

## **Probability for the Novice**

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### **INTRODUCTION**

One of the main purposes of a class lesson should be to expose student to a topic within in a given (and required, either by the school district or the state in which the student resides) subject that will be applicable to their daily lives. This statement may be one that sounds fashionable or “politically correct” in popular terminology, but the classes that I have had for the past six years have shown me in their varied ways and opinions that it is that specific application that is important to them. Certainly, this approach, or preference that the students have is difficult (if not impossible) to satisfy every day, but they understand that. They realize that they may need some background information upon which to build an idea and, to that end, they are willing to absorb one or two days worth of practice. And they really want to see how they can use the new information at their after-school job or at home when they are with their families and taking care of younger children. This is especially true with students in the ESL classes. They take great pride in assisting their newly emigrant parents adapt to life in the United States. Most often this assistance comes in translating from the family’s native language into English because the young student is frequently the first to learn our language, its idioms and its peculiarities. However, aside from language, any information that helps an emigrant family adapt to our society is valuable. The high school student who is able to impart this information at home is assigned an important status role at home, thus acquiring valuable contributions for the family. More importantly, perhaps, is that the status of the public school becomes rather paramount. These parents may never visit our school. We wish they would, but until that time comes, we hope that the information our students take home to them will be worthwhile and impressive.

### **BACKGROUND OF CLASSES**

The majority of students who are enrolled in my extended Algebra I classes either share a background that shows that they have limited English skills because they have recently arrived in the United States, or are students who are very proficient in English but have failed the course once already for a variety of reasons (poor attendance, lack of attention or application in a previous class, poor ability, etc.). These two examples of classes are typical at the school in which I teach, and each type of class has its own special set of considerations which need to be included and elaborated upon before any discussion of lesson plans is included.

## **ESL CLASSES**

The students who have recently arrived in the United States without much knowledge of the English language are placed in English as a Second Language (ESL) classes. If they have limited English proficiency (LEP) they are most often assigned to more than one English class each day in an effort to get them to learn our language as rapidly as is possible. One mathematics class is usually assigned to them, and this assignment is largely based upon on the school records that they provide to our school when they enroll. However, because many students arrive without school records from their own countries, they are given placement tests and assigned to an appropriate math class until their records arrive at the school. Of course, even more challenging situations regarding student scheduling exist. For example, some foreign students have not attended school at all for some time due to various circumstances in their lives. Placing such students in an appropriate class must be daunting for counselors. Placement tests are used as an initial guide until the mathematics teacher is able to identify from their daily work that they are placed in a class that is either too easy or too difficult for them. Teachers are often able to see good math training and background within a relatively short amount to time and can have the student “tested out” of the class and scheduled into a more appropriate class, but this situation is a facet of teaching ESL mathematics classes that must be taken into consideration a the very start of a semester, or as is often the case, whenever a new student enters the class. Often, students will ask to stay in the class regardless of his or her ability (or inability) to do the work. They do not always want the change. New students can arrive on any given day. The school accepts them when they come to the door.

ESL students are very likely to work at after-school jobs until very late hours, making them exceedingly sleepy during school classes. If they haven’t got jobs, they are often helping to baby-sit their younger brothers and sisters while their parents work more than one job. Parents often do not get home until long after midnight, so our high school students have many different roles which are time-consuming and full of responsibility.

These situations that frequently exist in the lives of our ESL students must be considered and handled. The students, of course, must do the required work and complete it with a reasonable amount of success in order to pass the course, but they understand this and show a fascinating amount of pride in their approach to the lessons. They have already accepted the responsibilities of after-school jobs or caring for younger siblings when their parents are at work, so a transfer of this work ethic and behavior to their schoolwork is something that they seem to embrace very willingly. Naturally, not every student in the class fits into this description. Not all ESL classes would be as industrious in their work as this class has been for the two semesters for which I have had them. But they have provided me with a wonderful introduction to teaching an ESL group, steering me to look for work that can be presented to them in a method that is unique for them.

