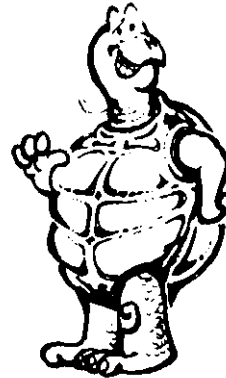


Chapter 2. Making Shapes

Let's play turtle!

You can use your Pencil Turtle, you can use yourself, or you can use some of your friends. In fact, why not try all three?



Rabbit Trail 4. Body Geometry

Can you use your fingers to make a shape that looks like a square? Not too easy, is it.

So try this one...

Get with a friend. Hold you arms out. Can you make a better square now?

Get a bunch of friends together and make a big circle.

Now make a very small circle.

What do you have to do to make a triangle?

Can you make a triangle by yourself?

Or do you need some friends to help you out.



Playing turtle gives you an idea of just what it takes to make different shapes.

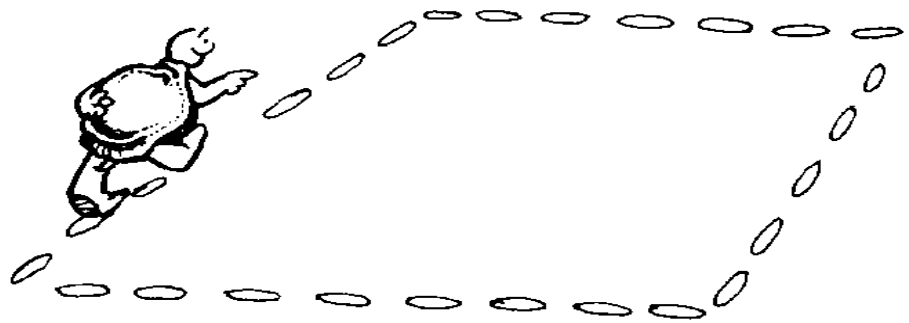
Exploring Squares

Let's start with an easy shape...like a square.

Do you know what makes a square different from, say, a triangle? Or a rectangle? Well, for one thing, all the sides of a square are the same size.

Tell the turtle to go HOME...not on the computer...you're still doing Body Geometry, remember? Pretend that HOME is in the middle of the room or the middle of your paper.

Now...what commands must you give the turtle to draw a square?



1. FORWARD _____ TURTLE STEPS

Are you going to make a **BIG** square or a **little** square?

2. RIGHT _____ TURTLE TURNS

You can turn left if you want. But how many turns do you have to make? 30? 67? 105? 298?

We've already done this, don't you remember? It was when we were talking about turtle turns. If you forget, why not turn back and find it again.

3. FORWARD _____ TURTLE STEPS

Fill in the blank with the same number of steps that you did in step 1.

4. RIGHT _____ TURTLE TURNS

How many turns should you make here? Should this be the same number of turns as you made in step 2?

5. FORWARD _____ TURTLE STEPS

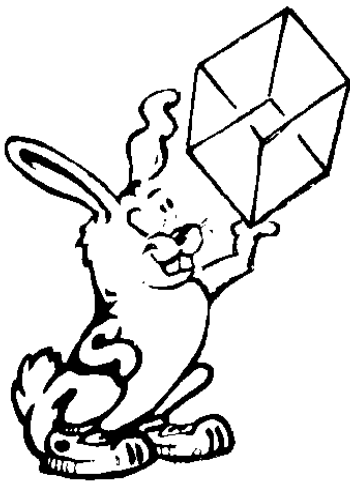
You should already know how many steps to go this time.

6. RIGHT _____ TURTLE TURNS

How many turtle turns this time?

7. FORWARD _____ TURTLE STEPS

8. RIGHT _____ TURTLE TURNS



What did you discover about a square?

Making Shapes

Sure, the four sides have to be the same. But what about the corners? Do they have to be the same? Why?

Simple. If they're not the same, you'll end up going off in some strange direction and never make it back HOME.

Let's try this on the computer.

Click on the MSW Logo icon to open MSW Logo. Then type your commands in the Input Box.

FD _____ RT _____ FD _____ RT _____

FD _____ RT _____ FD _____ RT _____

Wow! All the sides and all the corners have to be the same. But that's a lot of typing when you do that three or four times. There has to be an easier way!

Repeating Commands

Look at all those commands. Do you see what you did? You repeated the commands FD _____ and RT _____ four times. So let's try a new command...



REPEAT 4 [FD 100 RT 90]

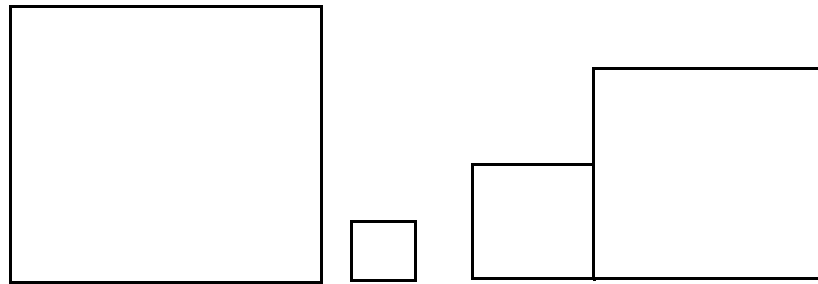
This tells the turtle to **REPEAT** the commands inside the brackets four times. Brackets look like square parentheses...[]. More about these in the next chapter.

OK, let's try some other squares. You fill in the steps. The number of turns has to be 90, right?

REPEAT 4 [FD _____ RT 90]

Make a great big square!

REPEAT 4 [FD _____ RT 90]

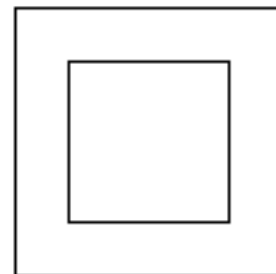


Make a little bitty square!

REPEAT 4 [FD _____ RT 90]

TERRIFIC!

Now for a tough one. Put a square inside a square? That means you have to draw a big square, pick the pen up, move inside the big square, and draw a little square.



I left out one of the steps.

Think about it. Which one is it?

Making Shapes

Draw a big square. Pick the pen up. Move inside the big square and draw a little square. You can't draw another square until you put the pen back down, right?

OK, no more tricks. Put the pen down and then draw a little square.

