Chances Are

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Riverlawn Elementary, Pulaski County

Grade Levels: 3rd-5th grade

Time Allotment: 2 – 60 min class lessons

Overview: The purpose of this lesson is to begin the process of helping students learn the basic principles of probability. Probability is a way of measuring the chance of something happening. The theory of probability is an important branch of mathematics, and an understanding of this theory is essential to understanding such things as weather reports, sports, politics, scientific research, and the state lotteries. Through a series of hands on games and activities the students will investigate this theory and have an opportunity to predict the possible outcomes for a specific event, collect and record data, construct bar graphs, and interpret the data.

Subject Matter: Math (Probability)

Learning Objectives:

Students will be able to:

- List possible outcomes of a given situation
- Collect data using tally marks
- Use data to create a simple bar graph
- Interpret collected data

Standards:

The objectives listed may be used in part to address the Virginia Standards of Learning at http://www.pen.k12.va.us
The student will be able to:

- investigate and understand the concept of probability as chance (VA SOLs Math 2.23, 3.23, 4.18,)
- list possible outcomes of a given situation (VA SOLs Math 3.23,)
- collect and use data to construct a simple bar graph (VA SOLs Science 3.1, 4.1, 5.1)

Media Components:

Instructional Video

- Bill Nye Science Video *Probability* #303

Internet

- Ken White's Coin Flipping Site
  http://shazam.econ.ubc.ca/flip/index.html

- Create a Graph
  http://nces.ed.gov/nceskids/graphing/

Materials:

For teacher:
- Overhead projector and pens
- Overhead graph transparency (Class graph sheet if desired)
- Overhead dice
- Transparency of "The Big Race" game board and game markers
- Large graph paper to post on wall

For each pair of students:
- Computers with Internet access
- Penny Flipping Tally sheet
- "The Big Race" game board (attached)
- A zip lock baggie including the following items:
  - √ 2 sets of 3 large cards for each student marked ***0***, ***1***, and ***?***
  - √ 12 gameboard markers such as buttons or M&Ms
  - √ colored pencils or crayons
  - √ 2 die of different colors (foam rubber die come in multiple colors and work well)

Teacher Preparation:

- Bookmark and preview sites listed
- Download necessary plug-ins for interactive sites
- Mark video cues for fast forwarding
- Prepare student baggies for Introductory Activity (Put dice, markers, and question cards in individual baggies for student pairs.)

Introductory Activity

Likely or not?

Begin with the following activity to get your students thinking about probability.
1. **Ask:** "Have you ever heard the expression, 'When pigs fly?' What does that mean? What about the expression, 'It's like finding a needle in a haystack?' "
Begin the discussion by telling students that life is a matter of chance. **Say**, " Either certain things will *always* happen, *never* happen, or *sometimes* happen. In this activity, your job will be to decide the possible outcome of certain events by holding up your cards at the right time."

2**.** Have each student remove a set of 3 large cards from their baggies labeled—***1***, ***0***, and ***?*** . Instruct them to hold up the ***1*** when the answer to a question is *always*, a ***0*** when the answer is *never*, and a ***?*** if the answer is *sometimes*.

3. **Say**: "Listen to the questions I ask and choose a card to hold up to show your response."
Ask students the following questions and wait for response cards to be held up:
- How likely is it that you will wake up tomorrow with a new extra finger on your hand?

- What is the probability that a watermelon will grow from a peach tree?
- How likely is it that the sun will rise in the morning?
- What is the probability that the principal will walk into our room today?
- How likely is it that you will graduate from high school within one week from now?
- What is the probability that it will be dark tonight?
- How likely is it that it will rain tomorrow?
- What is the probability that you will have a spelling test next week?
- What is the probability that each of us will win one million dollars in the lottery tomorrow?
- How likely is it that you will get a phone call from a friend this evening?

(Note: Continue to make up your own questions if desired.)

4. Following the activity, explain to the students that this is what probability is all about- determining the likelihood of events or happenings. Write the word *probability* on the overhead or board. Some things never happen, such as pigs flying, while some things always happen, like the sun rising each morning, but the majority, or most, of the things that happen fall somewhere in between these two.

Learning Activity

1. **Say**: "Today we are going to watch a Bill Nye video that is going to show us different ways to figure out the chances of things happening or not happening. When we have finished the video, you should have a better understanding of probability and ways to predict possible outcomes in certain situations."