My ESL students very much like working together after the “presentation” part of a day’s lesson has been given. They almost always listen attentively during the initial instruction, but ask virtually no questions during this time. They rarely raise their hands for further explanation. Although their English (if they did not speak it when they began the class) improves noticeably each week, they are reluctant to speak in front of the entire class. It is when the students are asked to begin practicing the problems and beginning their homework that they show their diligence and application. They translate for one another if needed, huddle together to work through problems, re-teach each other, and ask me questions individually now that the intimidation of speaking in front of the entire class is no longer an issue. Interestingly, because many of the students have had algebra in some form in their native country, they really like showing each other different methods of doing the same problem. Do we as teachers show them more than one way of doing the same problem? Yes, of course, but the impact a fellow student has when showing different methods is much greater and influential than any impact the teacher has. It has been a treat for me to observe the work habits of this class.

Teaching this group of students about simple probability will be fun because these students enjoy the group work to which probability problems can lend themselves.

### **TRAILER CLASSES**

Teaching probability to the trailer algebra class will be just as much fun as with the ESL classes, but their very different background must be taken into consideration. Their outlook on school, or a certain subject, is a very different one.

The Algebra I class that is comprised of students who have taken the course once already, and have failed for some reason present, a different set of challenges that are not all unlike those that the students in the ESL classes have. Although some are full of resistance when it comes to doing the work. Sometimes it is helpful to focus on why the students failed at their previous attempt at Algebra I. It is usually some aspect of poor attendance that contributed to their lack of success. Some get sick for two or three days at one time, while some skip classes for at least that amount of time. Other students are kept at home to take care of an ill younger sibling in order to enable a parent to go to work. It is not unusual for a student to be taken out of school for one or two weeks so the entire family can go out of the country to visit a sick relative.

Poor ability or a weak background in math is not to be excluded from this group of students, but poor attendance is most often the culprit in a student’s initial failure of the course. The entire school (faculty, administration and staff) tries various ways to improve attendance each year. Some methods are successful, while others are not.

Repeating parts of previous lessons each week is one method of attempting to review students in case they have been absent. Students are also constantly reminded that tutoring sessions are available at several times throughout the day.

These students often know much of the algebra that the course covers. Granted, they failed it during their previous attempt, but they did learn a portion of the topic. Thus, they respond better to being re-taught the course if the problems are presented very differently. This not always the easiest job, but it seems to keep them on-task more often. They get off-task very quickly if they work in small groups. Training them to work together when practicing problems has been challenging. It becomes a bit of a battle when first attempting group work of any sort.

These students are very capable. They just need to attend regularly, apply themselves to the work, and have some confidence in themselves. Probability should be a topic that they enjoy. If there is enough “hands-on” activity for them, interest will be shown.

## **TEACHING PROBABILITY REQUIREMENTS**

Probability problems are present in all of the courses that I have taught in high school. In Algebra I classes they are part of the curriculum required by the Houston Independent School District as well as those required by the State of Texas. The subject must be taught and a recommended number of days is suggested to devote to the topic. Of course, teachers are allowed to adapt or modify that amount of time to fit the class scheduling at their own school. For example, the school at which I teach is currently using the accelerated block schedule. Students take the same four ninety-minute classes every day. This has some benefit as compared with alternating block schedule classes in which students take their math class every other day. Accelerated block scheduled classes offer a type of back-to-back continuity that is similar to a regular schedule. However, a drawback (and it can be a significant and costly one) is that if a student is absent he or she is really missing what is comparable to nearly twice the amount of time of a regular, 55-minute period. Sometimes worsening the problem is the fact that we are not able to offer a depth to a topic’s coverage because of time constraints. Make-up work and tutoring is always available, but these “services” are not always taken advantage of by the absentee.

The amount of class time that our guidelines suggest we teach probability is a good example of how a one or two day absence from school can have a poor impact on a student’s performance. Our current guidelines suggest that approximately 2-3 days be devoted to teaching the subject. A student could easily miss the entire topic given poor health on those days. Positive approaches to this situation and teaching time frame, which on initial examination appears to be meager and insufficient, are that the topic can be offered to students many times again in the form of review problems or much shorter examples throughout the semester. The absent student (who should have completed the

make-up work as well as have come to tutoring sessions) may then benefit from the new coverage.

