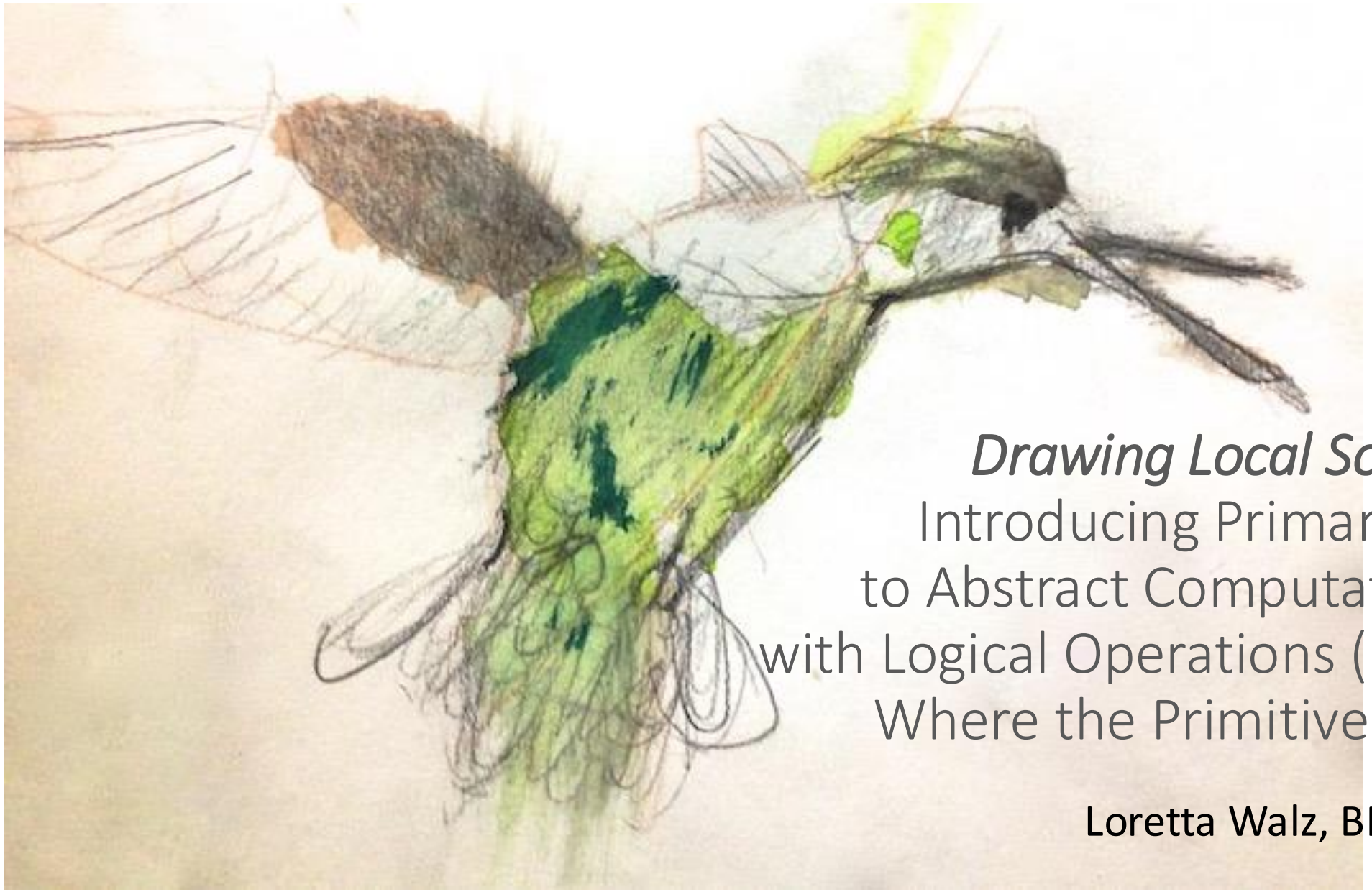


# *Drawing Local Songbirds:*
# Introducing Primary Learners to Abstract Computational Design with Logical Operations (Boolean Algebra) Where the Primitives are Shapes

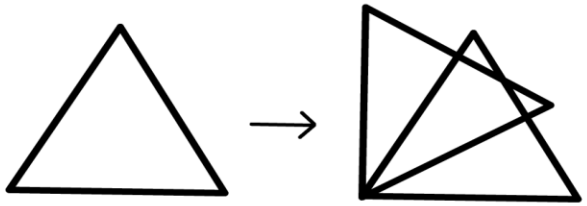
Loretta Walz, BFA, MAEd, PhD

2019. Female Ruby-Throated Hummingbird. Graphite, watercolour on paper by child of 9 yrs.

*“There’s no part I can see that a rule can’t find.”* (Stiny, G. 2005)