2. Provide a **FOCUS for Media Interaction** by saying, "In the first video clip, Bill Nye is trying to decide which door to go through to get to his science lab. He has three doors to choose from. Listen to how he describes the probability of choosing the correct door." **Start** the video*, Bill Nye #303 Probability*, where Bill Nye says, "The world is full of possibilities." **Pause** when you hear him say "…or door number three." **Ask**: "How did he explain the chances, or probability, of choosing the right door?" (*one out of three*). Ask for predictions. Provide a **FOCUS for Media Interaction** by saying, "Let's see whose predictions are correct. Listen to how the probability changes each time a door is chosen." **Resume** from pausing point and **pause** when you see him fall into the dumpster. **Ask**: "How did the probability change each time?" *(first it was one in three, then one in two, and finally there was only one left so it had to be that door; the probability got better each time*). Provide a **FOCUS for Media Interaction** by saying, "Listen for Bill Nye's definition of probability." **Resume** from pausing point and **pause** after he climbs out of the dumpster and says, "That's what we call in science, *probability*." **Ask:** "What did Bill Nye say probability is?" *(the chances of something happening or not happening)*

3. **Say**: "In the next video segment Bill is going to explain how to figure out the probability of a coin landing on heads or tails. Why do people flip coins?" (*ball games, to make decisions, etc.).* "Who knows how to flip a coin and would like to demonstrate?" (*Allow a student to demonstrate the procedure)*. "What are the possible outcomes?" (*heads or tails)* **Say**: "We know there is a 1 in 2 probability for heads or tails or what we sometimes call a 50/50 chance. Watch as Bill Nye flips his special coin on his Flip Master 50/50." (Allow students to predict heads or tails). Provide a **FOCUS for Media Interaction** by saying, "Let's see who predicted correctly." **Resume** from previous pausing point and **pause** when you hear him say, "…1 in 2 probability for either one." Check predictions**. Say:** "Bill Nye says we can't predict exactly

which way it will land on every toss but we can predict *exactly* the number of heads and tails for a whole bunch of tosses. Do you think that's possible? What do you think the result would be?" Provide a **FOCUS for Media Interaction** by saying, "Listen carefully for what he says the number of heads and tails will be for a whole bunch of tosses." **Resume** from pausing point and **pause** when you hear him say, "…eventually there will be exactly the same number of heads as tails." **Ask**: "What did he say the outcome would be for a bunch of tosses?" (*exactly the same number of heads as tails).*

3. Provide a **FOCUS for Media Interaction** by saying, "Watch as a boy and girl are tossing a coin and be ready to make your prediction." **Resume** the video from where you paused, and **pause** at when you hear the boy say, "It's got to be tails." **Ask:** "What do you think the next toss will be? Why do you think that?" (Allow for predictions) Provide a **FOCUS for Media Interaction** by saying, "Let's see if our predictions are correct and listen as the girl explains how to get the probability to come out 1 in 2." **Resume** the video from the pausing point as the girl explains the theory behind tossing a coin. **Stop** after the girl has explained the theory and says, "The probability always averages out to be 1 in 2". **Ask**: "How did the girl explain the fairness of the coin tossing?" (*If you toss the coin enough times it eventually ends up being about the same for both*). **Ask**: "How could we prove this theory to be right or wrong?" Engage students in a discussion explaining that the only way to prove the theory is to toss a penny many times and record the results.

4. Tell students that they will be working with a partner and flipping a coin 100 times, 50 times each. As they collect the data they will use tally marks to record their information. (Review how to record data using tally marks). **Ask**: "How long do you think it will take each set of partners to flip a coin 100 times?" (Allow for predictions) Explain it will probably take quite a while, but not to worry because we have something special that will speed things up… technology!

5. Take students to Ken White's Coin Flipping Site http://shazam.econ.ubc.ca/flip/index.html.

- At this site you will choose between flipping a Canadian penny or dime.
- Once you have selected the coin, type in the number of coins to toss (10 on each toss). The site will instantly give you a visual of the number of heads and tails along with the numerical data.
- Tell students they will record data in tally marks.
- Demonstrate how to flip a coin using this site and record tally marks on their Penny Flipping Tally sheet. Explain the importance of being honest and careful when recording your results so data will not be skewed.
- Pair students and have them take turns being the coin flipper and the recorder.
- Instruct students to flip 10 coins at a time and record data.
- Continue until one student has flipped 50 coins. Then have them change roles.
- After students have collected all their data, have them tally their total heads and tails. Allow students to use calculators if necessary. The sum of the two should equal 100.

