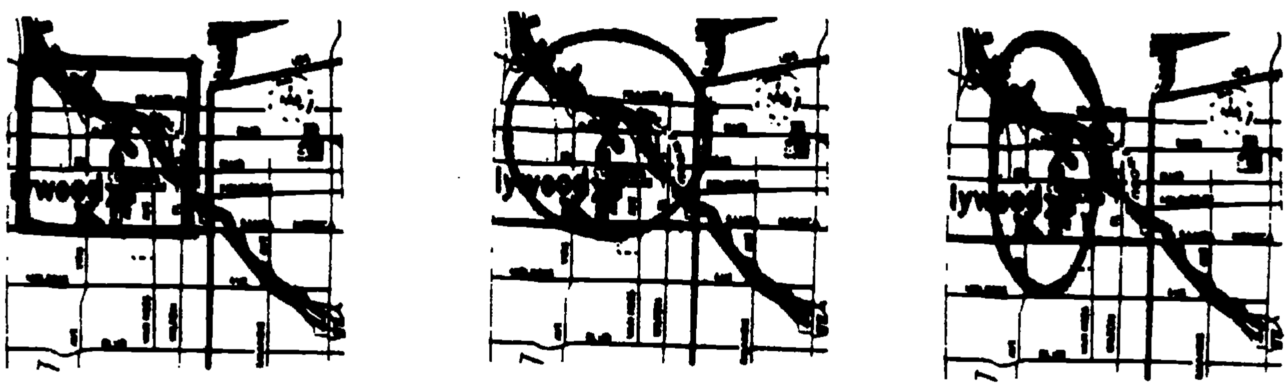
3b. 

Which shape did Debbie make on the map? Draw a line under the shape that Debbie made.

3c. Why did she do that?

She did that because: ______________________________

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4. We saw many things on today's show. Some of these things were used for mathematics. Some things were not used for mathematics. Put a Y next to everything that was used for doing mathematics. Put a N next to everything that was not used for doing mathematics.

____ ruler

____ gorilla cage

____ compass

____ giant hamburger

____ telephone

____ map

____ combination lock

____ calculator

____ doll

____ blackboard

____ pizza

WEDNESDAY

1. Kate thinks Grunt is robbing the stores. What did we see and hear today that makes us think she could be correct, that Grunt is the robber?

Kate thinks Grunt is the robber because: ______________________

2. Jane thinks Grunt is not robbing the stores. What did we see or hear today that makes us think Jane could be correct, that Grunt is NOT the robber?

Jane thinks Grunt is NOT the robber because: ______________

3a. Why might Grunt steal pizza from a pizza shop?

It might be Grunt who stole the pizza because: ____________

____

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3b. In the pizza shop, why did Jane measure the distance between the footprints?

Jane measured the distance between the footprints because:

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THURSDAY

1. Why did Debbie check other zoos?

   Debbie checked the zoos because: ______________________

2a. Kate and George think Janos took Grunt.

They think that because: ______________________

2b. Can you think why Janos would take Grunt from the zoo?

Janos might take Grunt because: ______________________

FRIDAY

1. This week we saw many people doing different kinds of things. Some of these things were mathematics. What things did they do that were mathematics? Make as long a list as you can.

Appendix C

Descriptior , of Mathnet Segments

MATHNET-CASE OF THE MISSING BASEBALL-1 6:27

The Mathnetters investigate a missing baseball by determining the angle at which it would have rebounded off a billboard.

GOAL 1:A GOAL 2:A1 B1 B3 B4 C1a C2c GOAL 3:G6 G4

MATHNET-CASE OF THE MISSING BASEBALL-2 5:23

The Mathnetters gather facts and use logical reasoning to determine the whereabouts of a missing house.

GOAL 1:A GOAL 2:A1 B1 B3 C1a C1e C4a C4b GOAL 3:G4

MATHNET-CASE OF THE MISSING BASEBALL-3 6:17

The Mathnetters continue their search for the missing house, using a database to access information about a pair of glasses that have turned up on the property.

