SUPERMATH Unit

Analyzing Angles

GOAL(S) OF THE UNIT: To learn: a) how to plan solutions by using systematic measurements, and b) how to measure angles. Students will practice both estimating angles and distances, and then using instruments to measure them.

Duration	7 days
Approach	Learn how to first estimate angles and line segments to improve ones golf score. Then the need to measure becomes paramount in the requirement to beat par (i.e., get holes in one) to obtain an A grade for the activity. In addition, a variety of other mathematical concepts are also integrated into the use of the game.
Supermath software	Golf Challenge
Pre/Corequisite skill	Converting fraction to decimal/adding signed numbers (desirable)
Followup practice	Types of angles, characteristics of angles in geometric shapes

Concepts and Skills in this Unit
Accuracy of measurement (approximate versus exact)
Average
Collecting data
Converting fractions/mixed numbers to decimals
Coordinate (optional)
Estimating angles/line segments
Estimation versus measurement
Adding signed numbers
Locating a point on a plane (optional)
Using a ruler
Using a protractor
Measuring a line segment
Measuring an angle
Number sequences
Parallel and perpendicular lines (optional)
Proportion
Rounding decimals
Signed numbers
Solving problems with distance, rate and time (optional)
Spatial visualization

Logistics:

In GOLF CHALLENGE students get information from the screen to make measurements from by either: a) tracing the hole with paper and a felt pen and then measuring the hole on the trace and entering the information into the computer, or b) by measuring the information on the screen directly using cellophane or paper protractors and rulers. Such tools can be placed right against the screen for direct measurement.

You can make cellophane or paper protractors and rulers for students that will not scratch the screen by placing overhead plastic or paper in a copier. Then carefully copy 2-4 real plastic/metal protractors and short rulers (with sixteenth inch markings) at a time onto the overheads/paper and then cut them out.

Materials:

Tracing technique—Light lined paper that can be used for tracing, soft thin point felt tipped pens for tracing lines on the computer screen without scratching the glass (if students copy holes off the computer as the measuring approach), a ruler (with sixteenth inch markings), Protractor for each student in a class.

Measuring on the screen technique—Make cellophane/paper protractors and 6 inch rulers (as described above) for students to conduct measurements right on the screen.

Chart paper, 2 long rulers (yardsticks) or several tape measures.

Copies of a homework assignment sheet that you make up that has 7-10 angles between 180 and 360 degrees.

Charts on: Angle, Golf Scoring, and Bonus Points

Logistics:

GOLF CHALLENGE has the following options.

Saving Game Progress: GOLF CHALLENGE has the ability to save student progress so it is possible for them to complete part of the course in one day and then return the next session to finish the game from where they left off.

New Game Or Continue Earlier Game: When the 'SAVE GAME' option is selected, students will be asked whether they want to continue with an earlier saved game or start a new one. If they choose to start a NEW GAME, they will be asked to enter a name for their team. (If team's are going to save more than one game, they will have to use a different name for each, e.g., CATS1, CATS2, etc.) When students quit the program, their progress will automatically be saved.

If teams choose to continue progress on an earlier game, they will be presented with a screen asking them to find their saved game. This is accomplished by clicking on 'OPEN' to open the GOLF TEAMS folder, selecting their team name from the choices offered, and then clicking on 'OPEN' again. They will then automatically be placed at the point in the earlier game where they left off.

Front Or Back Nine: Play may begin on either the front or the back nine. Starting on the front nine means the game will proceed by playing holes 1-18 in consecutive order. Starting on the back nine limits play to holes 10-18. The back nine is harder and so it is recommended that for the first few days students play the front nine.

TEACHER NOTE: Specific recommendations for choosing the appropriate options are included in each lesson for your convenience.

As the students play the game, there are a few choices they can make from the pull down menu bar at the top of the screen. These choices are described below:

FILE : There are three choices under the FILE menu item:

Save Game Progress: Selecting this option saves the game progress so far to a file in the GOLF TEAM FILES folder to a file with the name entered by the team when they first decided to save.

Print Score Summary: Selecting this option prints a copy of the score summary on the printer. These score summaries can be used to make student homework by asking them to analyze or interpret the different data on the scorecard.

Quit: Selecting this option quits the game and returns teams to the desktop. If the save option has been selected, current game progress is first saved.

CROSSHAIR: Selecting this option superimposes a labeled diagram over the ball to aid in the estimation of the angle to input to get the ball in the hole.

CHECK SCORE INFO

After completing a hole the game tells you the score for that hole. When you select CONTINUE the program prompts you to 'Check Score Info', which provides results both in actual scores (# of strokes) and score in relation to par. There are also subtotals, totals, and averages for each type of score.

When students take their first shot, land in a water or sand trap, or make a hole-in-one, Pippinochio comes out and does a short activity. If you or the students want to stop Pippinochio to save time. Click on the figure and it will disappear. (By the way, Pippinochio is drawn the way it is to avoid sexual, racial, or planetary stereotypes.)

When a team completes the back nine it is awarded with a special graphic treat (labeled under hole 19).

Pedagogical Approach:

GOLF CLASSIC develops students' understanding of angles and the relative value of estimating versus measuring. Students first try to get good scores by visual estimation. Then they make actual measurements of distance and angle from tracings of each hole on the screen using a ruler and protractor. The unit develops in a way such that students discover the need for measurement as the only way to beat par. Decimals and proportion are also used to help students get better golf scores.

Take the extra time to let students figure out how to estimate angles and distance, as well as discover the need for measurement on their own—as opposed to your telling them—even thought they may struggle a bit at first. Students will indeed get frustrated by their initial inability to get the ball in the hole till they figure out that they will have to enter part of a unit, and discover that they can only enter decimals. Do not tell them that they cannot enter fractions. These discoveries are critical to developing students' mathematical sense and ability to generalize from prior experience and information.

You can stimulate student interest in golf by encouraging them to read the newspaper or watch it on TV to get the latest information about what is happening on the men's and women's professional golf tour. It is important to stimulate students' interest in finding and measuring angles in things other than the golf game, such as the hands of the clock at different times, parts of a car, corners of a building, etc.

The score summaries provide tremendous opportunity to build and reinforce math concepts. Students should be challenged to analyze their score summaries after each hole and just before the end of the period. Question them about how scores of ‘under’ and ‘over’ par combine to give a total score in relationship to par.

