As a teacher in a school where **Constructivism** is the foundation of our approach to education, it is important to find ways that allow our students to experiment with and construct concrete examples from their knowledge.

Squeak is an open source authoring tool for children as well as adults. It's creation has been the dream of Alan Kay for many, many years. He has always wanted to help children learn to think better and deeper than most adults. **Squeak** was created as the medium which would serve as a new kind of electronic paper that would hold new ways to represent powerful ideas. The EToy part of this program is only a small part of Squeak's capabilities

Squeaks Etoy component allows me to move my students from abstract ideas to more concrete ones by helping them create simulations that characterize their thinking about math into other disciplines. It gives them a chance to explore and play with their ideas without risk and with immediate feedback. It also allows them to create tools that become building blocks for other tools.

The approach I take with my students is rather simple. After giving them some of the basics for getting around in Squeak, I pose a problem for them to solve, give them the tools they need to solve it , and then up the ante by posing a challenge to them which takes the problem to a more difficult level. This gets them practicing, exploring and spotting errors in their logic as they work through the problems. They are wonderful in collaborating with each other and often learn quicker from this collaboration than from me, which is always very exciting.

We have been working on several projects over the course of the year. As participants of this workshop you will experience what it is like to create a simulation that will have you using many of the math skills you have been teaching your children, but in a very concrete way. The purpose for which the lessons were created, and the curricular issues that they cover are explained on the following pages. I have included concrete examples of some of the lessons and the challenges as they were presented to the children . If you find that some things you will do with me today are missing from the lessons, please remember that as the teacher I have said or demonstrated things to them as I will to you that are not part of the written lesson that are in this booklet, so please feel free to take notes on the pages provided inside. There are things that I expect my students to remember and it should not be necessary for me to write down everything. The written lesson is more of a review and follow up to my verbal lesson.

Squeak is a wonderful tool not only for exploring math but for creating science simulations and animations. After todays workshop, you can surely imagine the car and the feedback that it is getting from the road changed into a salmon getting the feedback it needs from a body of water in order to swim upstream to its spawning grounds, or even a bee being attracted to a flower by its pollen and thereby helping new flowers to grow. Squeak's uses are limitless and are fueled by you and the imagination of your students.

If you need another Squeak plugin, it is available free at **www.squeakland.org**. Squeak is both Mac and Windows campatible.

B.J.Conn / OCS

Getting Started

• The Drive a Car Curriculum:

The Drive a Car project took place over many weeks. The students begin by drawing a car and then learning how to control it. At first they learn to control it by using a steering wheel. They strive to earn a drivers license by successfully steering their car through a maze.

The second part of the project has the children learning how to use feedback from the headlights of the car to get the car to steer itself down a road.

Curricular topics covered in the **Drive a Car** curriculum:

- Use of positive and negative numbers to help steer the car
- How the turn of the car relates to the car's heading
- Understanding if/then statements
- Understanding variables and how to create them
- Understanding the concept of random and how it applies to numbers
- Determining the average speed of their car by using the skills for finding mean and mode
- Using line plots
- Form hypothesis based on findings and make predictions

Here's how to begin a new project in Squeak.

Double click on the **Squeak** icon..

When Squeak opens click on the c**ancel** button.

This will place you in your first project.

At the bottom of your screen you will find two tabs: A **navigator** tab and a **supplies** tab.

Click on the **supplies** tab and drag out a trash can.

Click on the **navigator** tab. Click on the paint brush to enter the drawing area in Squeak.

We are going to draw a car from a top/down view. Here is an example.

On the page that follows are the directions for drawing the car.
When you have finished drawing your car, click on the 

button.

Steps for Drawing the Car

Bring up your paint palette by either **clicking on the brush** in the navigator flap or by **dragging out a paint palette** from the supplies flap.

Select any color and using the largest paint brush size, paint an oval.

Select a smaller brush size and paint the wheels.

Select the color white and paint on a small windshield.