Aside from being part of the current school curriculum, simple probability problems also appear in the TAAS review problems for the tenth grade exit test. They may not appear on the test that the State of Texas issues each year, but most teachers include them in any set of review problems because they have been part of the questioning on some tests. Geometry textbooks include probability problems. Once again, they are simple problems, which mostly deal with recognizing that one needs to form a ratio, then solve it to determine the outcome. Depending upon textbook publishers, geometry probability problems are often no different from those in algebra books.

## **PURPOSE OF TEACHING PROBABILITY**

The comprehensive, overall purpose in teaching probability is to help students draw conclusions about the characteristics of a large group given a small sample taken from the group. Probability is related to predicting the chance of a certain event taking place, or failing to take place. The thinking and application acquired in probability projects can be applied in general to other topics (their own lives included) to help students improve and further develop their reasoning skills. They would be hampered in other subjects at school without working at probability. They need to see that it applies to them directly now, as it will throughout their lives. Examples of such events in the lives of students could include the chance of getting tails when a coin is tossed, the chance of being scheduled to a certain math class, or the chance of their school's' basketball team winning a certain game.

Students need to learn about experimenting with such types of probability in order to learn about possible outcomes. They need to be steered away from guessing outcomes. Experimenting should allow them to approach fairly accurate results.

As an introduction to experimenting, tossing coins can be done. At first, students will most likely say that a fifty percent chance exists of having a coin land on the "heads" side when it is tossed. Having them toss the coin an assigned number of times (while keeping a record of the results) will either confirm or disprove their prediction or expectation. Different teams of students may be assigned a different number of times to toss the coins. Results may vary, but their averages may be compared for the best accuracy.

## **TEACHING APPROACHES**

What I should like to do for this seminar is to write one lesson plan that incorporates a few games involving something that can be put in students hands, perhaps cards, dice or coins because these are usually familiar to them. If any resemblance to gambling is involved, the materials used could be renamed or replaced with some other "gamepiece."

Other lesson plans will include using published sources. These may include games, but using published sources is the initial goal so that students see that probability is discussed in places other than classroom situations that appear to be contrived by the teacher. The school textbook will also be used so that further use of it will be made. Students frequently do not use the textbook.

The challenge in teaching simple probability lies in getting the students to understand what they are apt to call their “totals”, by which they mean to be the number of cards in a deck, or the number of letters in the alphabet, or the number of letters in a given, quoted sentence. They often lack confidence in recognizing the requested number. What is rewarding in problems such as these simple probability questions is that the students will, in my experience, discuss the solutions with one another much more than they will any other topic in math. An additional boost is that they have had a smattering of probability questions in middle school, so the topic is not unknown to them. For example, when they are given small bags of M & M candies and asked to count the number of candies in the bag, so that they are able to calculate the probability of extracting a red candy from the total when all are put back into the bag, they accomplish the task with ease. If a student near them is having trouble (mostly from never having done such a task before), they are sure to show them exactly how the problem is done. These “hands-on” types of problems are enjoyable to them. They are likely to see more success with this type of activity than they are with straight algebra or geometry.

A deck of 52 playing cards is another reasonably familiar form in which to introduce probability experiments. Some discussion will need to take place about the contents of a deck of cards because it is very likely that several students will not be familiar with the cards. Usually the students who know cards will teach the others themselves. They enjoy showing others in this sort of activity. Once all students are familiar with the deck, questions with predictable answers can be asked. For example, finding the probability of drawing red 2 from the deck, the P(a red king), or P(a diamond or heart).

