MAD SCIENTIST'S GUIDE

AGES 8 AND ABOVE

Widget WORKSHOP™
THE MAD SCIENTIST'S LABORATORY

MAXIS

SOFTWARE TOYS FOR KIDS

The Mad Scientist's Guide to

Widget WORKSHOP

THE MAD SCIENTIST'S LABORATORY

by
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Introducing Widget Workshop

What Is Widget Workshop, Anyway?

Widget Workshop is your very own mad scientist's laboratory. It's a special place inside your computer that you can go to play with all sorts of parts and pieces and hook them all together to see what happens.

What's a Widget?

A widget is anything you build in your Widget Workshop! Widgets can be puzzles, experiments, silly machines, strange inventions or anything else you can think of. There are hundreds of parts and pieces in the workshop—you can build millions of different Widgets.

What Can I Do With Widget Workshop?

You can solve the pre-built Widget puzzles—and make up your own puzzles to stump your friends. You can create Widgets to carry out experiments to solve science problems. You can create your own weird and wondrous Widgets that do almost anything (or nothing at all)! You can just play with science and have fun.

And you can save your Widgets in a special way so they will run on your friends' and your school's computers—even if they don't have Widget Workshop.

Hey! Wait a Minute!
Fun With Science???

That's right! Widget Workshop lets you have fun playing with science. We've all heard people say that science is too hard—or just plain boring. But those people are wrong! They just don't know what science is really about.

Science is about all these things and a lot more:

- Rockets
- Ecology
- Bugs and germs
- Plants and animals
- Airplanes and helicopters
- Brains
- Thoughts and dreams
- Nurses and doctors
- Planets and stars
- Strange sounds
- Movie monsters
- Soil erosion
- Explosions
- Slime and worms
- Dinosaurs
- Computers
- Machines
- Numbers and math
- Climate and weather
- Rocks and minerals
- Waves and vibrations
- Video games

But above all, science is the real magic in our world. And science is fun—if you look at it right. And the most fun way to look at science is from the point of view of a mad scientist.

What's All That
Other Stuff in the Box?

There are a number of different Exploration tools in the box to play and experiment with. They can be used by themselves, or along with computer widgets. An explanation of all the tools and toys—and some fun ways to use them—can be found later in this guide, and in the Widget Activities and Experiments Book.

How to Become a Mad Scientist Without Really Trying

Here are the 25 steps to becoming a first-rate Mad Scientist Level 1. Once you complete all these tasks, you will have earned your Certificate of Mad Scientism (on the inside back cover of this guide). You'll be ready to join the Mad Scientist Hall of Fame, take over the world, and advance to the Widget Activities and Experiments Book for more fun, more science and more madness.

Widget Workshop has two main sections: Puzzles and Free Play. In the Puzzles section, you can load in different puzzle widgets and solve them by fixing or finishing the widgets. In Free Play you can do or make anything you want: puzzles, experiments or whatever.

All of the following steps to becoming a mad scientist take place in the Free Play section. If you follow all the steps, you'll know everything you'll need to know about Widget Workshop. But if at any time along the way you want to try some puzzles, go ahead. If you get stuck, come on back.

As you advance through these steps:

Instructions for you to follow will appear in text that looks like this.

Explanations and background information will appear in text that looks like this.

Good luck! And if you get stuck, don't get angry—get mad!

Step 1. Install and Start Widget Workshop

The Quick Start Guide in the Widget Workshop box has complete instructions for installing and starting Widget Workshop on your computer.

Look at the Quick Start Guide now and follow the instructions in the section called Installation and Starting. Once you've got Widget Workshop up and running, you'll be ready for Step 2.

Step 2. Take a Quick Tour of Your New Laboratory

The first things you see when you start Widget Workshop are the Maxis Software Toys™ for Kids logo and the Elliott Portwood logo. Next, you'll see the Widget Workshop title screen. This screen will go away all by itself after a few seconds, but you can hurry it on its way by clicking your mouse button.

Now you will be given a number of choices.

Click here to quit Widget Workshop.

Click here to solve widget puzzles.

Click here to load a widget that you have already saved.

Click here to create a new widget.

Since we haven't saved any widgets yet, and we don't want puzzles at the moment, and we certainly don't want to quit Widget Workshop, there's only one thing to do:

Click on NEW WIDGET.

Soon you will see your Widget Workshop laboratory.

Menu Bar ——

Control Box ——

Tooltray
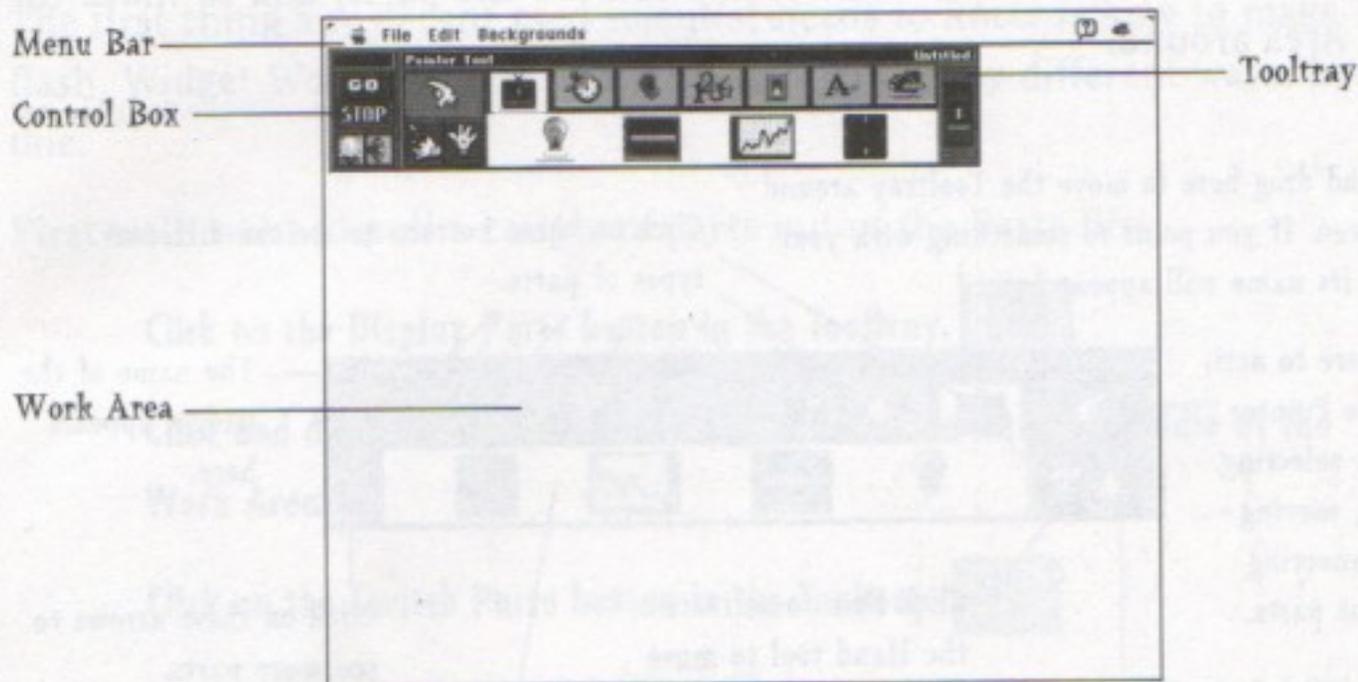
Work Area ——

There are four areas in your Widget Workshop:

The Menu Bar is where you access the menus. Your Menu Bar may look a little different, depending on your computer.

The Work Area is where you build your widgets.

The Control Box lets you start and stop widgets and control sound and lighting.

Click and drag here to move the
Control Box around the screen. ——

—— Click here to make your widget GO!

Click here to make your widget STOP! ——

Click here to switch the background
between light and dark. ——

—— Click here to turn the sound on and off.

The Tooltray lets you select the different parts for your Widgets, and choose the different tools to move, connect and remove the parts, and to move the Work Area around.

Click and drag here to move the Tooltray around the screen. If you point to something with your mouse, its name will appear here.

Click on these buttons to see the different types of parts.

Click here to activate the Pointer tool for selecting, placing, moving and connecting different parts.
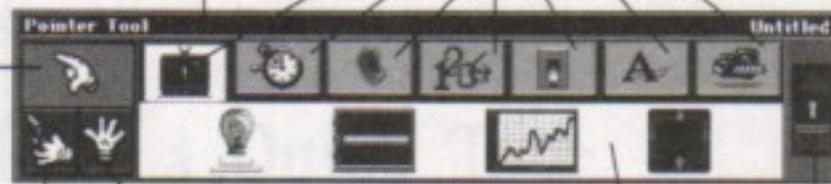
The name of the widget appears here.

Click here to activate the Cut tool, for removing different parts and connections.

Click here to activate the Hand tool to move the Work Area around so you can see it all.

Click on these arrows to see more parts.

This is the Parts Bin where you pick up the parts you want.

If you ever need to know what a part is called, or what a button does, just point at it with the mouse, and look at the top of the Tooltray. You don't even have to click!

Step 3. Your First Widget

The first thing any decent mad scientist needs to know is how to make lights flash. Widget Workshop lets you flash lights in many different ways. Let's try one.

First we'll need to pull a couple of parts out of the Parts Bin.

Click on the Display Parts button in the Tooltray.

Click and drag the Light Bulb out of the Parts Bin into the middle of the Work Area.

Click on the Switch Parts button in the Tooltray.

Click and drag the Light Switch out of the Parts Bin onto the Work Area, just to the left of the Light Bulb.

Now we need to connect the switch to the Light bulb.

Move the mouse so it points to the output connector (the little red ball) on the Light Switch. The pointer will change from this to this.

Press the mouse button down and hold it down (if you have more than one mouse button, use the left one).

Drag the pointer over to the Light Bulb's input connector (the little red socket). When the connecting line turns green, release the mouse button. You've just made an important connection!
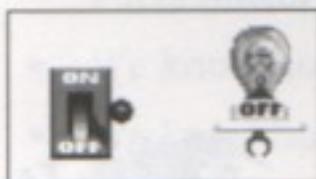
Ready to make a connection.

Put the pointer over the output connector.
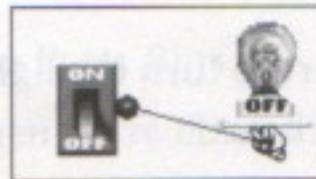
Click and drag from the output connector on the switch to the input connector on the Light Bulb. When the line turns green, release the mouse button.

The finished connection.

Now let's try out your widget.

> **Click on the GO button in the Control Box.** `GO`
>
> **Click on the Light Switch to turn the light on.**
>
> **Click on the Light Switch again to turn the light off.**
>
> **Click on the STOP button in the Control Box.** `STOP`

That was simple. Now let's try
something else.

Did you notice that the Tooltray disappears when you click GO and comes back when you click STOP?

Step 4. One More Time—
But Put Your Heart Into It!

Anyone can turn a light on and off with a light switch. A mad scientist (that's you) can turn lights on and off in all sorts of strange ways. Let's try one.

First, let's get rid of that Light Switch.

> **Click on the Cut tool button in the Tooltray.**
>
> **Click on the Light Switch to make it disappear.**
>
> **Click on the Pointer tool button.**

Now, let's get a fun part to turn the light
on and off—a human heart!

When you cut parts, all their connections disappear, too.

Click on the Super Parts button in the Tooltray.

Click on the down-pointing red arrow in the lower-right corner of the Tooltray.

Click and drag the Heart out of the Parts Bin onto the Work Area to the left of the Light Bulb.

Now connect the Heart to the Light Bulb and turn on the widget.

Move the pointer over the output connector on the Heart.

Click and drag the pointer to the input connector on the Light Bulb.

Click on the GO button in the Control Box.