The unit use the 'score in relation to par' measure to reinforce the use of signed numbers. If students have not already studied signed numbers skip the references to it in the lessons and in the homework problems.

Also discuss the relationship between the scores of actual strokes and strokes in relation to par and the averages of each, and what constitutes good scores (e.g.,, the lower the average number of actual strokes the better while the greater the negative number of the value in relation to par the better). This will get students thinking in terms that will help them when they work with signed numbers in a later unit, as well as a good reinforcement of the role of averages.

Do not have students save their games until they are comfortable and proficient at estimating angles.

<u>TEACHER NOTE</u>: This unit presents measurement as giving exact answers. Clearly, this is false. However, this misrepresentation is done deliberately. It gives students a sense of security about measurement, and presents it in a way which is intuitive. Future units will lead students to discover the truth, that measurements are also approximations—albeit more precise than just estimating.

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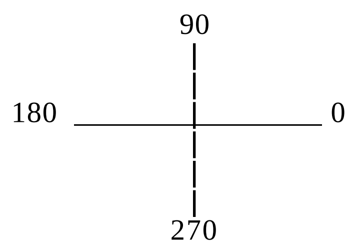
ON YOUR OWN

UNIT TITLE: MEASURING AND USING ANGLES

SOFTWARE: GOLF CHALLENGE

Pre-class setup: Demonstration computer set to the first hole. Load student computers with GOLF CHALLENGE by double clicking the program icon or alias. Students should pull down 'QUIT' from the FILE menu at the end of the period.

Materials: Student notebooks, pictures of professional golfers, including women and minorities such as Calvin Peete and Tiger Woods, Chi Chi Rodriguez, Lee Trevino and Nancy Lopez, etc., and a large version of the following diagram:



Lesson #: 1

<u>**PRE-TEACHING ACTIVITIES**</u> (Demonstrations, linkages, end result to be achieved):

Today you are going to start to play Golf. Has anyone ever played golf, or watched it on TV? Some may have played miniature golf. **What do you know about golf?** Let students explain what they know.

A key to playing golf is the motion of your body and club as you hit the ball. Much of math is used to describe motion, or how fast things are moving and why they are moving. Scientists use math to describe the motion of gigantic stars and tiny atoms. What kinds of motion are there? (Forward, backwards, sideways, up, down, etc.)

In addition to moving forwards, backwards and sideways, there is another important motion, called turning. What things do you know that turn? (Steering wheel, dancer, etc.) Then say:

Planets also turn, and that is called 'ROTATION'. Rotation is when something turns around and around, over and over again. What else has rotation? (Thrown baseball, top, dreidel, CD's, etc.)

The amount of turning is called an 'ANGLE'. Have a student come up. Tell him/her to take 3 steps forward, then ask. **What was the unit of motion forward?** (A step.) **What was the amount?** (3) Then tell him/her to about face, then say:

What you just saw was turning or rotation. The amount of rotation was 180 degrees. The unit for measuring rotation is a 'DEGREE'. What other measure uses degrees? (Temperature) **Even though rotation and temperature are measured in degrees, these are two different types of measurement.** Continue by saying:

An angle is the amount of rotation, and is measured in degrees. Today you are going to work with angles from 0 to 360 degrees in playing golf. There is a diagram on the screen to show you the size of the angle. The diagram looks like this. Point to the chart in front of the room, then say:

The amount of rotation you just saw when ??? —where ??? is the name of the student who turned around— **did an about face was the same as this.** Sweep a ruler from the starting position through 180. **This is why I said it was 180 degrees. What would it mean if he/she had turned some more?** (The angle would be more than 180 degrees.) Continue by saying:

Read the instructions on the computer carefully because I am going to ask you questions tomorrow about what you found out. When you are asked whether or not you want to have your game saved, click on the option that says 'NO'.

»» When students are working at the computer, show them the legend on the bottom that indicates the size of the unit used for each hole. Let them experiment with different values to get a sense of how the units work. Also tell them to use the crosshair to see how it can help them estimate the angle. ««

DOCUMENTATION TO BE PROVIDED TO STUDENTS: None.

NEW COMPUTER USE SKILLS: Learning to enter angles and unit lengths.

NUMBER OF STUDENTS PER COMPUTER: Two-three.

POST-TEACHING:

From what I've seen in class today, I don't think any of you are quite ready to become professional golfers, but by the end of this unit- Who knows? The homework tonight will get you started thinking about some of the things you'll need to know to become good golfers.

HOMEWORK

Give students a sheet containing several angles including some that are greater than 180˚. Also, have the angles facing in different directions (i.e., have some of the zero orientations being something other than horizontal and pointing to the right.) Ask them to estimate (not measure) the size of the angles.

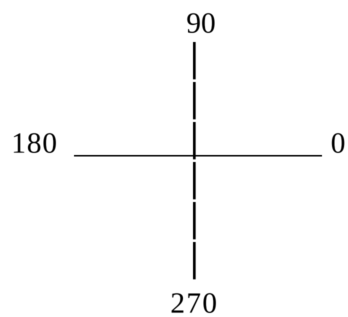
IDEA FORMULATION AND DEVELOPMENT

UNIT TITLE: MEASURING AND USING ANGLES

SOFTWARE: GOLF CHALLENGE

Pre-class setup: Load student computers with GOLF CHALLENGE by double clicking on the program icon.