More complex questions may follow. For example: a bucket contains 6 red balls, 12 white balls, 10 blue balls and 8 orange balls. One ball is randomly selected, noted and then replaced. Another ball is randomly selected. Find the P (1<sup>st</sup> red and 2<sup>nd</sup> orange). Some demonstration needs to take place. Putting balls (or blocks, whatever is at hand) into a box, then drawing them out may need to be done for visual learners. Discussion of the total number of balls, then the ratio of each color to the total is needed. Reducing fractions each time and then multiplying them must be shown. In this example, the answer could be shown as:

$$\frac{\underline{6 \text{ red balls}}}{36 \text{ total}} = \frac{1}{6} \qquad \frac{\underline{8 \text{ orange balls}}}{36 \text{ total}} = \frac{2}{9}$$

Multiply the two fractions:  $1/6 * 2/9 = 2/54$

Reduce the fraction:  $1/27$  is the answer.

## **OVERVIEW OF THE TEACHING UNIT**

### **Using the Internet**

The State of Texas allots approximately three days in their requirements for the teaching of probability. My plan is to devote one day of this schedule to retrieving probability problems from websites on the Internet where they seem to abound in various forms of difficulty. We will begin with the easiest problems or situations as a way of introducing the topic, advancing to more difficult problems if time allows.

As in any lesson, there are always adjustments or considerations to make along the way. The facts that most of my students are largely unfamiliar with the Internet (few have computers at home), and that they have very limited access to them at school, must be factored into any class plans. Our school has no mathematics computer laboratory which they can use, nor are there several computers in the classroom to use. Consequently, we will need to use my teacher assigned computer to retrieve the work we want. This can be done easily enough, but individual student use cannot be allowed on this machine. I shall try to encourage them to search for different websites on probability on their own in the library or in the ESL laboratory later on. For now, they will need to watch me retrieve the information. We can print out many copies of the website information to use for student notes or reference.

Very basic probability problems are quickly found on the website <http://www.figurethis.org>, a collection site for many other topics in math (algebra, geometry, measurement, and numbers) as well. There are many other sites that can be accessed, but the sets of problems on this site are very short, simple, and arranged for quick and easy retrieval. What appeals to me about this site are the very concise descriptions of how to “play”, or test, each situation. Simple directions are welcome in anything. This site writes them well. I have tested some of them with one of the classes already, and there have been no questions about how to conduct the work. An added bonus with all the problems is the hint question that is posed, and written underneath the problem instructions. Some of the problems are solved by playing a game in some form involving two or more students, while others are done with paper and pencil and in less of a group setting.

Other websites can be very similar. Problems involving games can require different materials. Dice and cards are often mentioned as “tools” to be used to solve the question.

If there is reluctance to using these, they can number the sides of plastic cubes or make cards.

My general goal in having the students play games to solve probability problems is to provide them with problems that are initially short and fun to do, while still observing Texas's requirements. It is not always possible for teachers to provide much hands activity in math classes. Manipulatives exist and are extolled by some educators, but their effectiveness is somewhat limited. The use of calculators in the classroom is always debated. Sets of graphing calculators are provided to most Algebra 1 classes if the school has a sufficient amount of them. Students seem to enjoy learning to use them. Calculators offer a different type of manipulation, but all of the Algebra 1 problems that they are tested on by the State of Texas can be solved without a calculator.

Naturally not all of the content of these probability games will be applicable to their daily lives, but playing games and deriving solutions from them is a feature that is familiar to them. Additionally, these types of activities are very social, leading to what is often termed "group work". They often need to keep some type of tabulation as they do the game. Hopefully, there will ensue various strategies and techniques for solutions within a group.

An even greater benefit to students using the Internet to find these problems is that they should become curious enough to delve deeper into the website that they are using. The different menus offered on sites are easily accessed and should be explored by them. Their natural curiosity will probably lead them into most aspects of a website.

A dual purpose when using the Internet for this purpose is to assign the students projects to complete on their own. Our mathematics department has no computer laboratory of its own, but the ESL students could be assigned a project to complete in the ESL computer lab. The trailer Algebra 1 class could do the same sort of assignment on the school library's computers. These students need computer work to become proficient in many areas of their lives. This type of assignment can be done piecemeal over a period of several days and need not be especially lengthy. They can do the research on-line, then finish the project in class.

### **Using Published Sources**

In an effort to get students to read, or at least look up information, about probability, basic books on the subject will be made available in the classroom for them to use. Also, the school's library has a few books on the subject that are suitable for the needs of our classroom. These are not textbooks. Rather, they are general books about the subject that often address situations that may appeal to our students or at least appear to directly affect their lives.