Look at that light flash. That's how a real mad scientist turns on a light bulb!

Click on the STOP button in the Control Box. STOP

Step 5. Investigating Parts

Every widget you build is made out of parts. What do we know about parts so far?

- We know that there are different kinds of parts, like switches and displays.
- We know that we can see different kinds of parts by clicking on the Parts buttons in the Tooltray.
- We know how to get parts out of the Parts Bins.
- We know how to get rid of parts when we're done with them.
- We know how to connect parts.
- We know that some parts have output connectors and some have input connectors.

That's a good start. Now let's take a closer look at parts.

If you just finished Step 4, then you should still have one Heart and one Light Bulb in your Work Area, and already have a head start. If you don't have anything in your Work Area, then get a Heart and a Light Bulb and connect them together in the middle of the Work Area just like you did in Step 4.

Now let's look into the matter of the Heart more closely.

Double-click (click twice in a row, quickly) on the Heart.

When you double-click on any part, an information box will open. Let's look closely at the Heart's information box.

Here is the name of the part.

Here is a picture of the part showing the part's inputs and outputs.

This is an explanation of what the part does.

Heart

out **Depends on your choice**

Hearts pump blood through animals' bodies. Hearts differ in shape, size, speed and pumping capacity depending on the size of the animal.

Whose Heart:
Human Adult ▼

Output:
⦿ On During Heart Beat
◯ Pulse Rate
◯ Heart Weight (lbs.)

Cancel   OK

The bottom section of this window has settings and controls that let you change what the part does. Some parts have lots of controls, some don't have any.

Click on Doc (the resident Mad Scientist) for construction tips that will help you use the part.

Click here to close this information window without keeping any changes you may have made.

Click here to accept any changes you have made and close this information window.

Click on the Cancel button to close the information box.

Step 6. Heart Attack!—Part 1

Now we'll play with all the different settings and controls for the Heart. Let's start by moving some things around.

> **Move the mouse so the pointer is over the middle of the Heart. A green rectangle will appear around the Heart.**

> **Click and drag the Heart up closer to the top of the screen, just below the Tooltray.**

> **Move the pointer to the middle of the Light Bulb.**

> **Click and drag the Light Bulb closer to the top of the screen to the right of the Heart.**

Did you notice that you can move parts around and the connections stay connected? Good. Now we need more parts.

> **Get two more Hearts out of the Parts Bin.**

> **Get two more Light Bulbs out of the Parts Bin.**

Now you should have 3 Hearts and 3 Light Bulbs in the Work Area.

> **Use the mouse to arrange the parts and connect them so they look like this:**
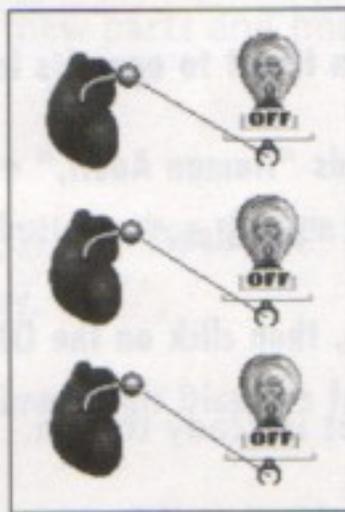
Now we'll open the information window for each of the Hearts, one by one, and change the controls.

Double-click on the Heart nearest the top of the screen.

Click and hold on the words "Human Adult."

> ✓Human Adult
> Human Infant
> Rabbit
> Tortoise
> Elephant
> Cat
> Dog
> Gerbil

Slide the pointer down to the word "Gerbil."

> ✓Human Adult
> Human Infant
> Rabbit
> Tortoise
> Elephant
> Cat
> Dog
> **Gerbil**

Release the mouse button, then click on the OK button.
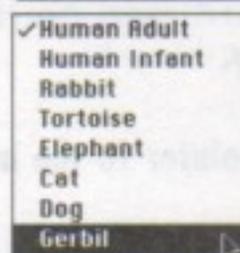
Congratulations! You just changed a human adult heart into a gerbil heart!

> A gerbil is a small rodent about the same size as a hamster.

Leave the middle heart alone so it will stay a human adult heart, but change the bottom heart into a tortoise heart:

Double-click on the bottom Heart to open its information window.

Click and hold on the words "Human Adult," and slide the pointer down to the word "Tortoise."

Release the mouse button, then click on the OK button.

> ✓Human Adult
> Human Infant
> Rabbit
> **Tortoise**
> Elephant
> Cat
> Dog
> Gerbil
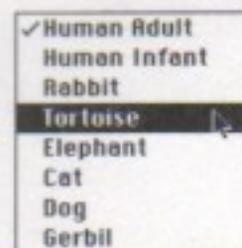
Now your three-hearted widget is ready to run.

Click on the GO button in the Control Box.

The three hearts will beat away at three different rates. When you've seen enough:

Click on the STOP button in the Control Box.

Step 7. Heart Attack!—Part 2

We know that we can change the heart part into different kinds of hearts, and we know how to use a heart's beat as a switch—but is there anything else we can do with a heart? You bet there is.

Double-click on a Heart to open its information window.

Look at the part of the information window where it says "Output." There are three choices there: Heart Beat, Pulse Rate and Heart Weight. So far we've only used Heart Beat. Let's try the other two types of outputs.
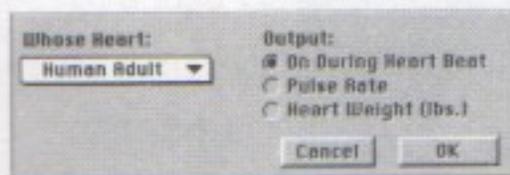
First we need to get rid of a few parts.

Click on the OK button to close the information window.

Click on the Cut tool in the Tooltray.

Click on one of the Hearts and all three of the Light Bulbs.

Now we need to get a couple of new parts and hook them to the two hearts:

Click on the Pointer tool.

Click on the Display Parts button, then click on the red down-arrow on the right side of the Tooltray.

Click and drag two of the Three-Digit Displays from the Parts Bin to the Work Area.

Connect each Heart to a Three-Digit Display.

Now we'll change the outputs of the hearts:
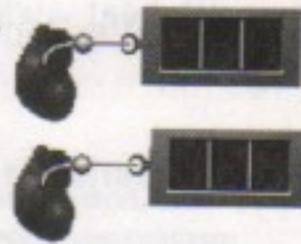
> **Double-click on the top Heart.**

> **Set "Whose Heart" to Rabbit.**

> **Click on the words "Pulse Rate." The bottom of the information window should look like this:**

> Whose Heart:
> Rabbit ▼
>
> Output:
> ○ On During Heart Beat
> ● Pulse Rate
> ○ Heart Weight (lbs.)
>
> Cancel   OK
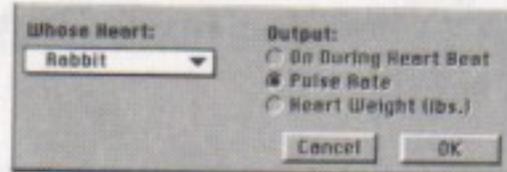
> **Click OK.**

> **Double-click on the bottom heart.**

> **Set the "Whose Heart" to Elephant.**

> **Click on the words "Heart Weight (lbs.)." The bottom of the information window should look like this:**

> Whose Heart:
> Elephant ▼
>
> Output:
> ○ On During Heart Beat
> ○ Pulse Rate
> ● Heart Weight (lbs.)
>
> Cancel   OK
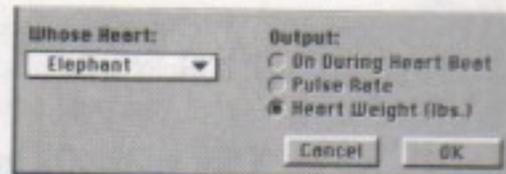
> **Click OK.**

Now let's make this widget go.

> **Click on the GO button in the Control Box.**

The display hooked to the top heart—the one set to give a rabbit's pulse rate—displays the number 60. This shows that a rabbit's heart beats 60 times per minute. The display hooked to the bottom heart—the one set to give an elephant's heart weight—displays the number 44. This shows that an elephant's heart weighs 44 pounds.

> **Click on the STOP button when you're done.**

> A heart that weighs 44 pounds? Is this what people mean when they say they have a heavy heart?

We adjusted the heart to do some very different things. When it was set to Heart Beat, it acted like a switch and its output was a lot of "ONs" and "OFFs." When it was set to Heart Rate and Heart Weight, its outputs were numbers. This is confusing for even an experienced mad scientist, so we'll take a moment and investigate the most important thing in science: data.

Step 8. Dig That Data

We've already hooked parts together. We hooked outputs to inputs. But what is it that travels from an output, through the connection, to an input? It's data. But what's data?

Data is information. There are many types of information, and all sorts of data.

Widget Workshop has three different types of data that travel through connections:

- On/Off data, also called digital data because on and off is like 1 and 0 (it's also called Boolean data).

- Number data—either variable (changing) numbers or constant (non-changing) numbers.

- Sound data—recorded sounds that can be played through a speaker.

Widget Workshop also makes use of two other kinds of data: words and pictures. It can display words and pictures on the screen, but they don't travel through the connectors.

One thing Widget Workshop does that you can't do anywhere else is connect different data types to each other. You can hook any output to any input and something will happen. We'll try this later, in Step 24.

In a real laboratory, hooking up different kinds of things to each other can cause problems—sometimes big problems, like broken equipment, or even explosions. But in Widget Workshop, nothing will explode, no matter what you do. But that shouldn't stop you from trying!

We've already experimented a little with on/off data using switches and hearts. In the next few steps we'll experiment with all the other types of data.

Step 9. Number Crunching—Part 1

One way to use numbers and numerical data in Widget Workshop is to build custom calculators. Let's build a calculator that figures out how many seconds there are in an hour, a day, a week and a year. We'll build the calculator in different steps, starting with figuring out how many seconds there are in an hour, then add more parts to figure out the seconds in a day, week and year.

First, we'll need to clean up the laboratory to make room to work. If your Work Area is empty, skip these next instructions and jump ahead. If your Work Area has parts in it, then:

> **Move the mouse pointer to the Menu Bar at the top of the screen and point to the word "Edit."**
>
> **Click and hold the mouse button to open the Edit menu.**
>
> **Slide the pointer down until the words "Clear Work Area" are highlighted.**
>
> **Release the mouse button.**

Now we're ready to go. But before we begin building, let's think about the problem we want to solve. What we want to know is how many seconds there are in an hour. What we already know is that there are 60 seconds in a minute and there are 60 minutes in an hour. So the formula we'll need is:

$$60 \ \frac{\text{seconds}}{\text{minutes}} \quad \text{x} \quad 60 \ \frac{\text{minutes}}{\text{hour}} \quad = \quad \text{the number of} \ \frac{\text{seconds}}{\text{hour}}$$

Now we're ready to build our calculator. Looking at our formula, we'll need these parts:

- One number to represent 60 seconds/minute
- Another number to represent 60 minutes/hour
- A Multiplier
- A display to show the answer in seconds per hour

Click on the Number Parts button.
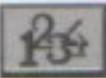
Click on the red down-arrow.

Click and drag one Multiplier from the Parts Bin to the Work Area.

Click on the red up-arrow until you can see the Mini Three-Digit Number part.

Drag two Mini Three-Digit Numbers from the Parts Bin to the work area.

Double-click on one of the Mini Three-Digit Numbers to open its information window.

Click in the place where it says "Enter Beginning Number:" and type in 60.

Enter Beginning Number: 60

Cancel   OK

Click OK to close the information window.
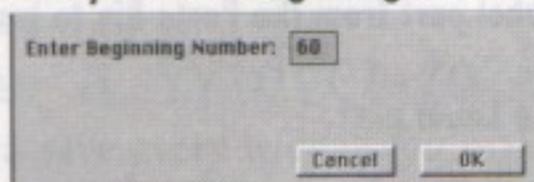
Set the other Mini Three-Digit Number to have 60 as its beginning number.