GOAL 1:A GOAL 2:A1 B1 B3 C1a C2c C3a GOAL 3:F4 A9

MATHNET-CASE OF THE MISSING BASEBALL-4 7:42

The Mathnetters determine the worth of stolen gold bars as they piece together a picture of the man who may have stolen the house. They also use a map to determine the range a helicopter could fly.

GOAL 1:A B GOAL 2:A1 B1 B2 B3 B4 B5 C1a C2c C3a GOAL 3:B4 G4 C3 B5

MATHNET-CASE OF THE MISSING BASEBALL-5 6:41

The Mathnetters use a floorplan to successfully locate the missing baseball.

GOAL 1:-0- GOAL 2:A1 B1 C1a C3b GOAL 3:G4 G6

MATHNET:PROBLEM OF THE MISSING MONKEY-1 8:05

The Mathnetters investigate a series of burglaries allegedly committed by a monkey that escaped from the zoo.

GOAL 1:C GOAL 2:A1 A2 B2 B3 C4a C4b GOAL 3:C3 D1

MATHNET:PROBLEM OF THE MISSING MONKEY-2 9:40

In their continued search for a missing monkey, the Mathnetters come across information presented in a circle graph and use a map and compass to estimate the approximate location of the gorilla.

GOAL 1:A C GOAL 2:A1 B1 B2 B3 B4 B5 C1a GOAL 3:G4 C3 B1 E1

MATHNET:PROBLEM OF THE MISSING MONKEY-3 8:18

The Mathnetters continue looking for the monkey, measuring the distance between footprints and using a map to figure distance, rate, and time.

GOAL 1:A C GOAL 2:A1 B1 B2 B3 B4 C1a C4a GOAL 3:G4 B5

MATHNET: PROBLEM OF THE MISSING MONKEY-4 8:17

The Mathnetter's recognize that, sometimes, one must look at a problem from a different point of view -- and so hypothesize that they are searching for a gorilla and a man in a monkey suit.

GOAL 1:C GOAL 2:A1 B1 B3 C1a C3a C4a C4b GOAL 3:-0-

MATHNET: PROBLEM OF THE MISSING MONKEY-5 10:01

George climbs atop the Hollywood sign, and the Mathnetters successfully solve the problem of the missing monkey -- putting both the gorilla and the thief behind bars.

GOAL 1:-0- GOAL 2:A1 B1 D1 C4a GOAL 3:-0-

MATHNET: PROBLEM OF THE PASSING PARADE-1 9:51

In anticipation of a rock star's visit, the Mathnetters calculate how much time a parade will take, estimate crowd size, and approximate the number of officers needed for crowd control.

GOAL 1:A GOAL 2:A1 A2 B2 B3 B4 B6 D1 C1a C2c GOAL 3:B4 B1 B5 G4

MATHNET: PROBLEM OF THE PASSING PARADE-2 9:07

In their attempt to find a kidnapped rock star, the Mathnetters tip a bottle with liquid in it to recreate a mountain's angle of incline. They also use musical beats to keep track of time.

GOAL 1:A C GOAL 2:A1 B1 B2 B3 B6 C1e C2c GOAL 3:C3 G6 G4

MATHNET: PROBLEM OF THE PASSING PARADE-3 10:06

As they gather clues to the kidnapping case, the Mathnetters attempt to decode a message, use a car registration database, and measure the width and tread of a car tire.

GOAL 1:A C GOAL 2:A1 A2 B1 B3 C1b C2c C3a C4b GOAL 3:C2

MATHNET: PROBLEM OF THE PASSING PARADE-4 7:21

In trying to decode Stringbean's musical message, the Mathnetters recognize that each note of the message corresponds to a tone/number on a touch-tone phone.