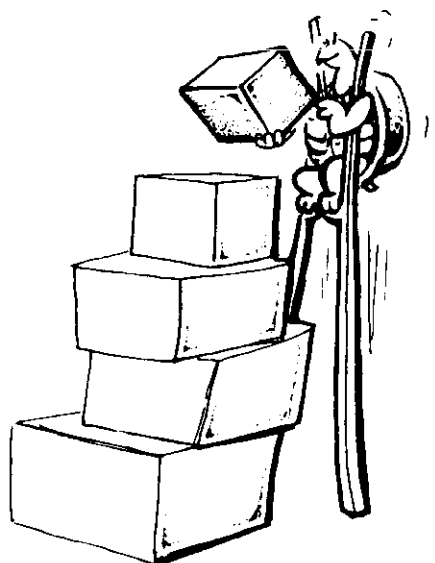
Adventures with Squares

There's lots of things you can do with squares.

Draw a little square first and then draw a big square around the outside.

Draw a big square and then put a little square in the corner.

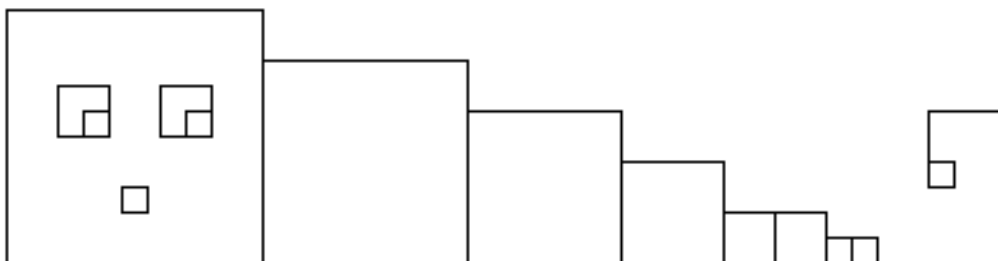
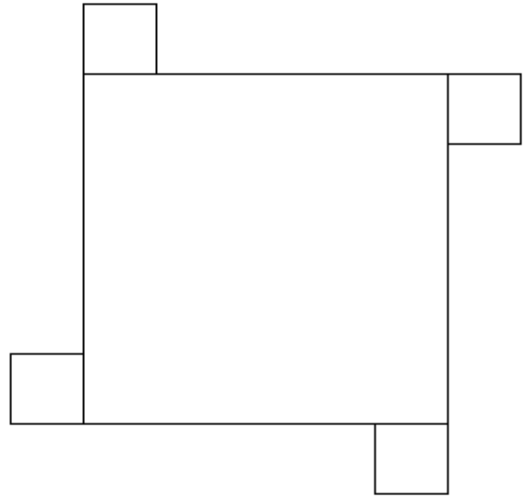
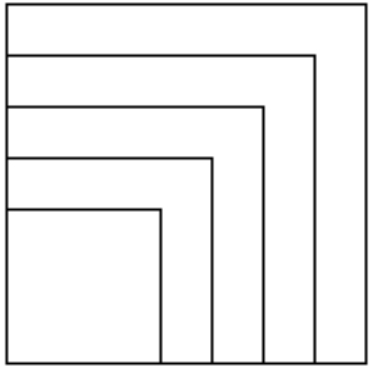
Draw a big square and then stack some other squares on top of it...like stacking up boxes.



What else can you do with boxes?

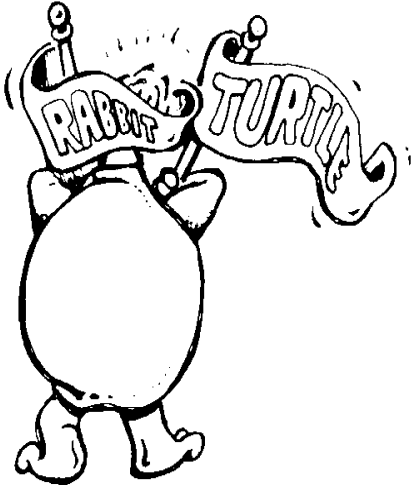
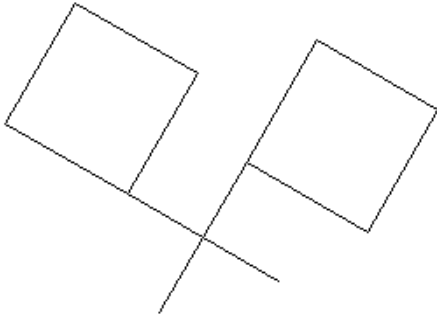
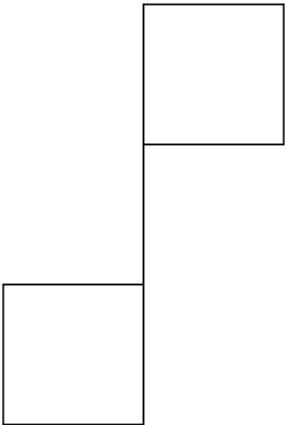
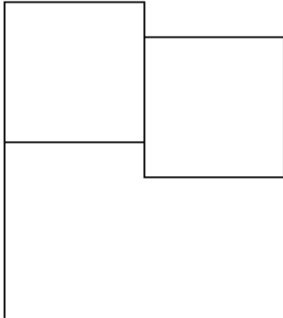
**“Take a look at these pictures. Can you make these?
What’s the same about them? What’s different?”**

“What other things can you make?”

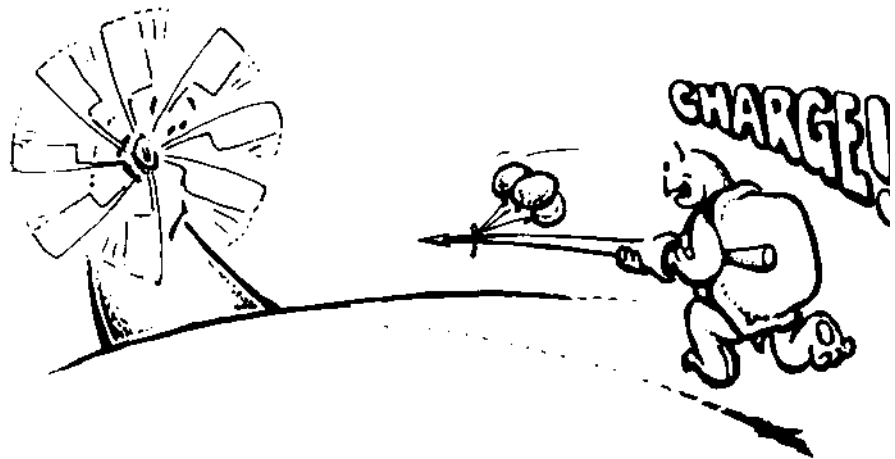
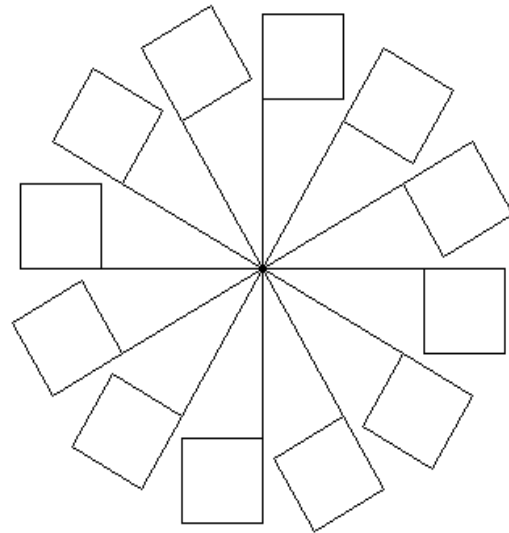


Making Shapes

How about flags?



