Elementary Math Focus Afternoon - September 28, 2015 at Manoah Steves Elementary Coding with Logo Language and Turtle Graphics by Fred Harwood

Writing CODE is simply giving a set of instructions for someone or something to do something. Attached are several pages of activities for getting students into coding quite easily. LOGO was a computer language written decades ago for this very purpose. Students give strings of commands to a turtle (originally a up-pointed triangle) which move the turtle around the screen. If the pen is down, it leaves a trace, if the pen is up, moving leaves no trace.

<u>The major affordances are</u>:

- **students control the mathematics making math something they do**
- **students can be seeking to do something they want to do**
- **learning needs come up in the context of these needs and are embedded**
- **mistakes are a natural part of the learning process and something to be learned from**
- **a growth mindset is embedded in coding**
- **creativity, reasoning, and visualizing are easily accessible**

Here is my idea for a primary class getting ready to do the Turtle Pond. You have a friend show up with dark glasses and a tapping stick. Standing in the doorway, you introduce him as, "This is my friend, Bart. His friends call him Blind Bart and he is not a pirate (pause) anymore. [If your class is sensitive and are not laughing at this pause you can add "Disney pirate"] "As you can see, he needs you to help him to his seat for today's class. He doesn't like to be touched by people he can't see so you will need to tell him how to get to his seat." (Maybe assign two students to tell Bart in how to get to his chair. Pre-arrange it so there will be some obstacles in the way).

Likely they will tell him "go forward" and now he can surge ahead quickly so the kids yell for him to stop. The teacher resets him in the doorway where they students are likely to say, "Go forward a bit" Now Bart moves a few centimetres. The idea is to create the angst in the students to engage them and create a desire to succeed in getting Bart to his chair while forcing them to be specific in instructions. For Forward they may choose steps or feet. If Bart is told feet, he can put one foot in front of the other to create that distinct dynamic that will parallel the grid. The fun anxiety is likely to happen again when they tell him to turn left. Bart can turn 15°. "No more!" So he'll turn 130°. Resetting, the students will discuss how to get him turned. Perhaps one will have the concept of 90° from skating or some other background. If not, a huluhoop handy measured off in 10° segments. [10° is the width of your fist at arms length when the back of your hand is facing you].

Key was to have Bart need to travel a path similar to Turtle Pond's so the students will be specific in "forward 6 feet, left 90°, forward 3 feet, right 90°, forward 3 feet" in able to get Bart to his seat. Having several students will have a visible discussion amongst them that the rest of the students will be engaged in hearing the ideas. Of course, they are also likely to 'help'.

Having Bart play with being blind will really set the tone too. "You sound really tall." "Did I hear you wave at me?" "Somebody smells really good." etc.

I've done this style of play teaching and it works great at church and summer camp so I think it would achieve our curricular goals of prepping them to 'be the turtle' and use the grid and turns to move the turtle to his/her pond.

With this activity students can access the **Turtle Pond** site by googling **"Turtle Pond NCTM".** It will be the first hit. I like to give students time just explore the program before giving anything more than "You need to direct the turtle to get into the pond for a swim." More direct instruction can happen after a while by making class observations like "Emily has figured out how to make all her directions before hitting the play button. That is clever." "Don has realized that the tree and rock button adds obstacles to the field making it more challenging. Has anyone else figured out what the other buttons do?" [**This means it is best for you to play with the program a bit as well.** The next page shows 3 formative assessments for the end of the play stage to check on individual progress.**]**

I recommend moving to Turtle Academy afterwards for more language and creativity access. Turtle Academy has lessons (tutorials) which are helpful for you or a student to learn the language but I recommend the activities I've produced first since they will create a desire to learn more, to control more and to make their creations more interesting, clever and beautiful. A few simple codes will allow for much beauty and math to be utilized. The change from Pond to Academy is to make the grid 10 per square instead of 1 as in the Pond. FD 50 will move the turtle 5 squares.