The amount of money that students can earn when they work seems to be of endless interest to them. Many students do not consider how much more they will earn if they graduate from high school. Dropout rates are high in United States urban high schools. Students have listened to warnings and pleas about the importance of staying in school. We often mention it at school. Reading about it in a published book could make an stronger impression. George Shaffner in his book entitled "The Arithmetic of Life" discusses exactly that topic (p. 13-16). Other chapters in this book with catchy titles such as "The Case for Smoking" and "The Value of Being Stupid" seem to beg a student to read them. Certainly the topics will make them appear to be present in theirs lives right now. There is only one copy of this book in the classroom so it may be one that I read aloud to them before discussion.

Reading aloud to the students can be fun as well as effective. Many have not been read to in class since elementary school. They may find it a bit strange at first, but the method is making a comeback in our high school because of the First Things First school reform/improvement program that we will be implementing during next year. Consultants have come to our school to give us programs on what to read to students. Much of the subject material has not been related to math. Perhaps probability books with relatively short, concise descriptions will rescue mathematics teachers from having to rely solely on textbook narrative which is not the type of reading material that the First Things First program leaders seem to have in mind. Until now, they have given us examples of thoughtful, short descriptive paragraphs or poetry. These may be interesting and appropriate listening for students in English or Social Studies classes, but hardly useful in a mathematics class.

Some of the recent mathematics books that are geared to discussing math in everyday life also include some very humorous illustrations which students would enjoy seeing. They could be copied onto a page with a short description and read aloud to our students to show them some funny outlooks.

Other books with similar approaches are available. Some appear to be rather childish because of the over-abundance of graphics to illustrate probability, but students will be asked to evaluate if the artwork is necessary for the effectiveness. It is often interesting to watch them evaluate or vote on the merits of books and articles. They see enough illustrations in textbooks and have fairly strong opinions about their value. Seeing whether they can evaluate a book is often worthwhile.

Projects that could arise from evaluating published materials other than textbooks could include choosing one or two problems for a student to teach to his or her group. Just as in the problems on the Internet websites, many are simple to perform but relevant to what needs to be taught for district and state requirements.

Two or three book reviews in the form of an annotated bibliography would provide students with a different method of work in a math class that is not overwhelming. They often write in their journals in English classes so this exercise may prove to be somewhat effective if kept relatively short.

### **Using Textbooks**

Very few (if any!) of my students like to use the textbook that we use for the classroom. We use it, but it can be a battle to get all students to do so. Many forget to bring it to class. What is even more discouraging is the fact that several students do not qualify to borrow a textbook from the book room because their records are not clear for some reason. Most often they have lost books during a previous semester. Regardless of the presence or absence of a textbook, my aim is to get them to evaluate and use textbooks to work probability problems.

We will first use the textbook that is assigned to this class, then we can use other textbooks that are available in the room. The classroom has several recent Geometry and Algebra textbooks that were given to the school and teachers by publishers during the review period before the last textbook adoption. Almost all of them have sections on probability. Many of the textbooks have multi-volume sets of workbooks, an added value because they often offer good illustrations with the problems.

The main goal of this part of the unit is to simply use the textbook. Students will be given assignments that will require using the glossary and the index as well as using the chapter or section on probability. Because this use of the textbook is coming on the third and last day of this curriculum unit, students should have some opinions and knowledge of the subject and be able to evaluate the textbook and its method of presentation. Perhaps at this point they will not object to doing some reference work in the books to answer a few short questions. They may find that some of the Algebra 1 books offer descriptions that are too lengthy, or that the illustrations are insufficient. They will need to compare the problems in the Algebra books to those in the Geometry books for variance. Their opinions and ideas will be asked in questions that require fairly brief answers. There seems little point to requiring long answers because much of the needed work will have been accomplished during the two previous days.

