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Number 67 **ASA/NCTM Joint Committee on the Curriculum in Statistics and Probability** **Fall 2005**

Welcome to the new school year! This issue of STN is written, in large part, by a class of graduate students and their teacher from Florida Atlantic University, Boca Raton, Florida. The authors have outlined data analysis and probability activities for K-2, 3-5, 6-8, and 9-12 that involve many objectives from the National Council of Teachers of Mathematics Standards. Do not be surprised if you recognize many of these activities, but the authors hope that these ideas will provide you with a new activity or a twist on an old one that you can use as the year begins.

Also In This Issue...

The Game of PIG (5 +)

Beth Lazerick, Saint Andrews School,
Florida Atlantic University, Boca Raton, FL

The object of the game is to be the first player to reach a score of 100. You need one pair of number cubes per group.

1. Player 1 rolls two number cubes and adds the pips for his or her score. The player can either "take" this score for the round or continue to roll the number cubes and add the second roll to the previous total. Keep a record of the score (adding each round in turn) for both players. The player can roll until he or she wants to stop **however, if the player rolls a "1" on either die**, the turn ends immediately and no score is recorded for the round.
2. Player 2 then rolls until he or she wishes to stop or the player rolls a "1" on either die.
3. **IF A PLAYER ROLLS "SNAKE EYES", double ones, s/he loses ALL the accumulated points and begins again at zero**.
4. The first player to get to 100 wins.

Some possible learning objectives for the game:

The student will

1. Add the "pips" on the dice to find sums for basic facts. (K-1)
2. Predict the chances of rolling a single "1" or double "1's" on a particular roll. (4-8)
3. Keep a running total "in your head" for each round before writing down the score for the round. (1-4)
4. Experiment with using different strategies for rolling. For example, always roll three times if no one is rolled or always try to get 20 points before passing. (6-12)

This game may have begun as a box game from Milton Bradley and was played with special dice. Someone may have invented it first and passed the idea on to Milton Bradley. The website *http://www.fontface.com/games/pigs* gives viewer an electronic version of the game with pictures of pigs!

You may want to develop your own scoring strategies if you use the "real" pigs by having students roll two small plastic pigs many times to determine the experimental probabilities of each arrangement of pigs. For instance, two pigs on their sides on the website earn you 1 point because this is a common occurrence, while two pigs with their feet in the air earn 20 points because this configuration is uncommon. Your students may want different point counts.

Teachers can purchase plastic pigs from a small Pennsylvania toy store by calling Mr. Foner at 1-888-569-4263. He keeps them in stock at a reasonable price. ■

Graphing Class Pets (K-2)

Danielle Lippa, Florida Atlantic University, Boca Raton, FL

In the first weeks of school teachers utilize "get to know you activities" that establish expectations and rules, and activities that promote an overall class climate of cooperativeness, respect, and responsibility. Once students explore what responsibility looks like at home and at school, they can create and assign classroom jobs and responsibilities for students. One major, and highly motivating, classroom responsibility is who will care for the class pet. But, where is the class pet? A graphing exercise will capture the students' interest when they vote on and graph their results to illustrate what pet will be theirs. Posters of the students' choices for a class pet could be posted and each student given small versions of each picture to place in a box to cast their vote. All pictures should be of the same size to use on a large graph of animal choices, where the animals' pictures would fall along the bottom horizontal line, and the students' votes stacked vertically in each column to illustrate which animal received the most votes. Because of the restrictions on "live things" in most schools, teachers might want to have students choose among "stuffed" representatives!

Students should analyze at their graphed results and the teacher can use questions to guide their understanding. Which animal received the most votes, and which received the least? "Greater than" and "less than" questions could then be explored when comparing the different number of votes each animal received. Other questions could involve children utilizing addition and subtraction. What if people who voted for a fish, changed their vote to a frog? Would that change what pet we will get?

Once students practice reading the graph, they could personally write a math question in their journals as a challenge to stump their classmates. In their journals they could also draw pictures and written explanations of the steps they took to solve their math problem (literacy and math). Other integrated extension activities could address why people vote (social studies) and the lifecycle and needs of the class pet (science).