Remember the joy of figuring out your distinctive signature? Have students write their names using LOGO. They can animate it by spinning it in a circle to make a flower of their name. They can have their name move around the screen filling up the screen. They can add colour changes, pen size changes and much more! They can send codes to other students with a turtle written secret message.

Mathplayground Math Programming has an online flash version of logo with sample scripts for creating some amazing shapes. I found when students start here, they didn't learn to code, they just copied and pasted the scripts to see what someone else did. We want them to plan and carry out their own codes first. Afterwards, they can visit a site like this to add to their language. http://www.mathplayground.com/mathprogramming.html

If you want to explore some other coding opportunities in elementary, Greenbriar and Ivy Hill Elementaries have combined to produce the following pages of apps, sites and activities to explore. http://greenivytf.weebly.com/coding-resources.html

Again, the power of coding for students to think mathematically with a growth mindset that can transfer over to all other areas of learning it not to be missed!

HAVE . . .
to wordf fd 80 rt 90 fd 40 bk 40 rt 90 fd 40 lt 90 fd 20 bk 20 lt 90 bk 40 pu rt 90 fd 50 lt 90 pd fd 80 bk 80 rt 90 fd 40 lt 90 fd 80 pu rt 90 fd 10 rt 90 pd fd 80 bk 80 lt 22 fd 90 lt 158 fd 80 pu bk 100 lt 90 fd 200 rt 90 pd end >
to wordfs cs repeat 20 [wordf rt 18] end
wordfs

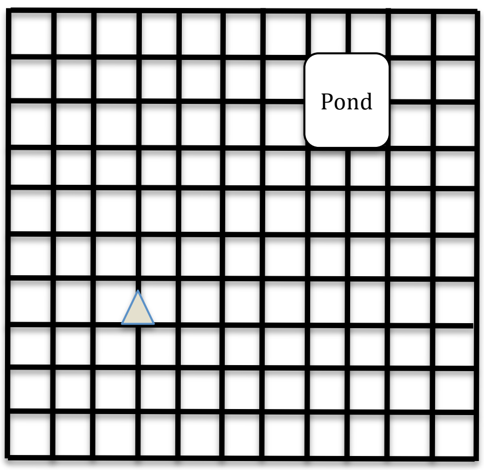
LOGO – TURTLE POND Name: ___________________________ Date: ___________

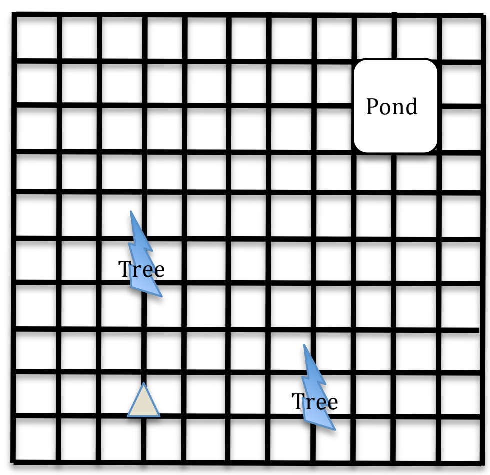
http://illuminations.nctm.org/Activity.aspx?id=3534

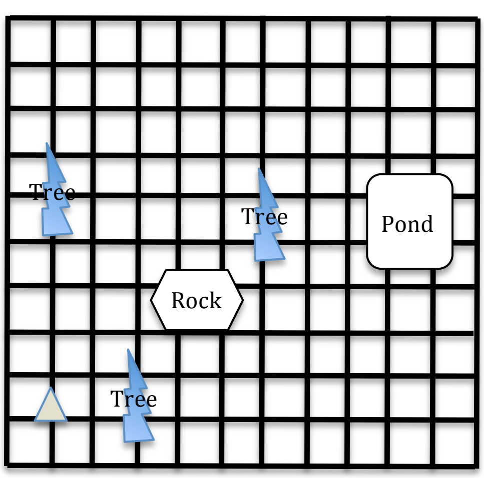
__Day 1__: Put in **"Turtle Pond Illuminations"** in your search window and search. Go to the link that shows up. It will look like the one below TURTLE POND Illuminations or NCTM Illuminations

First explore moving your turtle into the pond with just the grid and the pond. You can later add obstacles to move around, change how far the turns can go and even try without the grid.