Click on the Display Parts button.

Click on the red down-arrow.

Click and drag a Ten-Digit Display from the Parts Bin to the Work Area.

Now, we'll build our first calculator.

Arrange the parts on your screen so they look sort of like this:
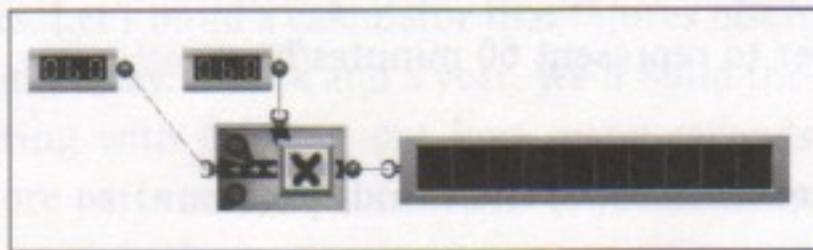
Our custom calculator is ready to run. Before you start it, look at it for a second or two. Doesn't it look just like the formula?

Now let's make it go.

> Building a custom calculator is like building a mathematical formula.

Click on the GO button and watch it calculate.

Click on the STOP button.

That's pretty good, but if you were looking at this for the first time, would you know what it was? Let's put a name on our calculator.

Click on the Text Parts button in the Tooltray. $\boxed{A}$

Click and drag a Label part from the Parts Bin to just above the calculator.

Double-click on the Label part.

Click the circle to the left of the words "Large Letters" to make the name nice and big.

Type "SUPER SECOND CALCULATOR."

Click OK.

Type your label here:

SUPER SECOND CALCULATOR

○ Small letters
● Large letters

Clear Text   Cancel   OK
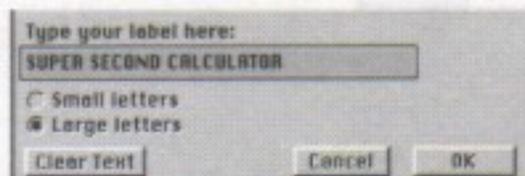
Get three more Label parts from the Parts Bin.

Double-click on one of the new Labels.

Type "sec/min."

Click OK.

Set another Label to say, "min/hr."

Set the last Label to say, "Seconds per hour."

Arrange the labels to look like this:

SUPER SECOND CALCULATOR

sec/min   min/hour

Seconds per hour
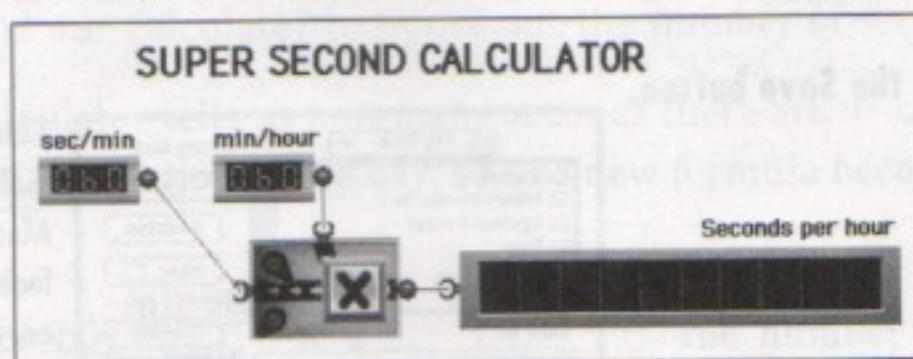
We'll be adding to and expanding our calculator step-by-step, and we won't want to have to start all over again, so let's save it to disk. That way we can pick up where we left off without wasting any time or energy.

Step 10. Saving a Widget to Disk

You probably won't want to save every widget you make, but when you make something you like or if you have to stop in the middle, then saving widgets will save you time.

Saving a widget to disk is easy:

Move the mouse pointer to the Menu Bar at top of the screen and point to the word "File."

Click and hold the mouse button to open the File menu.

**Slide the pointer down until the word "Save" is highlighted.**

Release the mouse button.

A dialog box will open that will let you name your widget and choose the disk and folder or directory where you want to save it. The way the Save dialog box looks and works is a little bit different on each type of computer. A complete description of the Save dialog box for your computer can be found in the Widget Workshop Addendum.

But for now, you can save your widget this way:

Type "SECONDS1"

Click on the Save button.
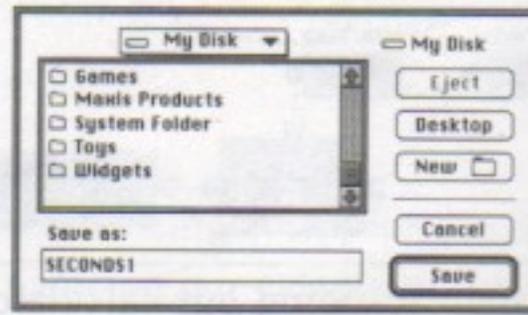
This is how the Save dialog box looks on a Macintosh. (It may look a little different on your computer.)

Step 11. Loading a Widget From Disk

Now that we've learned how to save a widget, let's learn how to load it back in.

First, make sure that you saved your widget, SECONDS1, to disk (Step 10). Now clear the Work Area:

Open the Edit menu and select Clear Work Area.

Now load in the saved version of SECONDS1:

Open the File menu and select Open....

When the Open dialog box appears, click on the name of the widget you want to load (SECONDS1).

Click on the Open button.
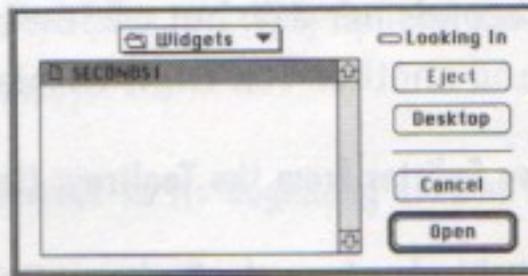
This is how the Open dialog box looks on a Macintosh. It may look a little different on your computer.

Simple! You can get more details on the Open dialog box for your computer in the Widget Workshop Quick Start Guide. Now let's add more functions to our calculator.

Step 12. Number Crunching—Part 2

Now let's expand our calculator to figure out the number of seconds in a day.

Our existing calculator tells us how many seconds there are in an hour and we know that there are 24 hours in a day, so our new formula becomes:

$$60 \; \frac{\text{seconds}}{\text{minute}} \; \text{x} \; 60 \; \frac{\text{minutes}}{\text{hour}} \; \text{x} \; 24 \; \frac{\text{hours}}{\text{day}} \; = \; \text{the number of} \; \frac{\text{seconds}}{\text{day}}$$

Get another Mini Three-Digit Number and another Multiplier from the Tooltray.

Set the new Mini Three-Digit Number so its beginning number is 24.

Arrange all the parts on the screen, connect them and add labels so they look like this:

SUPER SECOND CALCULATOR

sec/min   min/hour   hrs/day
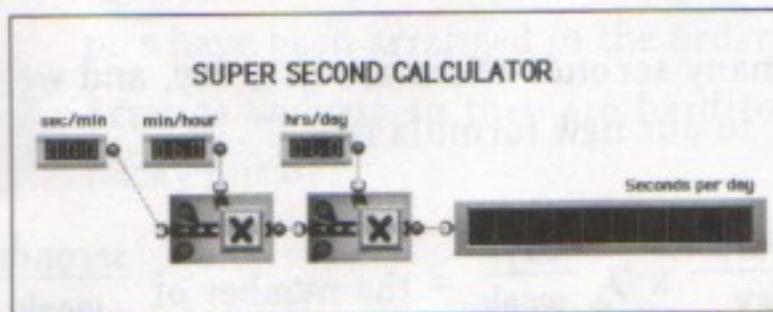
Seconds per day

You can use the Cut tool to remove connections, but be sure to change back to the Pointer tool before you try to make new connections or you'll delete parts by accident!

Well, we have our seconds per day, but we lost our seconds per hour. This is a job for a splitter—and another Ten-Digit Display.

Get a Two-way Splitter from the Tooltray. (It's under Switch Parts.)

Get a Ten-Digit Display from the Tooltray. (It's under Display Parts).

Rearrange, reconnect and label your calculator to look like this:

SUPER SECOND CALCULATOR
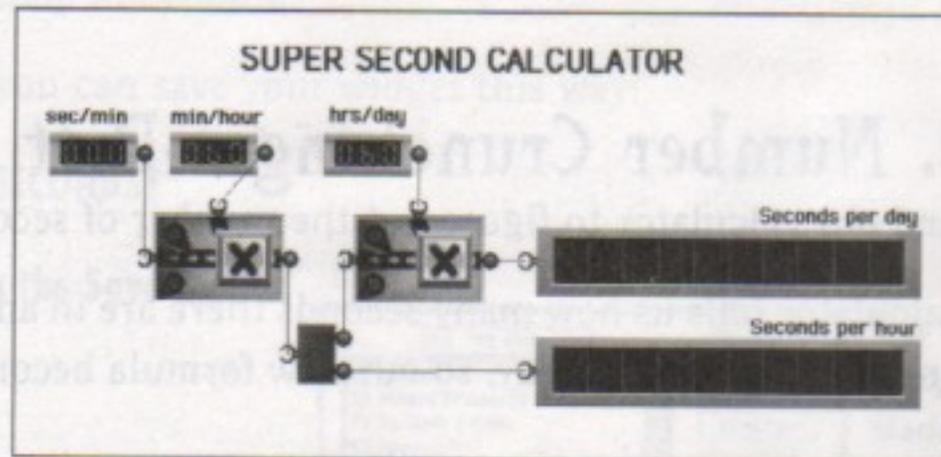
Try it out to see how it works, then save the modified calculator to disk under another name:

Open the File menu and select Save As....

Type in the name "SECONDS2."

Click on the Save button.

Now we'll expand the calculator again, this time to also calculate the number of seconds in a week.

Our calculator already tells us how many seconds there are in a day, and we know that there are 7 days in a week, so our new formula is:

$$60 \; \frac{\text{seconds}}{\text{minute}} \; \text{x} \; 60 \; \frac{\text{minutes}}{\text{hour}} \; \text{x} \; 24 \; \frac{\text{hours}}{\text{day}} \; \text{x} \; 7 \; \frac{\text{days}}{\text{week}} = \text{the number of} \; \frac{\text{seconds}}{\text{week}}$$

Get a Ten-Digit Display, a Multiplier, a 2-Way Splitter and a Mini Three-Digit Number from the Tooltray.

Set the Mini Three-Digit Number so its beginning number is 7.

Rearrange, reconnect and label your calculator to look like this:
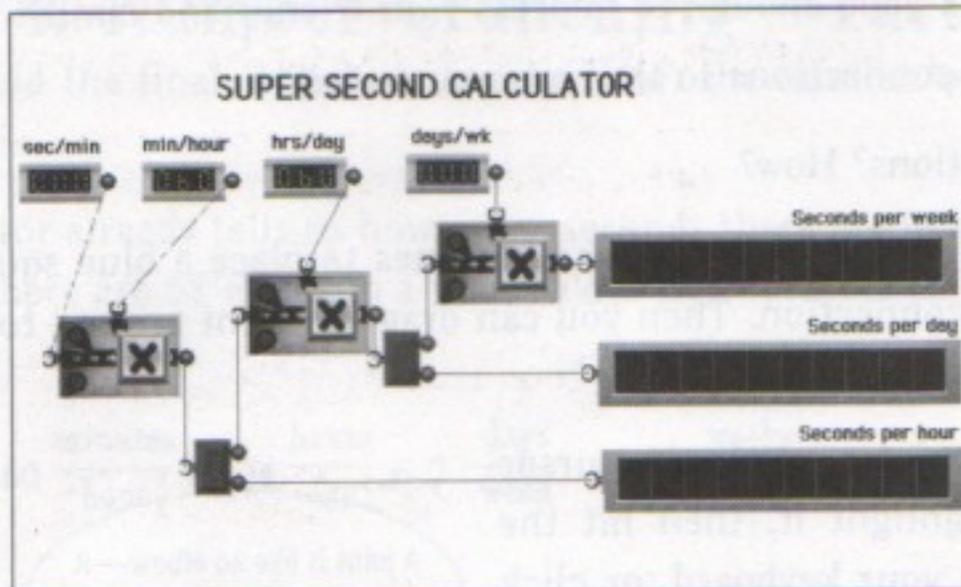
Test it out and see how it works, then:

Save the widget to disk as "SECONDS3."