For other graphing activities and ideas explore the following website: *http://nces.ed.gov/nceskids/graphing/*. ■

Graphing Goodies (3-5)

Kathy Lintz, Florida Atlantic University, Boca Raton, FL

Students eat their fair shares of candy and they can use candy as a tool for learning. The ability to interpret and analyze data presented in a graph is a valuable skill that students need to develop in order to be successful in math and science. The following activity is may enhance students' abilities to analyze graphs, as well as introduce students to the concept of probability.

This activity can be performed with M&Ms, Skittles, Valentine heart candies, or any multicolored candy that comes prepackaged in 12 oz. bags. First, the teacher holds up the bag of candy and asks each student to predict what color of candy will appear most often in the bag. All of the answers are recorded on the board in the form of a bar graph. The class examines the bar graph and makes a prediction about which color will occur most often in the bag of candy. Next, the teacher places the students in groups of three and distributes one bag of candy to each group. Then, two of the students in each group sort the candies according to color, while the third student records the results. After the students in each group have calculated their final results, they will record them on a circle graph. All of the students in the class will compare their graphs and decide if their predictions were accurate. This can lead to a discussion of probability by asking the students to determine if they would yield the same results if they opened another bag of candy. For more information and ideas about graphing please visit: *http://www.state.sd.us/deca/DDN4Learning/ThemeUnits/Charts/index.htm.* ■

Graphing Heights (6-8)

Barbara Locasale, Florida Atlantic University,
Boca Raton, FL

The simple task of measuring height in centimeters can be a good beginning of the year activity. After measuring each person (tape two meter sticks to the wall), write initials and heights on sticky notes, and then post them on a wall in ascending order. Solicit suggestions from the students about how best to graphically display this data. Depending on your curriculum, students can develop stem and leaf displays, box plots, or the more conventional bar graphs or line graphs. As an extension to this activity the teacher could assign homework; the students could bring in the height measurements of everyone in their household and add it to the whiteboard. The class graph will show a classroom family graph, complete with range, median, and mode. The second graph of family's heights would show extended families with the appropriate range, median and mode and averages.

See *http://www.funbrain.com* for additional suggestions. ■

Graphing (K-1)

Ellen Gottsegen, Saint Andrews School, Boca Raton, FL

One simple way to introduce graphing into a kindergartner's day would be to conduct surveys. Asking straightforward yes/no questions encourages the children to think for themselves and graph daily. Each morning a yes/no question is placed on the board, for example: Did you come to school in a car today? Each child locates their name on an index card and places it on the large graphing mat. As a part of group time we discuss the results. By using the words more, fewer and same it can be determined if they can read and understand the graph. Finally, the children draw their own pictographs and discuss the results with their classmates.

The following link contains many yes/no questions: *http://www.canteach.ca/elementary/numbers13.html.* Here are a few examples:

Do you have brown eyes?

Do you like pepperoni on your pizza?

Does your jacket have a hood?

Did you wash your hair last night?

Do you have pierced ears?

This is a great opportunity for the children to get to know each other while exploring graphing in the classroom. ■

Skittles—I like the red ones! (3+)

Lisa Husnu, Lisa.Husnu@comcast.net,
Florida Atlantic University, Boca Raton, FL

A fun and tasty lesson to introduce statistics and data analysis using probability could be done using Skittles. It would provide students with a hands-on, cooperative learning experience using the process of collecting, analysing and interpreting data, and improve decision-making skills through the use of probability.

In this lesson, the students will use Skittles to determine the probability of getting a red Skittle when they stick their hand a bag and pick a random skittle. The makers of Skittles claim that there is an equal chance of getting any one of the five colors (20% chance). The students will organize, graph and interpret their data by predicting and determining probability. Is a particular bag "typical"? This leads to the idea of Chi-Square, a statistical concept that appears in Advanced Placement statistics and at the college level.

This lesson illustrates how charts and graphs are valuable instruments for communicating data quickly and simply. Data produced by students during this activity is used to stimulate discussion and promote mathematical thinking regarding probability.

