Ways to Think about the Problem	Ways to Solve the Problem
• **Long tally** • **Repeated addition** • **Multiplication** • **Subtraction**	• **Make a lot of tally marks and count** • **Make 180 stacks with three items in each, then count them** • **Make 3 stacks of 180 items in them, then count them** • **Make 3 stacks of 18 items in each, count them, then add a zero to the result** • **Multiply 3 times 180 (or the reverse)** • **Multiply 3 times 100, add to 3 times 50 and add to 3 times 30** • **Multiply 3 times 200, then subtract 3 times 20** • **Many others…**

Theme: My Place in the Universe

"That teacher is 'plum loco', crazy," said Escondito.

"Can you believe three pages of math every day?" asked BogeyBandit.

"Yea, that's ___ pages of work over the 180 day school year," said MonkeyWrench.

"That's why we have started this secret club, to do something about the mess," said Escondito.

"We'll always use our secret names so that no one will find out who we are, or what we are up to," said BogeyBandit.

Ways to Think about the Problem	Ways to Solve the Problem

• It might be possible for someone to just look up the code letters and write the message once, if they were careful, but only if the coded message were in the correct word order
   ▪ If the words were scrambled in some way, then the entire message would have to be written out first, then scrambled
• If they were to use this procedure, they would
  1. Write out the message before coding it
  2. Code the message
  3. Write out the received coded message to decode it
	• Draw a diagram of each step that the secret message has to be written
	• Create a table

Normal Word Order

	Coder	Decoder	Grand Total
Write out message	1		
Code the message	1		
Decode the message		1	
Column Totals	2	1	3

Scrambled Word Order

	Coder	Decoder	Grand Total
Write out message	1		
Scramble word Order	1		
Code the message	1		
Decode the message		1	
Unscramble the word order		1	
Column Totals	3	2	5

Theme: My Place in the Universe

"Do we need a secret handshake?" asked BogeyBandit.

"No, that was in the "Woman Haters" club movie, that's ancient history," said Escondito. "This is modern math."

"I think that we need a secret code," said MonkeyWrench. "I saw that in two out of three spy movies."

"No," said Escondito. "Stop and think. First you have to write the note, then you have to look up each letter in the code, then you write the coded note."

"Yea," said BogeyBandit, "Then the person who gets the note has to look up every letter, and write the encoded message."

"I see," said MonkeyWrench, "you end up writing the note _____ times."

"Yea," that's as bad as the teacher giving us three pages of stuff that we already know how to do," said Escondito.

Ways to Think about the Problem	Ways to Solve the Problem
• **If there is only one member, that person must always ask the question…** **1 -1 - 1 -1 – 1 -…** • **If there are two, the people can alternate, or use a pattern something like… 1 – 2 – 1 – 1 – 2 -2 – 1 - …** • **If there are three people, the pattern could be… 1 – 2 – 3 – 2 – 1- 3 – 1 -2 -…** • **If there are four people, the pattern could be…1 – 2 – 3 – 4 - 2 – 3 – 4 – 2 – 1 – 3 - 2 – 4 – etc.**	**The problem requires an estimate of risk, i.e., the risk of more people and one revealing the existence of the group vs. not enough people and the pattern of their plan being detected by the teacher**

Members	Number of Unique Patterns	Chances of Slip Up
1	1	1
2	10	2
3	15	3
4	20	4
5	25	5
6	30	6

At least one more person should be asked to join. Can they find more than one person that they could trust?

Theme: My Place in the Universe

"We will just send our messages by E-mail," said Escondito.

"That way, everyone will have a password, and the messages will be safe.

"Great," said BogeyBandit. "But what happens when we have to get more members?"

"More members, why?" asked MonkeyWrench.

"Because if it is only three of us asking questions to stall the lesson, the teacher will get suspicious."

"Well, how many members do we need so that our plan looks random instead of calculated?" asked Escondito.

"That's easy; we need _____ more members, so that _____ of us will be asking a different question each day. Remember that there are two days each week when we won't come to school," said BogeyBandit.