Materials: Student notebooks, blank chart, 2 rulers, and a large copy of the diagram below :



Lesson #: 2

<u>PRE-TEACHING ACTIVITIES</u> (Demonstrations, linkages, discussion of ideas):

Hand out students notebooks, then ask: **What did you learn about GOLF CHALLENGE yesterday?** Let students mention what they learned. Then ask:

A 'UNIT' is the basic, single amount of what you are measuring. What units did each measure have? (Length was a piece of a line, and angle was a degree.) Then say:

Let's see if you read the instructions carefully. What kind of shot results in a penalty stroke? (Going out of bounds or landing in the water or a sand trap.) **What is special about the numbers you must use for entering what direction you want the ball to go?** (They must be whole numbers between 0 and 360.) **How can you get a diagram on top of your ball to help you enter a number of degrees for the angle you want your shot to go?** (Pull down the crosshair menu item from the top of the screen) Then point to the chart of angles and ask:

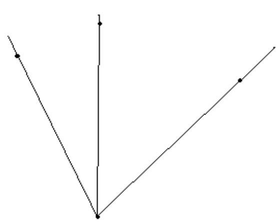
Do you think this diagram means that we can only use the angles listed? (No) Then have a student volunteer come to the front of the room and say: **Hold out both your arms in front of yourself. Now show me an angle of 45 degrees by rotating one of your arms.** After the student responds, ask: **Why do you think that would be 45 degrees?** (Because it is halfway between 0 and 90.) Then say:

I want everyone to stand up and put your arms together and hold them at zero degrees. Let students start facing in different directions, but all should have their arms together. **Now move your left arm horizontally until your arms are at a 90 degree angle and then freeze. Do you see anything else in the room that has the same angle?** (Probably a corner of the room.) Then say:

Now move your left arm horizontally until the angle between your arms is 180 degrees. After students do this, say: **Now visualize what 270 degrees looks like, and let's see if you can rotate your left arm to 270 degrees. Let's see you really stretch.** Then as a joke ask them to move the arm to 360 degrees, and when they start groaning, say:

Rotation not only is measured with degrees, it also has direction. Line up two rulers at the 0 degree mark on the angle chart. Then show how, as you rotate, one it makes all the angles. **The direction in which I moved the ruler, which represents a line, is called 'COUNTER-CLOCKWISE'. Why?** (The direction is the opposite of how the hands of a clock move.) **When you are asking somebody to rotate a certain number of degrees, you have to tell them which direction to move if you want your instructions to be clear.**

Draw the diagram below on the board.



Look at a window in the room, and using a tone of voice which indicates that the following request is simple and obvious, say to no one in particular:

I want 'you' to tell me how big the angle on the board is. If no student responds, act irritated and impatient. If a student does call out an answer, say: **No not you, I wanted a different you. Besides, you are looking at the wrong angle.** Repeat this process several times, acting more frustrated each time and pretend it's the wrong student and the wrong angle. Then when students look totally confused, ask:

What is the problem here? (We don't know who you are referring to.) **That's right. How is not knowing who I want to talk the same as the problem in dealing with the angle?** (We don't know which angle you are referring to.) **How many possible angles are there?** Students will probably see only 3 because they will not think of the possibilities greater than 180— that is OK. Don't point out the other angles at this time. Rather ask: **How might the solution to the problems of identifying which people and which angles be the same?** (Use names.)

Good thinking! What do we need to give names to? (The angles.) Students will still not be able to tell which angle you are talking about. Then say:

I guess I need to be more specific. How many points would I have to name for you to know for sure which angle I am talking about? (Three) **Good! The point named ???** —Where ??? is the one name at the vertex— **is a special point called the 'VERTEX' of the angle. Why do you think the vertex is special?** (It is where the lines meet.) **What was the vertex of the angles you made with your arms?** (Body, head, etc.) Continue by saying:

The vertex of an angle is so self centered that it always wants its name to appear on center stage, or in the middle of the other two parts of the angle's name. So how could we name the largest angle in the diagram? Make sure students use three names to name the angle and that they have correctly placed the name of the vertex in the middle. After giving them practice naming the other angles in the diagram, say:

You are truly excellent readers and thinkers. Now let's see you become terrific golfers. As good golfers are you trying to get a high score or low score? (Low) **If you are going to get a good score you had better watch out for the sand and water traps.**

CHALLENGE ACTIVITY:

Today I want you to keep track of your scores and see if you can beat PAR. PAR is the number of strokes that good golfers are expected to need on each hole. The best score is a hole-in-one which means that your first shot goes in and you have no putts.

Let's see if you can get some holes-in-one today. As you get your scores during the game, what variables should you write down to find out how well you did? Write student suggestions on a chart. They should include at least 3 of the following: Number of holes played, PAR, total number of strokes, average number of strokes, number of putts, number of penalty strokes, etc. Then say:

Choose the 'No' option again today when the program asks if you want the games to be saved. Send teams to the computers.

NUMBER OF STUDENTS PER COMPUTER: Two-three.

POST-TEACHING:

As you try to estimate the size of the angles in your homework, make believe that the diagrams are pictures from the perspective of how your rotated arms would look if someone had watched you from above your head.

HOMEWORK

Give students a sheet containing several angles that are greater than 180˚ but less than 360˚. Ask them to estimate (not measure) the angles.

Also assign problems from a text that will allow students to estimate angle measures.

EXPERIMENTAL/HYPOTHESIS TESTING AND FORMULATION

UNIT TITLE: MEASURING AND USING ANGLES

SOFTWARE: GOLF CHALLENGE

Pre-class setup: Load student computers with GOLF CHALLENGE by double clicking on the program icon.

Materials: Student notebooks, tracing paper, felt pens with fine tips (if you are using the tracing approach), rulers and protractors, drawing of an angle between 0 and 90 degrees on a chart, and several copies of a tracing of a hole in which the angle is between 180 and 270 degrees, along with the legend chart around the ball.

Lesson #: 3

<u>PRE-TEACHING ACTIVITIES</u> (Demonstrations, linkages, generation of hypotheses):

In reviewing the homework, remember that student answers are only estimates. Accept all reasonable answers. If an answer is really off, have the student explain how (s)he arrived at the answer.

You may also want to introduce the terms 'acute angle' and 'obtuse angle'.