They need to realize that their opinions are important to them if to no other person. Using books for reference aside from instruction is necessary for their advancement. Many students tend to wait to be told everything by a teacher. They want to be told everything to put into their notes. This lack of initiative and imagination is exceedingly difficult to change. It is our hope that they will all continue their education in college where self-reliance and taking the initiative are essential to success. Teaching them to use all materials at hand in a constant fashion is what is desired.

One assignment on this last day of probability will be for them to make quiz and a test from the textbook problems as well as the Internet problems. They may work in assigned groups to choose problems and do some comparing between groups. They will need to follow some prearranged rules. We will not take the test for a few days so that review can take place, but making test and quiz questions can be a productive exercise for them. It helps them to realize that students often learn very differently from one another. Some will know how to answer a question while others will think that the topic was never even covered in class because he or she was daydreaming while it was being demonstrated. Also, if a student had been absent from school, this type of exercise may show what level of effort was put into doing the make-up work.

## **A POINT OF VIEW ABOUT TIME LIMITS**

Three days to cover probability seems too short, but this entire course is fast-paced because of the accelerated block program. We have little choice about keeping the lessons limited to approximately three days in scope, or at least three days devoted to just probability. It would be far better to be able to spend two weeks on the topic, but we are unable to “borrow” the time from another portion of the course. If we did that, another topic would be short-changed. It is frustrating at times to be rather confined to a time frame. More in-depth study of any topic is valuable. However, the days we will spend in these problems may have a good impact, one that offers a different perspective on math problems.

The subject of probability will have been introduced to those who have never formally had it. To students who have seen it in middle school in some form, doing different problems with the topic may be fun. Hopefully, it will be fun for all of the students. My aim is to make it different from the algebra in which they are currently immersed. Algebra often seems to be chore for them, particularly to students in the trailer classes whose attitudes seem jaded.

## **LESSON PLANS**

### **Plan Number 1**

This plan is intended to give students very basic probability problems using Internet websites. One website will be assigned by the teacher for access at first and students will work with one of the menu choices. The website will be one that mostly offers problem solutions in the form of games. Printed copies of the site pages may be given to each group for reference. The lesson may later be expanded to include three or four choices from the menu. Additional websites will be used as time permits.

**Required Materials:** The teacher’s assigned computer and printer is needed if others are not available for student use. The overhead projector and the chalkboard may be used for

some demonstration. Gamepieces (usually dice or cubes, and cards) are used. Paper and pencils.

**Objectives:** The students will

- Become more familiar with accessing websites for information
- Test probability problems with experimentation in small groups
- Keep tabulations in order to show how conclusions may be drawn

**Prior Knowledge Needed:** Some discussion about probability in general is necessary. Talking about what students already know about the subject is needed because some students done some similar work in middle school. Discuss about taking tabulations.

**Lesson:** Once the website is accessed, assign one game to be played for all students who will already have put into small work groups. These games are usually played very quickly. All students in the group should have the opportunity to play as well as to keep the record. Have some class discussion about the results of this experiment. Next, allow students to choose one of three games from the same website to play in their group. Again, they need to keep records of findings. These records will be turned in at end of class for a grade.

My class has accessed the website [www.figurethis.org](http://www.figurethis.org) and has used several of their probability situations. Specifically, their title “I Win!” is a good introductory problem. In it, students are challenged to see if one of two players is apt to win the game more often. Two students each roll one six-sided die. The website’s rules state that “of the two numbers showing, the smaller is subtracted from the larger. If the difference is 0,1, or 2, player A gets 1 point. If the difference is 3,4, or 5, Player B gets 1 point.” It is suggested that 12 rounds be played. The students need to decide if the game is fair, and if the odds of winning are equal. Discussing the expectations that students had before and after the experiment can be amusing. Many more complex situations exist on websites. This site is a good place to start.

## **Plan Number 2**

Using published books that are not textbooks will be the focus of this plan. Its purpose is to show students that probability is discussed in books that are not their textbooks. Many are written in very readable (and illustrated as well!) form. Newspapers are also a good source, and one that is more easily obtainable than books.