Describe what commands you would give the turtle to get into the pond in each situation: Use FD # to go forward, RT 90 to turn right, LT 90 to turn left, BK # to back up: For example: FD 3, RT 90, FD 5 would go forward 3, turn right and go forward 5







LOGO – TURTLE ACADEMY Name: _________________________ Date: ___________

http://turtleacademy.com/playground/en

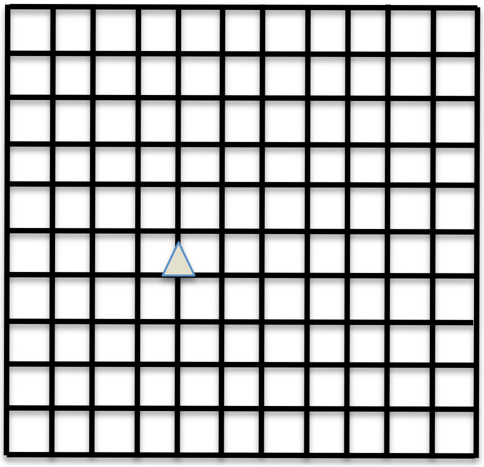
<u>Day 2</u>: Spring Is Blooming All Around You: Time to grow your own flowers
The concept: there is a turtle (triangle shaped) that you can give instructions that move it about the screen. When it's pen is down, it leaves a line, when the pen is up, it just moves.

<u>The Basics</u>:
Clearscreen: **cs**
Penup: **pu**
Pendown: **pd**
Forward (distance): fd #
 Eg. **fd 100**
Back (distance): **bk #**
Right Turn (degrees): rt #
 Eg. **rt 90** is a turn right a quarter circle
Left Turn (#°): **lt #**
Hideturtle: **ht**
Home: returns to (0, 0) pointing up (make sure pu before moving or the line draws to home)
Loops: Repeat (number of times): repeat # [set of commands or programs]
 Eg: **repeat 4 [pd fd 100 rt 90]** will draw a square of size 100 pixels
Loops can be nested: Eg: home cs repeat 36 [rt 10 repeat 8 [fd 50 lt 45]]
Mini Program: To (name) . . . END
 Eg: **To Sqr repeat 4 [pd fd 100 rt 90] END** will draw a square of size 100 whenever SQR is typed and entered (or called into another program)
Variable mini- program: To (name) :variablename
 Eg: To Square :side repeat 4 [fd :side rt 90]
 Eg: Square 60 will draw a square of side length 60
Arc (degree of angle, radius): arc #° #
 Eg: **arc 90 40** draws a quarter circle of radius 40
 Eg: **arc 360 60** draws a circle with radius 60
Setwidth: setwidth # changes pen size (use small #'s)
Predict what this program will do:
cs pu home pd repeat 4 [repeat 5
[setwidth 1 fd 10 setwidth 3 fd 10] lt 90]
rt 90 pu fd 71 lt 90 pd repeat 8
[repeat 5 [setwidth 1 fd 10 setwidth 3 fd 10] lt 45]

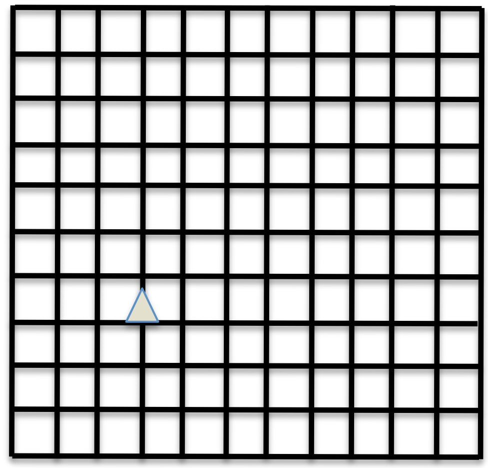
Driving the Turtle by being the Turtle! Exercises Name: ________________________