You made some good estimates. I want you to hold onto your sheets as you will use them again today. What scores did you get yesterday? After students respond, say in a disturbed tone:

Yesterday's scores are better than the day before but they are still too high and you are not beating par or getting holes in one. In a few days you are going to take a test on playing golf and to get an A if you can get a score of 11 or less on the front seven. How many holes in one will you have to get in order to have a score of 11 or less for seven holes of golf? (At least 3.) At this point students will get very frustrated and angry. Let this build for a minute. Then ask:

I have lots of confidence in you, but am wondering why you are having so much trouble getting holes in one? (We cannot get good enough measurements.) **Is that all? Then I predict that you will all get holes in one today or tomorrow because I will now show you how to make better, exact measurements of angles. By an 'EXACT' measurement, I mean one that is as close to correct**

as possible. Point to the angle on the board. How big is that angle? Students will guess a variety of angles, like 50 degrees. Continue by saying:

Instead of an exact measurement, you have given me an estimate which is an 'APPROXIMATE' value one for that angle. Unfortunately, 'approximate' measurements are not good enough when measuring important things for critical jobs. If the astronauts do not know the exact angles to fly at what would happen? (They would fly into space and not be able to get back to earth.) Then hold up a protractor and say:

Fortunately, there is a way to measure angles exactly using this funny looking instrument which is called a 'PROTRACTOR'. Show the protractor, and show how you would use it to measure the angle on the board. Then say: **This angle is exactly ???** —where ??? is the result of the measurement— **degrees.** Go to one of the student computers with Golf Challenge and ask:

Does anyone have an idea of how we can use a protractor to get an exact measurement of the angle on the screen? Students will probably suggest putting the protractor against the screen. Tell them (depending on which of the following approach you choose):

Using Tracing Technique (i.e., tracing the hole on the screen onto paper)	Using Paper Protractors and Rulers on the Screen
That is a good idea, but it might scratch the glass. Can you think of another way? (Hopefully, someone will suggest tracing the hole.) Then ask:	**That is a good idea and I have paper protractors that will not scratch the glass.** Show them the plastic protractor and then ask:
What things must we trace? (Where the ball is and the hole.) Have students gather around as you trace the ball and the hole, and then ask:	**What things must we measure?** (Where the ball is and the hole.) Have students gather around as you place the protractor over the screen, and then ask:

But how am I going to know how to line up the bottom of the protractor? (Pull down the crosshair menu item so that the angle diagram is around the ball, and trace the horizontal line from 0° to 180°.) Do this, and then try to line up the ball and hole, and ask:

Now that I have the protractor lined up with zero, I know what the zero position is. Then act puzzled and ask:

What is missing to help me measure the angle between the hole and the golf ball against the markings on the protractor? (A line <u>connecting the hole and ball</u> on the tracing paper.) Draw the line, measure the angle, and then enter the information. Then enter a unit amount you think is too short, and when the ball doesn't go in the hole, act surprised/upset and say:

I was gypped. The ball didn't go right in the hole. Did I put in the wrong angle—how can you tell? (The angle is correct because the ball is lined up with the hole.) **Then I don't understand, why didn't the ball go right in?** (Wrong length.) **In order to get the ball in the hole with just one shot, what else are you going to have to measure exactly?** (Distance or length.) Then show the tracing of a hole whose angle is between 180˚ and 270˚, and ask:

TEACHER NOTE: If students ask now, or when they are at the computer, whether they can enter part of a unit length, say: "I am not sure. Experiment and see what you find out and let me know."

What do you estimate this angle is approximately? (Students should respond between 200-250°.) **What would be a problem in using a protractor to measure this angle?** (It only goes up to 180°.) Then say:

Actually, it is possible to use this protractor to measure angles that are greater than 180 degrees one you know an additional characteristic of angles. Then ask two students to come up. Ask the first to turn 90 degrees. Then have the second start at the point where the first student is and turn another 90. Then ask the class:

What angle have these two turned all together? (180 degrees.) **What does that mean about angles?** (That angles can be added together.) **Good, knowing that you can add angles together will be important to being a good golfer. For example, if I know an angle is 25 degrees more than this angle** —point to 180 degrees— **how big is it?** (205 degrees.) Then point to 270 degrees on the angle chart and ask:

If this angle is 270 degrees, how much do you think this angle is, —point to zero— **and why?** (360, because each point on the angle chart is 90 degrees more than the one before it.) Then say:

That's right, 360°, which is 270° plus 90°, ends up in the same position as zero degrees. Invite a student up, and tell him/her: **Rotate zero degrees.** The student shouldn't move. Then say: **Rotate 360 degrees.** The student should turn all the way around. **Notice that the student ends up in the same position.**

By the way, those of you who play basketball probably know what a 360 is. It's when you are driving to the basket and make one complete rotation while in the air before shooting the ball. How many of you can do that? Then ask the class:

What other sports or activities have 360's? (Jumping rope, skateboarding, diving, etc.) Continue by asking: **Can rotations be bigger than 360°—why?** (Yes. You can keep on turning as much as you want.) Invite another student up and say:

Show me a rotation of 720°. Hopefully, student will make two complete revolutions. Then ask: **How big do you think a rotation could be?** (As big as you want, until you get dizzy, or infinite, etc.) Then ask:

How many degrees would one and a half rotations be? (540˚) If students need help, tell them that half of 360 is 180. Then ask: **Would it be exactly 540°?** (Yes) Then say:

The fact that a characteristic of angles is that they can be added together means that you can use a protractor that is only 180 degrees to measure larger angles, but you are going to have to figure out on your own how to make the measurement.

CHALLENGE ACTIVITY:

Hand out team protractors and rulers. Then say:

I want you to set up a chart in your notebooks. The chart should have 2 columns labeled 'Approximate' and 'Measured'. Draw a quick demonstration of what you want the chart to look like on the board, including these words as headings of the two columns. Then say:

You are now better anglers and you are ready to fish for holes in one. Pause. **Sorry, I got my fishing and my golf mixed up. When you play the game today, I want you to write down your estimates for the angle of each stroke and then use your protractor to measure the angle. I also want you to check the score information after each hole.**

»» Keep an eye out for groups when they encounter an angle greater than 180° for the first time. Make sure that they first write down their estimate. Then encourage them to manipulate the protractor in different ways to see if they can figure out a way to measure the angles.

The students should realize that you can use a variety of techniques from turning the Protractor upside down to holding it vertically, and then adding together the extra angle to the part not measured. For example, if they hold it vertically and get 110 degrees, they should realize and articulate that you add that to 90 degrees, because you can add angles together. Make sure they understand the direction of the angle so that they know what to add. A typical mistake would be to add the wrong part of the angle scale, e.g., to measure an angle that is 245 degrees by adding 135 degrees to 180 and mistakenly getting 315, rather than adding 45 degrees to 180.

Also ask them to show you their computer score card after two holes and discuss the different measures of performance and what they mean. ««

NEW COMPUTER USE SKILLS: Tracing the screen.

NUMBER OF STUDENTS PER COMPUTER: Two-three.

EXPERIMENTAL STRATEGY (Method of data collection):

Students make angle measurements from the tracings to see if that improves their scores, and compare their estimations with their measurements to see if their measurement technique for angles greater than 180° is correct.