A windmill?

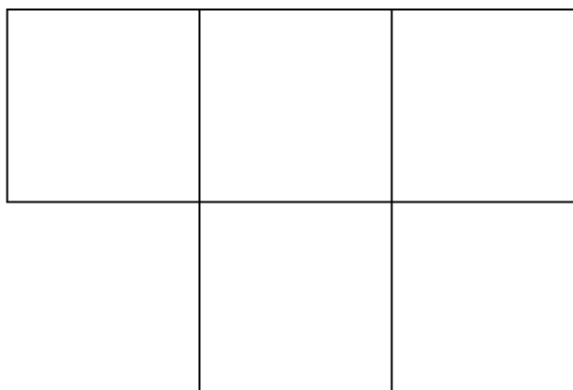


Don't forget to write down your ideas. You may just want to use some of these ideas later on.

Rabbit Trail 5. Logo Puzzles

Here's a puzzle for you.

Look at this picture.



It looks like four squares hooked together, doesn't it.

Get some straws or some sticks and make this puzzle on a table top. Now...take away just one straw or stick so that there are only three squares left.

Can you do that?

You can also try solving the puzzle by drawing it on paper or on the computer. Later, after you learn about writing procedures, we'll show you how to have the turtle solve the puzzle for you.

Adventures with Triangles

Now...ready to tackle a triangle? What makes a triangle different from a square?

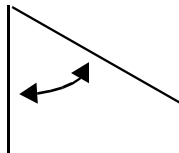


That's right, a triangle has three sides and three corners. A square has four of each...four equal sides and four equal corners or angles.

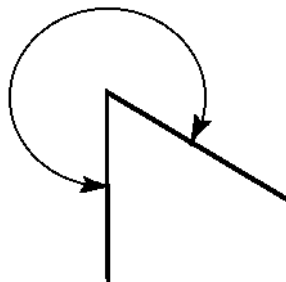
Working With Angles

There's a new word for you. Angles! Is that something like a corner?

Draw a line. Turn a number of turtle turns and draw another line. Make it any number of turns.



Just like magic...there's an angle between the lines, right? But what about on the outside? Is that an angle, too?



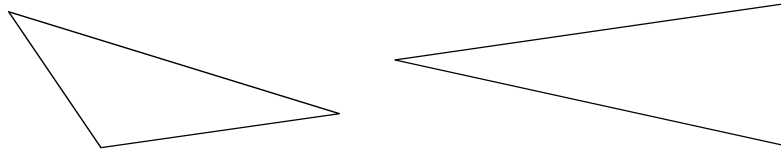
Sure it is. It's just a big angle.

Wow! That's a lotta turtle turns!

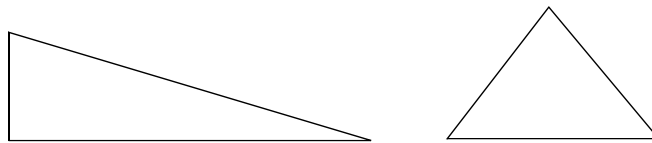
Making Shapes

Morf calls them turtle turns. Some other people call them “degrees.” More about degrees later.

Now, what about a triangle? Do all the sides and corners have to be the same or can they be different?



If you said the sides and the corners can be different, give yourself a big Gold Star! But there's a funny thing about triangles. If all the sides ARE the same, can the angles be different?



Give yourself another Gold Star if you said, No!

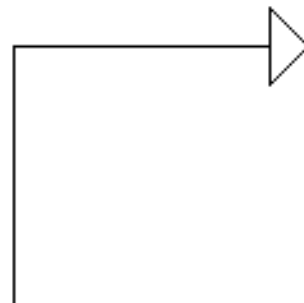
But how do you know? If all the sides are the same, why do the angles have to be the same? Let's explore some triangles and see if we can figure this out.

Get MSW Logo up and running. Let's start where we left off with the squares.

FD 100

RT 90

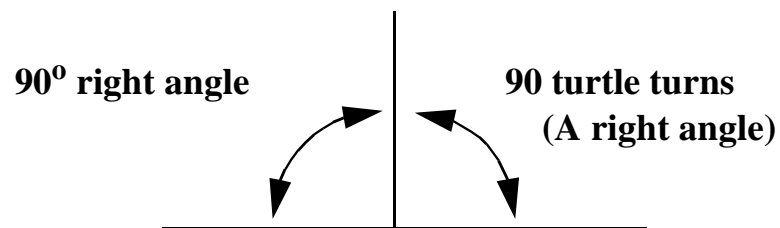
FD 100



OK! Now you have two sides and one angle on the screen. That angle has a special name. It's called a Right Angle.

"I know," Morf chimed in. "That's because the turtle goes to the right!"

"No, I'm afraid not, Morf. They call it a right angle because it has 90 degrees. You can make a right angle by turning left. I know that sounds crazy. Just trust me.

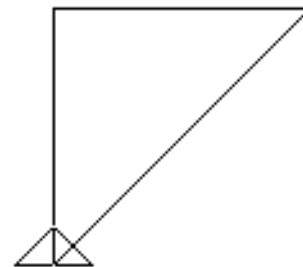


When you talk about degrees, you use that little ^o symbol. You'll hear more about angles and degrees later. For now, let's get back to triangles."

A triangle has three sides and three angles. So, let's make the corner into a triangle.

The easy way is to just type HOME.

There's a triangle, three sides and three angles. We know for a fact that two of the sides are equal. You typed FD 100 two times, right?



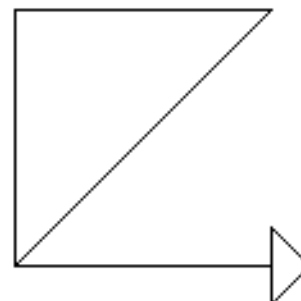
Look at the angle down near HOME. Compare that with the one in the upper right corner.

Making Shapes

Do they look to be the same? Are they the same as the corner you made when you went RT 90?

With the turtle at HOME,
type...