# Everyone Drew A Songbird

2019. Bluejay. Graphite, watercolour on paper by child of 9 yrs.



$$\mathrm{X} \implies \mathrm{X} + (t)\mathrm{X}$$

*(t)* = rotate

2019. Bluejay. Graphite, watercolour on paper by child of 9 yrs.

# Before and After – Identified Class Artist

2019. Downey Woodpecker. Graphite, watercolour on paper by child of 9 yrs.

2019. American Kestrel. Graphite, watercolour on paper by child of 8 yrs.

# Y “Branch” Grammar

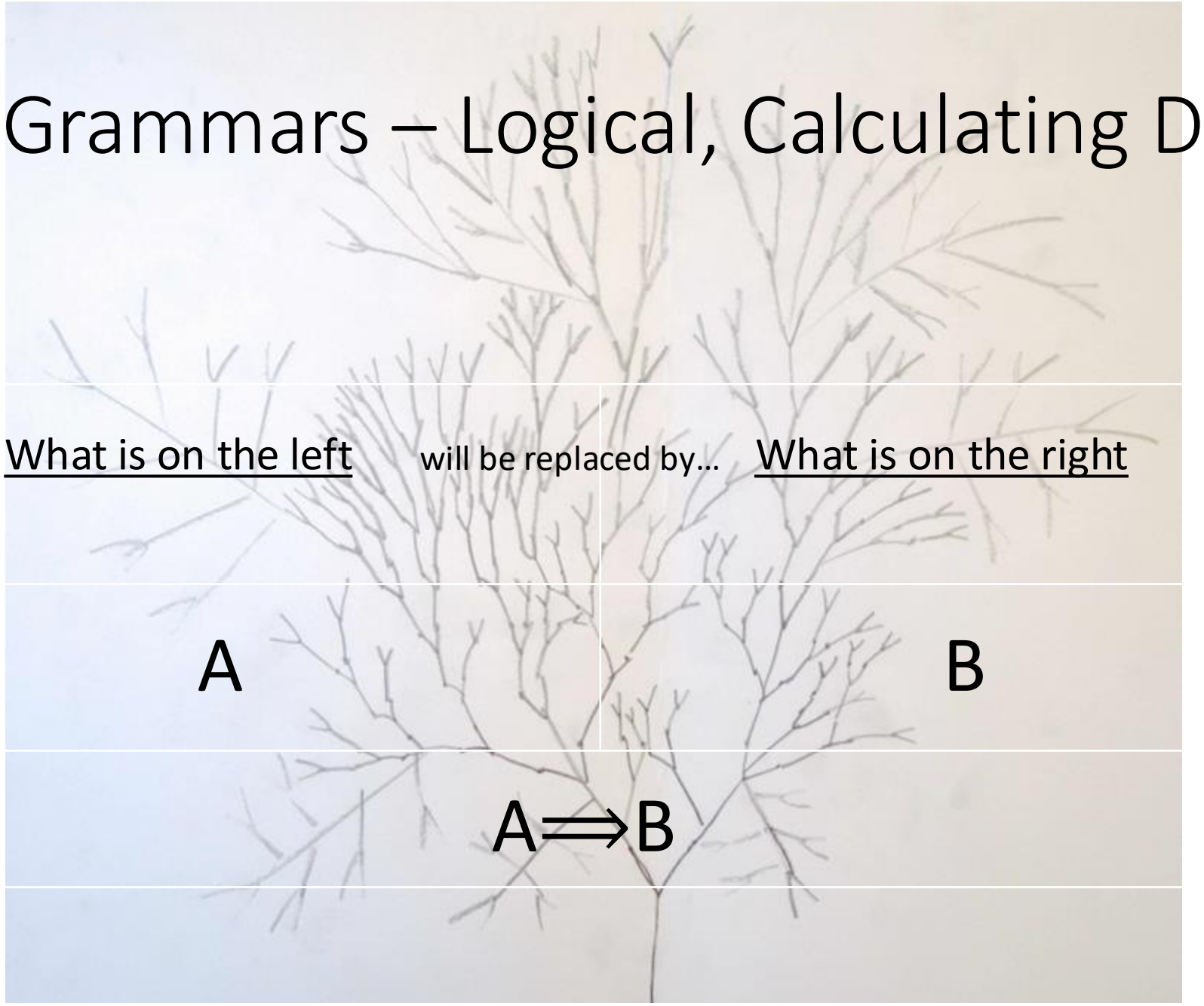
Schematic:

$$X \Longrightarrow X + Y$$

$$X \Longrightarrow X + Y$$

2019. Scrub Jay. Graphite, watercolour on paper by child of 11 yrs.

# Shape Grammars – Logical, Calculating Design



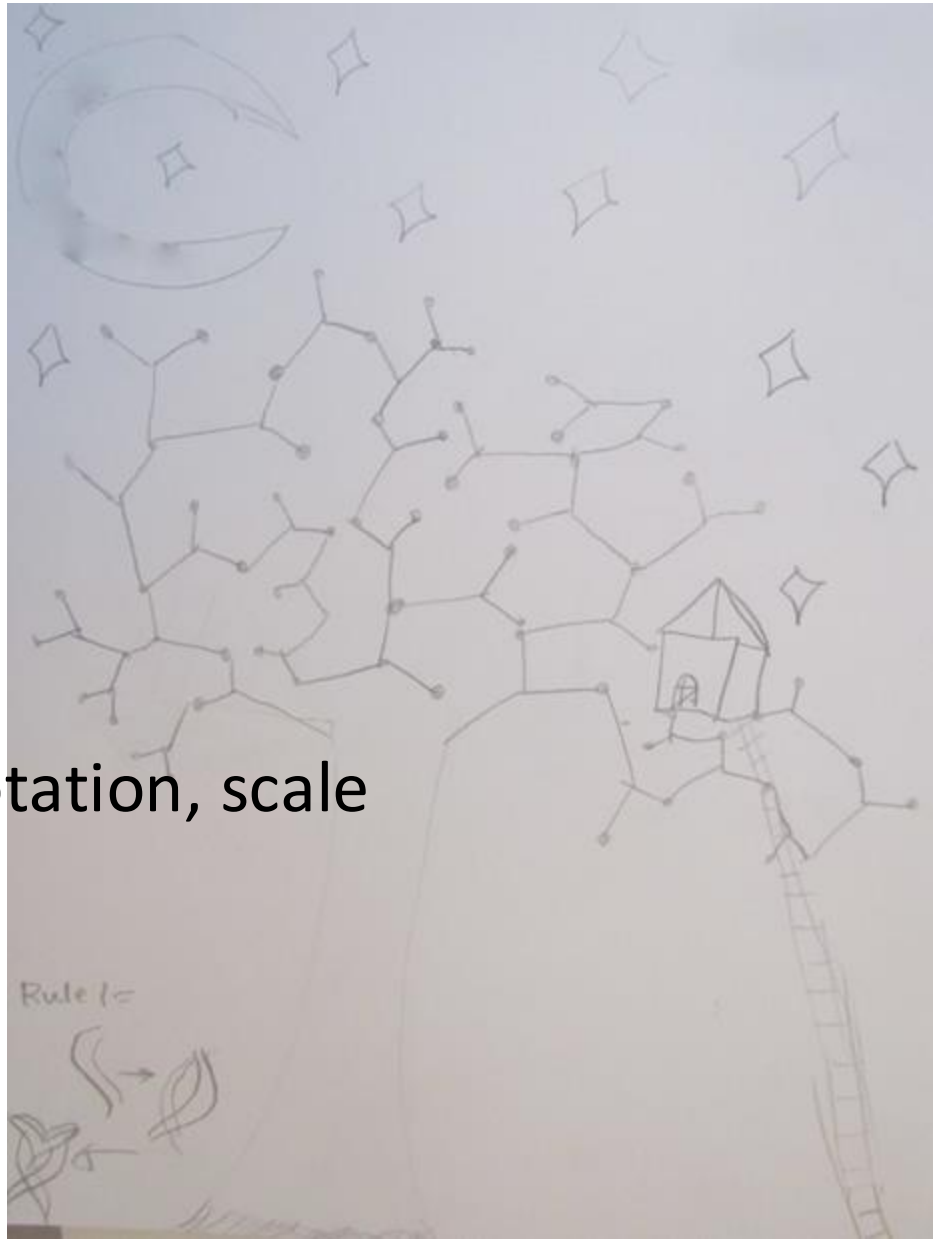
# Calculating with Shapes

<u>Operations</u>

Addition (+)