The last thing that you will paint are the car's headlights.
Use a different color than the one you used to paint your car.

When you are happy with your painting, remember to click on the **keep** button.
This will transform your painting into an object and remove the paint tools.

- MouseOver your car to bring up its handles.
- Check the direction that your car will go forward. This is indicated by the green arrow found in the center of your object.
- Make sure that your car is going forward in the direction you desire.
- Name your car. Click on the word sketch to highlight it and type a new name.

Now that the car is finished, we are going to draw a steering wheel. We do not want the steering wheel to be too big. Once again click on the paint brush found in the navigator tab.

Draw a simple steering wheel. On the top of the steering wheel place a colored ball. Make sure that the ball is on the top of your steering wheel.

Here is what my steering wheel looks like.

To bring up the handles of the steering wheel , hold down the Ø key and click on the steering wheel.

Mouse/down on the blue handle of the steering wheel and move it to make the steering wheel turn.

To bring up the **VIEWER** of the steering wheel, click on the turquoise handle. The **viewer** shows categories and instructions for the object. These instructions are represented by tiles. By combining these tiles, we can create scripts which can send messages to our object and tell it how to behave. Watch what happens to the value of the heading of the steering wheel as you move the blue handle.

Bring up the handles of the car. Mouse down and drag out of the viewer the 

tiles. When you do this you will create your first script. It will look like the sample below.

Click on the **clock to the left of the normal button** to see your car respond to this script. Click on it again to stop the script.

Drag out the **turn by tiles** and place them in your script below the forward by tiles.

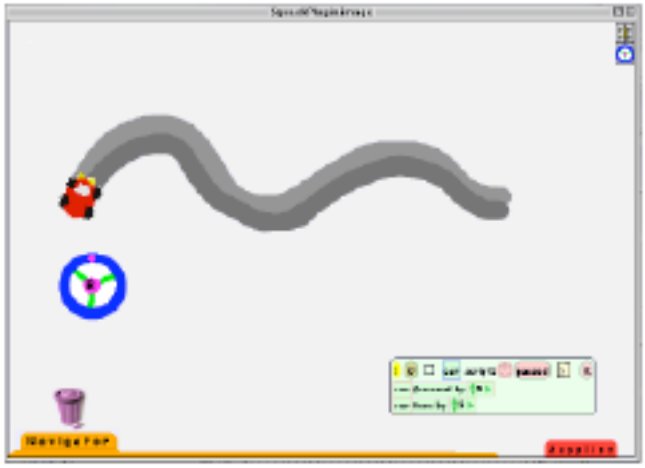
Click on the clock to set this script going. Your car will happily go forward in a perfect circle. **Play with the up and down arrows** next to the value of the turn by tiles while the car is in motion. Notice what the car does when the value of these tiles is a negative number.

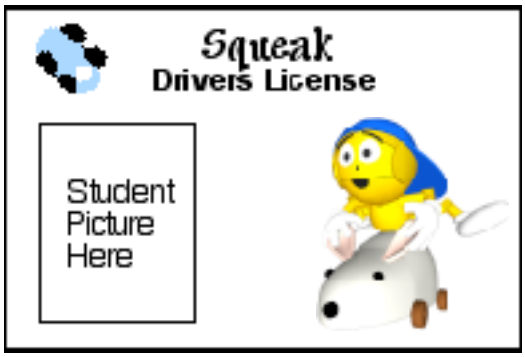
Our next step is to control the turn of the car with the steering wheel. Once the two objects are connected, whenever you move the steering wheel to the right and to the left by its blue handle, the car will respond and turn in that same direction. The trick is to tie the turn of the car to the heading of the steering wheel.

This is easily done. Bring up the viewer of the steering wheel. Drag the **heading tiles** of the steering wheel and place them on the **value of the turn by tiles** of the car.

Set your script to ticking. As quickly as you can, bring up the handles of the steering wheel and mouse down on the blue handle. As you turn the wheel to the right and to the left, the car will respond in that same direction. When the heading of the steering wheel is **0** the car will go straight. If the value of the heading is **a negative number**, the car will turn left, and if the value is a **positive number** the car will turn to the right.