Ways to Think about the Problem	Ways to Solve the Problem	
• Parameters are: 1. Easy vs. Hard 2. Short time vs. Long time	**Time vs. Problem Difficulty**	

	Short	Long
Hard	Hard question but answer time too short. This kind of question only good if it distracts the teacher.	Hard question but time to answer is also long, the teacher may give up or not know the answer. This is the worst kind of question.
Easy	Easy question, but time to answer too short. This kind of question only good if it distracts the teacher.	The best kind of question. Easy enough for the teacher to know the answer. It takes a long time to answer.
	Short	**Long**
	Time to Answer	

Theme: My Place in the Universe

"OK, we'll get one more person, now, and maybe another person later," said Escondito.

"Then, we'll mix up taking turns asking the teacher questions about our other classes when the math period starts," Escondito continued.

"Be sure to ask a math question about another subject or about something in the news," so that the teacher has to think about it," said BogeyBandit. "Then, the teacher will use up some of the math time, and someone else in the class can complain that there isn't enough time to do all those pages.

"Maybe, if everybody does just as well on the math test, the teacher will see how stupid it is to just do all those math pages and she will answer questions instead," said MonkeyWrench.

"No, the teacher isn't that smart," said Escondito, "and that's why we have to make sure that the questions we ask are not too hard for the teacher, either."

"The best question will not be to _____, but will take a lot of ____ to answer," said BogeyBandit.

"No, the best question will be _____, but will get the teacher off the subject, and talking for a _____ time," said Escondito.

Ways to Think about the Problem	Ways to Solve the Problem
The Earth makes on spin each day, or 24 hours.	• **Count the lines on the globe, there are 12 – this doesn't help much** • **Divide 24,000 by 24 to get the answer**

Theme: My Place in the Universe

"Exactly what kind of problem do you have in mind?" asked BogeyBandit.

"Well, look at the globe where I've placed two stickies, "said Escondito.

"When I spin the globe, both stickies hit the bar at the same time, but the one in the middle has to go a lot farther," Escondito continued.

"So, if a person is standing in the middle of the Earth, on the Equator, how fast are they traveling?" asked MonkeyWrench.

"You got it," said Escondito. "But you have to know that the Equator is about 24,000 miles around."

"You mean that the person just sitting on the beach down there is traveling at _____ miles per hour?" asked BogeyBandit.

"You got it," said Escondito.

Ways to Think about the Problem	Ways to Solve the Problem
• A hurricane might be 300 miles across, but the eye of the storm is relatively still • If air was moving at 100 miles an hour, but within an area of one inch, what would possibly be pushing it?	• Spin both a hard boiled egg and a raw egg • The hard boiled egg spins, but the raw egg does not • The raw egg doesn't spin because the liquid inside doesn't move at the same rate At some point, we can imagine that the air is completely stopped, moving at zero miles per hour 180 days minus 15 school days in three weeks leaves 165 days left

Theme: My Place in the Universe

"That's the old two ants on one bicycle tire question," said MonkeyWrench.

"Yea, which ant travels farther, the one on the rim or the one on the axle?" asked Escondito.

"Yea, or the question about a hurricane and exactly how fast the wind is moving exactly in the middle if the hurricane winds are moving 100 miles per hour on the outside," said BogeyBandit.

"Yea, the answer has to be almost _____ miles per hour in the very center," said MonkeyWrench.

"And solar systems and galaxies work the same way, too," said Escondito.

"This should be easy enough, even for this teacher," said MonkeyWrench, "Who is going to ask the question tomorrow in class?"

"I will," said BogeyBandit, "but where are we going to get enough math questions to last the whole year?"

"Well, we have already used up three weeks of school, so there are only _____ more days," said MonkeyWrench. "We should be able to find enough questions in a math puzzle book in the library."

Ways to Think about the Problem	Ways to Solve the Problem
• **The group can not just announce to everyone that there as some openings in the club and wait for students to ask to join** • **The new members will have to be found individually** • **The plan can continue even if it takes a few days or a week to find another member**	• **The minimum number of new members that can be added to the group is "one" since a part of a person cannot join** • **The steps to assessing whether the prospective member should be invited to join are steps in logic…**

	Yes	No
Student can solve math puzzle	Continue	Find Another Prospect
Student can keep a secret	Continue	Find Another Prospect
Student agrees to come to a secret meeting	Invite	Find Another Prospect
Student wants to join	New Member	

There are four steps or tests for becoming a new member.