Subtraction (–)

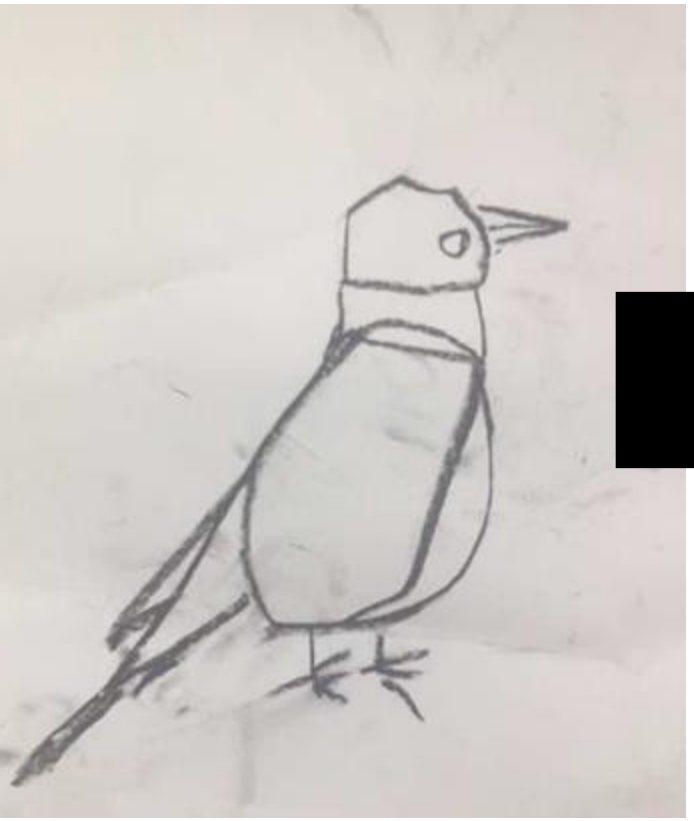
Transformation (*t*) reflection, translation, rotation, scale