Here is a **CHALLENGE**. Can you draw a road with a curve or two in it and steer your car successfully from one end of the road to another? You could earn a drivers license.





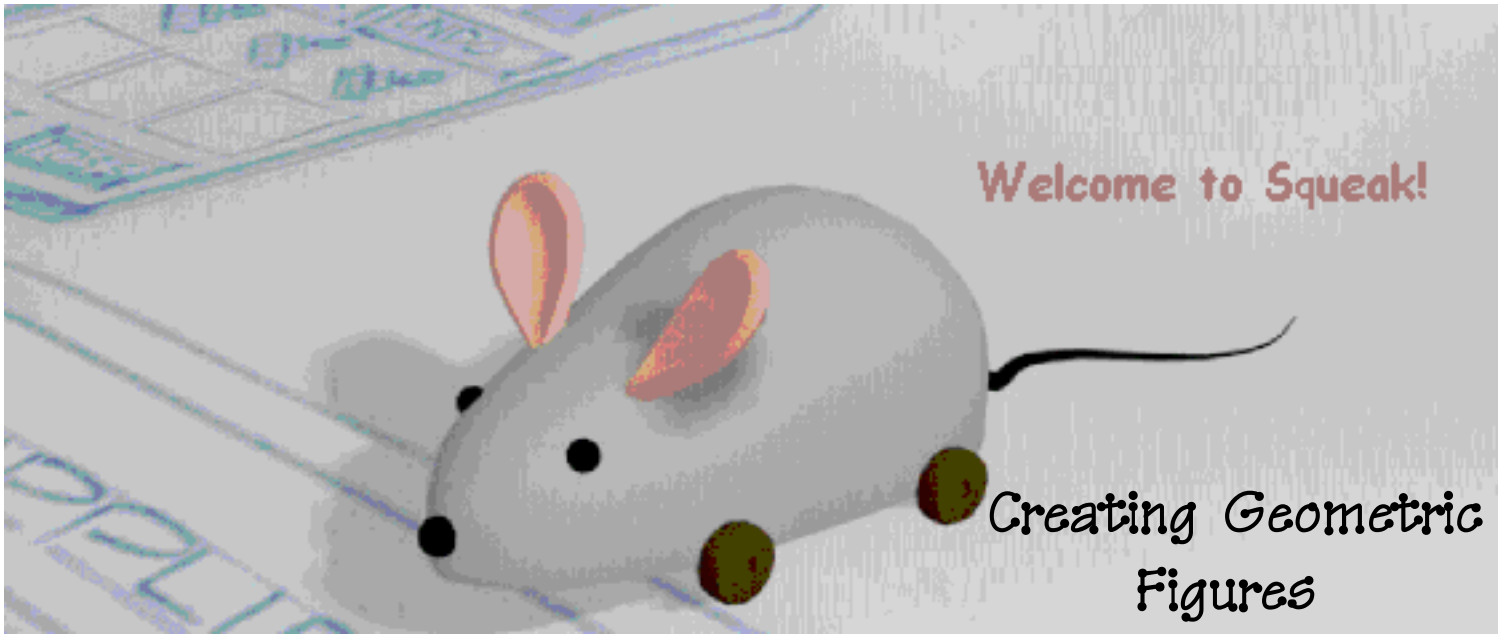
A Diversion: Into Geometry

The geometry lessons just sort of happened. As a lover of "Logo, I decided to use Squeak to see what kinds of rules or proceedures the students could create to show their understanding of circles and polygons.

The problems posed to the students were designed to help them develop conceptual understanding and become better adept at problem solving. Hopefully along the way they developed an appreciation for the beauty and power of mathmatics.