POST-TEACHING: None.

HOMEWORK

Have students practice estimating angles greater than 180 degrees, or if they have protractors available, ask them to measure exactly.

EXPERIMENTAL/HYPOTHESIS TESTING AND FORMULATION

UNIT TITLE: MEASURING AND USING ANGLES

SOFTWARE: GOLF CHALLENGE

Pre-class setup: Load all student computers with GOLF CHALLENGE by double clicking on the program icon.

Materials: Calculators, protractors, rulers, tracing paper & felt tipped pens (if you are tracing), student notebooks, Copies of the Blackline Golf Tracing #1 for each student.

Lesson #: 4

PRE-TEACHING ACTIVITIES (Demonstrations, linkages, generation of hypotheses):

What types of scores do you get on each hole? (Strokes used and score in terms of par.) **If you use 4 strokes on a real golf course, is that good?** (Hopefully students will realize that this depends on par.) **Suppose par for that hole is 5 is that a good score?** (Yes) **How would the computer write that score in terms of par?** (1 below) **We can write that result as the signed number, -1. Write down the situation as a signed number the situation where you take 7 stroked for a par 4 hole.** (+3)

Write two par and stroke situations on the board and ask students to write them as signed numbers.

---------------If you did the 3 Smile Island program with the class you could ask them to remember the last time they used signed numbers in the class-------------

Then say:

Yesterday, I asked you to record in your notebooks your estimated and measured angles as you were playing the game. Take those charts out now and let's talk about them for a while. After students have opened their notebooks to where they have recorded their findings from yesterday, ask:

It is always important to estimate before you measure because that way you will know if you measured wrong. For example, if you estimated an angle to 210° and your measurement came out to be 35° what probably happened? Hopefully students will suggest that when you measured, you forgot to add the 35° to 180°. Continue by saying:

When you make an estimate to get an approximate answer, it is a type of prediction—which you then test by measuring. Then hand out student rulers and say:

Please take out your golf score sheets from yesterday. Pause, then ask: **How many of you consistently made holes-in-one for the first six holes?** (No one.) **How many of you made any holes-in-one?** (Probably no one, or very few.) **What was the biggest measurement problem in getting the ball right in the hole given that you measured angles and distance?** (Getting the distance right, the unit length does not get you exactly to the hole.) Some students may also say measuring angles greater than 180. Then say:

You are right. There is a problem with measuring distance. What strategy did you use yesterday to measure the distance to the hole? Let students share and compare strategies, e.g., we measured the size of the length unit and then marked off the number of units with the ruler, etc.

I am about to make a major prediction. Pause dramatically, then say: **This is the day that you are going to get holes-in-one. In fact, I am so sure that you are ready to play for real that I want you to start saving your games. When you save your games today, that means that when you enter your team name tomorrow you will start from where you left off and get to see the rest of the golf course. To save your game answer 'yes' when the computer asks you if you want to save your game. Then enter your team's name.** Then say:

But first, to get really good scores for your saved holes you need a better strategy for measuring the distance to the hole. Suppose 5 units is too short and six units is too long, if you choose either 5 or 6 you are rounding off the distance which isn't the exact distance. So what type of number do we have to use for the exact length? (Decimal or fraction or percent.) **Unfortunately Pippinochio is not as smart as you and only understands decimals.** Hand out rulers and ask:

If our golf game will accept a decimal what problem do we have measuring distance exactly with this ruler. (It does not have decimals.) **Is there anything on these rulers we can use to indicate a part of an inch?** (Markings for 4ths, 8ths, or 16ths) Then ask:

If we use four equally spaced intervals, what part of an inch is each one? ($\frac{1}{4}$)

Good, but $\frac{1}{4}$ is a fraction. What should I do to get numbers the computer can handle? (Convert the fraction to a decimal.) **How can I do that?** (Use proportions, or use a calculator.)

This is another example where we have to convert from one way of representing parts to another. Hand out copies of the Blackline titled: GOLF Tracing #1, found at the end of the unit and say:

BRAINSTORM:

Using this map of a golf hole, I want you to meet in small groups to see if you can figure out how to use the small marks on the ruler to find the mixed number that is the exact distance needed to get a hole-in-one. Then convert the number to a decimal that is rounded off to one place. You can use the proportion tool on my computer or use your calculators depending on how you choose to do the calculation.

APPROXIMATE SOLUTION—The unit length is 13 tic marks (in terms of sixteenths of an inch), and the distance from the tee to the hole is 5 units and 8 tic marks, or 5 and $\frac{8}{13}$. The ratio $\frac{8}{13}$ is .62 or .6, and the hole is therefore 5.6 units. As students come up, if their answers are less than 5 or more than 6, try to get them to see that approximate distance (without worrying about fractional parts of a unit) is between 5 and 6 units. Then encourage them to go back and try again.

CHALLENGE ACTIVITY:

As teams come up with the correct answer, send them to the computer saying**: Save your game and print out your scores again at the end of the period.**

»» When students are at the computer, make sure that they are correctly converting the partial units into decimals. ««

NEW COMPUTER USE SKILLS: Saving the golf game.

POST-TEACHING: Did anyone get a hole-in-one? (Hopefully, yes.) **What did Pippinochio do when you got a hole-in-one?** (Danced)

HOMEWORK

Practice in Converting Fractions to Decimals. Several of the problems should involve rounding the answer.

Suppose you played 9 holes of golf and had the following scorecard.

Hole	Par	# of Strokes
1	3	2
2	2	5
3	4	7
4	3	3
5	5	3
6	4	9
7	2	3
8	3	1
9	4	6

Calculate how you did:

a) Total number if strokes ________________

b) Average strokes per hole _________________

c) Represent the scores in relation to par as signed numbers, and add the signed numbers to determine the total score (or the total number of strokes) in relation to PAR both as a signed number and as an English sentence.

____

IDEA FORMULATION AND DEVELOPMENT

UNIT TITLE: MEASURING AND USING ANGLES

SOFTWARE: GOLF CHALLENGE

Pre-class setup: Demonstration computer set to any hole, load all student computers with GOLF CHALLENGE by double clicking on the program icon. Draw a diagram on the board of a tee and a hole where the distance is 5.6 units. (Choose your own tool for measuring these units.) Do not label the distance.