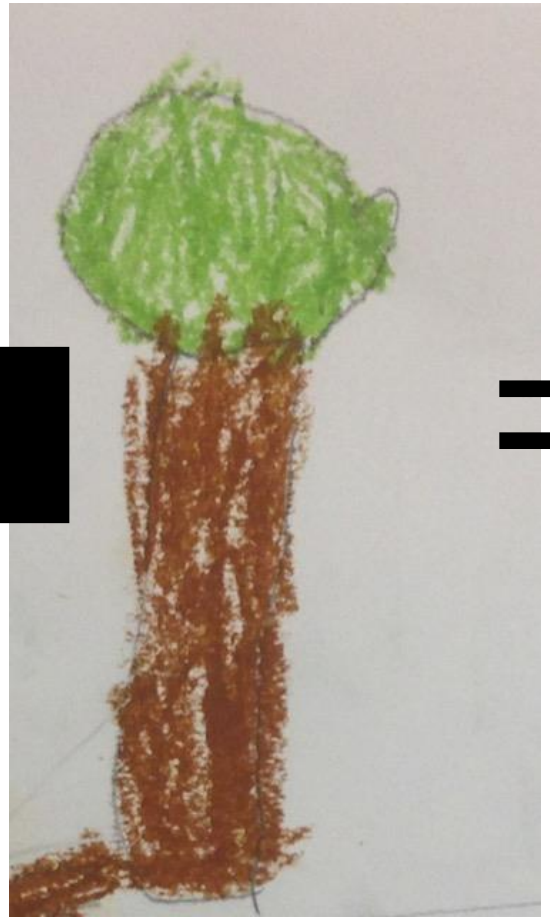


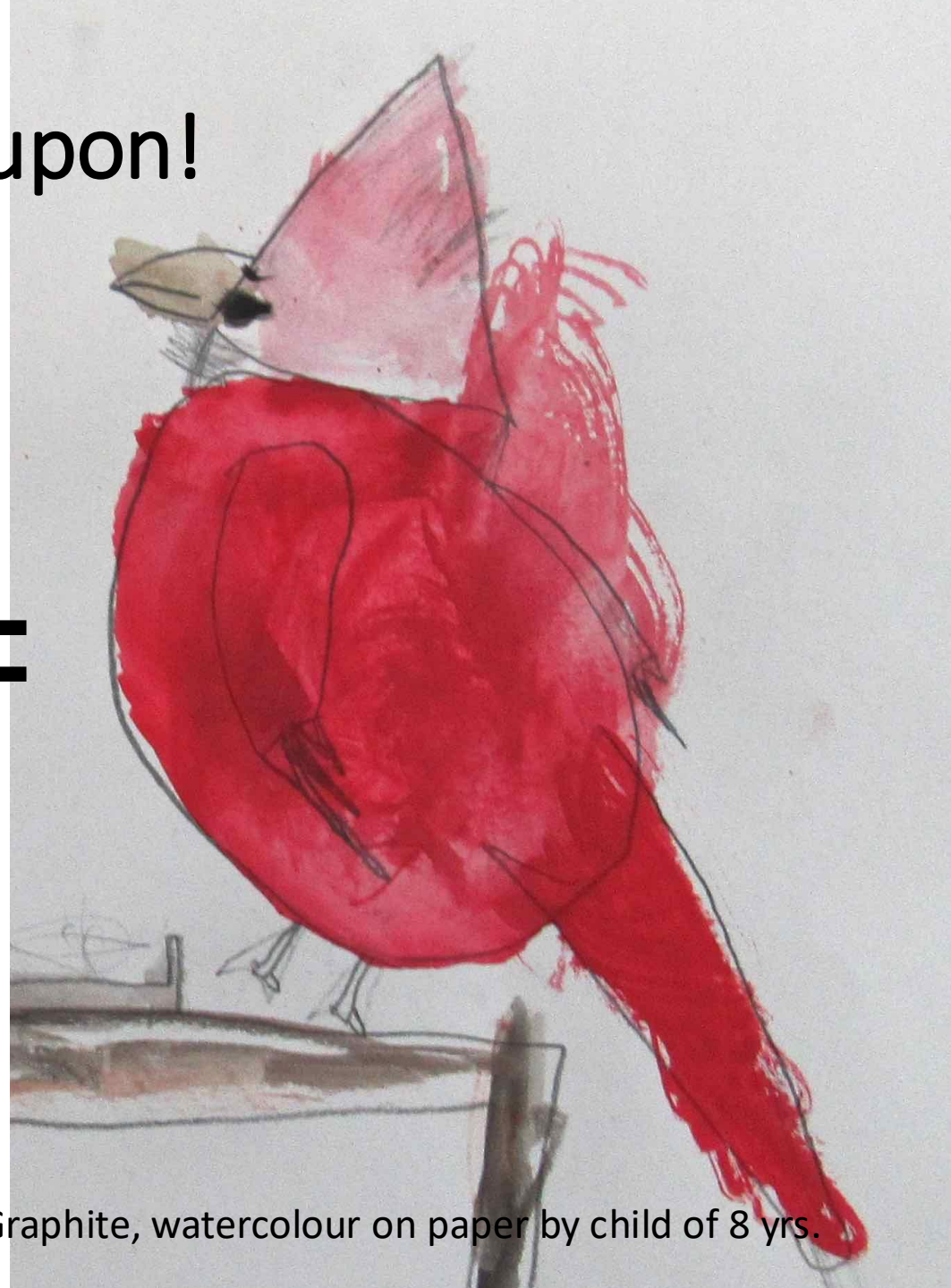
# Three kinds of emergence are produced using a shape grammar:

- anticipated
- possible
- unanticipated

# Our birds need a branch to perch upon!







2019. Cardinal. Graphite, watercolour on paper by child of 8 yrs.

# OK, Let's use a Y "branch" grammar to build a nice perch!

Schematic:

$$X \Rightarrow X + Y$$

$$X \Rightarrow X + Y$$

2019. Scrub Jay. Graphite, watercolour on paper by child of 11 yrs.

Sketch of Cape May Warbler family, graphite, watercolour, 9 years old

# …and many questions followed!!!

- How much do I do? How many times do I draw the Y?
- Do I have to point my Y in the same direction?
- Can my lines be squiggly?
- Do they have to touch?
- Is this right/am I doing it right?
- What’s it supposed to look like?

Sketch of Cape May Warbler family, graphite, watercolour, 9 years old

2019. Black Capped Chickaee. Graphite, watercolour on paper by child of 8 yrs.

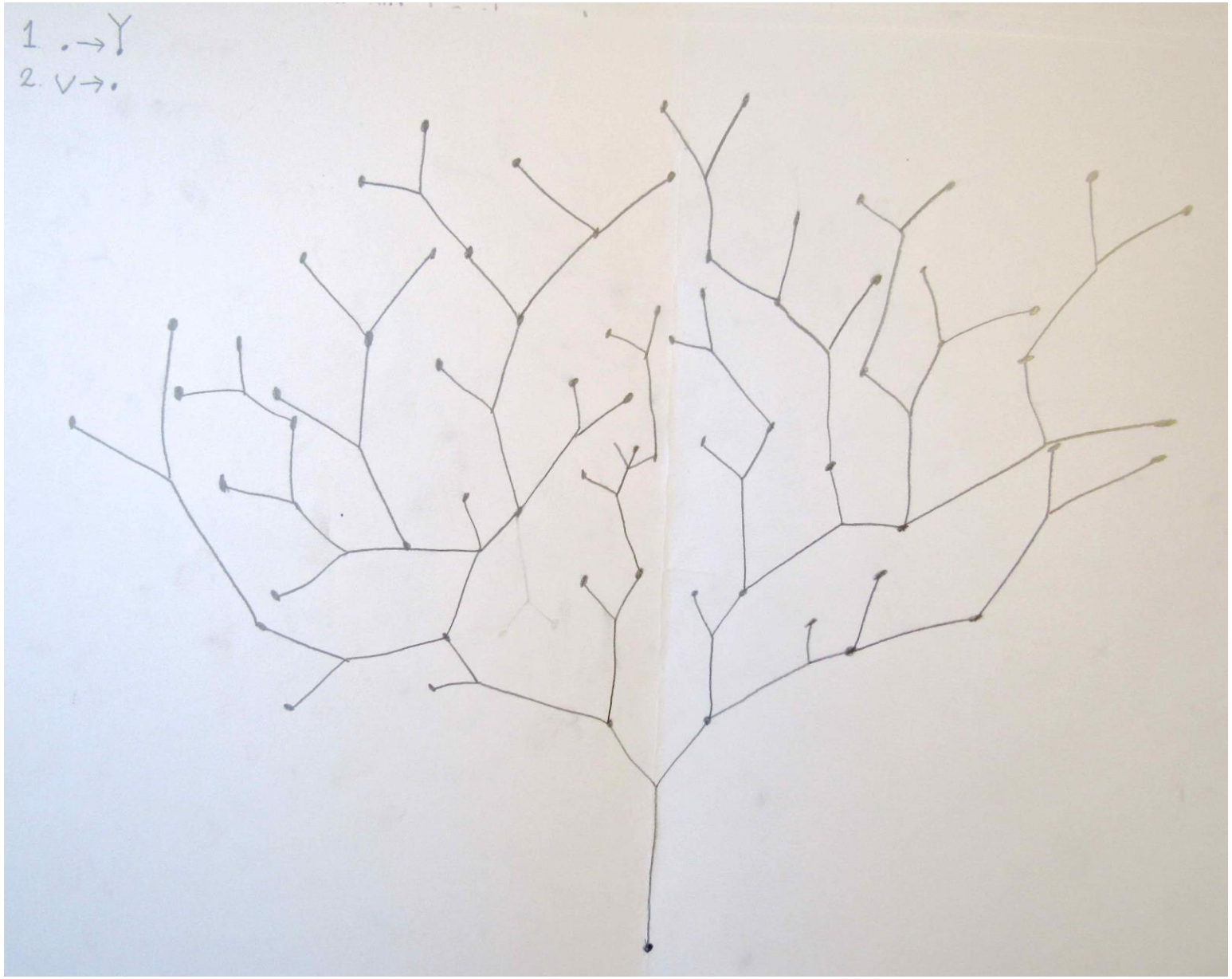
2019. American Robin. Graphite, watercolour on paper by child of 10 yrs.