RT 90 FD 100



Hey! That looks like three sides of a square. What commands do you need to finish the square? RIGHT 90 sends you in the wrong direction. So try...

LT 90 FD 100

Now you should be at the upper right corner of a square that is also two triangles, correct?

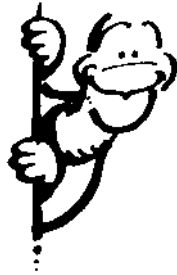
Hiding the Turtle

To see your drawing more clearly, let's try a new command. Type **HIDETURTLE** and press Enter. Ernestine disappears! You can abbreviate **HIDETURTLE** by typing **HT**.



Now type **HOME**.

To see the turtle again, what do you think the command will be? Sure, **SHOWTURTLE**.

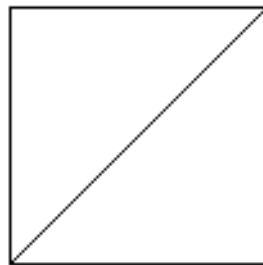


SHOWTURTLE - ST



HIDETURTLE - HT

OK, the turtle is back home. And there's two triangles and a square on the screen. Wow!



Look at the angles there at HOME. Compare them with the angles in the upper right corner of the square. Do all four of the angles look the same?

You're right. They are the same. Let's check this out.

Type CS to clear the screen and take the turtle HOME. Then type...

REPEAT 4 [CORNER] to draw a square.

Now turn RIGHT 45 and go FD 200. What happened? The turtle drew a line right through the upper right corner. Now type HOME and then type...

REPEAT 2 [CORNER]

This takes you to the upper right corner of the square with the turtle facing the bottom of the screen.

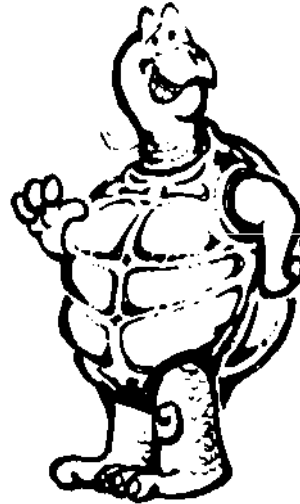
Making Shapes

Again...turn RIGHT 45 and go FD 200...just like you did before. What happened?

The same thing, right? Only this time the turtle drew a line through the lower left corner.

Do you think we can make a rule from all this?

I think so. Seems to me that when a triangle has two equal sides, you're going to have two equal corners or angles. In the example above, you turned RT 45 twice, correct?



Just to make sure, let's try another triangle. Clear the screen. Then try this...

FD 100 RT _____ FD 100 HOME

Add any number you want. Do you see two equal sides and two equal angles there on the screen? Try it again a few times...just to be sure. Use lots of different numbers for the turtle turns.

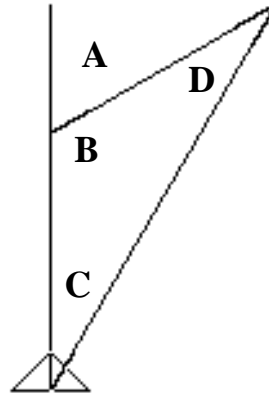
FD 100 RT _____ FD 100 HOME

FD 100 RT _____ FD 100 HOME

FD 100 RT _____ FD 100 HOME

Seems to work, doesn't it.

Do you notice anything else about your triangles?



First you went FD 100. Then you turned right and went FD 100 again. This created the angles A and B in this drawing. When you went home, you created the C and D angles, right?

Now let's try something. Type...

FD 100 RT 60 FD 100 HOME

Now type...

RT 60 / 2 FD 200

That's 60 divided by 2...FD 200.

WOW! The angle C is half the number of turns to draw angle A. What about angle D? Type...

FD 100 RT _____ FD 100 (Fill in a number.)

Making Shapes

Now type `RT 180 - _____` Fill in the number of turns you just made. What happened? Is the turtle facing the bottom of the screen?

Hmmmmm...this is getting interesting. Now type...

`RT _____ / 2 FD 200`

Fill in the number of turns you made above and divide it by two and then go `FD 200`. What happened?

DOUBLE WOW!

You're discovering all sorts of things about triangles!

Take another look at the triangle drawing on the last page, the one with angles A, B, C, and D. What do you know now?

Angles A + B = 180

Angles C + D = Angle A

Angle C = Angle D

If all this is true, then...

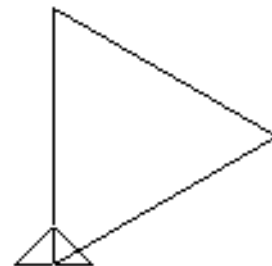
Angles B + C + D = 180

So...the sum of all the angles in a triangle equal 180. But before we look at more rules...

Try this one...

`FD 100 RT 120 FD 100 HOME`

Do you see anything different about this triangle?



Let's check this out. Type...

RT 60 FD 100

What happened? Where's the turtle? Seems all three sides are equal now, aren't they? And if the sides are equal, what about the angles?

Well, that's easy to check, too! All you have to do is use the **REPEAT** command to draw three sides and three corners.

REPEAT 3 [FORWARD 100 RIGHT 120]

Wow! It works! And just to be completely certain, let's go back to the triangle with two equal sides. Clear the screen and type...

FD 100 RT 90 FD 100 HOME

Now let's check that last line. Turn **RIGHT 45** and go **FORWARD 100**. Did this take you back to the other corner?

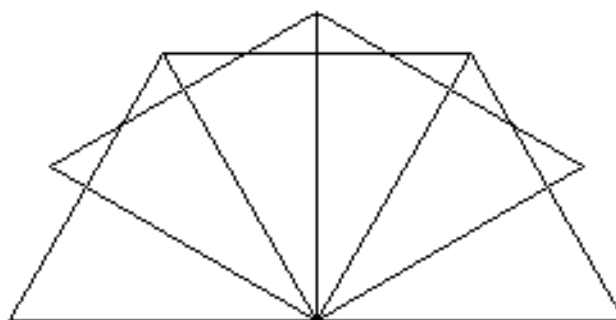
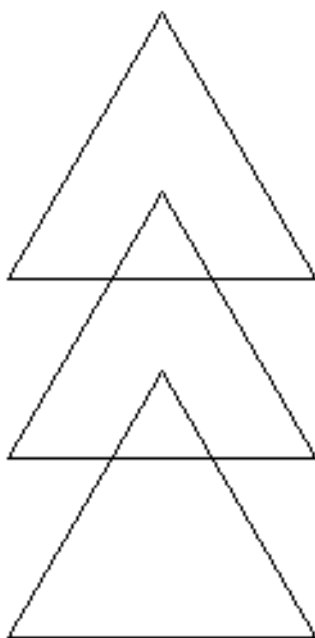
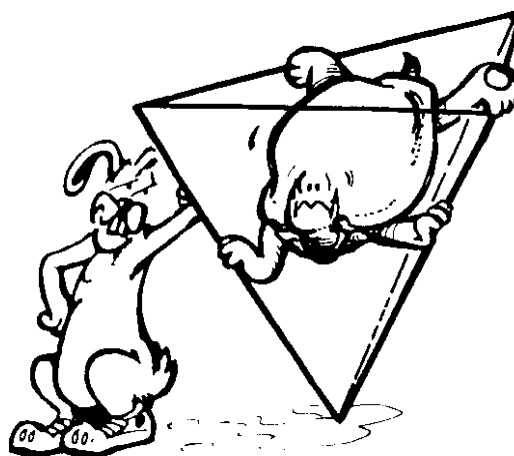
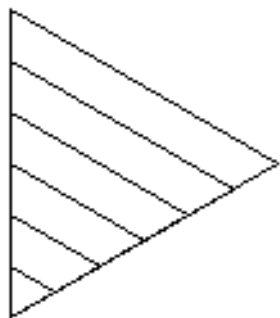
Rules for Triangles