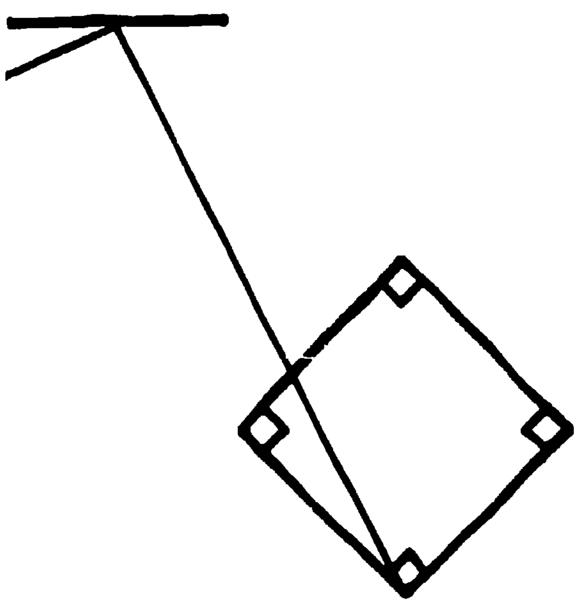
GOAL 1:A C GOAL 2:A1 A2 B1 B3 C4a C4b GOAL 3:-0-

MATHNET: PROBLEM OF THE PASSING PARADE-5 9:01

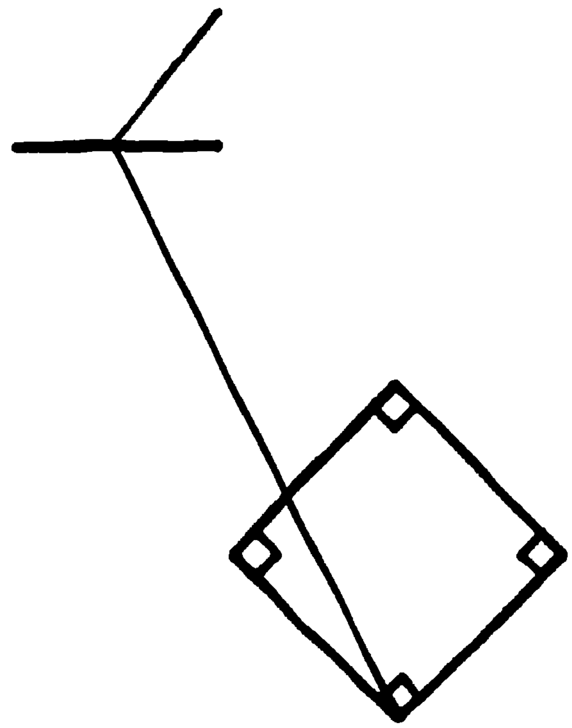
The Mathnetters successfully solve the problem and rescue Steve Stringbean.

GOAL 1:A B GOAL 2:A1 B1 B3 C2c GOAL 3:D2 F4

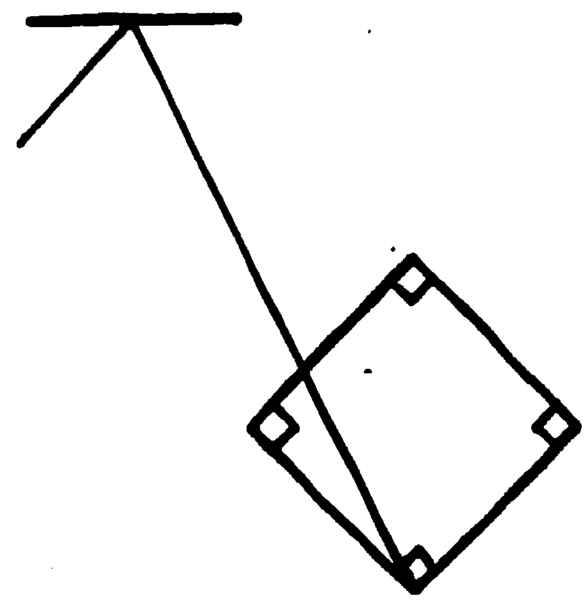
2a. Which picture looks most like the one you saw on the computer? Draw a circle around the picture you saw.



picture
#1



picture
#2



picture
#3

2b. What does this picture stand for?