Step 13. Getting Fancy

You probably noticed that the more parts there are in a widget, the longer it takes to arrange everything to fit on the screen and to make the connections.

Here are a few things to think about while building a widget:

1. Arrange it so it is easy to understand. That's why the calculator samples have been arranged in the order that the calculations are made.

2. Arrange widgets so they are hard to understand if you are making a tricky puzzle.

3. Add labels, titles and instructions. A widget makes much more sense with titles and labels. And numbers in a formula don't mean as much without labels. If you see the number 327 without a label, it could be 327 inches, 327 pounds, 327 ounces or 327 elephant toes.

4. Make it look cool. Why not? You might as well have fun and make things look good enough to impress your friends and family.

5. Route the connections so they are easy to follow.

Route connections? How?

You can click on the green connection lines to place a blue square, called a joint, on the connection. Then you can drag the joint around to reshape the connection line.

To get rid of a joint, move the cursor over it to highlight it, then hit the Delete key on your keyboard, or click on it with the Cut tool. Be sure only the joint is highlighted, or the whole connection will be deleted.

> A joint is like an elbow—it lets connections bend and reach around parts.

If it's not already loaded from the last step, load in SEC-ONDS3, and route the connections so they look something like this:

SUPER SECOND CALCULATOR

sec/min   min/hour   hrs/day   days/wk

Seconds per week

Seconds per day

Seconds per hour
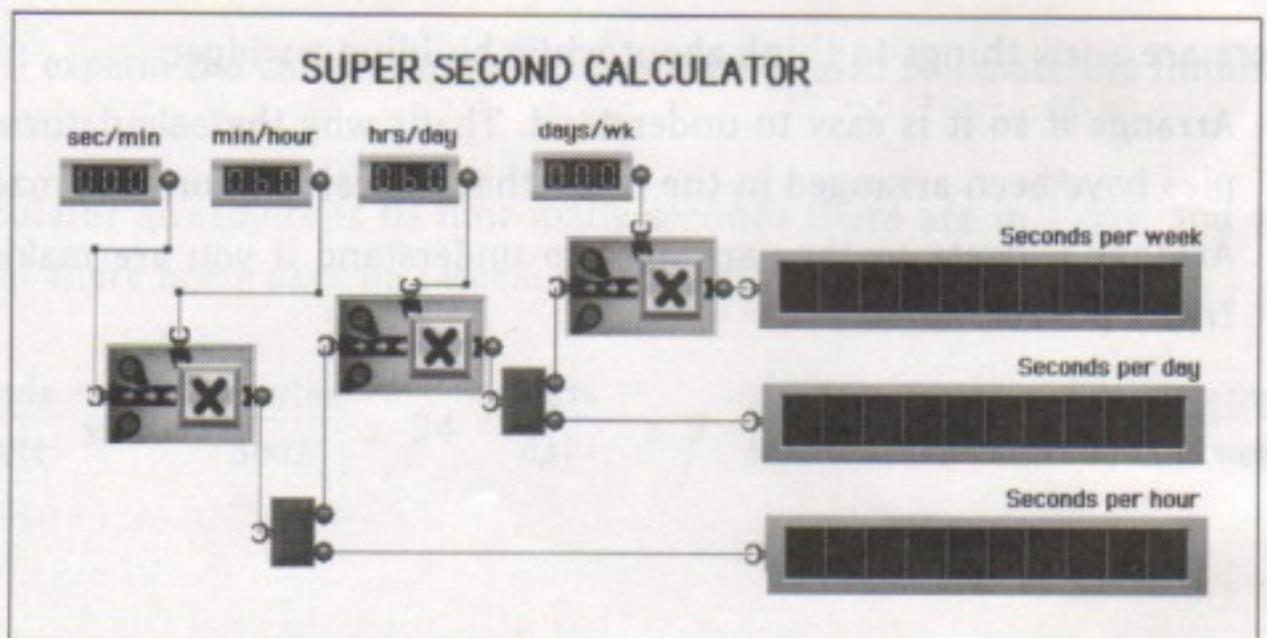
Save your newly routed widget under the same name:

Open the File menu and select Save.

Take some time and play with making, adjusting and deleting joints.

Step 14. Number Crunching—Part 3

Now we'll add the final stage to our calculator: the number of seconds in a year.

Our calculator already tells us how many seconds there are in a week, and we know that there are 52 weeks in a year, so our new formula is:

$$60 \frac{\text{seconds}}{\text{minute}} \times 60 \frac{\text{minutes}}{\text{hour}} \times 24 \frac{\text{hours}}{\text{day}} \times 7 \frac{\text{days}}{\text{week}} \times 52 \frac{\text{weeks}}{\text{year}} = \text{the number of} \frac{\text{seconds}}{\text{year}}$$

Get the extra parts you need from the Tooltray and expand your calculator to look something like this:

SUPER SECOND CALCULATOR
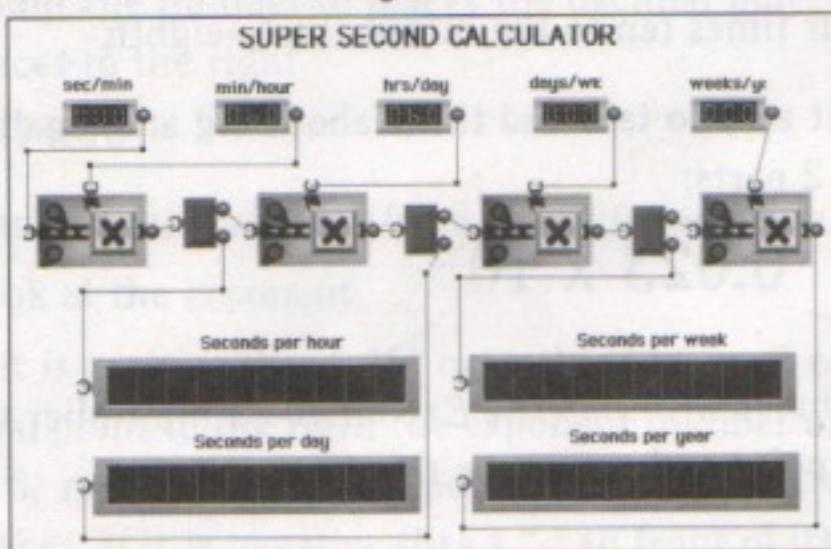
Be sure to set the new Three-Digit Number to 52.

Try out the finished calculator, then save it under the name SECONDS4.

Hey! Did you see what I saw? The number of seconds in a year is 3.1450E+07? What does that mean? Did I do something wrong? Is this widget broken? For the thrilling answers to all these questions, stay tuned to Step 15!

Step 15. Scientific Notation

Scientific notation is an easy shortcut way to write and talk about really big and really small numbers.

What if someone asked you what number these numbers were?

9684000000000000000000000000000000000000

.00000000000000000000000000000000009684

They would be hard to say and hard to think about because of the number of digits. You'd have to count all those zeros and remember how many zeros are in a million, a billion, a trillion and a googol.

These same numbers in scientific notation would be written like this:

9.684×10^{39}

9.684×10^{-38}

and pronounced like this:

Nine point six eight four times ten to the thirty-ninth

Nine point six eight four times ten to the minus thirty-eighth

Scientific notation makes it easy to talk and think about big and small numbers by dividing them into 2 parts:

$$6.023 \times 10^{23}$$

The *Mantissa*—a number with one digit, a decimal point and possibly more digits.

The *Exponent*—a multiplier to move the decimal point.

To turn a number into scientific notation, follow these steps:

1. Put a decimal point between the first digit that isn't zero and the second digit.

2. Write the number with the new decimal point, and without all the zeros (the mantissa).

3. Count the number of places from the original decimal point to the new one.

4. After the mantissa, write "x 10" and make the number of places you counted the exponent for the 10. If you moved the decimal to the left, then put a "+" or nothing before the exponent. If you moved the decimal to the right, then put a "-" before the exponent.

Here's how to do it with a big number: 123000000

1. 123000000 changes to 1.23000000

2. Rewrite it without the zeros: 1.23

3. Count the number of places the decimal moved: 0, 0, 0, 0, 0, 0, 3, 2— that's 8 places to the left.

4. 1.23×10^8 or $1.23 \times 10^{+8}$

Here's how to do it with a small number: .0000567

1. .0000567 changes to 00005.67

2. Rewrite it without the zeros: 5.67

3. Count the number of places the decimal moved: 0, 0, 0, 0, 5—that's 5 places to the right.

4. 5.67×10^{-5}

To change a number back from scientific notation, follow these steps:

1. Look at the exponent.

2. If it is positive (has a "+" or nothing in front of it) then move the decimal point to the right the exponent number of places (if the exponent is 6, move the decimal point 6 places), and add zeros to fill in the spaces. If it is negative (has a "-" in front of it) then move the decimal point to the left the exponent number of places (if the exponent is 6, move the decimal point 6 places), and add zeros to fill in the space.

Here's how to do it with a big number: 4.3×10^9

1. The exponent is a positive 9.
2. Move the decimal point 9 spaces to the right and add in zeros to fill the spaces: 4.3 becomes 4300000000.

Here's how to do it with a small number: 7.6×10^{-7}

1. The exponent is a negative 7.
2. Move the decimal point 7 spaces to the left and add in zeros to fill the spaces: 7.6 becomes .00000076.

But what's that E thing in the Seconds Per Year of the second calculator?

Digital displays like these can't display the small numbers you need to show exponents. So instead, they display the letter E to let you know that the next number is an exponent, then a "+" or "-" and then the actual exponent.

So, when you see E-7 it means 10^{-7}. And when you see E+22 it means 10^{22}. And when you see...I think you get the idea.

Step 16. What Are Random Numbers?

Sometimes you need a little uncertainty in your widgets, and using random numbers is the way to do it.

The two most common ways we use random numbers in our daily lives are:

1. Rolling Dice: with one die, each roll randomly picks a number between 1 and 6; with two dice, each roll randomly picks a number between 2 and 12, and so on and so on and on and on.
2. Tossing a Coin: this is just like rolling a two-sided die—the choices are heads and tails and not two numbers, but it works the same way.

Random numbers are used a lot in computer games to add surprises and to make it harder for the player to predict what is going to happen next.

Widget Workshop has two parts that generate random numbers:

1. The Random Number Generator picks numbers randomly from a range that you can set.

2. The Coin Toss tosses a coin and outputs a 1 for heads and a 0 for tails.

There is a whole branch of mathematics that deals with random numbers: the laws of probability. We'll come back to that later.