Materials: Calculators, student notebooks, protractors, rulers, tracing paper, felt pens.

Lesson #: 5

PRE-TEACHING ACTIVITIES (Demonstrations, linkages, generation of hypotheses):

HW Answers

a) 39 b) 4.33 c) You are adding the following signed numbers: -1 +3 +3 0 -2 +5 +1 -2 +2 The final value is +9, which is 9 strokes above par.

What kind of scores did you get yesterday, and how many holes-in-one did you get? After students respond, continue by saying:

It looks like getting more exact measurements has really helped. Your scores are getting better. By the way, when you measured the hole yesterday it looked something like this. Point to the diagram of the hole on the board. Measure off 5 units from the tee to the hole and then say:

This last piece is about .6 units. Does that mean that the distance is .6? (No, it's 5.6) **That's right.** Then ask:

What do you call a number which is made up of a whole number and a fraction? (A mixed number.) **Good! Take a moment and convert 5.6. What is 5.6 as a mixed number, and as a percent?** ($\frac{56}{10}$ and 560%) After an appropriate pause and discussion, then get a puzzled look, and say:

Wait a minute. I just thought of something. Whenever I see angles in a book they have two lines meeting at a Vertex. That is not true in the golf game. All we have is the golf ball. Where is the angle if there is no vertex or no lines? (The vertex is the golfer or ball, and the sides of the angle are imaginary lines going from the ball to zero or horizontal, and the other going from the ball to the hole.)

That's a relief to know that there really is an angle in the golf game. I guess that sometimes there are real lines in an angle, and other times you imagine one line going out from the starting point and another line from the position where the rotation ends. Continue by saying:

Yesterday we measured the distance of the partial unit as a one-place decimal and the results got better. Would rounding the partial unit to two decimal places be less accurate or more exact than one-place—and why? (It is more accurate since hundredths means that you divide the space into a hundred pieces instead of ten, and each piece is smaller so that you come closer to the real value.)

How many of you were able to get all the way through the first nine holes yesterday? Probably none did. Then say:

One way you can make the game go faster is to click the mouse on the movies of the funny little golfer to make it go away. Try that today and see if you can finish the first 9 holes. Continue by saying:

CHALLENGE ACTIVITY:

I want you to retrieve the game you started yesterday. Tell the computer that you want to save the game, and then on the next screen tell it that you want to CONTINUE AN EXISTING GAME. Then enter the team name you used yesterday. When you finish the first nine holes, print out your team's score. Then if you have time, choose to play the back nine holes, which is golfer talk for holes 10-18. These holes are harder. You will probably find that it is impossible to get a hole-in-one on most holes. At the same time, the more difficult holes will have a higher par. If the hole is a par 3, try to get a two. Then say:

Remember, choose to save your games. I want you to work with your team to figure out good strategies for scoring below par on each hole.

NOTE TO TEACHER: Today the game is going to have trees that the students will have to shoot around. Let them discover this for themselves.

NEW COMPUTER USE SKILLS: Retrieving a saved game.

POST-TEACHING:

What new challenge was thrown at you today and how did you deal with it?
(There were trees in the way for many of the holes, so we often had to make a detour on our first shot to a place on the course that would allow us to shoot straight at the hole.)

HOMEWORK

Give out the Blackline GOLF TRACING #2 (found at the end of the unit) for students to solve.

Suppose you played 9 holes of golf and had the following scorecard.

Hole	Par	# of Strokes
1	3	4
2	2	2
3	4	3
4	3	7
5	5	3
6	4	9
7	2	3
8	3	1
9	4	4

Calculate how you did:

a) Total number if strokes ________________

b) Average strokes per hole _________________

c) Represent the scores in relation to par as signed numbers, and add the signed numbers to determine the total score (or the total number of strokes) in relation to PAR both as a signed number and as an English sentence.

____

EXPERIMENTAL/HYPOTHESIS TESTING AND FORMULATION

UNIT TITLE: MEASURING AND USING ANGLES

SOFTWARE: GOLF CHALLENGE

Pre-class setup: Demonstration computer set to any hole, and Load all student computers with GOLF CHALLENGE by double clicking on the program icon. Have two spots marked on the floor of the room, and a marking on the wall. This is for the bonus stroke problem where students will be at the first spot, facing the wall marking, and will need to measure the angle and distance to get to the second spot.

Materials: A large drawing of a 90 degree angle on a piece of chart paper, a copy of the angle legend chart from the first two days, calculators, student notebooks, protractors, tracing paper, felt pens, several rulers, yardsticks, and tape measures, examples of blue-prints or architectural designs that show angles. These can be found in an issue of Architectural Digest, or any home-building magazine.

Lesson #: 6

PRE-TEACHING ACTIVITIES (Demonstrations, linkages, generation of hypotheses):

Solution to homework problem

The unit of length has 12 tic marks, or is 3/4 or .75 of an inch, and the distance to the hole is 5 unit lengths and approximately 4 tic marks, or 4/12 or .33, so the distance is 5.33 to the nearest hundredth.

Golf scorecard:

a) 36 b) 4 c) +1 0 -1 +4 -2 +5 +1 - 2 0 adds up to +6 or 6 strokes above par.

What special problem did the computer throw at you yesterday, and how did you deal with it? (We had to shoot around trees.) Then ask:

You are getting better at estimating and measuring angles. Good work! There are special names for some of the angles. A 90˚ degree angle is called a 'RIGHT ANGLE'. A 180˚ degree angle is called a 'STRAIGHT ANGLE'. Sometimes names make sense, and sometimes they don't. Why do

you think a 180˚ degree angle is called a straight angle? (It looks like a straight line.) Continue by saying:

So far, all the angles we have been dealing with have been facing to the right. By that I mean, the zero degree angle faces to the right. Do you think that angles must always face the same direction, or that you must always be facing the same way when using or making angles? (No) **How could we demonstrate that?** (You could face a different direction and then rotate your arms, or you could hold the tracing paper and protractor facing a different direction and the angle measure would be the same.)