It stands for: ______________________________

____

____

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____

2c. What is the picture for?

The Mathnetters used the picture to: ______________________

____

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TUESDAY

1. What is Mrs. MacGregor's problem?

Mrs. MacGregor's problem is: ______________________________

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____

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____

2. Why were all those people interested in Mrs. MacGregor's house?

Maybe they were interested in her house because ____________

3a. Why was Mrs. MacGregor's house probably not blown up?

Probably it was not blown up, because: ____________________

____

____

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3b. Why was Mrs. MacGregor's house probably not taken apart?

Probably it was not taken apart, because: ____________________

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3c. Why was Mrs. MacGregor's house probably not taken away on a truck?

Probably it was not taken away on a truck, because: __________

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WEDNESDAY

1. What is a data base?

   I think a data base is: ______________________

   ____

   ____

   ____

   ____

   ____

   ____

   ____

2. What things have we seen and heard this week that might make us think that Clarence Sampson stole Mrs. MacGregor's house?

Here's why I think maybe Clarence Sampson stole Mrs. MacGregor's house: ______________________________

3a. How was Mrs. MacGregor's house stolen?

Mrs. MacGregor's house was stolen by: ______________________

____

____

____

3b. How do you know?

I know that because: ______________________________

____

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THURSDAY

1a. Do you think Clarence Sampson stole Mrs. MacGregor's house with a helicopter?

_____ probably yes _____ probably no

1b. Why? ______________________________

____

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1c. What have we seen and heard this week that might make us think Clarence Sampson stole Mrs. MacGregor's house?

Here's what we saw and heard this week: ______________________________

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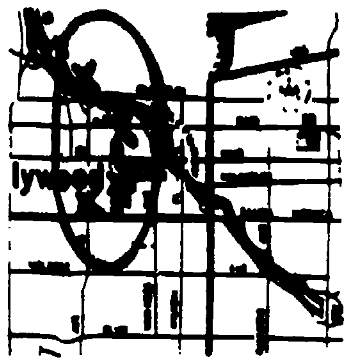
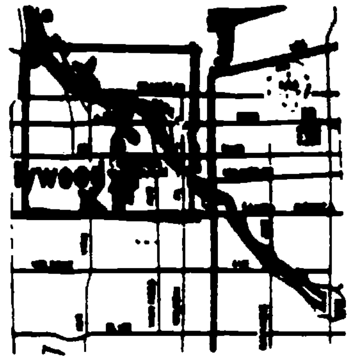
____

2a. Which shape did Ginny make on the map? Draw a line under the shape that Ginny made.





2b. Why did Ginny make that shape?

Ginny probably made that shape because: ______________________

3. How did the Mathnetters find out which direction the helicopter had gone?

The found out because: ______________________________

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4. How did Howie help find Mrs. MacGregor's house?

What Howie did to help was to: ____________________

FRIDAY

1a. What things did we see this week that were mathematics?

MONDAY

1. What is the problem that the Mathnet Squad must solve?

   The Mathnet problem is: ______________________________

   ____

   ____

   ____

   ____

   ____

   ____

2a. Do you think a real monkey is robbing those stores?

____ probably yes   ____ probably no

2b. Why? ______________________________

2c. What did we see and hear today that might make us think it is a real live monkey?

The robber might be a monkey because: __________

3a. Do you think a man in a monkey suit is robbing those stores?

____ probably yes ____ probably no

3b. Why? ____

____

____

____

3c. What did we see and hear today that might make us think that it is a man in a monkey suit?