**Required Materials:** Fairly recent published works on the topic that are written to illustrate that probability is for all of us and is present everywhere. The school library may have some, or a few could be borrowed from the public library by the teacher just for classroom use. Newspapers are often kept in the school library. Paper and pencil.

**Objectives:** The students will:

- Become more familiar with published information
- Learn to read instructions carefully

**Prior Knowledge Needed:** None.

**Lesson:** Use newspaper articles about probability experiments.

The trailer classes used the article “Why Mathematicians Now Care About Their Hat Color” that appeared in the Science section of the April 10, 2001 New York Times. The puzzle that is presented in this article is about three players wearing a red or a blue hat. Each person knows the colors of the hats worn by the other two players, but does not know his or her own. A coin toss at the beginning of the game determined the color hat that each of the persons would wear. The hats are placed on their heads by some person not playing. No communication between players is allowed (except some “initial strategy session before the game begins.”) Their job is to use odds to guess their own hat color. A prize for winning may be offered. This game takes a lot of practicing in the classroom, mostly because it is different from what the students have done, and because students are apt to clue other players about their hat color. The second day during which it is played is much more successful. By then, the idea of trying to get the highest probability of success is more understandable.

Our ESL class used the Houston Chronicle to discuss tracking the probability of a hurricane coming ashore near Houston during the storm season. We used the tracking charts that the newspaper issues. Previous storm histories were recorded by the students. Discussions were held throughout the weeks of the project. Many students who have attended elementary school in Texas have done this type of project already, but it was suitable for the ESL students this year, many of whom could not have joined in a discussion of published material at the beginning of the school year. It did get them using a newspaper. They seemed to enjoy that.

### **Plan Number 3**

Aside from using probability problems found in high school mathematics textbooks, the aim of this lesson plan is quite similar to that of the other plans. Students

are to do some of the probability problems in a textbook. The purpose of limiting the assignment to a textbook is so that they actually use one of these books. This statement may seem odd, but in two of my classes very students have a textbook because they have “holds” on their book room accounts. Regardless of the reason, I want them to learn from a textbook. These books are often good sources.

**Lesson:** Students will be placed in teams of 4-6 persons and be assigned two textbooks in which to find one probability problem to experiment with. They will then need to work the problem, keep a written tabulation of the results and write a one-paragraph description of what they did. The written tabulation and the description will be turned in for a grade.

Two groups in one of the classes chose to do a dice problem. It follows as an example:

Consider the experiment of a random toss of two fair dice.

- In how many ways can the first die land?
- In how many ways can the second die land?
- How many arrangements of numbers may appear on the two dice?

The total number of possible outcomes would be 36. For example, there would be 6 dies that have a 1 on them for the first number: (1,1), (1,2), (1,3), (1,4), (1,5), and (1,6). Obviously, the same arrangement exists for dies with beginning with 2, 3, 4, 5, and 6. Many students wrote a chart showing all the possibilities.

The problem that the students did stated that in a roll of the die that yielded (3,4), the 3 represented the toss of the first die, and the 4 was the roll of the second die. From there they determined problems such as finding the probability a tossing a (2,5) or a (1,3). Answers to questions like these would be 1 out of 36.

More complex questions followed. What is the  $P(4 \text{ on the first toss})$ ? The  $P(2,1)$  or (1,5) on one toss of the dice?

**Required Materials:** Several Algebra 1 and Geometry textbooks that are either already available in the classroom or in the Math Department offices. Paper and pencil.

**Objectives:** The students will:

- Become more familiar with the textbook
- Use reference skills
- Write brief annotative descriptions

**Prior Knowledge Needs:** Discussion about how to reference a textbook. When should they use a glossary, an index, or notation in the individual chapters.

## ANNOTATED BIBLIOGRAPHY FOR TEACHERS

Huff, Darnell. *The Complete How to Figure It: Using Math in Everyday Life*. W. W. Norton & Company, New York. 1996.

One-half page to one-page descriptions of posed situations are written in prose. Some situations are illustrated with good graphics. Almost all mathematics situations are represented. The probability section has good examples.

*Math on Call: A Mathematics Handbook*. Great Source Educational Group, A Houghton Mifflin Company. 1998.