No, not quite. So, looks like you proved something about triangles.

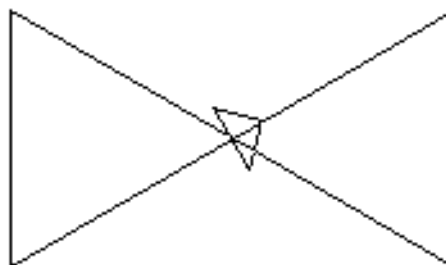
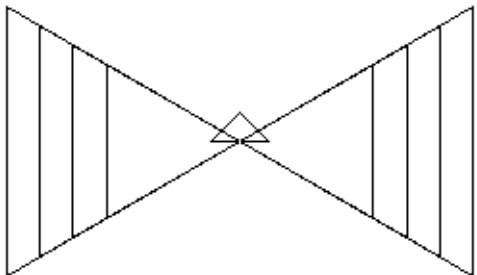
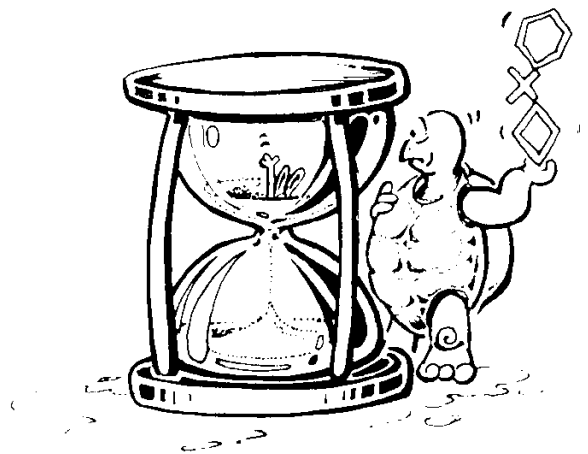
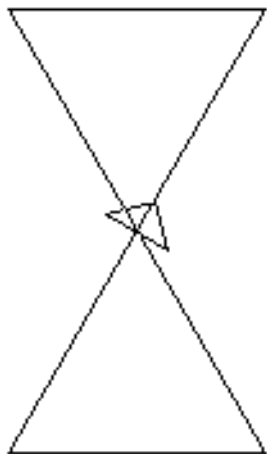
1. If you have three equal sides, you'll have three equal angles.
2. If you have two equal sides, you'll have two equal angles.
3. If you have no equal sides, none of the angles will be equal.
4. The sum of the three angles in a triangle equal 180 degrees.

Making Shapes

Looks like Logy got into a bit of trouble exploring triangles. How about you?

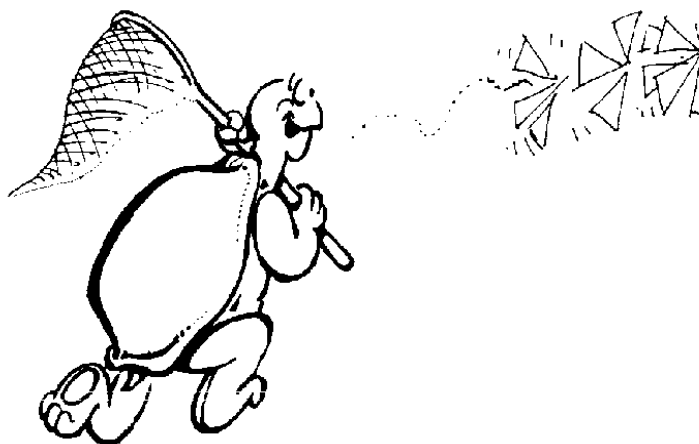


What about an hourglass?



Looks like a bowtie!

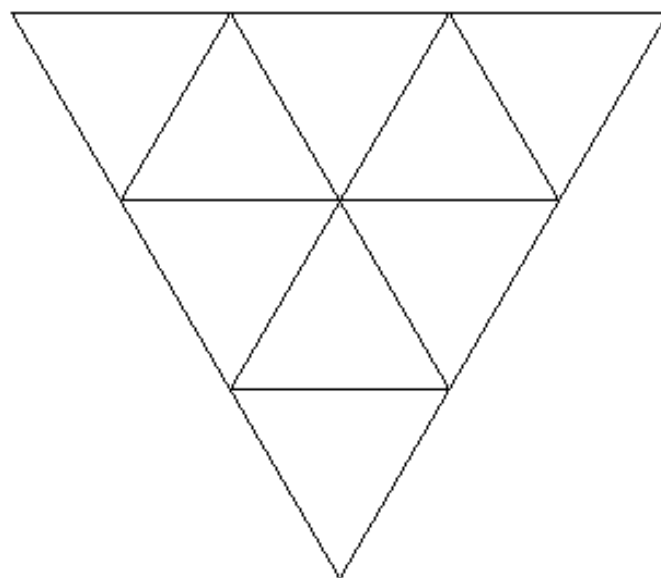
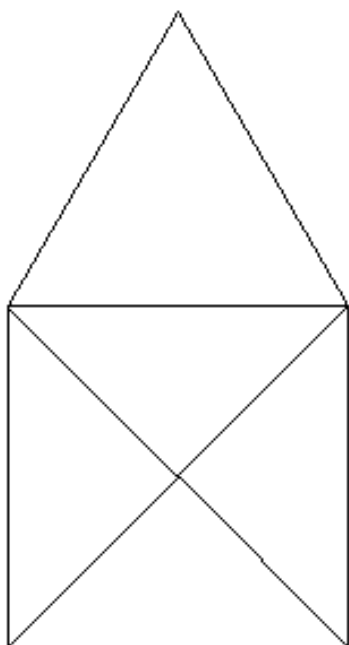
Try a butterfly?