It might be a man in a monkey suit because: ____________________

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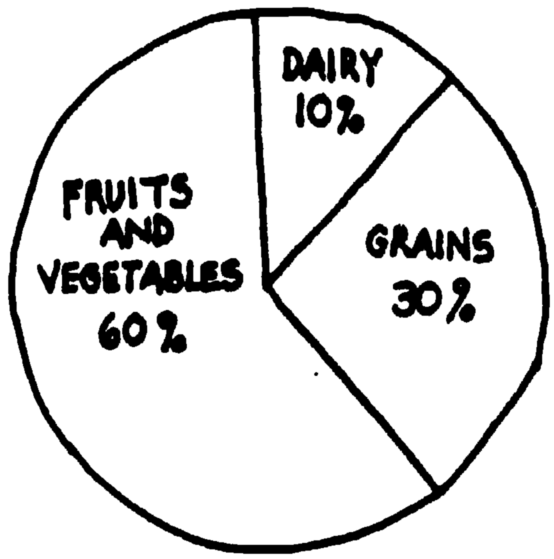

TUESDAY

1a. What is this?

It is: ____________________

1b. What is it for?

It is for: ____________________

1c. What kind of food does Grunt eat the most?

Mostly, Grunt eats:

fruits and vegetables | grains | dairy products

Put a line under the food that Grunt eats the most.

1d. How do you know?

I know because: ____________________

1e. Why does Kate want to know what Grunt eats?

Kate wants to know because: ______________________

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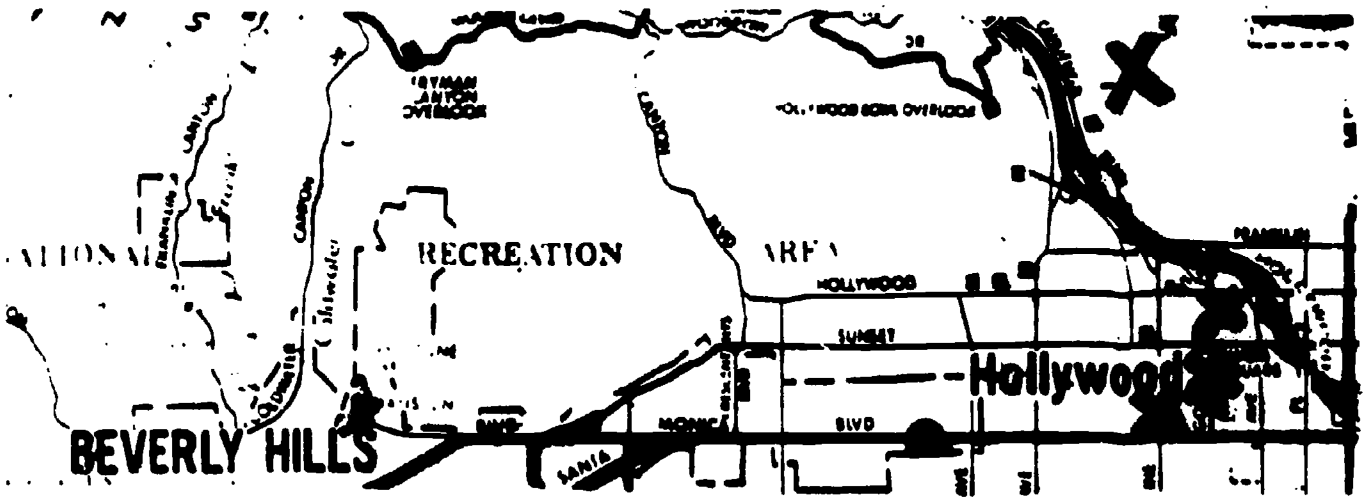

3a. Remember when Debbie put these blue Xs on the map? What are they?