Step 17. Designing a Number Guessing Game—Part 1

The next few steps will aid you in a couple of ways as you follow your quest to become a mad scientist:

1. You will have fun with random numbers.

2. You will learn how to design your own widgets.

Now we'll make a number guessing game. Just like we did with our second calculator, we'll start simple, and build it up in steps. Here's how the simplest version of the game will work:

1. The widget and the player each pick a number between 1 and 10.

2. If the guess is right, the player wins.

3. If the guess is wrong, the widget will tell the player to guess again.

It's very simple to build a widget for this game, but since we'll be getting more complicated later, we'll think it through step-by-step, and make a flowchart to help us design it.
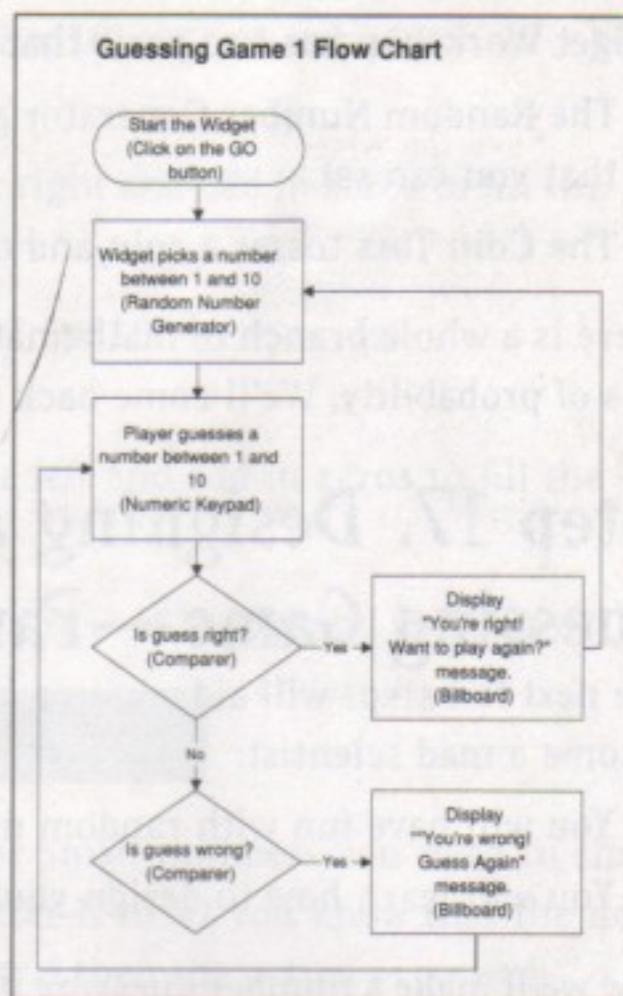
Flowcharts are like maps, but instead of showing where things are, they show what happens when. They're like time maps.

In this flowchart, we show all the steps that we want our number guessing game widget to follow. The flowchart is made of boxes and arrows. Each box is one step. Inside each box is a description of the step, and the Widget Workshop part that is needed for the step.

See if you can follow the flowchart through all the steps. You can even play the guessing game with a friend while following the steps—you can be the widget and your friend can be the player.

Now let's build our widget. Here's the parts list:

- 1 Keypress
- 1 Random Number Generator
- 1 Numeric Keypad

- 2 Two-way Splitters
- 2 Comparers (one set to =, one set to ≠)
- 2 Billboards (One with a "win" message, one with a "lose" message)

Guessing Game 1 Flow Chart

```
Start the Widget
(Click on the GO
button)
        │
        ▼
Widget picks a number
between 1 and 10
(Random Number
Generator)
        │
        ▼
Player guesses a
number between 1 and
10
(Numeric Keypad)
        │
        ▼
   Is guess right?     ──Yes──▶  Display
    (Comparer)                   "You're right!
        │                        Want to play again?"
        │ No                     message.
        ▼                        (Billboard)
   Is guess wrong?    ──Yes──▶  Display
    (Comparer)                   "You're wrong!
                                 Guess Again"
                                 message.
                                 (Billboard)
```

Get the parts from the list above out of the Tooltray and build the Number Guessing Game to look like this:

NUMBER GUESSING GAME

Press A to pick a random number

You're right! Press "A" on your keyboard to play again.

Enter your guesses here

Try again!
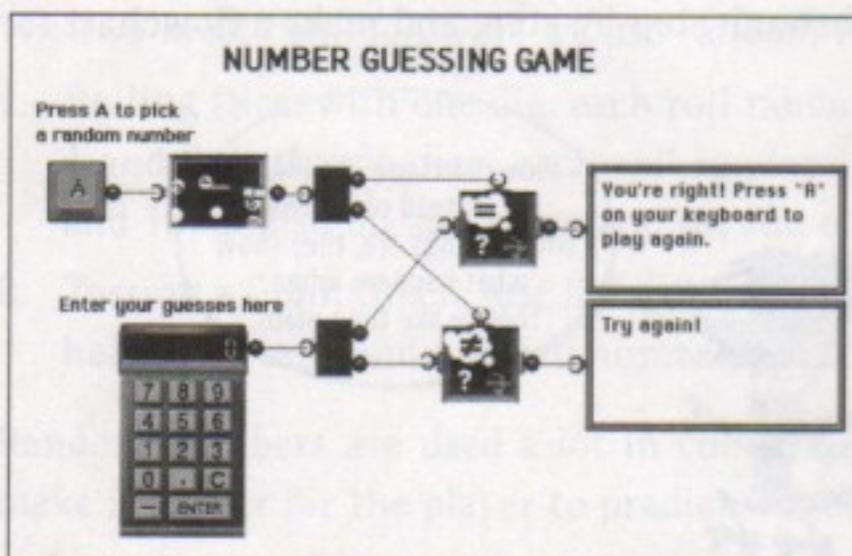
Be sure to double-click on both of the billboards and type in the new messages. And don't forget to set one of the Comparers to =, and the other one to ≠!

Try out the game.

Save the widget to disk. Call it GUESSER1.

It's a pretty simple game, but how do we know if it really works? Let's put a temporary modification in there to help us test it: a display to tell us what the random number is. Once we play this as a game, we'll take it out, but for now it'll help us test the game.

Get a Three-way Splitter and a Three-Digit Display.

Delete or cut the Two-way Splitter that is hooked to the Random Number Generator.

Put the Number Guessing Game together to look like this:

NUMBER GUESSING GAME

Press A to pick a random number

For testing only

You're right! Press "A" on your keyboard to play again.

Enter your guesses here

Try again!
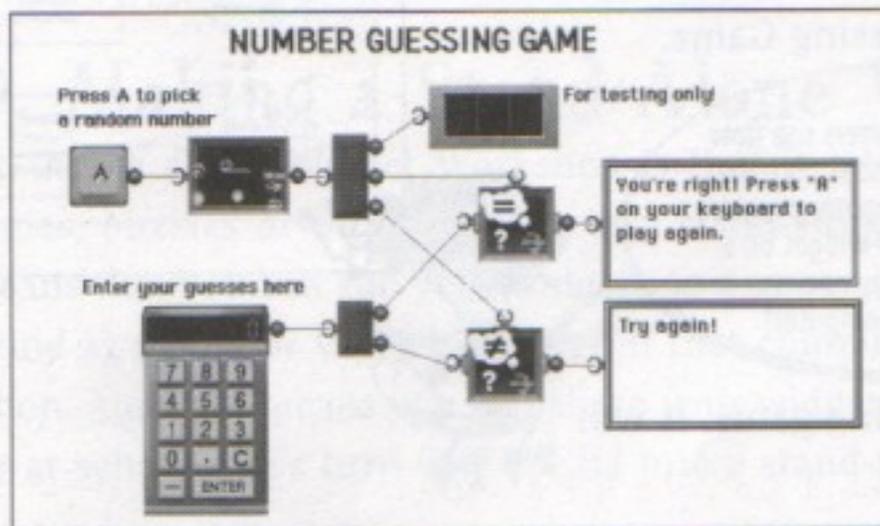
The words in the Billboards won't all appear at once—they're just displayed here to show you what to type in.

Run it to test the game.

Save the widget to disk. Call it GUESSER2.

Not bad. But we can make it better.

Step 18. Designing a Number Guessing Game—Part 2

Now we'll add all these features to our Guessing Game:

1. Give the player hints: tell them if their guess is too high or too low.
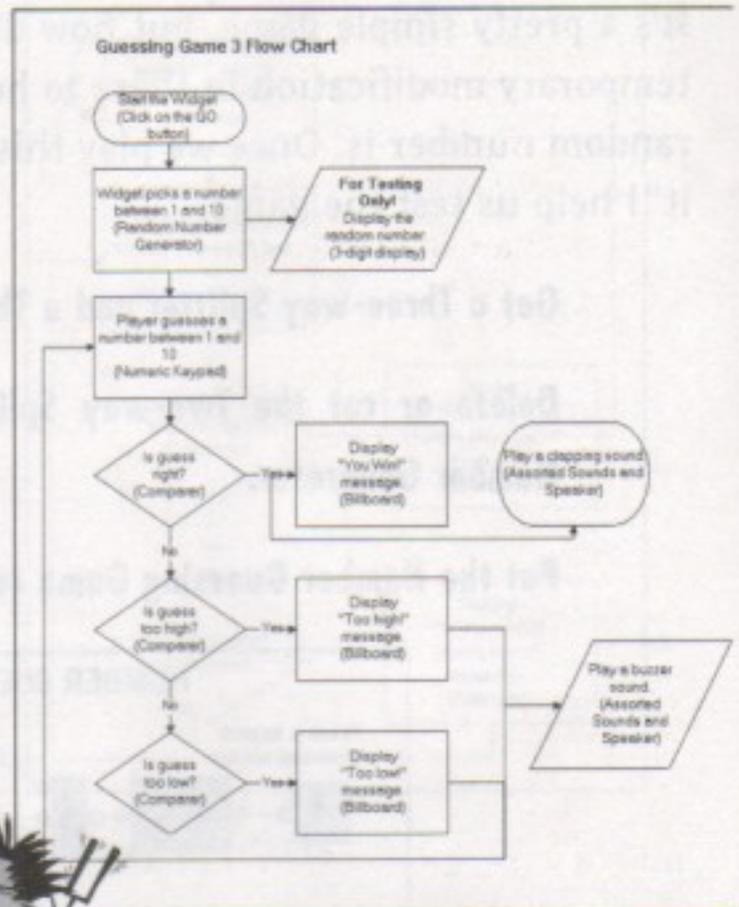
2. Play a clapping sound for a right guess.

3. Play a buzzer sound for a wrong guess.

Here's the flowchart for the new version of the Guessing Game.

> Computer programmers use flowcharts. And the instructions list looks just like a computer program. In fact, building a widget on a computer is actually one way to program the computer!

Guessing Game 3 Flow Chart

Build the guessing game. It will look like this:
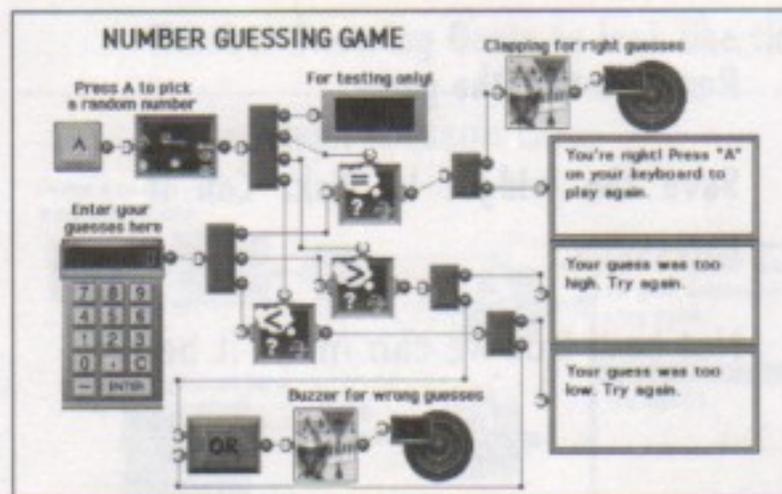
You will have to delete some parts, add others, and adjust many of the settings.

Run the widget to test the game.