2019. Bluebird.. Graphite, watercolour on paper by child of 8 yrs.


**Downey Woodpecker perched on the very top of a tree, 9 years old**

**Black and White Warbler nestled amongst branches, 8 years old**

# The Lollipop Tree!




2019. Maple tree design using  the Y grammar by child of 8 yrs.

2019. Elm Tree.  Graphite  on paper by child of 8 yrs.

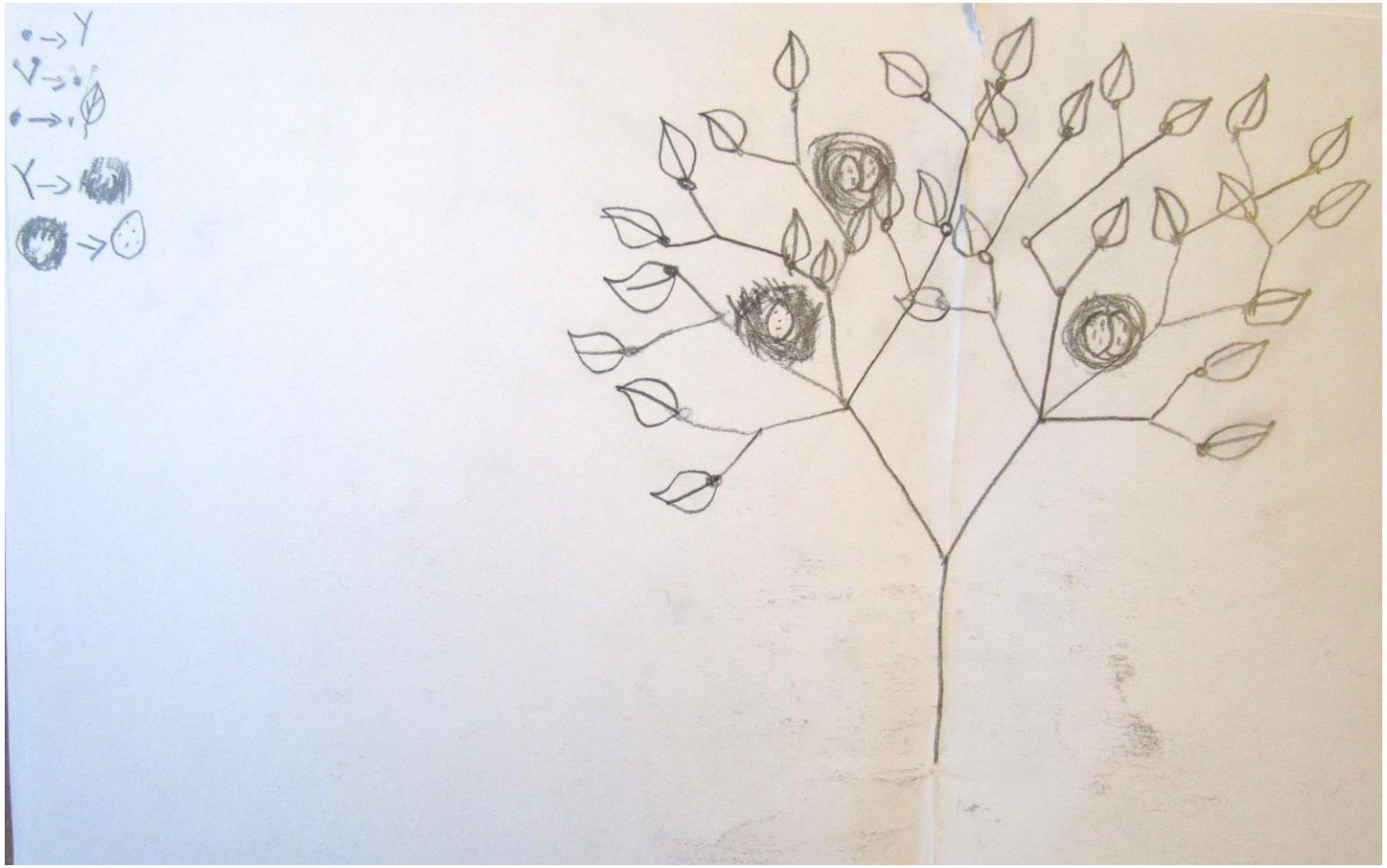
2019. Elm Tree.  Pastel and Tempera  on paper by child of 8 yrs.