6. After all students have compiled their data **ask**: "Is there any other way we could show this data other than using tally marks? Could we show this data on a graph?" Explain that a graph is a simple way to show data visually. Take students to the bookmarked, "Create a Graph" site http://nces.ed.gov/nceskids/graphing/

7. Using some fabricated data such as 44 heads/56 tails, guide students through a demonstration of creating a graph using the Create a Graph Tutorial. As you explain the different types of graphs, ask students what type of graph would be best to use. Allow them to look at each type of graph and if necessary, explain that bar graphs are used primarily to compare data and would be the best choice. After selecting the bar graph, ask students to help provide the necessary information to be included on the graph (labels, title, scale) and the importance of each. After modeling the construction of a sample graph to be sure students include all necessary labels, have each pair of students create a graph to share their results of 100 flips as a visual way of representing their data. (See attached student tutorials for pairs to use in a lab setting.)

8. After the graphs have been completed, have students print one graph per pair. Ask students to write two true statements at the bottom of their graphs comparing their data. Post the graphs and allow students time to share and compare their graphs with others. **Ask**: "Are the graphs similar? If so, how?" Students should come to the conclusion that the probability of flipping heads or tails averages out to be almost equal over a period of 100 or more flips, regardless of whether heads is flipped twenty times in a row.

(Note: This is a good place to end the first lesson.)

Day 2

1. **Say**: "Yesterday we experimented with coin flipping. What have you learned about the probability of flipping coins?" (*Each time you flip a coin you have a 50/50 chance of heads or tails but if you flip a coin enough times, you will end up with about the same number of heads as tails*).
Say: "Flipping coins is an example of a high probability. That is, you have a 1 in 2 chance, or a 50/50 chance of tossing a head or tail each time you flip the coin. But not all probabilities are that high. The probability of finding a needle in a haystack isn't very high. It is a very low probability. But the chance, or probability, of most things happening to us is usually somewhere between the two, even though some probabilities are higher than others."

2. **Say**: "There are other ways to predict probability besides tossing a coin. Watch as Bill Nye tries to get his favorite color gumball out of a gumball machine. Watch how he figures out the probability of getting a blue gumball." **Resume** the tape from the point it was stopped where Bill Nye is in the supermarket and says, "…gumballs." **Stop** after the boy blows the bubble and it pops on his face.
Ask: "How did Bill Nye figure out the probability of getting a blue gumball?" (*He figured out how many of each color*). "Why were his chances of getting a blue better than getting a red?" (*there were more blue than any other color*)."How did the probability change when he tried to get a blue followed by a red gumball?" (*it wasn't as good*)

3. Provide a **FOCUS for Media Interaction** by saying, "Scientists can use probability to predict things that will happen in the future. During the next video clip, listen to how Bill Nye explains the word *average*. Listen carefully and be ready to tell me what *average* means." **Fast forward** to Bill Nye saying, "By figuring out what's average, we can predict the future." **Pause** the video when you hear "…that's the average." **Ask**: "What does *average* mean?" (*in the middle or where most are).* Provide a **FOCUS for Media Interaction** by saying, "Every

time scientists do this experiment the balls end up in the same shape. Listen for the name of this shape and why scientists call it this." **Resume** from the pausing point and **Stop** the video when you hear "…shaped like a bell." **Ask**: "What do scientists call this shape?" (*Bell curve*) "Why?" (*It's shaped like a bell*).

4. **Say**: "Probabilities can be high, having a better chance of something happening like flipping a coin, or low, having less of a chance of something happening. Do you know someone who has played the lottery and won?" Provide a **Focus for viewing** by saying, "Watch this segment and be able to tell me what the probability is for winning the lottery." **Fast Forward** to where Bill Nye is holding a lottery ticket and saying, "Most states have a lottery." **Pause** after Bill Nye falls into the bin and says, "It's down here. I know it's here." **Ask**: "What is the probability of winning the lottery?" (*1 in 5 million*). "Is that a high or low probability?" (*low*) "Why do you think so many people play the lottery if the probability is so low?" Continue with a discussion on the pros and cons of the lottery.