Explore the following situations by predicting first what you expect to happen and then testing your prediction by typing the command sequence into the Turtle Academy workspace. Assume that each square in the grid is 10 on each side. The bottom

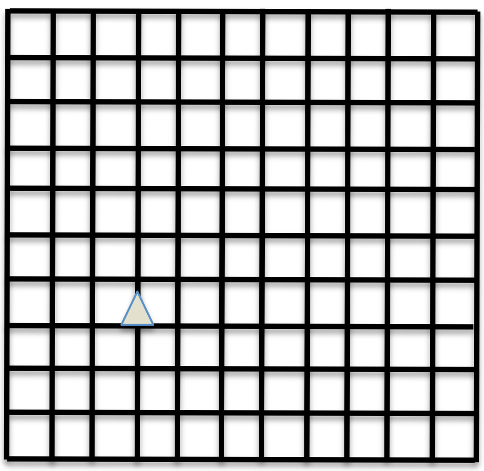
1. pd fd 50 rt 90 fd 10 rt 90 fd 70



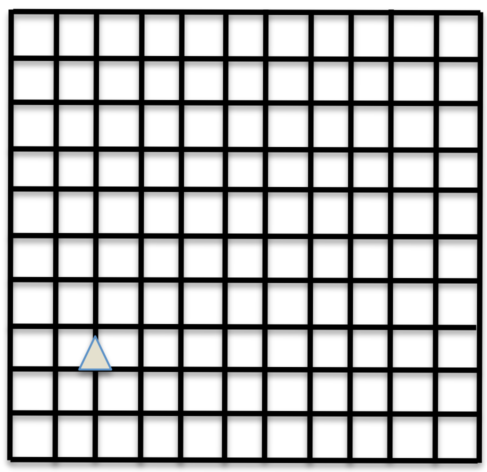
2. cs pu fd 30 pd rt 90 fd 30 rt 90 fd 50



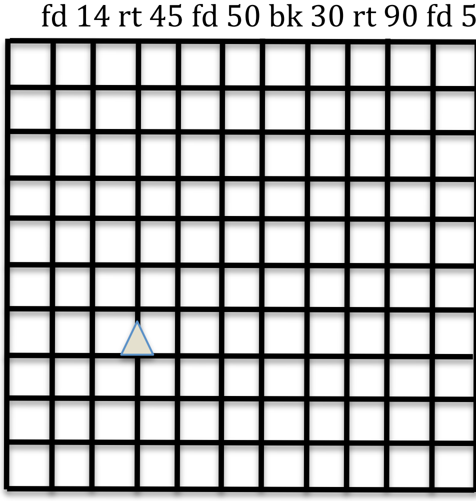
3. cs repeat 4 [fd 40 rt 90]



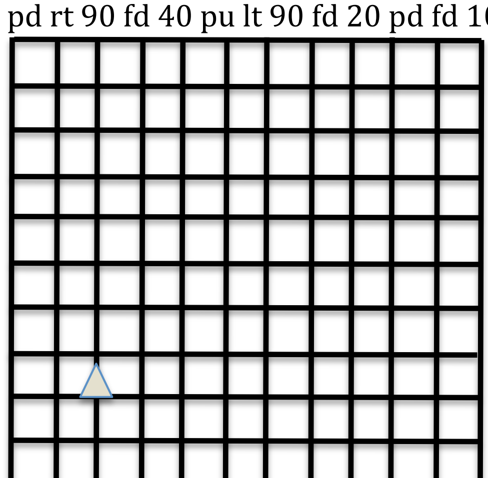
4. Cs repeat 2 [pd fd 30 rt 90 fd 30 lt 90]