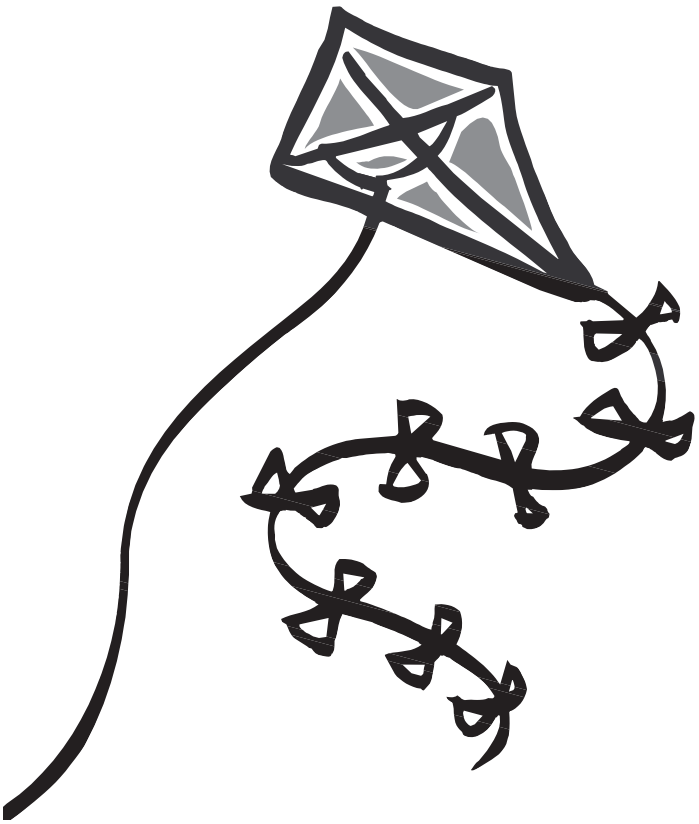
We can expand this lesson by picking and replacing the Skittle a number of times and charting the results. Introducing a frequency table and drawing reasonable conclusions can be a logical next lesson. ■

Glyphs (K-2)

Kim Keane, Florida Atlantic University, Boca Raton, FL

(A "glyph" is a pictorial representation of information. We see glyphs when we look at weather maps. Here are a few activities that involve this new graphical representation.)

Glyphs may be used with any theme including seasons (snowman) or holidays (Easter basket). A fun "getting to know you" glyph is perfect for the first week of



school. The following are suggestions for instructions for students. Teachers should modify the categories to meet the needs of their particular classes:

1. On your paper, draw a very large kite. Write your name on the back of the paper.
2. If you walk to school, color your kite blue. If you ride the bus, color it yellow. If you travel to school in some other way, color the kite green.
3. If you have freckles, put dots on your kite. If you do not have freckles, put stripes on your kite.
4. If you brought your lunch today, draw one cloud in the sky. If you did not, draw two clouds.
5. Draw a line on your kite to hold some bows. Now add to the line one bow the color of your eyes for each brother you have and one bow the color of your hair for each sister.
6. Draw as many birds in the sky as years you are old.
7. If you have a birthday this month, draw a sun in the sky. If your birthday is not this month, draw a moon.

After students create their glyphs have them meet in small groups and discuss them. After the small group discussion have students post their glyphs and conduct a grand discussion about what we learned from the glyphs.

Further enhancements are found at *http://illuminations.nctm.org.* ■

Glyphs (6-8)

Debra Khanna, Florida Atlantic University, Boca Raton, FL

Provide each student with a blackline drawing of an oval to represent a face. The girls will put long hair on the face and the boys will put short hair on the face. For their eyes, the students will put the ball of their favorite sport, for their nose, the students can draw a "J" to the right if s/he is the eldest child in the family, a "J" to the left if s/he is the youngest, and a "Double J" if s/he is an only child or a "U" if s/he is a child in the middle! The mouth can show teeth to indicate how many years old the student is. Teachers can select different "ears" to indicate what the students like to read (sci-fi, fiction, adventure, biography) and eyebrows can represent other important things about each child.

The teacher can then pose questions that elicit responses that begin to explore concepts in probability:

- What is the probability that everyone selects the same favorite sport?
- What is the probability that nobody has the same favorite color?
- What is the probability that at least one person has no siblings?
- Which of these things are likely? Unlikely? ■

Probability and Aces High! (6-8 +)

Audra Lehmann, Delray Beach, FL

For a pair activity, give each set of students a deck of 52 cards and briefly explain the standard order of the cards (A,K,Q,J,10,9,8,7,6,5,4,3,2). Students will shuffle the deck of cards and then place one card face up on the table. Students must guess if the next card will be a higher or lower card. Play continues for a total of five cards face up or until a wrong guess is made, then the second player reshuffles the deck and begins a new round. Let students play the game a few rounds by just merely guessing if the next card will be higher or lower, and then explain how to find the probability.