5. **Say:** "Probability is used in many ways. Wildlife biologists use probability to study animal behaviors. In this part of the video we will see how a scientist uses probability to study the migration habits of shore birds." **FAST FORWARD** to the *Way Cool Scientist* segment. Provide a Focus **for Media Interaction** by saying**,** "Listen carefully for at least one thing that these scientists hope to learn about migration habits by studying just a few birds." **Play** and **Pause** when you hear "…how fast they are flying." **Ask**: "What do scientists hope to learn about the migration of these shore birds?" *(How far they fly, how long they stay there, and how fast they are flying*)**.** Provide a **FOCUS for Media Interaction** by saying, "Listen for why probability is so important to these scientists. **Resume** from pausing point and **pause** when you hear "…by sampling a small number". **Ask**: "Why is probability so important?" (*It allows them to gain an immense amount of information by sampling just a small number*)**. Say:** "Let's watch as they let this bird go." **Resume** from pausing point and **pause** after the biologist lets the bird go and says, "We're going to let this bird go 3,000 miles up to the breeding grounds in Alaska." **Ask:** "What do you think the chances are that they will be able to find this same bird? How do you think scientists will be able to keep track of this bird?" (*Discuss possible ways of marking the bird; banding, transmitters, etc.)* "Could the scientists increase the probability, or chances, of locating the bird? How?" (*Allow students to give their ideas*)

6. Provide a Focus for Media Interaction by saying**,** "Let's watch the rest of the video. Listen carefully to how they marked the bird and their chances of finding the same bird." **Resume** at where the biologist says, "Transmitters work by emitting a signal." **Stop** at the conclusion of the *Way Cool Scientist* segment. **Ask:** "How did the scientist mark the bird so that it would make it easier to locate that particular bird to study it?" (*they used a radio transmitter*) "What was the probability of finding the bird with only a band?"(*5%*) "How did the probability change when they added a radio transmitter?" (*80%*)

Culminating Activity: The Big Race

1. Say: "You have learned that probabilities can be high, having a better chance of something happening like flipping a coin, or low, being unlikely to happen, like winning the lottery. You have also learned that knowing certain information or data can help you determine whether your chances are higher or lower."

2. Say: "Let's use what we've learned about probability to play a game and experiment with the probabilities of rolling dice. Pretend that you are at a NASCAR race. How many of you have ever been to a race before? Do you have a favorite driver? Do you think race car drivers win because of chance or because of their skill?" Follow with a discussion that it involves skill and luck. **Say**, "Today we are going to use probability to help us predict which racecar will win a race. This activity is called 'The Big Race'."

The Big Race

In this activity, students play, "The Big Race," in which twelve cars compete to cross the finish line first. The cars are numbered 1-12. Two dice are used. A particular car will move one space towards the finish line when the sum of the two dice rolled equals its number. Students make predictions about which car they think will finish first. Students will play the game many times to generate data.

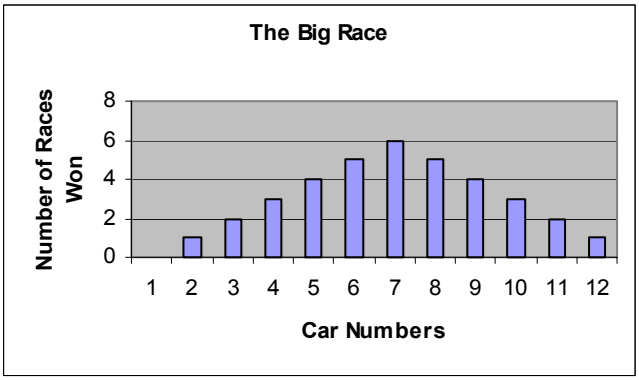
1. Each pair of students should have a copy of "The Big Race" game board. The teacher should use a game board transparency and overhead die to model the rules of the game. Make a class bar graph on large graph paper. (Graph posters may be purchased at teacher supply stores). Label one axis 1-12 for each of the cars. Label the other axis "Number of Races Won". Title the graph, "The Big Race".

2. Place a copy of the game board transparency (see attachment) on the overhead and place 12 markers on the starting line, one to represent each car. Roll 2 overhead die and explain that the car whose number matches the sum of the 2 die moves ahead one space. Continue to roll the die and move a car until one car has made it to the finish line. The results of the race will be the car who won.

3. Allow students to cheer for different cars during the demonstration race and predict which car will finish first. During the overhead demonstration, pause frequently to look at the results. Ask students if they notice a pattern in the way the cars are moving. Ask students to comment on why they think some of the cars haven't moved yet. **Ask**: "Do you think this is a fair race?"(*Students may suggest it isn't fair since they were assigned a particular car. Students will begin to understand that it's impossible to roll a 1 with two die and therefore Car 1 has no chance of advancing.*) Students may want to change their predictions as the race progresses. It is okay to change predictions as they receive new information.