Rabbit Trail 6. More Logo Puzzles

Here's some more Logo puzzles to do using a pencil and paper.

Draw each of these figures without retracing any line, and without lifting your pencil from the paper. Later on, you'll find Logo procedures that will solve the puzzles for you.

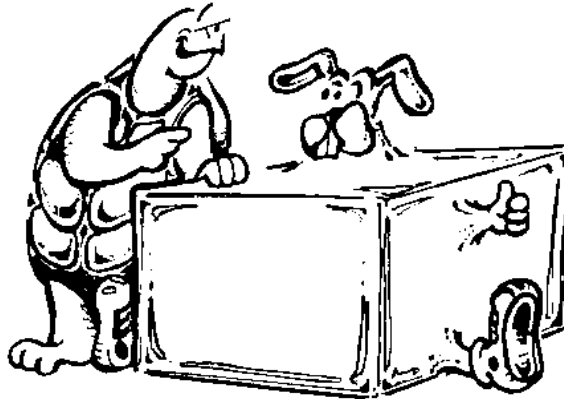


Adventures with Rectangles

Speaking of rules, what about squares and rectangles? We know a square has four equal sides. And, because the four sides are equal, the four angles are equal.

What makes a square different from a rectangle? Or is it different?

I'm confused!



“Morf, seems like you got yourself into a box; I mean it looks like the box got into you!”

Let's figure all this out.

To start, let's draw rectangles. You fill in the blanks.

Rectangle #1

Rectangle #2

FD _____

FD _____

RT _____

RT _____

FD _____

FD _____

RT _____

RT _____

FD _____

FD _____

Making Shapes

RT _____ RT _____

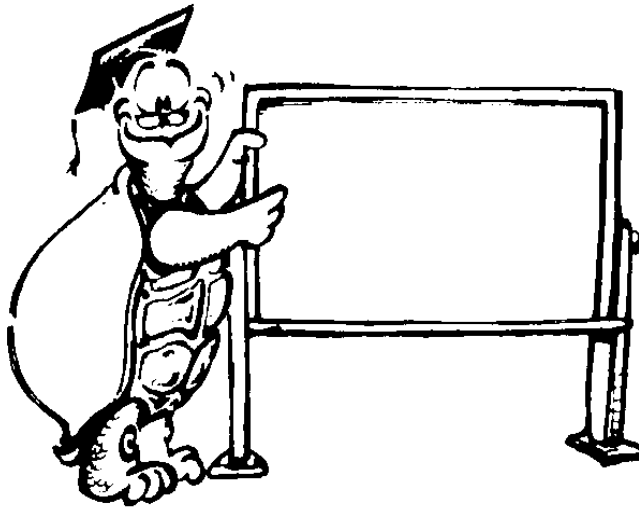
FD _____ FD _____

RT _____ RT _____

What rules did you discover when trying to draw a rectangle?

Can you draw a rectangle where all four sides are different lengths? Not very easily, right?

Can you draw a rectangle with only two equal sides...the other two would be unequal? Nope, that didn't work either, did it.



What about this blackboard? Is that a rectangle?

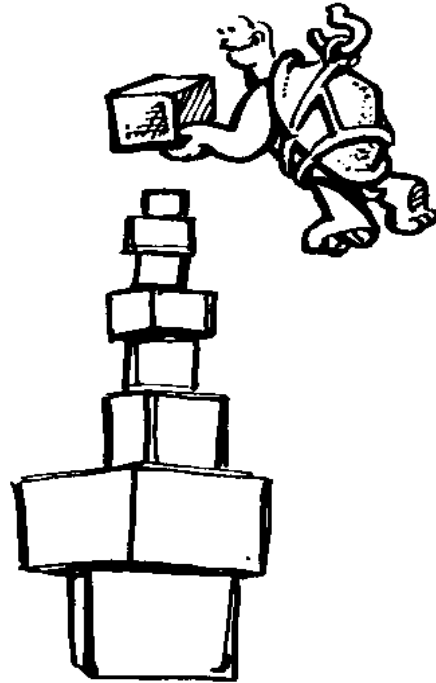
Can you draw a rectangle that has two sets of equal sides; where two sides are 100 steps long and two other sides are 200 steps long?

Yes! That's something you can do!

What does this tell you about the angles? They all have to be 90 turtle turns, or 90 degrees...just like the square.

Go ahead.

Try stacking up some rectangles.



REPEAT 2 [FD _____ RT 90 FD _____ RT 90]

REPEAT 2 [FD _____ RT 90 FD _____ RT 90]

REPEAT 2 [FD _____ RT 90 FD _____ RT 90]

REPEAT 2 [FD _____ RT 90 FD _____ RT 90]

REPEAT 2 [FD _____ RT 90 FD _____ RT 90]

What happens when you make the number of turtle steps the same for both blanks? You got it! That's a square!

Making Shapes

Rectangle Rules

So, I guess you can make some rules about rectangles and squares.

- 1. A rectangle has to have four equal angles and four sides.**
- 2. A square is a rectangle with four equal sides and four equal angles.**
- 3. A rectangle has two sets of equal sides.**

One more thing...what's the sum of the angles of a rectangle?

Awfully simple? Or simply awful?

Rabbit Trail 7. Logy's Oneliners



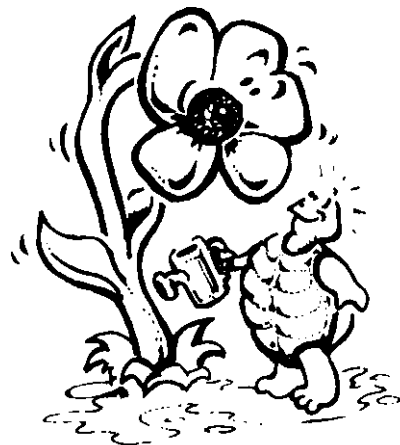
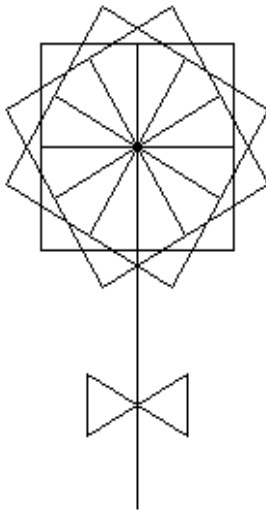
OK, so this one isn't off the computer. But it's a Rabbit Trail just the same. And it gives you the chance to use your shapes commands.