Let's make sure that angles stay the same when we rotate them. Point to the drawing of the right angle and ask: **What size angle does this look like?** (90˚ or right angle.) Measure the angle and verify that it is 90˚. Then say: **Let's turn it and measure the angle again.** Turn the paper with the drawing of the angle on it and have students come up and measure it, then ask: **Is it still 90˚ degrees?** (Yes) **What does that mean about the measure of an angle?** (It stays the same even when you turn the angle.) Then say:

Let's find some things in the room that make angles. After students respond, refer to one of the angles mentioned, such as a nook in the room, and say:

We have talked about angles as being the amount of rotation, or turning. When we see this angle in the corner of the room, does that mean that the walls have turned? (No) **Then how can that be an angle?** This is a difficult question for the students. Give them time to think about it. (It measures how much turning it would take if the walls did turn, or if we used something that could turn, it measures how much we would have to turn those things.) Demonstrate by taking two rulers, putting them one on top of the other, and then rotating one to make an angle. Then refer to that same angle made with the rulers and say:

Let's measure this angle. To make measurements you have to use tools. How could we measure this angle that I have made with the rulers? (Put a piece of paper under the rulers, trace the angle, then measure it with the protractor.) Then say:

Angles are often not the actual rotation, but how much rotation would have to occur to make certain shapes—even though the lines have not actually rotated. If you have any blueprints or architectural plans which show angles, show them to the students. Then ask:

Today is your last day to practice. Tomorrow you play golf for a grade. To get an A if you need a score of 11 or less on the front seven. How many holes in one will you have to get in order to have a score of 11 or less for seven holes

of golf? (At least 3.) **That means you will have to put all your exact measuring and conversion skills to good use.** Then say:

Choose to save your games again today, and when the computer asks you whether you want to play a new game or a saved game, select the saved game option. Then find your team's name in the computer by clicking on the word 'OPEN' and looking at the list you are shown. Then click 'OPEN' again and the game will begin right where you left off yesterday. If you finish the back nine, you can start playing a new game until I tell you to stop. Send students to the computers.

NEW COMPUTER USE SKILLS: Retrieving a saved game.

NUMBER OF STUDENTS PER COMPUTER: Two-three.

EXPERIMENTAL STRATEGY (Method of data collection):

Practice making more exact measurements and seeing their effect on the score.

POST-TEACHING:

When you play for real tomorrow, do you want your score in relation to par to be plus or minus? (Minus)

HOMEWORK

I. Provide practice in Converting Units of Measure, such as 2.5 ft = ? inches.

II. While we solved the problem of number of units the past several days by using proportion to convert tic marks to a decimal, you can also have solved it by converting both the unit measure and length to inches, and solving by dividing decimals. Find the number of units to the nearest tenth for the following holes:

a) The unit length is 1.8 inches, and the distance to the hole is 7.1 inches.

b) The unit length is 2.3 inches, and the distance to the hole is 11.7 inches.

BRAINBUSTER:

c) The unit length is .2 feet and the distance to the hole is 9.5 inches.

IDEA FORMULATION AND DEVELOPMENT

UNIT TITLE: MEASURING AND USING ANGLES

SOFTWARE: GOLF CHALLENGE

Pre-class setup: Load all student computers with GOLF CHALLENGE by double clicking on the program icon. Have two spots marked on the floor of the room, and a marking on the wall. This is for the second type of angle problem where students will be at the first spot, facing the wall marking (which should not be facing in the same direction as the zero point in the Golf crosshairs), and measure the angle and distance to get to the second spot.

Materials: In addition to the usual assortment of felt tip pens, tracing paper, ruler and protractor templates, you need a tape measure, protractor, and two charts that say:

GOLF SCORING

Score for 7 Holes of Golf:

11 or less	A
12-13	B
14-15	C
16-22	D
More than 22	Q You are banned from golf courses for life.

BONUS STROKES

Measure the angle formed by lining up the first spot marked by the letter A on the floor with the mark on the wall, and the spot on the floor marked by the letter B, and measure the length from A to B in feet expressed as a mixed number.

Lesson #: 7

PRE-TEACHING ACTIVITIES (Demonstrations, linkages, discussion of ideas):

Answers to part II of homework:

a) 7.1 ÷ 1.8 = 3.94 =3.9 units   b) 11.7 ÷ 2.3 = 5.08 = 5.1   c) .2 ft = 2.4 inches 11.7 ÷ 2.4 = 4.875 = 4.9

Today you are golfing for a grade. Then point to the first chart, and say:

This chart shows you how to earn a high grade. As you can see, to get an A you need to get a score of 11 or less for the first seven holes. This will be difficult, but you can get two bonus strokes to help your score. Point to the second chart, and point out the places in the room with the mark on the wall, and the 2 spots on the floor, and say:

If you can do the following measurements, you get 1 stroke taken off your golf score.

<u>CHALLENGE ACTIVITY</u>:

Try to get as good a score as you can for the Front seven. After you have finished seven holes print out your score information and give me the result. Save your game by typing your team's name followed by a capital 'G' for Grade. Then say:

During the period I will call your team over to give you a chance to make your measurements. You can express the length in feet as either a fraction or decimal. To get credit everyone on the team has to participate.

Ladies and gentleman, start your golf course and may you get lots of holes in one.

If time permits, have teams convert their floor length measurement from whichever way they expressed length, e.g., mixed fraction, into the other, e.g., decimal—or visa versa.

You can also let students continue to play additional holes once they have their printout for the first seven holes.

<u>NUMBER OF STUDENTS PER COMPUTER</u>: Two-three.

<u>POST-TEACHING</u>:

Calculate scoring and assign team grades. Then say:

Tonight you get a chance to see how angles and distance can help pilots to keep from getting lost.

HOMEWORK

NAME____________________________________

1) Using the map below, tell in words what direction a plane would have to travel to go from Meigs Field to O'Hare International Airport.