When it works, remove the test display.

Save the widget to disk. Call it GUESSER3.

Did you notice that blue thing with the word "OR" on it? That's a type of Logic Gate. You'll learn all about them in Step 21, but see if you can figure out what it's doing.

Step 19. Designing a Number Guessing Game—Part 3

You're on your own now! See if you can modify the Guesser to have these extra features:

- Have a dog bark when the guess is too low.
- Have a cat meow when the guess is too high.
- Replace the input keyboard key with a Metronome set to 2 beats per minute—that gives the player 30 seconds to guess each number.

Try making a flowchart for the new version of the game before you start to build it.

After you build it, save it as GUESSER4.

Step 20. Making a Stand-Alone Widget

One of coolest things about Widget Workshop is that it lets you turn your inventions, games, puzzles or other widgets into stand-alone computer programs. This means that you can run your widgets on any computer (as long as it's the same kind as yours, or very close) even if that computer doesn't have Widget Workshop. And that means you can share your widgets with friends at their homes or at school. Let's turn GUESSER3 into a stand-alone game:

Load GUESSER3 into Widget Workshop.

Warning! Stand-Alone Widgets may be too big for a disk—you may need to compress the Widget file to make it fit.

Open the File menu and select Save Into a Stand-Alone Widget.

When the dialog box opens, type in this name: GuesGame, then click on the Save button.

Now you can put it on a floppy disk and take it to school or a friend's house.

Step 21. Logic Gates

Logic gates are very important to mad scientists—and the other kind, too. They are the basic building blocks of computers.

> Remember the blue logic gate with the word "OR" on it back in Step 18? Did you figure out what it was doing?

Logic gates work with digital data. They only understand 1 and 0, YES and NO, TRUE and FALSE, or ON and OFF. Some gates have one input, some have two inputs, and some have more. All gates have one output. For our purposes, we'll call the inputs A and B.

Widget Workshop has four different types of logic gates. Here's an explanation of what they do:

Gate Name	# of Inputs	Output
AND Gate	2 (A, B)	If A and B are 1 (ON), then the Output will be 1 (ON). Otherwise the output is 0 (OFF).
OR Gate	2 (A, B)	If A or B or both are 1 (ON) then the Output will be 1 (ON). Otherwise it will be 0 (OFF).
XOR Gate (Exclusive OR)	2 (A, B)	If A or B—but not both—are 1 (ON), then the Output will be 1 (ON). Otherwise it will be 0 (OFF).
NOT Gate (Inverter)	1 (A)	If A is 1 (ON), then the output will be 0 (OFF). If A is 0 (OFF) then the output will be 1 (ON).

The easiest way to understand what logic gates do is with truth tables. A truth table shows all of the logic gate's possible combinations of inputs and the resulting outputs. Here are truth tables for the four gates in Widget Workshop:

AND Gate

A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate

A	B	Output
0	0	0
0	1	1
1	0	1
1	1	1

XOR Gate

A	B	Output
0	0	0
0	1	1
1	0	1
1	1	0

NOT Gate

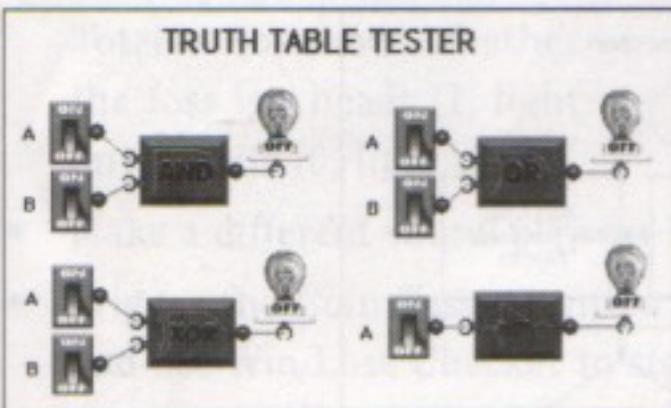| A	Output
0	1
1	0

In these tables we could use YES or TRUE or ON instead of 1 and NO or FALSE or OFF instead of 0 and it would mean the same thing.

Now let's test these truth tables to see if they're telling the truth.

Build this Truth Table Tester:

TRUTH TABLE TESTER

When the light is ON, then the gate's output is 1 or YES or TRUE. When the light is OFF, then the output is 0 or NO or FALSE.

Start the widget and try every combination for the inputs of each logic gate.

Are the truth tables truthful?

Step 22. Testing the Laws of Probability

Let's build a probability tester. Back in Step 16, we mentioned the laws of probability. These laws tell us how likely (or how probable) something is to happen. They have a lot to do with random numbers.

According to the laws of probability, if you flip a coin, there is an equal chance (50-50) that the result will be either heads or tails. If you flip a coin 100 times, it should, according to the laws of probability, come up close to 50 heads and 50 tails. The odds (another way to say laws of probability) are that:
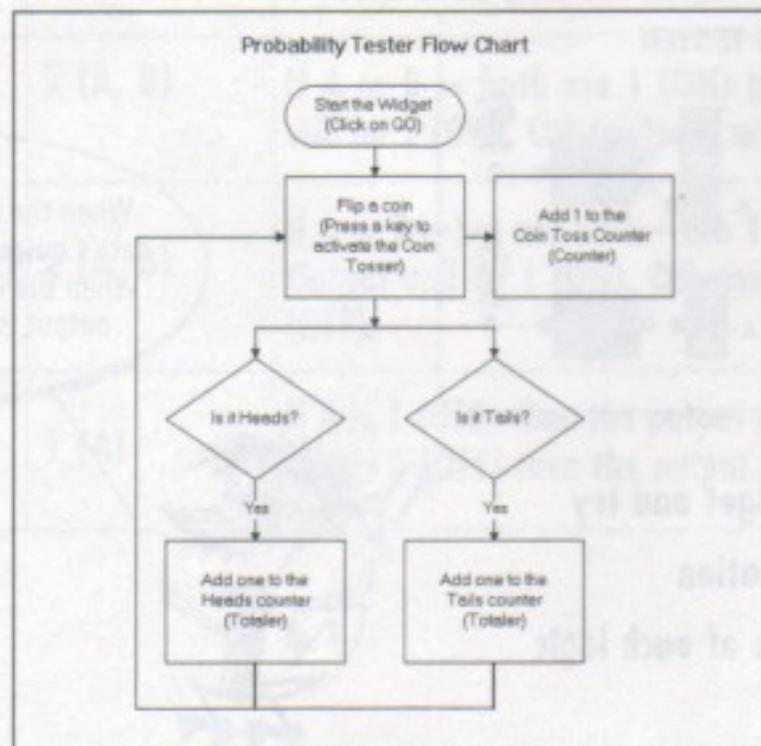
    50 times out of 100 it will be heads, and

    50 times out of 100 it will be tails.

We won't explain the laws of probability right now (ask one of your parents during dinner or your teacher during math class), but we can build a widget to test the laws to see if we think they're right.

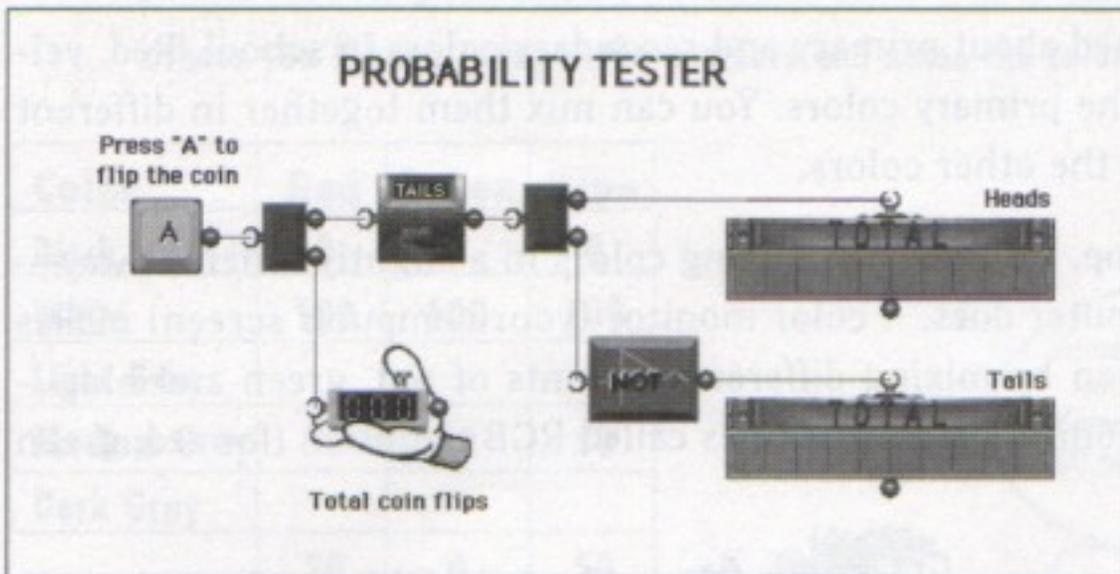Of course, the laws of probability don't work with trick coins!

Here's a flowchart for our Probability Tester:

Probability Tester Flow Chart

Start the Widget
(Click on GO)

Flip a coin
(Press a key to activate the Coin Tosser)

Add 1 to the
Coin Toss Counter
(Counter)

Is it Heads?   Is it Tails?

Yes   Yes

Add one to the
Heads counter
(Totaler)

Add one to the
Tails counter
(Totaler)

Build the Probability Tester:

PROBABILITY TESTER

Press "A" to flip the coin

TAILS

Heads

TOTAL

Total coin flips

NOT

Tails

TOTAL

Save it to disk. Name it Prob1.

Run the widget and press the key 100 times to make 100 coin tosses.

Did the laws of probability hold up?

Here are some ways to fix up the probability tester if you can:

> You probably won't come up with exactly 25, 25 and 50, but you should be pretty close.

- Put a Splitter and a Light Bulb at the input of each Totaler to show whether the toss is a heads (1, light on) or tails (0, light off).

- Make a different sound play for heads and for tails.

- Trigger the Coin Tossers with a metronome set to 2 beats per minute and use Win/Lose Checker to stop the widget after 1,000 tosses.

- Divide the Totaler outputs by the total number of coin tosses, then multiply them by 100 to calculate the percentages of the different outcomes.

Step 23. Mixing Colors

You probably learned about primary and secondary colors in school. Red, yellow and blue are the primary colors. You can mix them together in different amounts to get all the other colors.

In Widget Workshop, we deal with mixing colors in a slightly different way—the way your computer does. A color monitor (your computer screen) makes colors on the screen by mixing different amounts of red, green and blue—that's why color monitors are sometimes called RGB monitors (for red, green and blue).

Widget Workshop comes with a Color Mixer that's just like a giant pixel. (A pixel is a single dot on a computer screen. Look closely at your screen...can you see that everything is made of tiny dots?) It has three inputs, one each for red, green and blue.

The input range for each input is from 0 to 100. The higher the number that you hook to an input, the more of that color is displayed. There is an exception to this rule: If you hook a part with a digital output (1/0, YES/NO, ON/OFF, TRUE/FALSE) to a Color Mixer input, a "1" or "ON" will turn that input all the way on, just as if you had connected the number 100.

We'll try a couple of different experiments with the Color Mixer. First, we'll try to find the right mixtures to make a few special colors, then we'll see if we can make the Color Mixer continuously change colors.

Build this widget:
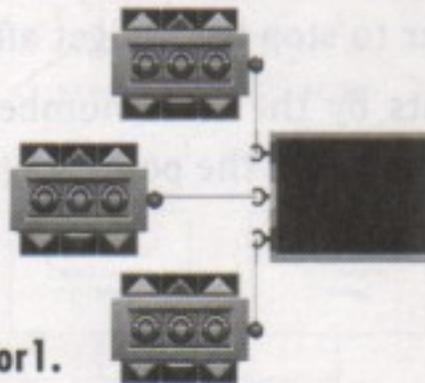
Save it to disk as Color1.