4. After the completion of the demonstration race, record the winning car by filling in one square on a large bar graph grid, to represent that car's victory. (See sample graph below)

Sample of completed graph:



5. Instruct students to play as many rounds of the game with their partners as time allows. Have students record each race result on the class graph as soon as a game is completed. Emphasize the importance of recording data accurately, as statisticians do. After students have had sufficient time to play several games, the graph should begin to look similar to the one above. The more games played and the more data collected, the more the graph will begin to look like a bell curve.

6. Discuss the results of the class graph as soon as each pair has had the opportunity to play the game several times and record their results. Ask questions such as, "Who won the most races? How many more races did car 6 win than car 3?" etc. To check comprehension ask students to give reasons why some cars won more often than others.

7**. Say**, "Let's look at another way of showing the same thing we just saw. Each group has a set of die (each of a different color if possible). On the overhead projector make a number line from 1- 12. Above each number have students generate the different combinations you could throw with the two die to get that particular number. Allow them to use their die to make different combinations. For example, 5+1 or 1+5 would be written above the 6. There would be no combination above the 1 since there is no way to throw a 1 using 2 die. Continue until the chart is complete."

8. When the chart is complete it will form a bell curve and show that the average will be in the range of 6, 7, and 8. **Ask**: "Which is more likely to happen, rolling a combination of 7 or rolling a combination of 4? Can you explain your answer?"(*There are more ways of rolling a 6, 7, or 8*) "Which roll is impossible using two dice?"(1)

						1+6					
					1+5	6+1	2+6				
				1+4	5+1	2+5	6+2	3+6			
			3+1	4+1	2+4	5+2	3+5	6+3	4+6		
		2+1	1+3	3+2	4+2	3+4	5+3	4+5	6+4	6+5	
	1+1	1+2	2+2	2+3	3+3	4+3	4+4	5+4	5+5	5+6	6+6
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**

Assessment:

- Have students write an explanation for the results of "The Big Race". Encourage the use of vocabulary such as *probability* and *average*.
- Additional assessment could be a paper/pencil activity with questions, which involves predicting outcomes by answering with *always, never,* and *sometimes*.
- Students will also be given a picture graph and/or a bar graph to interpret.
  (Note: The assessment can be modified to meet the needs of students at Higher grade levels.)

Cross Curricular Extensions:

Math/Science

- Have students collect and record data from other probability activities. Using graph paper or graphing software, graph the results of the data collected and record the probabilities of each occurring.

- Investigate how biologists use probability to determine the survival of species from a sampling.

- Investigate the use of probability in forecasting the weather. How do forecasters predict the path of a hurricane?

Art

- Have students illustrate pictures of different probabilities. Some pictures will show events that happen always, some never, and some sometimes. Have other students determine the chance of these happening and categorize the pictures into the three different categories. Post the pictures on the wall in the three categories. (It would be helpful for the students to write a sentence describing the event in their picture.)

- Study a variety of game boards and design one of your own.

Social Studies

- Study and play the game of the Dreidle and determine the probability using the game.

- Study games from other cultures that use probability.

- Investigate the use of probability and the economy, stock market, and politics.

Physical Education

- Determine the probability of local sports teams winning a championship etc.

- Use physical fitness test results from previous years and determine the probability of students winning a race or competition in a particular field event.

- Write a report on the difference of games involving skill and those involving chance. What makes games fair? How are the Olympics different from other games?

Language Arts

- Have students read a story beginning. Make a prediction and write an ending according to the variables in the story.

- Design a game complete with directions, rules, and a spinner or other type of probability device. Be sure to make the game fair.

- Conduct a debate on the effectiveness of the lottery and the pros and cons of it. Why do some states have the lottery and others don't?

Computer/Technology

- Have students use a graphing program or Microsoft Excel for Windows to graph results of particular probability extension activities.

- Have students experiment with spinners as they customize their own to adjust probabilities and collect data at the following site:
  Probability
  http://www.shodor.org/interactivate/activities/prob/index.html
  This site allows you to customize spinners and dice to adjust probabilities and spin or roll to collect data in tally mark form.

- Have students look up terms like probability, statisticians, probably, chance, etc. at the following website:
  Thesaurus.com
  http://thesaurus.reference.com/

Community Connections:

- This is an opportune time to have someone like a weather man come in to talk to the class about how s/he uses probability in determining weather forecasts.

- Invite a local government official to talk to the class about the lottery and how the profit is used to help the state.

- How do game makers use probability in designing games for manufacturing? Investigate the art of making games. What makes some games more popular than others?