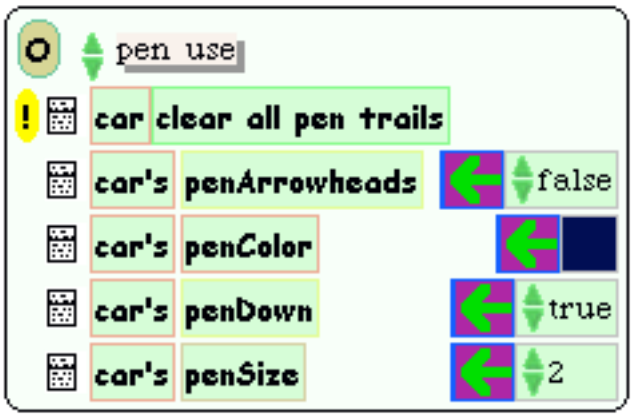
Curricular topics covered in the **Geometry Constructions** curriculum:

- Use of positive and negative numbers
- Understanding the number of angles and sides in regular shaped polygons
- Understanding relationsip between a circle and a polygon
- Understanding variables
- Understanding that the sum of the angles of any triangle is 180 degrees and the sum of the angles of any quadrilateral is 360 degrees
- Undertanding the concept of parallel and perpendicular lines
- Identify acute and obtuse angles
- Draw congruent figures



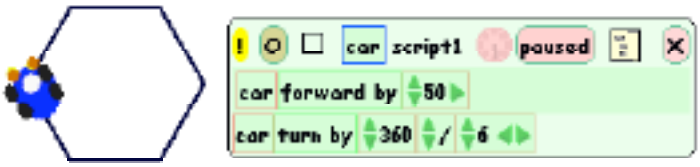
The students could use their car for this project or draw another object of their choice. They were to begin their exploration through trail and error in order to discover what the angles of the sides of the polygons might be in order to recreate them using Squeak. They were asked to create 3,4,5,6 and 8 sided polygons. Some of the children discovered that if they set the turn by tiles to 360 divided by the number of sides of the polygon, they did not have to spend time with the trail and error method. Of course they did not come by this discovery immediately.

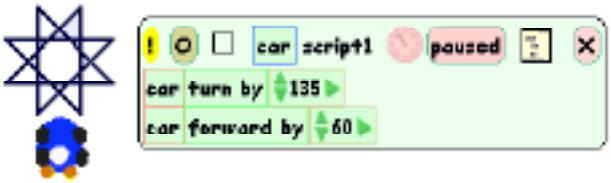
Once they were able to complete this task they were asked to define each proceedure that created each polygon. They were then **challenged** to create a model of a house using (for example) their square and triangle scripts. The difficulty to the challenge was in determining the actual angle that had to be turned and the position of the cursor before firing the scripts. From houses they were challenged to create neighborhoods and hotels as a means of challenging them to create ever more complicated scripts.



To begin you would need to open the viewer for your object and select a **pen color**,a **pen size** and set your **pen down** to **true.**

Here are some examples that are one way to solve some of the challenges.





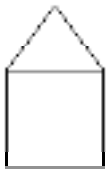
Here is an example of how creative the students can be as they play with the angle changes of the polygons.

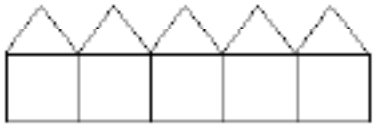
It is good practice to have the students learn to make reset scripts, especially as they experiment with this challenge. They will want to be able to eliminate any mistakes that are created as they experiment with their ideas. This can be done by creating a script that will erase all pen trails and set the heading of the object that is creating the polygons to a given number. An example of such a script can be see below.

This set of tiles will erase all pen trails in the world.

This set of tiles will reset the object that is doing the drawing to a specific heading.

The challenge to create other objects by combining their scripts to make mor complicated proceedures. The house would look something like the example below





The challenge was to write a proceedure to create a set of houses and then a neighborhood of houses. There was actually no limit to their creativity. They learned to create small proceedures and combine them to create more difficult designs. The Eiffle tower was not out of the question.