Change the numbers to fill in the rest of this chart. On some you'll have to find the red, green and blue values to make each of these colors. On others you'll have to input the numbers and name the color.

Color	Red	Green	Blue
Black	0	0	0
White	100	100	100
Light Gray			
Medium Gray	50	50	50
Dark Gray			
	50	0	50
	90	30	0
	90	0	40
	100	100	0
Lime Green			
Chocolate			
Sky Blue			

Remember: only the values from 0 to 100 affect the Color Mixer. Numbers over 100 produce the same colors as 100.

Now let's build a widget that'll really put the Color Mixer through its paces— a Random Color Generator:

Build this widget:

RANDOM COLOR GENERATOR
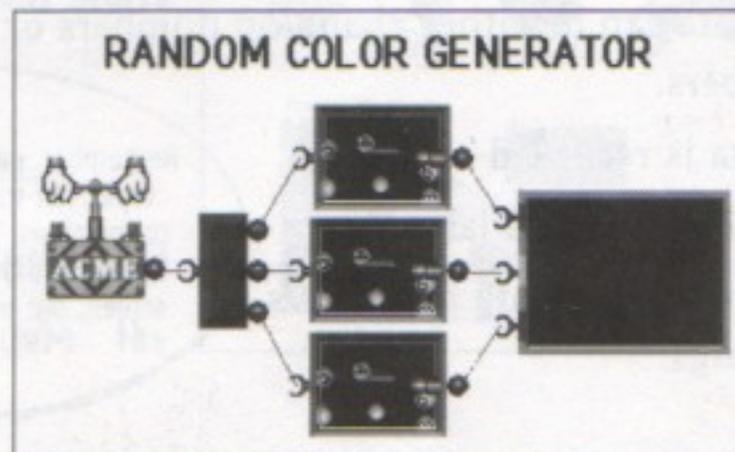
Set the Number Range on all three Random Number Generators to 1-100.

Save it to disk as Color2:

Try it out.

Try to make different color changers by replacing one or all of the Random Number Generators with other parts that have changing numbers. Here are a few possibilities:

Sliders, Counters hooked up to metronomes at different speeds, Stop Watches run through Multipliers and Dividers and set to reset when they go above 100.

Step 24. Mixed-Up Data Types

As you must have realized by now, you can do things in Widget Workshop that you can't do in the "real world." One of those things is connecting different data types. Widget Workshop lets you hook any output to any input, and something will happen—not necessarily what you wanted to happen, but something will happen.

Here's a review of the different data types:

- On/Off data, also called digital or Boolean data, consists of On/Off, 1/0, YES/NO, or TRUE/FALSE.

- Number data can be either changing numbers or constant (not changing) numbers.

- Sound data is recorded sounds.

- Text data is words and labels.

- Picture, or graphic data is pictures and drawings.

> Remember, only the first three data types can travel through widget connections. Text data and picture data can be displayed on the screen, but not sent through connections.

Here's a chart of what happens when you mix data types:

Mixing Data Types
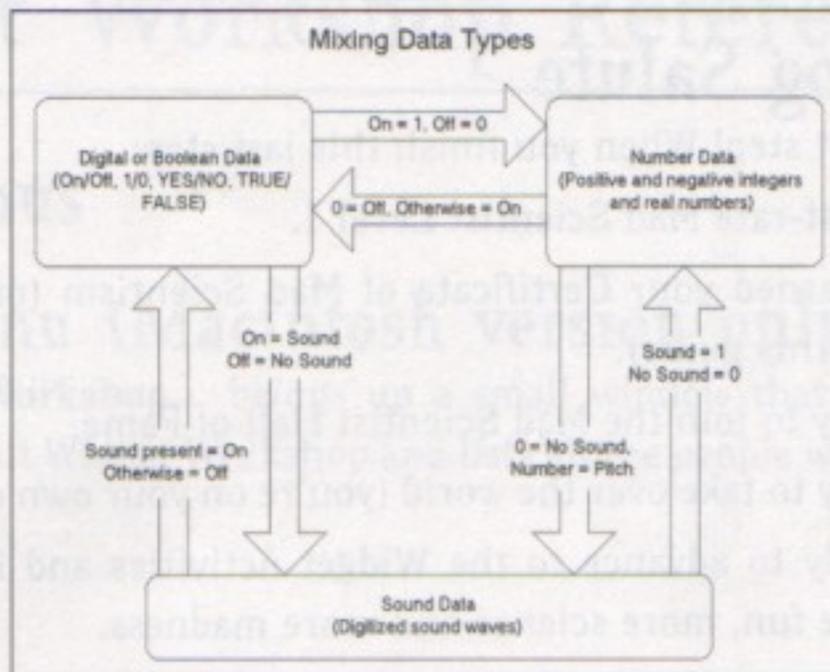
Now let's try some data mixing and see what happens. We'll make a widget that has three data creators: a Mouse Button for On/Off data, a Tuning Fork for sound data and the Numeric Keypad for number data. We'll hook each of these three data creators to three types of data receivers: a Light Bulb for On/Off data, a Three-Digit Display for number data and a Speaker for sound data.
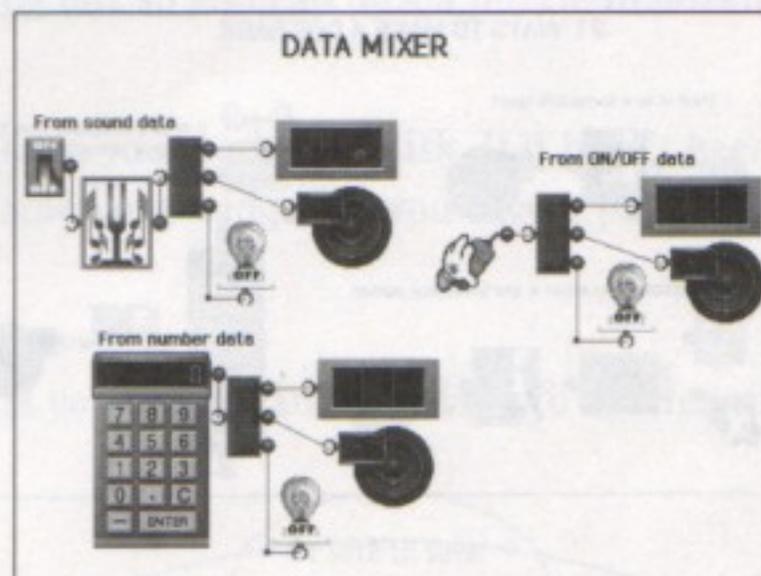
Build this widget:

Start the widget.

Turn on the switch that starts the Tuning Fork.

Click the Mouse Button.

Enter different positive and negative numbers into the Numeric Keypad.

DATA MIXER

Did you get the data mixing results you thought you would?

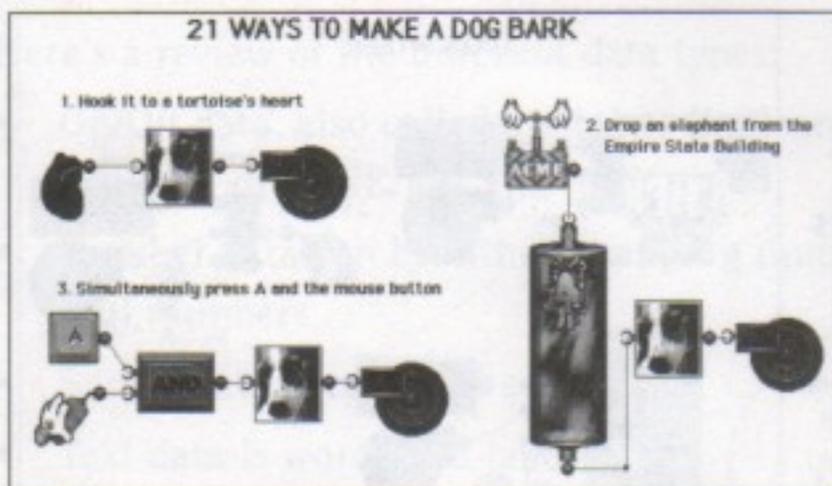# Step 25. Graduation Exercise: The 21 Dog Salute

This is it! The last step! When you finish this last step:

- You'll be a first-rate Mad Scientist Level 1.
- You'll have earned your Certificate of Mad Scientism (on the inside back cover of this guide).
- You'll be ready to join the Mad Scientist Hall of Fame.
- You'll be ready to take over the world (you're on your own on this one).
- You'll be ready to advance to the Widget Activities and Experiments Book for more fun, more science and more madness.

For our final experiment, we'll figure out 21 ways to make a dog bark—actually, you'll figure out most of them.

Here's a widget with the first three ways to make a dog bark, to get you started. For the next 18, you're on your own.

No animals will be harmed in the testing of this widget!

21 WAYS TO MAKE A DOG BARK

1. Hook it to a tortoise's heart
2. Drop an elephant from the Empire State Building
3. Simultaneously press A and the mouse button

Be creative and try to think up strange and funny ways to make the dog bark. Use as many parts as you can.

Print out your funniest, fanciest, most creative way to make a dog bark and mail it to:

MAXIS Attention: 21 Dog Salute
2 Theatre Square
Orinda, CA 94563

Widget Workshop Reference

The Menus

Apple Menu (Macintosh version only)

About Widget Workshop... brings up a small window that gives important information about Widget Workshop and lists all the people who helped to create it.

File Menu

New starts a brand-new widget. If you already have a widget on the screen, you will be given the chance to save it to disk before the new one takes over.

Open... lets you load a widget that has already been saved to disk into Widget Workshop. If you already have a widget on the screen, you will be given the chance to save it to disk before another one is opened.

Load Puzzle... opens the Puzzle dialog box so you can pick a puzzle to puzzle over.

Save saves a copy of the widget that is on your screen to disk. If it hasn't been saved before, you will be asked to name your widget. If you save a puzzle, it will turn into a regular widget.

Save As... lets you rename a widget as you save it, and/or save it to a different disk, folder or directory.

> Be sure to save your widgets to disk often!

Revert is a go-back. If you're working on a widget, and decide you like it better the old way, choose Revert. Widget Workshop will change the widget to the way it was the last time you saved it. If you haven't saved it yet, you can't revert.

Import a Stand-Alone Widget... lets you load a Stand-Alone Widget into Widget Workshop to change it. When you are done changing it, if you want the fixed-up widget to be a Stand-Alone Widget, then be sure to choose **Save Into Stand-Alone Widget**. If you just choose **Save** or **Save As...** it will be a regular widget that will only work on computers with Widget Workshop.

> Stand-Alone widgets will only work on the same kind of computer they were created on, so if you have a Macintosh, it will only work on Macintoshes, and if you have Windows, it will only work on computers with Windows.

Save Into a Stand-Alone Widget... lets you save a widget as a complete program that will run on your friends' or your school's computers even if they don't have Widget Workshop.

Page Setup... lets you print out your widget. If you can, set your printer to print the widget sideways (sometimes called Landscape). That way, the whole widget will fit on one page.

Print... prints out the widget that is currently loaded into Widget Workshop.

Quit ends Widget Workshop. If you are working on a widget and haven't saved your most recent changes, you will be given the chance to save it to disk before Widget Workshop quits.

Edit Menu

Undo lets you backtrack one step. For instance, if you delete a part by accident, you can choose **Undo** to bring it right back without searching for a new part in the Tooltray.

Clear Work Area removes all parts and connections from the Work Area.

Remove All Connections deletes all the connections between all the parts in the Work Area, but leaves the parts there.

Remove All Joints deletes all the blue joints from all the connections on the screen. All the connections and parts will stay where they are.