Theme: My Place in the Universe

"How are we going to find at least _____ new member?" asked BogeyBandit.

"I know, let's have a test to find out who is really good in math that we can trust," said MonkeyWrench.

"Giving a test would be weird, and we would be acting like the teacher," said BogeyBandit.

"We don't have to rush," said Escondito,

"Let's just talk around the playground and cafeteria about math puzzles, and see who likes them. Then, when one of us finds someone, one of the others will see if they can keep a secret."

"Yea, and then the third one can invite them to join our secret team if they do keep a secret. This is really _____ tests, but they won't know it."

Ways to Think about the Problem	Ways to Solve the Problem

• Walking south, east and west should make a trail that is the shape of a square "U"
 • In this case, the trail is the shape of a triangle.
 • There is only one place where this can happen, and that is at the North Pole
 • If it were summer, the bear might have to swim here instead of walk, but when it is really cold, this place covered by ice
 • So, the bear was probably walking there in the winter
	• The globe shows that the lines around the Earth come together at the top and bottom.
	 • At the bottom, though
	   1. No bears live there
	   2. If you start south, you can't go south because you can only go north
	
	 The answer must be the North Pole Bear, the polar bear.

Theme: My Place in the Universe

The next day, MonkeyWrench was talking to Leslie and Jaime on the playground.

"I just heard a riddle; a bear walked in a straight line one mile south, then one mile east, then one mile north, and came back to the same place that it started. What color was the bear?"

"That's stupid, said Leslie. "Everyone knows that bears can't read a compass, and they don't have a pocket to carry a compass in."

"No, the bear was _____," said Jamie. "There is only one place where this could happen, and only one kind of bear lives there."

"How can a bear walk straight?" asked Leslie. "There are too many trees in the way to walk in a straight line."

"No," said Jaime, "There are no trees there, but I know that it was the _____ time."

Ways to Think about the Problem	Ways to Solve the Problem
• The natural way to contain the bull would be to keep the bull inside the field • The quickest way to complete the perimeter of the field would be to close and lock the gate • The gate cannot lock	• The fisherman closes the gate and wraps the gate together with as many loops of fishing line as he can before the bull gets there • One strand by itself could not stop the bull, but many strands could hold the gate closed long enough for the fisherman to get away

Theme: My Place in the Universe

The same day, BogeyBandit talked to students in the cafeteria during lunch.

"Someone was fishing and came to a broken gate where a fighting bull was standing at the other side of the field. Using only what he was carrying, the fisherman had only two minutes to save himself before the bull made it across the field. How did he do it?" asked BogeyBandit.

"Maybe he pulled the fishing rod apart, and used each part to stab the bull in both eyes when it got close enough," said Sandy.

"No," said Ronnie. "He probably closed the gate, and then used the line that was on the fishing rod to wrap around and around the gate to hold it together."

"One _____ couldn't stop the fighting bull, but the number of _____ that he could wrap around the gate in two minutes could stop the bull from opening the gate," Ronnie continued.

Ways to Think about the Problem	Ways to Solve the Problem
• Clockwise and counterclockwise are terms that were invented by people • The spin of hurricanes, the swirl of a drain, the whirl of a whirlpool are natural phenomena • The different directions of a spinning drain is a Urban Legend, but the different directions of spinning hurricanes are not • This spinning of hurricanes is caused by a factor called the Coriolis effect • Gravity determines the direction that is "Up," not the North and South Pole • The Universe is three dimensional • In a space station that was shaped like a wheel and set to spin, if the floors were on the outer edge, up would be in the direction of the "hub"	• The Earth turns toward the east and the air travels faster at the Equator than it does farther away from the Equator (or seems to anyway) • This effect works for long distances such as the winds of a hurricane or the launching of a missile • The direction of the flow of the water and the irregular shape of the containing vessel effect what direction the water swirls • Water in sinks and toilets can spin in either direction on either hemisphere

Theme: My Place in the Universe

During math class, before the teacher could assign the three pages of math, Escondito asked the teacher a question.