With 52 cards, there are 4 of each of the 13 different cards. If the first card is a king, there are only four cards (the aces) in the deck higher so 4/51 or about 8% and there are 44 cards that would be lower, so 44/51 or 86%. For each of the next three rounds, there is one less card in the deck. You do not count the same cards as a win or loss. If the next card is a 10, the probability of the third card being higher is 15/50 or 30%, note that it is not 16/50 because there is a king already in play. The probability of a lower card is 32/50 or 64%. Show students how the divisor is 50 because there are already two cards missing

from the deck. After each player has had a few turns, compare whether they did better using the percentages than pure guessing. Remember that the percentage changes each time taking into account the cards that are already down on the playing surface.

Example:

Card		Probability of next card being higher	Probability of next card being lower	Guess: higher or lower
1	10	16/51 or 31%	32/51 or 63%	Lower
2	3	43/50 or 86%	4/50 or 8%	Higher
3	A		46/49 or 94% (note that it is not 100 because another ace is 6% probability)	Lower
4	10	15/48 (not 16 because one ace is already out on the board) 31%	31/48 (a 3 is on the board) 64%	Lower
5	9	Winner – next player reshuffles and starts over		

This game is a good introduction to the concept of independent and dependent events. For more math games online, check out *www.coolmath.com.* ■

Geometry and Probability for Secondary Students

Marcial Echenique, mecheniq@broward.edu,
Broward Community College, FL

The field of probability and geometry can be merged in the study of the probability of landing in a circle. Suppose we have five concentric circles with the smallest circle having radius 1, and the largest circle having radius 5, with the circles in between increasing by 1 unit each time. We want to study the probability of landing in the non-overlapping area of each circle if you are randomly tossed in the circles. This exercise shows how to define probability by measuring proportions instead of defining probability by counting outcomes.

The area of the first circle is $A_1=\pi r_1^2=\pi$. The area of the second circle available for landing is given by $A_2=\pi r_2^2-A_1=\pi r_2^2-\pi r_1^2=\pi(r_2^2-r_1^2)=\pi(2^2-1^2)=\pi(4-1)=3\pi$. Continuing the process we can summarize the area that each circle has available for landing in the following table:

Circle (radius)	Landing Area (Total Area $25\pi=78.50$)	Theoretical Probability of Landing Area
1	$\pi=3.14$	0.04
2	$3\pi=9.42$	0.12
3	$5\pi=15.70$	0.20
4	$7\pi=21.98$	0.28
5	$9\pi=28.26$	0.36

The concept of measuring probabilities by measuring proportions is similar to the activity given in *http://www.shodor.org/interactivate/lessons/pm3.html.* The probability is measured using sectors of a circle and a spinner game. ■

Let's Win a Prize

Michelle Natarus, Florida Atlantic University,
Boca Raton, FL

(This is **not** an original game and references follow)

The object of the game is to pick the box with the prize in it. You need three shoeboxes labeled one, two, and three and prizes. (pencils, erasers, stickers, a homework "pass," etc.)

1. Before the game begins, player 1 (or the teacher), the "host", places a prize in one of the shoeboxes. Then player 1 asks player 2, what box do you think the prize is in? Player 2 answers one, two, or three.
2. After player 2 selects a box, player 1 opens one of the **unchosen** boxes that does NOT contain a prize.
3. Player 1 then asks player 2 if he or she wants to switch their answer. Now if he or she doesn't want

to switch their guess, player 1 shows player 2 what is in the box. If the prize is there, player 2 wins the prize but if the box is empty the game is over. If player 2 decides to change he or she guess then player 1 opens that box. If the prize is there, player 2 wins the prize and game but if the box is empty, player 1 wins.

4. Now the players switch roles and repeat steps 1 and 2.

Discuss with students what the best strategy is for winning. Calculate percentages of each possible strategy.