Be careful with this one! If you choose Clear Work Area by accident, open the Edit menu and select Undo right away!

Options Menu

This menu lets you decide whether or not to have scroll bars on the screen, and lets you choose different backgrounds for Widget Workshop. A checkmark shows which background has been chosen. Each background will change when you click on the Light on/off button in the Control Box.

Plain Background chooses a plain white background or a plain black background.

Metal Waves chooses a light-colored wavy metal background or a dark-colored wavy metal background.

Noise chooses a light speckled background or a dark speckled background.

Steel chooses a metallic (corrugated steel) background or a dark metallic background.

Help Menu (Windows version only)

About Widget Workshop... brings up a small window that gives important information about Widget Workshop and lists all the people who helped to create it.

Help Contents opens the Windows on-screen help system to the table of contents, so you can easily look up anything you want to know.

The Off-Computer Exploration Tools

Widget Workshop comes with a number of things that you can experiment with off the computer and combine with on-computer widgets:

- A Spinning Top
- A Thermometer
- A Magnifier
- A Compass
- Some Rubber Bands
- Some Straws

A number of sample experiments using these Exploration tools are included in the Widget Workshop Experiment and Activity Book.

Puzzles

Widget Workshop comes with a number of fun puzzles to solve. By the time you figure them all out, you'll know all about most of Widget Workshop's parts and features.

Puzzles are special widgets. You solve them by adding parts and connections. Puzzles are just like regular widgets, except for two things:
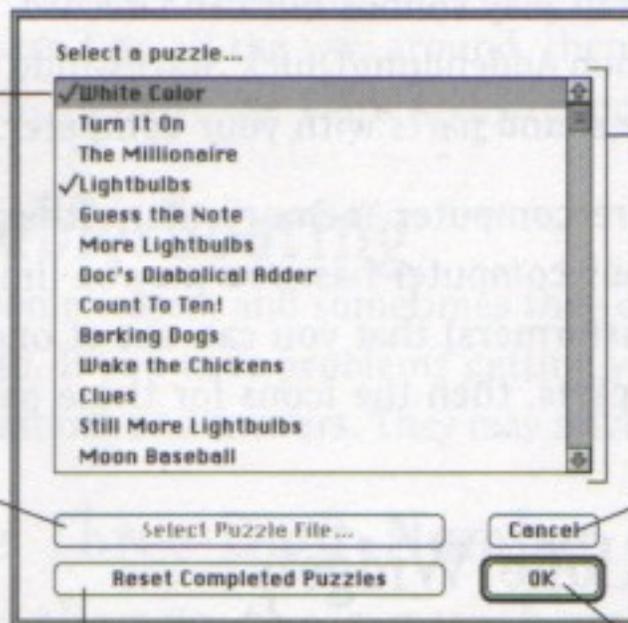
1. There are some parts and connections that you can't move, delete or change.
2. You are only allowed to add a certain number of parts to solve them.

You can get to the puzzles in two ways:

1. When you first start Widget Workshop, click on Load Puzzle in the opening screen.

2. At any other time while Widget Workshop is running, open the File menu and select Load Puzzle.

Once a puzzle has been solved, a red checkmark appears next to its name.

Click here to open a dialog box that will let you select different sets of puzzles. (Only the one set comes with Widget Workshop. Check your local software dealer or on-line service for news of additional puzzle sets.)

Here is the list of puzzles. Click on a puzzle name to select it.

Select a puzzle...

√ White Color
Turn It On
The Millionaire
√ Lightbulbs
Guess the Note
More Lightbulbs
Doc's Diabolical Adder
Count To Ten!
Barking Dogs
Wake the Chickens
Clues
Still More Lightbulbs
Moon Baseball

Select Puzzle File...   Cancel

Reset Completed Puzzles   OK

Click here to remove all checkmarks.

Click here to close the Puzzle Loader without loading a puzzle.

Click here to load the selected puzzle.

Once you select Load Puzzle, the Puzzle Loader will appear:

Puzzles have some pieces and connections that are "locked" in place, and can't be moved or removed. And you will have to solve the puzzle with a limited number of parts.

Once you load a puzzle, you can save it to disk, then load it back in as a regular widget. Once you do this, you can move and delete and change it all you want and use as many parts as you want to make it a new puzzle or widget. But if you solve it after you save it and load it back in, it won't be marked as solved in the Puzzle Loader.

Special Features

About Sound and Recording

The parts that involve sound will only work on computers that support sound. Sound works a little differently on different computers. Some can play and record sounds. Some can play sounds but can't record. Some can't do either. See the Widget Workshop Addendum/Quick Start Guide for details on whether or not you can use the sound parts with your computer.

Sound parts need more computer memory than other parts. Depending on how much memory your computer has, you may be limited in the number of parts (like Sound Transformers) that you can use at one time. If you run out of memory for sound parts, then the icons for those parts will be grayed out in the Tooltray.

About Stand-Alone Widgets

Widget Workshop lets you turn your widgets into complete Stand-Alone programs. This means that you can take these Stand-Alone Widgets and run them on computers that don't have Widget Workshop.

Stand-Alone Widgets that were created on a Macintosh with a color screen will only work on a Macintosh with a color screen and Stand-Alone Widgets that were created on a computer running Windows will only work on another computer that is running Windows. Be sure that the computer you play the Stand-Alone Widget on has as much RAM as the computer you made the Stand-Alone Widget on—or it might not work.

Some Stand-Alone Widgets can be too big to fit onto a floppy disk.

Work Area Size

The Work Area in Widget Workshop varies on different types of computers. On many computers, the Work Area is too big for the whole thing to fit on the screen. You can tell if there is more Work Area than meets the eye by opening the Options menu and selecting any background except Plain. If you can see the complete frame around the whole Work Area, then you can see the whole thing. If the frame doesn't go all the way around, then you can use the Hand tool ✋ in the Tooltray to move the Work Area around so you can see it all.

Widget Troubleshooting

Widgets can be very complicated, and sometimes they don't work the way you expect or want them to. If you have problems getting your widgets to behave, look through these questions and answers. They may solve your widget problems.

Why won't the Three-Digit Number or the Numeric Keypad let me change their numbers?

You can only change these numbers *while the widget is running*. You can double-click on these parts to open their information windows so you can set their beginning numbers, but you have to click GO in the Control Box and start the widget before you can change their numbers by clicking on them.

I put parts to make sounds in my widget, but I don't hear sounds. What's wrong?

First, you can only hear sounds on computers that have support for sound. See the Widget Workshop Quick Start Guide for information about sound on your computer.

If your computer *can* play sounds and you still don't hear them, then be sure you hooked up a Speaker to the parts that make sound. You can't hear sounds without a Speaker.

If all else fails, make sure that your sound volume is turned up in the Sound Control Panel. See the manual that came with your computer or your sound card for instructions on finding and adjusting the Sound Control Panel.

The Three-Digit Display doesn't display what it should. What's going on?

The Three-Digit Display only displays whole numbers, from negative 99 to positive 999. It won't show decimal points. Fractions and decimals will be rounded off to the nearest whole number. If a number is lower than -99 or bigger than 999, a red "X" will appear to let you know something is wrong.

There is a weird number with a letter "E" in it on the Ten-Digit Display. What happened?

When numbers are too big or too small to be completely displayed in the Ten-digit display, then the numbers will be converted to *scientific notation*. The "E" stands for *exponent*. See Step 15 for more information on scientific notation.

Why is there a red "X" over a part on the screen?

If there is something in your widget that confuses the computer, a red "X" will appear over the part that is causing the confusion.

Things that confuse the computer include:

- Trying to use a number that is too big or too small for a part, like trying to make the Three-Digit Display display four digits, and

- Undefined or invalid mathematical operations, like dividing any number by zero. Nothing confuses a computer more than trying to divide a number by zero.

So any time a part gets confused, it will display a red "X," until the confusion stops. Sometimes as the widget runs and you adjust numbers the red "X" will go away by itself, but sometimes you will have to fix your widget.

Also, if you use the Sound Transformer to change the pitch of a sound, and it is too high or too low in pitch for the speaker to play, a red "X" will appear over the Transformer.

Why is a part icon grayed out in the Tooltray?

If lots of part icons are grayed out, then you are probably in puzzle mode. In puzzle mode, many parts are grayed out and unavailable to make the puzzles more of a challenge

This also happens when you don't have enough memory to add any more of these parts to your widget. Sound parts in particular need a lot of memory to work, so these are usually the first to go.

I'm building a big widget, and I can't fit all the parts onto the screen. What do I do?

First, remember that on many computers, there is more room in the Work Area than shows on the screen. Use the Hand tool to move the Work Area around so you can use all the corners and edges.

Another way to save space is to overlap parts on the screen. You can put parts on top of each other and they'll still work—just be sure that all the connections are right and that the parts you'll need to click on while the widget is running are on top.

The Mini Three-Digit Number is another good way to save space. It can be used instead of the (regular) Three-Digit Number as long as you don't need to change it while the widget is running.

I click the GO button in the Control Box and things happen (like the Counter counting 1) before I'm ready.

Widget parts are eager to start working, and will do their job as soon as they see an input. For instance, Counters will sometimes register a count or Totallers will start adding up numbers before you intend them to start.

Watch for this, because it will happen every so often, and it can confuse your widget. Here's an example:
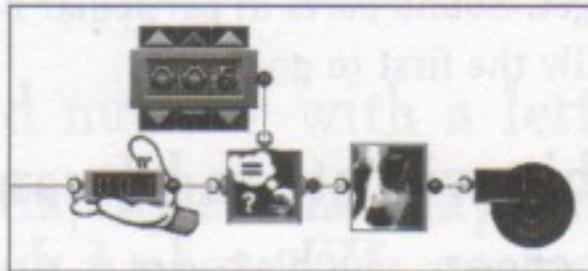
Here we have the output of a Counter hooked to a Comparer. When the count reaches five, the Comparer makes the dog bark. If the Counter counts the first one before you think it should, then the dog will bark at four, not five. There are two ways to work around this problem:

1. Change the comparing number (the 5 in the Three-Digit Number) to six. That way, even though the number says six, the dog will bark after five "real" counts.

2. Add parts to subtract one from the Counter before it goes to the Comparer, like in this example:
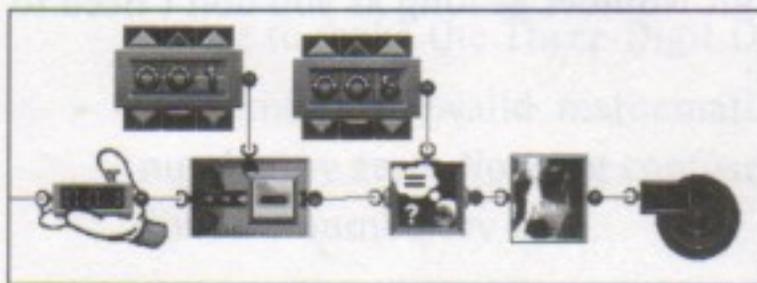
> Widgets can be tricky! They won't always do what you want or expect them to do right away. But if you think about it and keep trying, you can create some wonderful widgets!

Index

Certificate of Mad Scientism

I, Doc, the Widget Workshop Mad Scientist in Residence, do hereby proclaim

_____

(Your Name Here)

an official first-rate Mad Scientist Level 1, for completing all 25 Steps to Mad Scientism, as listed in the Mad Scientist's Guide to Widget Workshop. The abovely aforementioned newly maddened scientist is now qualified to join the Mad Scientist Hall of Fame, take over the world (as long as you don't hurt any people, animals or innocent data), and advance to the Widget Activities and Experiments Book for more fun, more science and more madness.

Hey! This is real official stuff! You can tell because of this important signature:

_____

Doc, Mad Scientist in Residence

M(A)XIS

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