# There was always one or two who struggled

2019. Trees and Deer. Pastel and Tempera  on paper by child of 7 yrs.

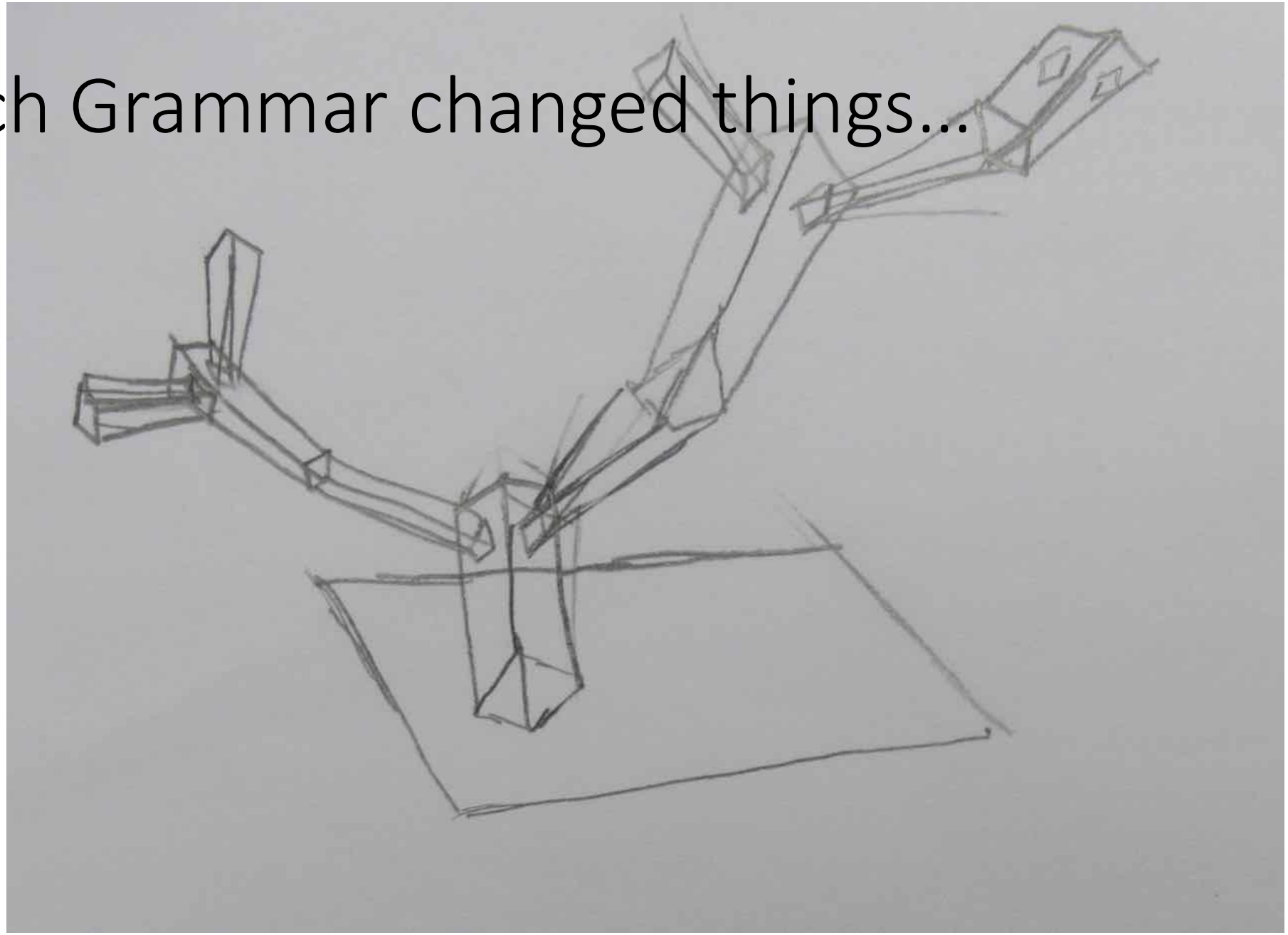
2019. Tree. Pastel and Tempera on paper by child of 8 yrs.

# Free time Drawing Produced Many Variations



2019. Y Grammar Tree. Graphite on paper by child of 8 yrs.

# The Y Branch Grammar changed things…

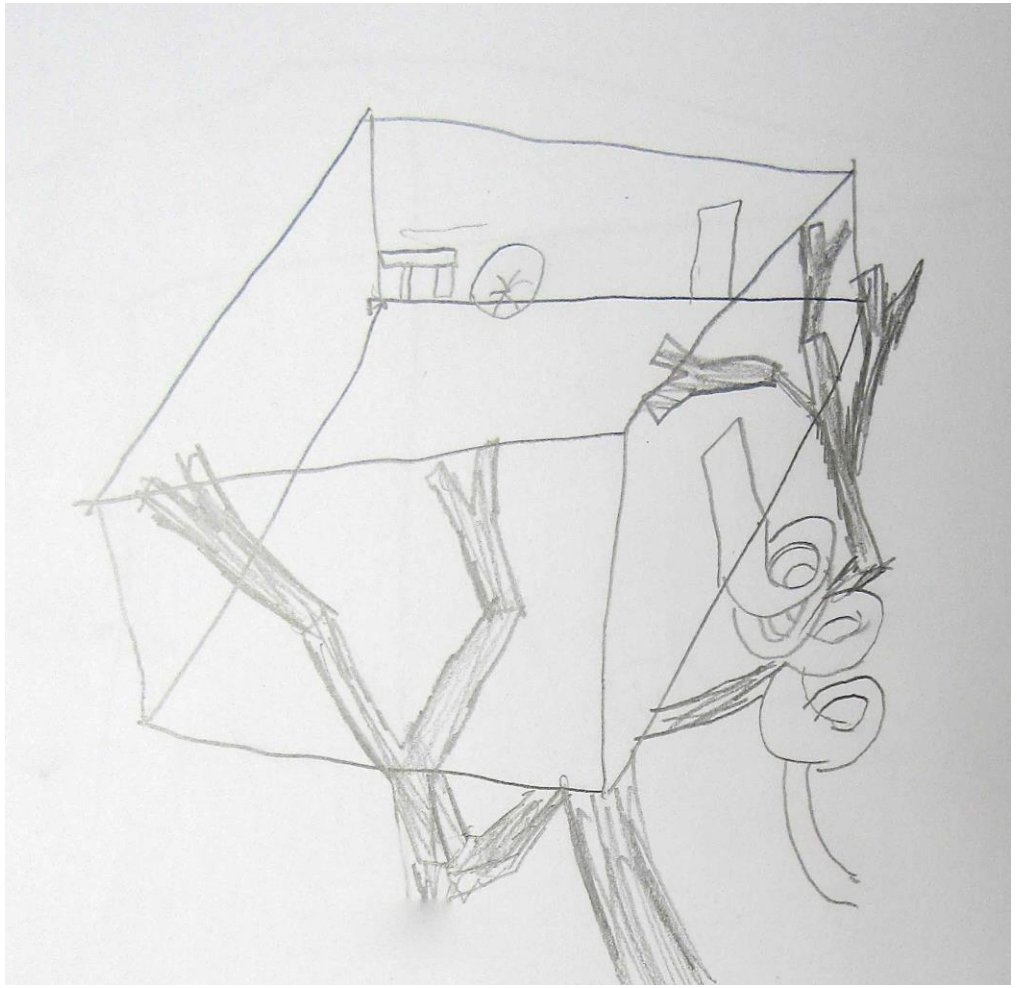


All the children succeed in drawing a corresponding tree. There were many chances for children to improve and build on their tree design skills.