The Xs are: ______________________________

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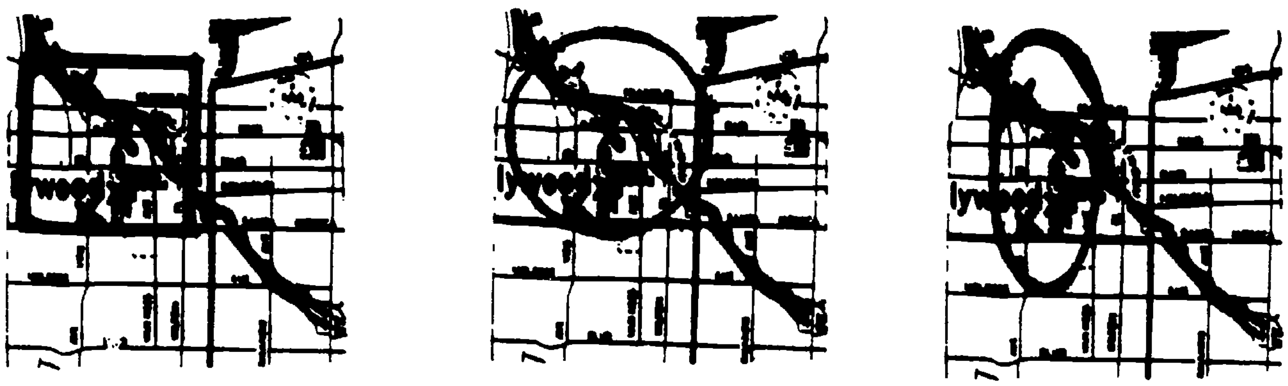
____

____

3b.



Which shape did Debbie make on the map? Draw a line under the shape that Debbie made.

3c. Why did she do that?

She did that because: ______________________________

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4. We saw many things on today's show. Some of these things were used for mathematics. Some things were not used for mathematics. Put a Y next to everything that was used for doing mathematics. Put a N next to everything that was not used for doing mathematics.

____ ruler

____ gorilla cage

____ compass

____ giant hamburger

____ telephone

____ map

____ combination lock

____ calculator

____ doll

____ blackboard

____ pizza

WEDNESDAY

1. Kate thinks Grunt is robbing the stores. What did we see and hear today that makes us think she could be correct, that Grunt is the robber?

Kate thinks Grunt is the robber because: ____________________

2. Jane thinks Grunt is not robbing the stores. What did we see and hear today that makes us think Jane could be correct, that Grunt is NOT the robber?

Jane thinks Grunt is NOT the robber because: ____________________

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____

3a. Why might Grunt steal pizza from a pizza shop?

It might be Grunt who stole the pizza because: ___________

____

____

____

3b. In the pizza shop, why did Jane measure the distance between the footprints?

Jane measured the distance between the footprints because:

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THURSDAY

1. Why did Debbie check other zoos?

Debbie checked the zoos because: ______________________

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____

2a. Kate and George think Janos took Grunt.

They think that because: ______________________________

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2b. Can you think why Janos would take Grunt from the zoo?

Janos might take Grunt because: ______________________

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FRIDAY

1. This week we saw many people doing different kinds of things. Some of these things were mathematics. What things did they do that were mathematics? Make as long a list as you can.

Appendix C

Descriptions of Mathnet Segments

MATHNET-CASE OF THE MISSING BASEBALL-1

The Mathnetters investigate a missing baseball by determining the angle at which it would have rebounded off a billboard. 6:27

GOAL 1:A GOAL 2:A1 B1 B3 B4 C1a C2c GOAL 3:G6 G4

MATHNET-CASE OF THE MISSING BASEBALL-2

The Mathnetters gather facts and use logical reasoning to determine the whereabouts of a missing house. 5:23

GOAL 1:A GOAL 2:A1 B1 B3 C1a C1e C4a C4b GOAL 3:G4

MATHNET-CASE OF THE MISSING BASEBALL-3

The Mathnetters continue their search for the missing house, using a database to access information about a pair of glasses that have turned up on the property. 6:17