5. pd fd 50 rt 45 fd 14 rt 45 fd 30 rt 45 fd 14 rt 45 fd 50 bk 30 rt 90 fd 50



6. cs pd fd 60 bk 30 rt 90 pu fd 20 pd rt 90 fd 40 pu lt 90 fd 20 pd fd 10

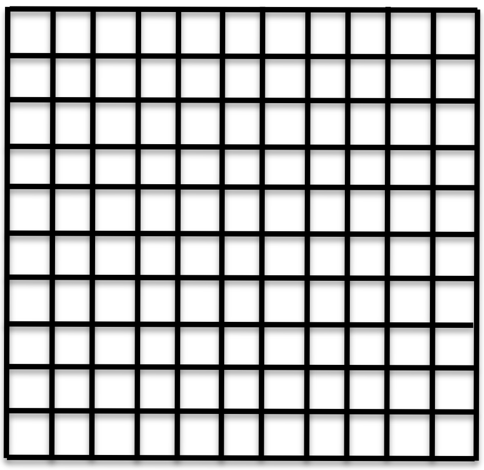


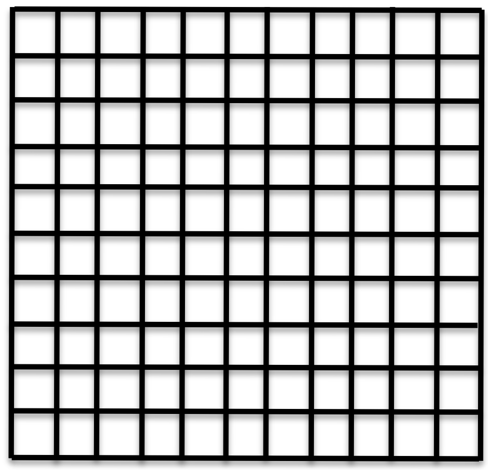
Blooming Your Math Knowledge in LOGO's Turtle Academy Name: ________________

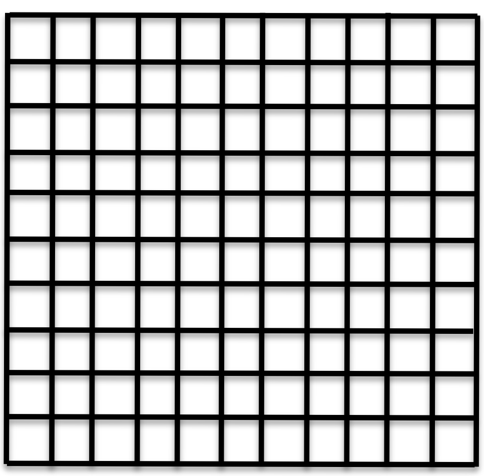
Your task is to breed some beautiful flowers by taking some basic shapes you create and repeating them in a circle. Observe what happens on your workspace when you create a mini-program called "Square" and then spinning them in a circle:

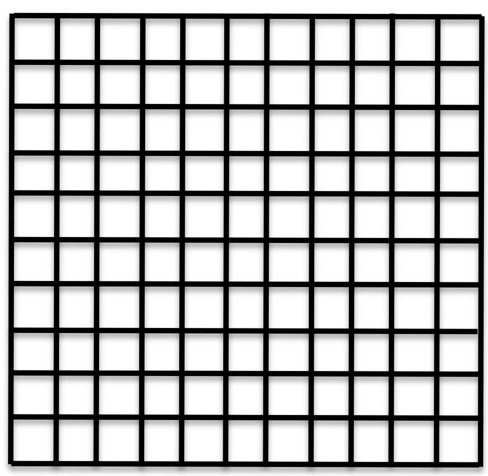
1. cs To Square repeat 4 [fd 100 rt 90] END repeat 30 [Square rt 12] ht

Now create some different starter shapes as mini-programs and then repeat them in a circle to create different blossoms. The grids are to help plan your starter shapes. Record all your programs and coding so others can test your designs. Share your successes with other people.









Colour Calculator Explorations: **Name:**

http://mathforum.org/mathtools/tool/953/

Using the colour calculator tool, record your data in the following table for the following questions and then look for emerging patterns:

1. **Which unit fractions (1/n) terminate? Which repeat?**
2. **How many decimal digits don't repeat? How many digits repeat?**

Predict and test ideas as they develop.