The Big Race












							1
							2
							3
							4
							5
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							7
							8
							9
							10
							11
							12

Penny Flipping Tally

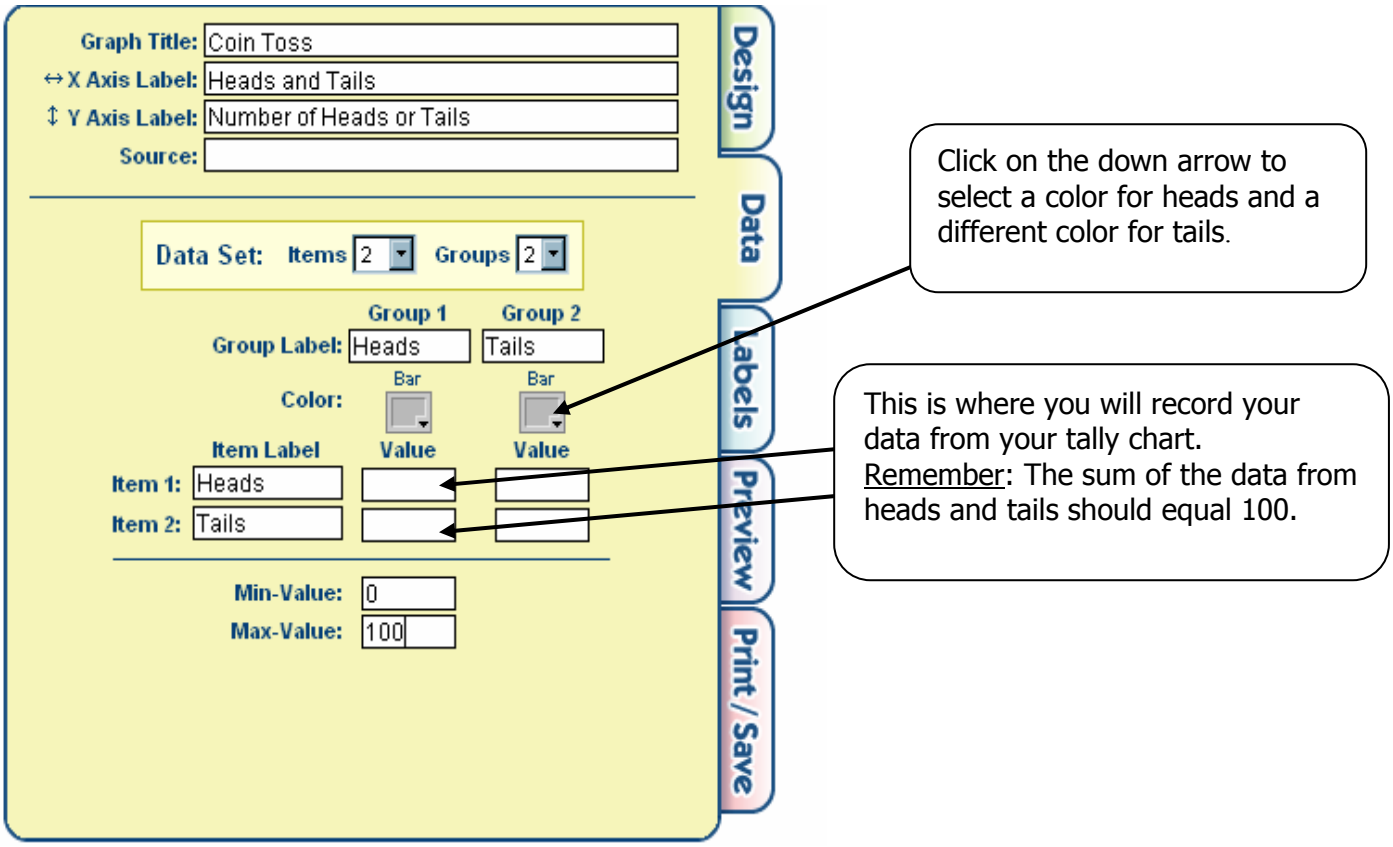
	

Create a Graph Tutorial

1. Go to http://nces.ed.gov/nceskids/graphing/

2. Click on **Start Making Graphs** and click on the **Bar Graph** icon.

3. Click the **Data tab** and fill in each field according to the example below.



4. After you have filled in the data click on the **Preview tab** and raise your hand for your teacher to check your work.

5. Once your teacher has checked your graph click on **Print/Save** to print your graph.

6. Work with your partner to write two true statements comparing the data on your graph.