Think about all the things you know how to do now. You can move Ernestine around the screen. You can draw squares, rectangles, and triangles using the REPEAT command. Why not put them all together in a Big, Fantastic, Gorgeous "oneline."

What's a "oneline?" Well, why not start with this one. It uses a square.

REPEAT 12 [REPEAT 4 [FD 100 RT 90] RT 30]

Add a stem and it looks like a flower, doesn't it?



Making Shapes

```
REPEAT 6 [FD 100 [REPEAT 6 [FD 10 BK 10 RT 60]
BK 100 RT 60]
```

What's that look like?

```
REPEAT 6 [FD 100 REPEAT 60 [FD 20 BK 20 RT 6]
RT 60]
```

What about this one?

All of these are nice shapes. But why not some crazy shapes...just to discover what you the turtle can do.

```
REPEAT 12 [FD _____ RT _____ BK _____ LT _____]
```

Now...why not see who can come up the prettiest or the fanciest “one-liner.”

Try It on Paper

Dreaming up one-liners can be tough sometimes. So why not try it on paper?

Draw a design or a picture using just one shape. Earlier in this chapter, you saw a caterpillar made from squares.

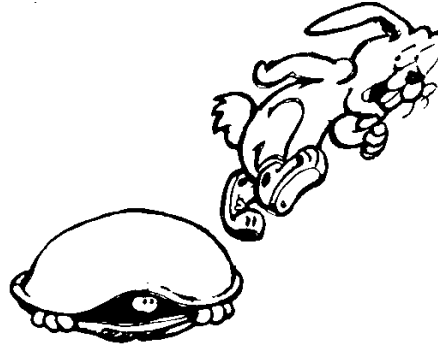
Now...what can you do with triangles or rectangles?

A young lady in the third grade drew a cat using just triangles. Then she drew it on the computer so she could print it to show to her family.

Think of what you can do with just one shape?

Let's Review

This is really like a test...to see if you know where to find the answers if you need to. Sometimes it is more important to know where to find answers than it is to know the answers.



Anyway, we call this a Review because when I mention the word, "Test," Morf runs off and hides.

A square has _____ sides and _____ angles, all of which are _____.

A triangle has _____ sides and _____ angles.

A rectangle has _____ sides and _____ angles, all of which are _____.

To make the corner of a square, you have to turn _____ turtle turns.

To make the corner of a triangle with equal sides, you make _____ turtle turns.

If you add up all the angles of a square, you get _____.

$$\underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

If you add the angles of a triangle, you get _____.

Making Shapes

$$\underline{\quad\quad} + \underline{\quad\quad} + \underline{\quad\quad} = \underline{\quad\quad}$$

If you add up all the angles of a rectangle, you get _____.

(That's just like a square and you've already done that, right?)

Now...look at your answers. See something strange there? Do you think that may be important? We'll see later on. We've got lots more to learn about shapes.

Rabbit Trail 8. Clocks and Walnuts and Other Stuff



Do you need some help understanding angles, degrees, and things?

Well, here's some ideas you can use to make some sense out of this.

The Turtle's Clock

Let's start with a clock. If you can tell time, you can understand angles and degrees.

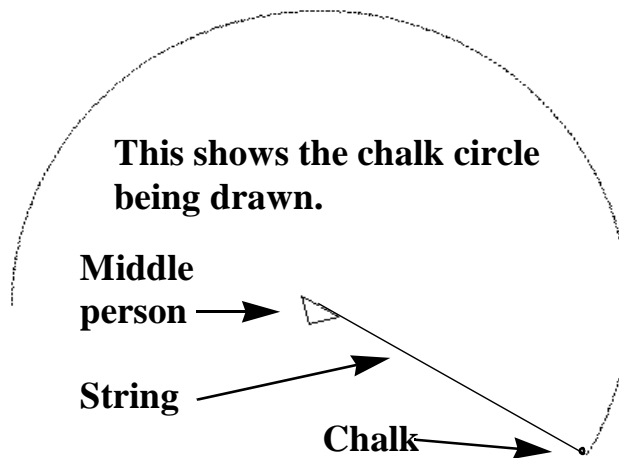
You'll need some help from your friends or the others in your class. You'll also need a large room or a big space outside. The last thing you'll need is a long piece of string or rope; at least as wide as your circle will be.

The first thing to do is draw a large chalk circle on the floor.

1. Have one person hold the string down on the floor in the center of the room.
2. Stretch the string out to where you want the edge of the circle to be.
3. At the edge of the circle, wrap the string around the

chalk a few times.

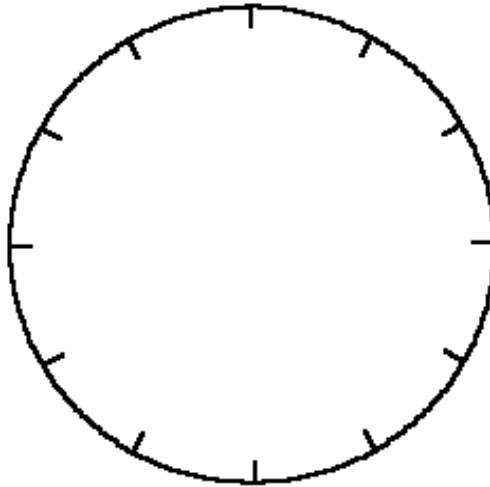
4. With the chalk on the floor, keep the string tight and walk in a circle around the person in the middle. Make sure the middle person turns with you so the string doesn't get wrapped around their legs or something.



5. When your circle is complete, stretch your string across the middle of the circle from top to bottom.
6. Mark the top and bottom positions on the circle as 12:00 o'clock and 6:00 o'clock.
7. Stretch the string across the middle of the circle from side to side. This should divide the circle into four equal parts. Mark the side positions as 3:00 o'clock to the right of 12:00 o'clock and 9:00 o'clock to the left.
8. With the string stretched across the center of the circle, mark off the positions for 1:00 o'clock and 7:00 o'clock, 2:00 o'clock and 8:00 o'clock, 4:00 o'clock and 10:00 o'clock, 5:00 o'clock and 11:00 o'clock.

Making Shapes

Now you have a clock face on the floor.



If you're at Home facing 12:00 o'clock, what time will it be if you turn RIGHT 90? 3:00 o'clock, right?

If you turn RIGHT 90 again, what time is it? 6:00 o'clock, right? Turn RIGHT 90 again and it's 9:00 o'clock. Turn RIGHT 90 again and you're back at 12:00 o'clock again.

You turned RIGHT 90 four times for a total of 360° or 360 turtle turns. There's that number, 360, again.

Standing at Home and looking at 12:00 o'clock, turn to 1:00 o'clock. If it's 90 turns to 3:00 o'clock, how many is it to 1:00 o'clock? To 2:00 o'clock?