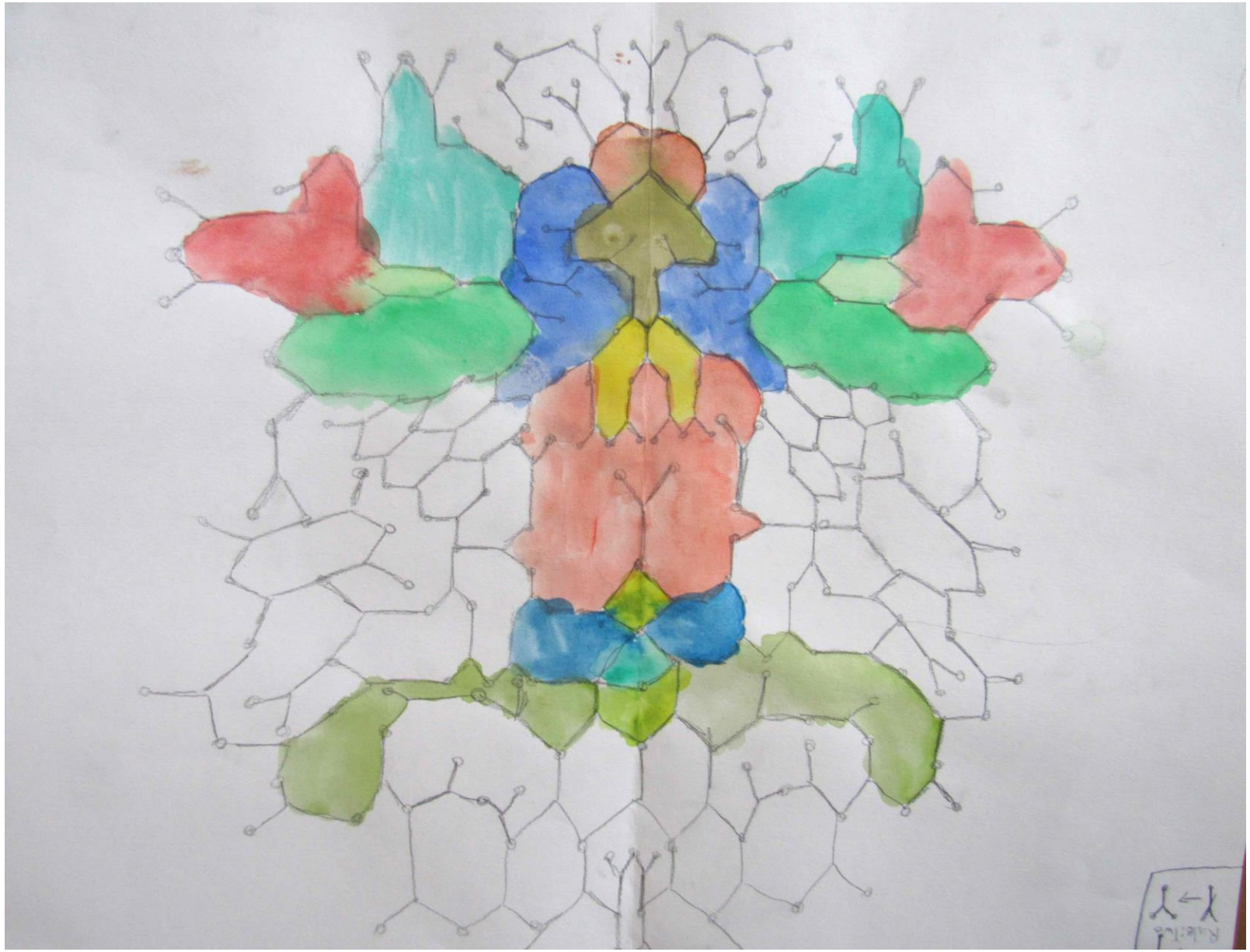
2019. Maple tree design using  the Y grammar by child of 8 yrs.