"How come the hurricanes spin counter clockwise in the northern hemisphere and _____ in the southern hemisphere?" The Earth is spinning the same way, one half is not going one way and the other half the reverse," Escondito continued.

"No way," said Leslie. "If that were true, then clocks would go backwards in the southern hemisphere, too. Then, the people would grow younger, not older down there, and everybody would move there to be younger."

"And, what proof is there that they are on the bottom of the Earth, and we are on the top?" asked Ronnie. "They don't walk upside down, do they?"

"Yea, we're studying the Universe, how do we know which side is up?" asked Lee.

Ways to Think about the Problem	Ways to Solve the Problem
• **Possibility means that something could happen** • **Probability means how likely it is that something will happen** • **It is possible that the teacher won't know some answers, and it is probable that the teacher won't know some answers** • **It is possible and probable that the teacher won't be able to find the answer to some questions** • **It is possible and probable that the teacher isn't smart enough to understand the answer to some questions even after looking the answer up** • **It is possible and probable that answer to some questions is too complicated for the students to understand**	• **Which word fits depends upon what the speaker meant** • **Since the student is making a logical argument, the word "possibility" probably fits better ☺** • **If the student were making a mathematical argument such as, "The teacher knows the answer only two out of three times," than it would be highly possible that "probability" would be the correct answer ☺**

Theme: My Place in the Universe

That evening, after school...

"Our plan worked better than expected," said MonkeyWrench, "but we can't count on being so lucky every day."

"Yea, the teacher had so much trouble explaining the questions that there was no time for other math," said BogeyBandit.

"Lucky for us that there is Internet access in the classroom, or the teacher wouldn't have known the answer," said Escondito. "We have to factor in the - _____ that the teacher doesn't know the answer, and tells us to get to work and the teacher will research the answer and tell us tomorrow."

"If this happens, we have to write the question down so that we don't forget. The teacher might hope that we forget about the question by the next day," said MonkeyWrench.

Ways to Think about the Problem	Ways to Solve the Problem

	Bear	Bull	Class
Jaime	Y		
Lee			Y
Leslie	N		N
Ronnie		Y	Y
Sandy		N	

Ways to Think about the Problem

- **The testing is anecdotal**
- **The test questions cannot be validated in advance**
- **It is possible that the person being tested hear the question before, and just remembered the answer instead of figuring out the answer**

Legend: Y = Yes
N = No
C = Can't Tell

Theme: My Place in the Universe

"What happened with the testing of new recruits?" asked Escondito.

"Well, Jamie knew that answer to the 'White Bear' question," said MonkeyWrench.

"And, Ronnie knew how to stop the fighting bull," said BogeyBandit.

"Ronnie also asked a great question in class," said Escondito.

"How about Lee? Lee asked a great question in class," said MonkeyWrench.

"Let's test Ronnie ___, since we have extra evidence that Ronnie is smart and can ask _____," said MonkeyWrench.

"Yea, we didn't test Lee with a question, yet," said Escondito.

Ways to Think about the Problem	Ways to Solve the Problem			
• Because the testing must be kept secret, only a small sample can be tested • Answers to the test question, and anecdotal evidence has to be used • It does not matter if the best person is recruited, only that a competent and trustworthy person is recruited	• The unknown factors are what creates the risk			
		Possible	**Can't Tell**	**Impossible**
	Test Everybody			X
	Test One at A Time	X		
	Test the Wrong Person	X		
	Find the Best Person		X	
	Find Someone who can't Keep a Secret	X		
	Test Someone who will Tell the Teacher	X		
	Find a Trustworthy Person		X	

Theme: *My Place in the Universe*

"What kind of "Keep it Secret" secret can we use to test Ronnie?" asked BogeyBandit.

"If we make up gossip about boyfriends and girlfriends, and somebody tells," then we are going to have a big mess with people mad at us."

"No, let's make something about the teacher that is good, then when it doesn't happen, everybody will be happy," said MonkeyWrench.

"Let's make up something about the teacher that is bad, then when it doesn't happen, everyone will be happy," said Escondito.