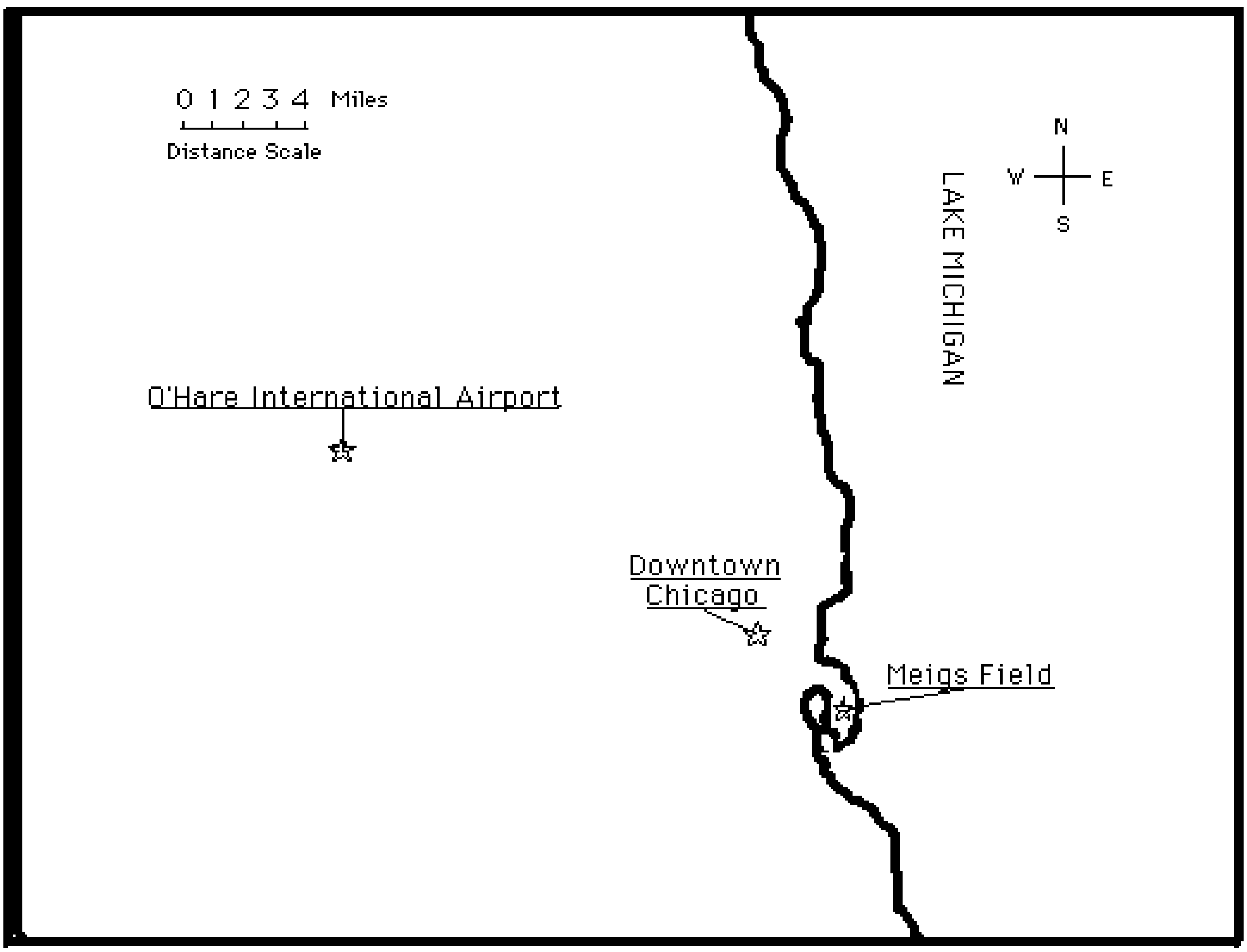
   ____

2) Use your protractor to find the number which tells the angle a plane should travel to get from Meigs Field to O'Hare International Airport. NOTE: For this problem, label N as 0°, E as 90°, S as 180° and W as 270°.

   ____

3) Use the scale of distance on the map and a measuring instrument to give the distance between the two airports. Give your answer in decimal form rounded to the nearest tenth of a mile.

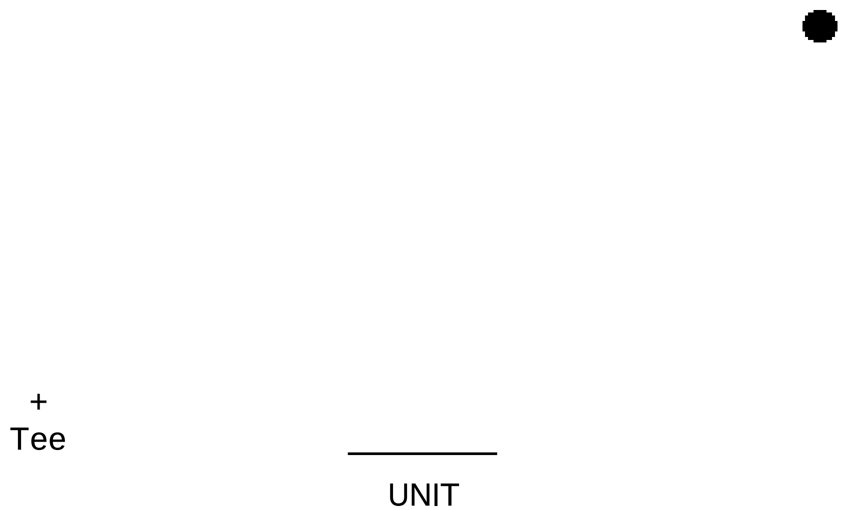
   ____



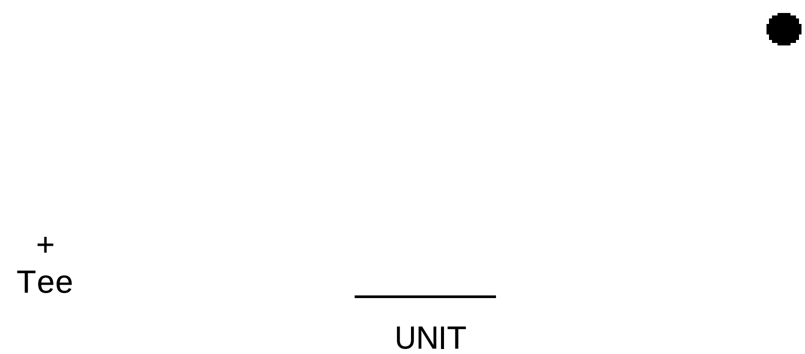
BLACKLINE MASTERS

Blackline Master a	GOLF TRACING #1	Used in leson #4
Blackline Master b	GOLF TRACING #2	Used in lesson #5

GOLF TRACING #1



GOLF TRACING #2



Calculate the distance from the tee to the hole to the nearest hundredths (two decimal places).