The color graphics in this book are very appealing. The chapter on probability and statistics talk about very elementary problems, but students may be drawn to them because of the way the work is presented.

Mosteller, Frederick. *Fifty Challenging Problems in Probability*. Dover Publications, Inc. New York. 1965.

Although many of the problems appear to be advanced for basic high school classes, there are some possibilities (such as the one on craps) that are concisely written and very easy to present.

National Council of Teachers of Mathematics. Website: <http://www.figurethis.org>. 1999-2001. Funded by the National Science Foundation and the U. S. Department of Education.

Easily readable and retrievable topics in high school and middle school mathematics are listed on this website. The topics, along with their activities, seem basic, but the site offers a good beginning for students who are just learning to find information about math topics on the Internet.

Pappas, Theoni. *More Joys of Mathematics. Exploring Mathematics All Around Us*. Wide World Publishing. San Carlos, CA. 1998.

The book contains some possibilities for high school presentations. This author is prolific. Several books authored by her appear on the current lists of booksellers.

Paulos, John Allen. *A Mathematician Reads the Newspaper*. Anchor Books, Doubleday. 1995.

These “mathematical angles of stories in the news” is immensely fun to read. The author, who has written several other books with a similar outlook for everyday math, shows a reader that math is everywhere, especially in newspaper stories.

Seitner, Charles. *Everyday Math for Dummies*. Hungry Minds, Inc., New York, 1995.

There are Dummy books for just about all subjects on the shelves of booksellers. This fairly comprehensive book for consumer-type math contains an informative section on the planning and odds that insurance companies use for their policy costs.

Shaffner, George. *The Arithmetic of Life*. Ballantine Books. New York. 1999.

Chapters with catchy and humorous titles such as “The Value of Being Stupid” and “The Odds of Getting Caught” are samples of an appropriate book for all ages, and are especially suitable for high school. This author also has written a similar book entitled *The Arithmetic of Life and Death* which has the same publisher and publication year. Chapter titles appear to be virtually the same.

## STUDENT SOURCES

The following is an arbitrary list of suggested titles that may be of assistance to students, a point at which to start. By no measure is it representative of the entire range of resources for probability problems.

Cole, K. C. *The Universe and the Teacup: The Mathematics of Truth and Beauty*. Harcourt Brace & Company. 1997.

The author is a newspaper science writer whose prose in this book may be too advanced for most first or second year high school students, but she discusses the occurrences of math in our lives which is a popular topic in the educational world. Students could use or glance at, this book to stretch themselves and their minds if they are willing.

Gonick, Larry and Woollcott Smith. *The Cartoon Guide to Statistics*. HarperPerennial. 1993.

The contents, or subtlety, of the drawings and captions are deeper than the title implies. If students see this book, many of the cartoons will be a challenge to them. The drawings are captive.

Kogelman, Stanley and Barbara R. Heller. *The Only Math Book You'll Ever Need*. Revised Ed., HarperPerennial. 1994.

This book probably contains more prose than students would like. What is interesting is the probability problems in the game of backgammon that the authors discuss. Most books that talk about chance in games never mention backgammon, which might be a good game for students to learn.

*More Mathematical Puzzles of Sam Loyd*. Selected and Edited by Martin Gardner. Dover Publications, Inc. New York. 1960.

Questions and puzzles are posed to the reader. Strategies are left for the reader to devise. Answers are in the back of the book. These puzzles appear to be fun if students will give some of them a try.



Paulos, John Allen. *Once Upon A Number*. Basic Books. 1998.

This author has written several books for the casual reader in math.

## **WEBSITES**

These are just a minute set of examples that may be accessed.

[www.figurethis.org](http://www.figurethis.org)

[www.mathispower.org](http://www.mathispower.org)

[www.hmco.com](http://www.hmco.com)

This is Houghton Mifflin Company's website.

[www.nytimes.com](http://www.nytimes.com)

Click on the Learning Network section, then enter probability to retrieve recent articles printed in this newspaper.

[www.utm.edu/research/primes/](http://www.utm.edu/research/primes/)