"You're both _____," said Escondito, "but we have to be very careful about this. The reason that you are both _____ is that 'Everybody' never agrees."

"You're right," said MonkeyWrench. "Maybe we need to figure out another way to tell if someone can keep a secret."

"What if we ask Ronnie to give us $20.00 as collateral?" asked BogeyBandit.

Ways to Think about the Problem	Ways to Solve the Problem

• **Diagrams**
• **Definitions**
	Two female persons born to the same parents are sisters.
	    • **The son of a sister is a nephew**
	    • **The daughter of a sister in the niece**

Theme: My Place in the Universe

"How did you find out about our secret club," asked Escondito.

"I am sure that Ronnie was the mole," said BogeyBandit. "I told you that getting $20 in collateral would have been a good idea."

"Well Ronnie did tell me what you girls were up to," said the teacher. "You see, Ronnie is the daughter of my sister.

"She's your _____!" said MonkeyWrench in an excited tone.
"Yes, but she didn't exactly tell your secret," said the teacher.

"Well, why are we in here, while the rest of the class is outside for recess?" asked BogeyBandit.

"Because Ronnie thought of something that you didn't think of, and I am proud of her," said the teacher.

"Ronnie came and asked me if there was another way for me to teach the class," said the teacher.

"She did that?" asked Escondito.

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Ways to Think about the Problem	Ways to Solve the Problem

Possible locations for conference:
• **Playground**
• **Gym**
• **Classroom**
• **Principal's Office**
	Map locations to teacher's reaction
	
	Playground:
	    Everyone could hear what the discussion was about
	
	Gym
	    There is too much noise there, and no one could hear what the discussion was about, even the participants
	
	Classroom
	    With everyone else outside, the conversations would be private
	
	Principal's Office
	    The conversations would be semi-private, but the reason that the conference would be held there would be to punish the girls

Theme: My Place in the Universe

"Well, why are we here in the classroom instead of in the principal's office?" asked MonkeyWrench. "You don't seem to be _____ at us."

"Well, I may be a first-year teacher, but I am not stupid," said the teacher. "If I am wasting your time in class, then that would make me a bad teacher."

"What Ronnie thought of, but you didn't, probably because you were having too much fun with your club, is that I might like your help in creating puzzles and interesting math questions for the class," the teacher continued.

"Yes, we were having a lot of fun with our club," said Escondito.

"So, if you are still interested in your club, I propose that you make up a question for math every day."

"Can we surprise you, and everybody, with the questions like we were doing?" asked BogeyBandit.

"Yes," said the teacher. "But I would like to ask you to do two things…"

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Ways to Think about the Problem	Ways to Solve the Problem
Pay vs. Payoff **Pay** is what one earns **Payoff** is the benefit that one receives What is late at night for one person might not be late for another. Factors: • How far the teacher has to travel to get to work • If the teacher has to drop husband or children off somewhere before coming to work	**Add** that work to your own assignments The value of 100% would be added to the tutor's grade for the assignment **Subtract** that work from your own assignment The requirement to turn in that assignment would be subtracted from the amount of assignments due

Theme: My Place in the Universe

"What two things?" asked MonkeyWrench.

"Well, number one, I wonder if you would still consider letting Ronnie stay as a member of your secret club?" said the teacher.

"Ronnie is very good in math, and she didn't tell me about your club until after I agreed to make changes in the math class," the teacher continued.

"And, what is the other request?" asked BogeyBandit.

"Well, almost everyone understands the math assignments, but a few students are having trouble," said the teacher. "I could use some help in tutoring them."

"Any pay for us for doing your work?" asked MonkeyWrench.

"Yes," said the teacher. "I will give you 100% credit for each page that you help another student with, and you can _____ that work ___ your own assignments."

"You know, there is a _____ for me, too," the teacher continued. "I have been staying up until _____ every night grading all those math papers," Ronnie suggested that I might have more _____ for myself if assigned fewer math pages."

"Smart girl," said Escondito. "That's why we're proud that she is a member of our semi-secret club."

"But only if you promise to be our mentor, and keep the club secret from everyone else," BogeyBandit said to the teacher. "Deal?"