GOAL 1:A GOAL 2:A1 B1 B3 C1a C2c C3a GOAL 3:F4 A9

MATHNET-CASE OF THE MISSING BASEBALL-4

The Mathnetters determine the worth of stolen gold bars as they piece together a picture of the man who may have stolen the house. They also use a map to determine the range a helicopter could fly. 7:4

GOAL 1:A B GOAL 2:A1 B1 B2 B3 B4 B5 C1a C2c C3a GOAL 3:B4 G4 C3 B5

MATHNET-CASE OF THE MISSING BASEBALL-5

The Mathnetters use a floorplan to successfully locate the missing baseball. 6:41

GOAL 1:-0- GOAL 2:A1 B1 C1a C3b GOAL 3:G4 G6

MATHNET:PROBLEM OF THE MISSING MONKEY-1

The Mathnetters investigate a series of burglaries allegedly committed by a monkey that escaped from the zoo. 8:05

GOAL 1:C GOAL 2:A1 A2 B2 B3 C4a C4b GOAL 3:C3 D1

MATHNET:PROBLEM OF THE MISSING MONKEY-2

In their continued search for a missing monkey, the Mathnetters come across information presented in a circle graph and use a map and compass to estimate the approximate location of the gorilla. 9:40

GOAL 1:A C GOAL 2:A1 B1 B2 B3 B4 B5 C1a GOAL 3:G4 C3 B1 E1

MATHNET:PROBLEM OF THE MISSING MONKEY-3

The Mathnetters continue looking for the monkey, measuring the distance between footprints and using a map to figure distance, rate, and time. 8:18

GOAL 1:A C GOAL 2:A1 B1 B2 B3 B4 C1a C4a GOAL 3:G4 B5

MATHNET: PROBLEM OF THE MISSING MONKEY-4

The Mathnetter's recognize that, sometimes, one must look at a problem from a different point of view -- and so hypothesize that they are searching for a gorilla and a man in a monkey suit. 8:17

GOAL 1:C GOAL 2:A1 B1 B3 C1a C3a C4a C4b GOAL 3:-0-

MATHNET: PROBLEM OF THE MISSING MONKEY-5

George climbs atop the Hollywood sign, and the Mathnetters successfully solve the problem of the missing monkey -- putting both the gorilla and the thief behind bars. 10:01

GOAL 1:-0- GOAL 2:A1 B1 D1 C4a GOAL 3:-0-

MATHNET: PROBLEM OF THE PASSING PARADE-1

In anticipation of a rock star's visit, the Mathnetters calculate how much time a parade will take, estimate crowd size, and approximate the number of officers needed for crowd control. 9:51

GOAL 1:A GOAL 2:A1 A2 B2 B3 B4 B6 D1 C1a C2c GOAL 3:B4 B1 B5 G4

MATHNET: PROBLEM OF THE PASSING PARADE-2

In their attempt to find a kidnapped rock star, the Mathnetters tip a bottle with liquid in it to recreate a mountain's angle of incline. They also use musical beats to keep track of time. 9:0

GOAL 1:A C GOAL 2:A1 B1 B2 B3 B6 C1e C2c GOAL 3:C3 G6 G4

MATHNET: PROBLEM OF THE PASSING PARADE-3

As they gather clues to the kidnapping case, the Mathnetters attempt to decode a message, use a car registration database, and measure the width and tread of a car tire. 10:06

GOAL 1:A C GOAL 2:A1 A2 B1 B3 C1b C2c C3a C4b GOAL 3:C2

MATHNET: PROBLEM OF THE PASSING PARADE-4

In trying to decode Stringbean's musical message, the Mathnetters recognize that each note of the message corresponds to a tone/number on a touch-tone phone. 7:21

GOAL 1:A C GOAL 2:A1 A2 B1 B3 C4a C4b GOAL 3:-0-

MATHNET: PROBLEM OF THE PASSING PARADE-5

The Mathnetters successfully solve the problem and rescue Steve Stringbean. 9:01

GOAL 1:A B GOAL 2:A1 B1 B3 C2c GOAL 3:D2 F4