(This game is a knock-off of the TV game show "Let's Make a Deal" The website: *www.cut-the-knot.org* provides different possibilities to how a player can be successful and the site also gives a twist to the game that makes it more challenging.) ■

Globe Toss (2-5)

Janna Vann, Florida Atlantic University, Boca Raton, FL

Materials:

Blow-up Globe Beach Ball
Paper
Pencil

Put the students into pairs or toss a globe beach ball around the room. Have them toss their globe 100 times. Keep a record of where left thumbs land each time the ball is caught; did the left thumb land on water or on land? When finished, calculate the proportion of "water" vs. "land." Ideally the class will have several different trials so you can calculate the average percent for the class water and land results. Have the students make predictions about what they think the results would be if they did tossed the globe 50 times, 200 times, and so on. The results should be close to 75% water and 25% land. If it does not come close to these numbers, the class should discuss why the percentage was off. Accurate and inaccurate results will generate questions about errors in statistics, hypothesis testing, and confidence intervals, depending on grade level and sophistication of students.

Toss #	Water	Land
1	✓	
2		✓
3	✓	
4	✓	
5 ↓ 100		
Total		

Adapted from: *http://www.urbanrivers.org/activities.html.* ■

Fun With Dice (3-5)

Laura Kohler Whiting, Florida Atlantic University,
Boca Raton, FL

The object of this game is to get a sum between 300 and 400. (These numbers may be adjusted.) A pair of students will share one die. The students will be completing an addition problem of two three-digit numbers. (Again, this may be adjusted.) The game is played by rolling a die six times to determine two three-digit numbers and the students playing the game use the same set of six numbers. For example, if a student rolls a 6, s/he should not put that number in the hundreds place because that would make the answer over 400. S/he could choose to put the 6 in the tens or ones place of either three-digit number.

The students will start with six blanks:

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  ___
+ ___
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The pair will take turns rolling the die and they may choose to put the rolled number wherever they want in their addition problem.

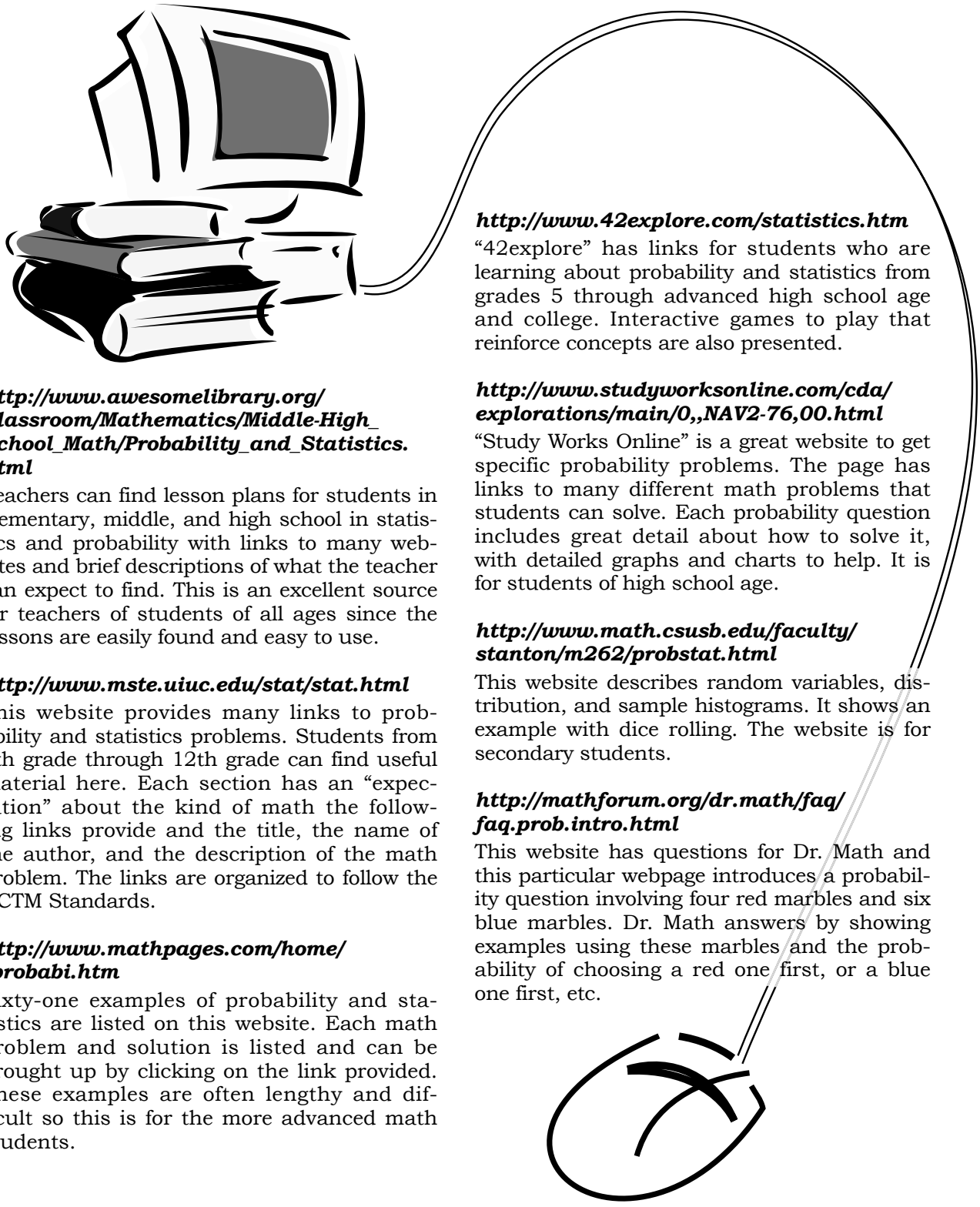
When all six blanks are filled, they should add their numbers to see if the sum is between 300 and 400.