Denominator	Non-repeating digits	Repeating digits	Denominator	Non-repeating digits	Repeating digits
2			21		
3			22		
4			23		
5			24		
6			25		
7			26		
8			27		
9			28		
10			29		
11			30		
12			31		
13			32		
14			33		
15			34		
16			35		
17			36		
18			37		
19			38		
20			39		

Tasks:

1. Highlight the ones that have no repeating digits. What do they have in common? Can you predict how many digits will be in the decimals of these types?
2. Which ones have only repeating digits? What do they have in common? Can you predict how many digits ones of this type will have in their repeating patterns?
3. Which ones have a mixture of non-repeating and repeating digits? Can you predict how many digits of each type might be in a denominator of different numbers like 56?

Test your predictions with new denominators.

Calculator Creativity:

142 Israelis fought 154 Arabs over 69 oil wells. The battle lasted 5 years. Who won?
14215469 x 5 = 71077345 This doesn't look creative or interesting and is of possible poor taste with the fragile conditions of the Middle East but turn your calculators upside down and marvel at the creative turn! On the blue calculators, this clearly spells "ShELLOIL" which is an ironically funny answer to the initial question.

The curricular topic will be "Order of Operations" within number operations.

What do we need to do/know to turn this topic on it's head creatively so to speak?

1. Determine what letters are possible with the numbers on the calc turned upside down.
2. Brainstorm some words that are possible from these 'letters'.
3. Choose a selection of the words to form a theme.
4. Determine a publishing format to display our theme creatively.
5. Work backwards from the inverted answers to create order of operation questions that produce these words.
6. Publish them into our format with the answers hidden.
7. Challenge others to solve our arithmetic/literate puzzle(s).
8. Celebrate our collective creativity.
9. Reflect on our process and how this investigation aligns with the cross-curricular competencies.

Some quick examples: from http://www.pleacher.com/mp/puzzles/mathpuz

After doing each problem on your calculator, turn the calculator upside down to read the message! Unfortunately, some scientific calculators display the numbers/letters differently!

1. What did the jolly fat man in the red suit say? (.344552 - .22334) ÷ 3 = ________

2. What does Jimmy do after drinking too much? (37,164.18 + 1.2) ÷ 7 = __________

3. What has a thigh, a knee, and a shin? (251.03 - 16.78) x 4 = _____________

4. Who invented the first phone? 7,700 + 40 - 2 = _____________

5. What is your teacher's best tennis stroke? 148,488 ÷ 184 = _____________

Broken Calculator Challenge: Only some keys are available on a broken calculator. Can you beat the clock to meet all the target values using the calculator?
https://www.mathsisfun.com/games/broken-calculator.html

"Even for elementary school students working with simple arithmetic calculators, there are activities, such as the "broken calculator" activities, that help students focus on and analyze the structure and elements of arithmetic and gain skills along with understanding, rather than have the calculator replace their thinking. The broken calculator activities are essentially puzzles in which students must figure out how to perform certain tasks on a calculator that has one or more non-working keys. At different stages of students' arithmetic learning, problems like "How can we multiply 20 times 50 if the zero key isn't working?" or "How can we multiply 5 times 12 if the only working number keys are 5 and 7?" or "How can we get 6 on the calculator if the only working number key is 5?" can be challenging, fun, and instructive." [from **Thinking (And Talking) About Technology in Math Classrooms** *E. Paul Goldenberg, Education Development Center, Inc.*]

http://www.pleacher.com/mp/probweek/p2003/a111003.html

	A	B	C	D
1	$\frac{\text{MINUTE}}{60}$ NATURE	N TWENTY V E	BAD + VICE	1 3 terminus 5 extremity 9 7 conclusion
2	$\frac{\text{TIME}}{2}$ 20	+ LIB	DANCE^2	POLLEN 123456
3	$(X)^2$	1T 2T 3T 4T 5T 6T LIFE	CHEDDAR >	π CC
4	< PERFECT	144 WORD WORD 144 WORD WORD	NOMIAL NOMIAL NOMIAL	1 2 SAFETY 3 4 5 6
5	20 BORED	SKπY	1 D 2 R 3 A 4 C 5 U 6 L 7 A	ho ho +ho