Look back to 12:00 o'clock. How far will you have to turn to look at 6:00 o'clock? How far is it if you turn right? If you turn left? It's the same, isn't it...180 turns each way.

Let someone else have a turn playing turtle.

If that person faces 6:00 o'clock and turns RIGHT 90, where are they facing? Remember the turtle turns from the direction she is facing, so it's 9:00 o'clock.

Don't just play using RIGHT or LEFT 90. What's the turn from 4:00 o'clock to 8:00 o'clock? From 1:00 o'clock to 10:00 o'clock?

Try out all sorts of turns in both directions. Here's your chance to get used to working with many different angles.

There's a clock face with hands on the next page that you can cut out and use for practice. Make copies of the page so that you and your friends can each have your own clock.

Use the clock with the hands that are included. Or use your pencil turtle or the walnut turtle described below.

The Clock on the Computer

Write the numbers 1 through 12 on small stickers you can put on the screen. Start with the turtle at Home and have one of your friends type FD 200 BK 200. Put the 12:00 o'clock sticker at the top of the first line. Have the next friend type RT 30 FD 200 BK 200. Put the 1:00 o'clock sticker at the end of this line. Continue like this all the way around the circle until you have all twelve numbers on the screen.

Does this look like a clock? Have fun with it!

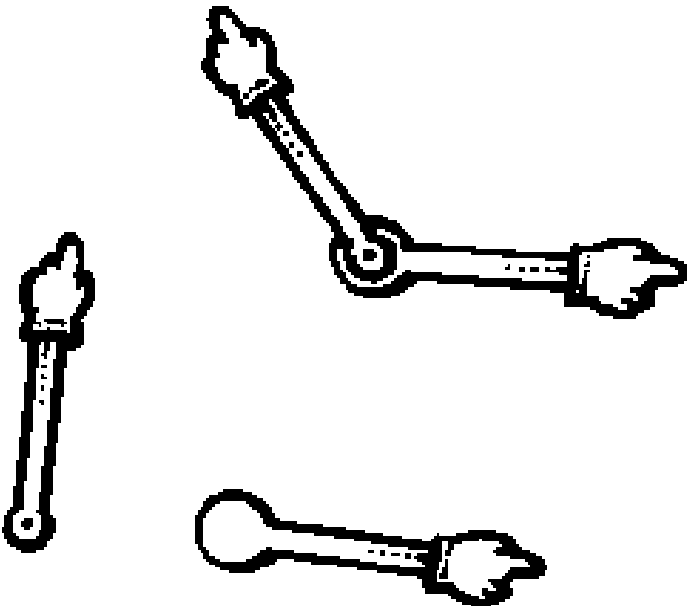
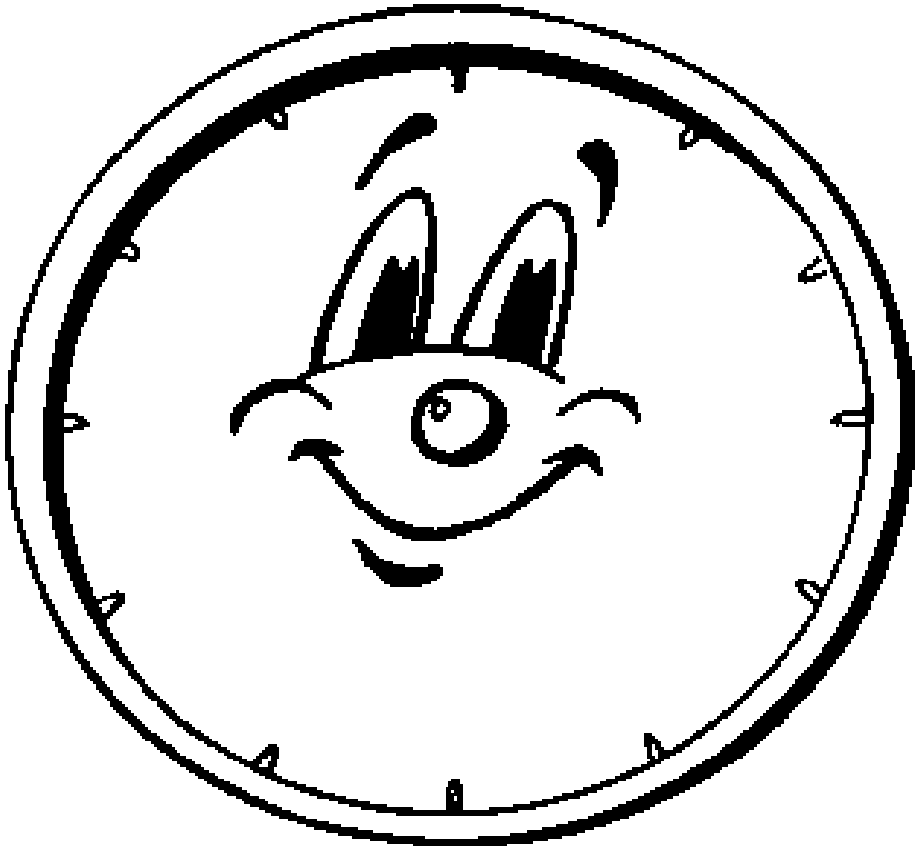
Now you can play SIMON SEZ or MOTHER, MAY I on the computer using times instead of distances.

Simon Sez turn to 4:30

Simon Sez turn to 11:00

Turn to 9:00

Making Shapes



Rabbit Trail 9. Walnut Turtles and Turtle Town

You've already made a Pencil Turtle. How about a Walnut Turtle?

Carefully crack open a walnut so that you don't break the shell. You can then glue the walnut shell to the pencil turtle shape and move it around to try out different actions.

If you don't have any walnuts, try cutting an egg carton apart. The sections that the eggs sit in make good turtles too.

Exploring Turtle Town

Sometimes a local printer has extra sheets of paper; really big sheets where you can draw your whole neighborhood. Some print shops use rolls of paper and they'll let you have the end of a roll.

Draw your neighborhood. Then use your walnut turtle to go see your friends, to go to school, or to go to church.

You and your friends can make up your own town and then make up a game. Make sure that you include some diagonal streets so that all the turns aren't 90 degrees.

Starting from Home, who can go pick up a pizza, go to the grocery store, and stop at the Post Office without making any mistakes?

To make things interesting, you can add road repairs so that players have to move around it. You can add penalties if players don't stop at a Stop sign.

There's all sorts of things you can do in Turtle Town. Use your imagination.

Here's something else to try.

Get yourself some clear plastic sheets. Then draw Turtle Town on these sheets and tape them to the screen. Now you can program the turtle to move around through your Turtle Town.

Making Shapes