This game could also be played using subtraction or multiplication, and with larger or smaller numbers.

For more games with dice visit: *http://www.boardgamesusa.com/cgi-bin/category.cgi?category=183.* ■

Some Websites for Consideration

Laura Ylijoki, Florida Atlantic University, Boca Raton, FL



http://www.awesomelibrary.org/Classroom/Mathematics/Middle-High_School_Math/Probability_and_Statistics.html

Teachers can find lesson plans for students in elementary, middle, and high school in statistics and probability with links to many websites and brief descriptions of what the teacher can expect to find. This is an excellent source for teachers of students of all ages since the lessons are easily found and easy to use.

http://www.mste.uiuc.edu/stat/stat.html

This website provides many links to probability and statistics problems. Students from 9th grade through 12th grade can find useful material here. Each section has an "expectation" about the kind of math the following links provide and the title, the name of the author, and the description of the math problem. The links are organized to follow the NCTM Standards.

http://www.mathpages.com/home/iprobabi.htm

Sixty-one examples of probability and statistics are listed on this website. Each math problem and solution is listed and can be brought up by clicking on the link provided. These examples are often lengthy and difficult so this is for the more advanced math students.

http://www.42explore.com/statistics.htm

"42explore" has links for students who are learning about probability and statistics from grades 5 through advanced high school age and college. Interactive games to play that reinforce concepts are also presented.

http://www.studyworksonline.com/cda/explorations/main/0,,NAV2-76,00.html

"Study Works Online" is a great website to get specific probability problems. The page has links to many different math problems that students can solve. Each probability question includes great detail about how to solve it, with detailed graphs and charts to help. It is for students of high school age.

http://www.math.csusb.edu/faculty/stanton/m262/probstat.html

This website describes random variables, distribution, and sample histograms. It shows an example with dice rolling. The website is for secondary students.

http://mathforum.org/dr.math/faq/faq.prob.intro.html

This website has questions for Dr. Math and this particular webpage introduces a probability question involving four red marbles and six blue marbles. Dr. Math answers by showing examples using these marbles and the probability of choosing a red one first, or a blue one first, etc.

Dear Readers,

From the Editors:

We hope that you find this issue of interest. Please pass it or a copy on to a fellow teacher as we hope that everyone can discover something of interest.

STN wants to hear about unique and successful activities that incorporate data analysis and probability concepts in subjects other than mathematics. Please contact the editors if you want to pursue an idea for publication.

Sincerely,
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Send mailing address corrections and additions to: Madge Haven: *madge@amstat.org*

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