2019. Maple tree design using  the Y grammar by child of 8 yrs.

# The Y grammar was used for quick sketching…

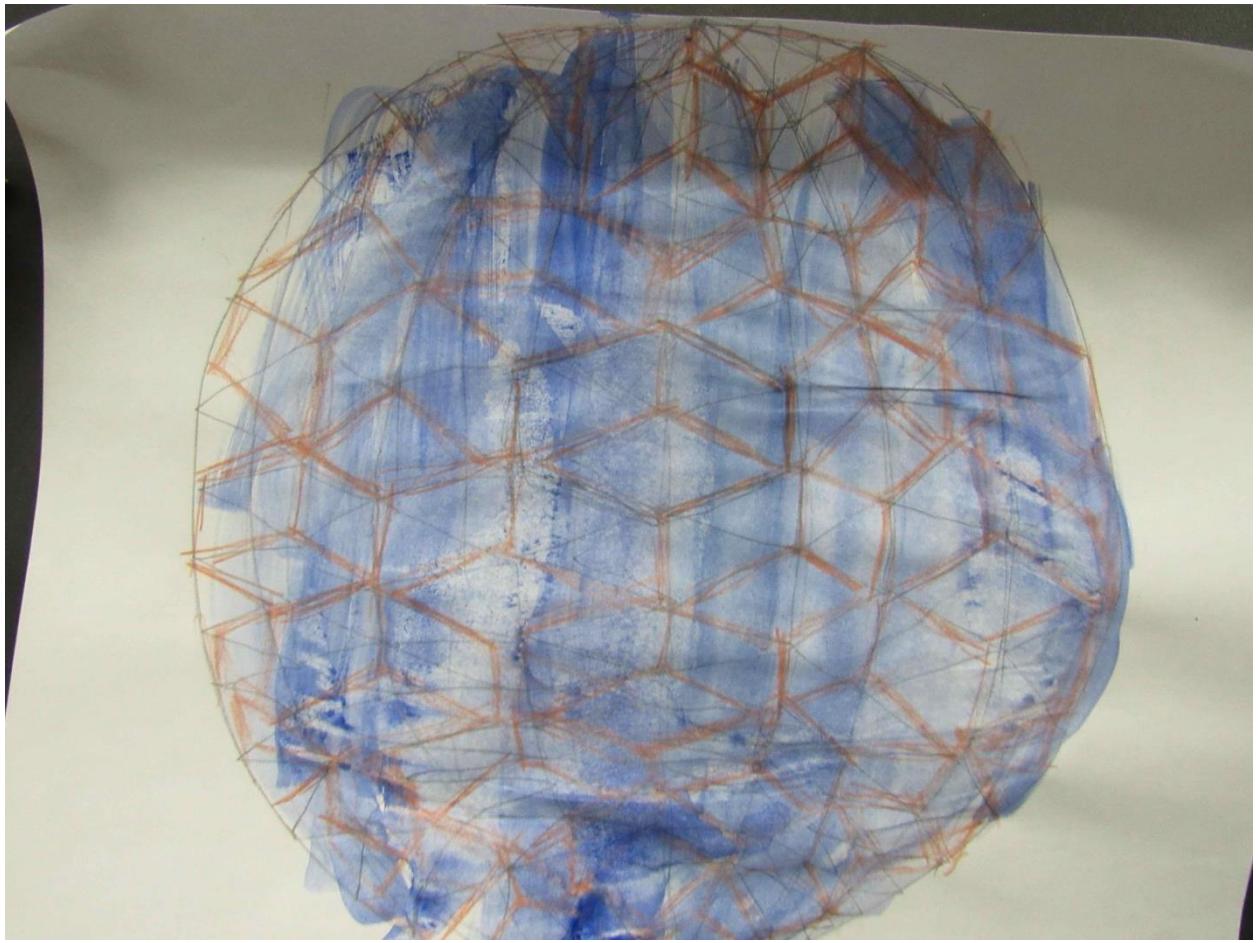


The Y grammar was used in more emergent ways



2019. Y Grammar Bug. Graphite, watercolour on paper by child of 8 yrs.

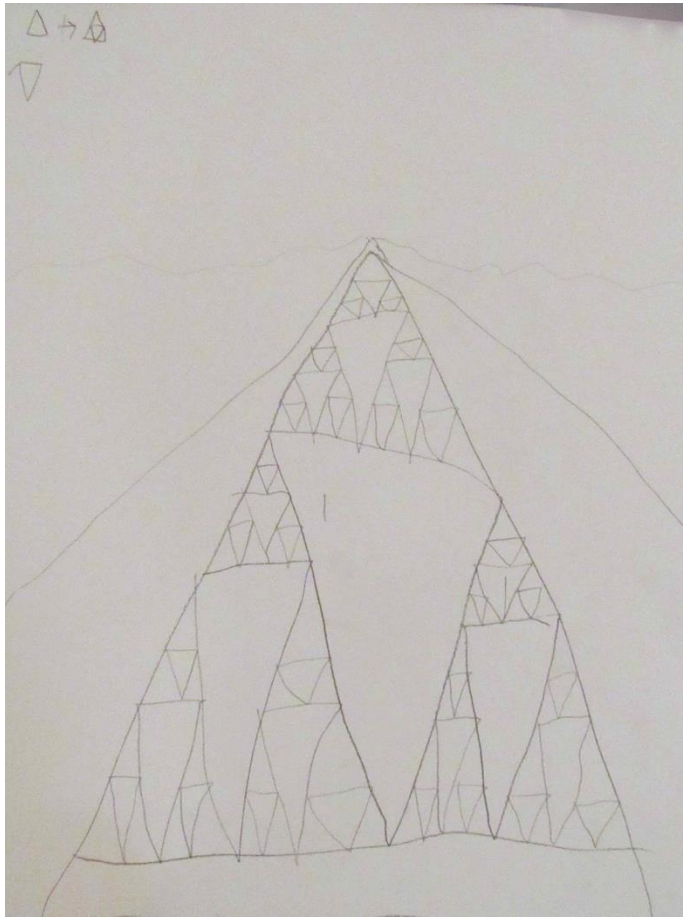
The Y Grammar was even found in other drawings

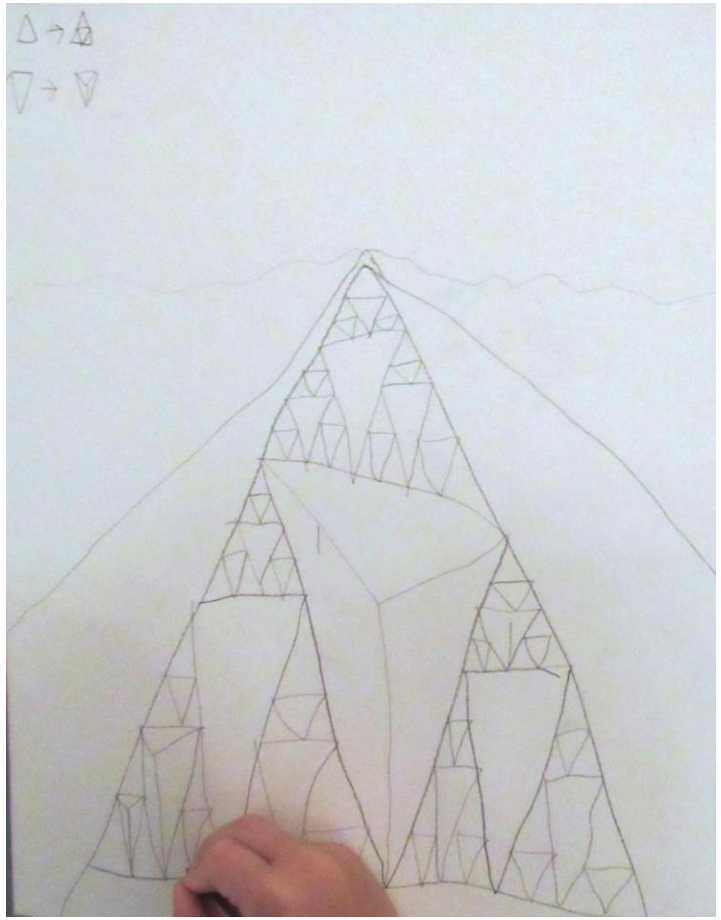


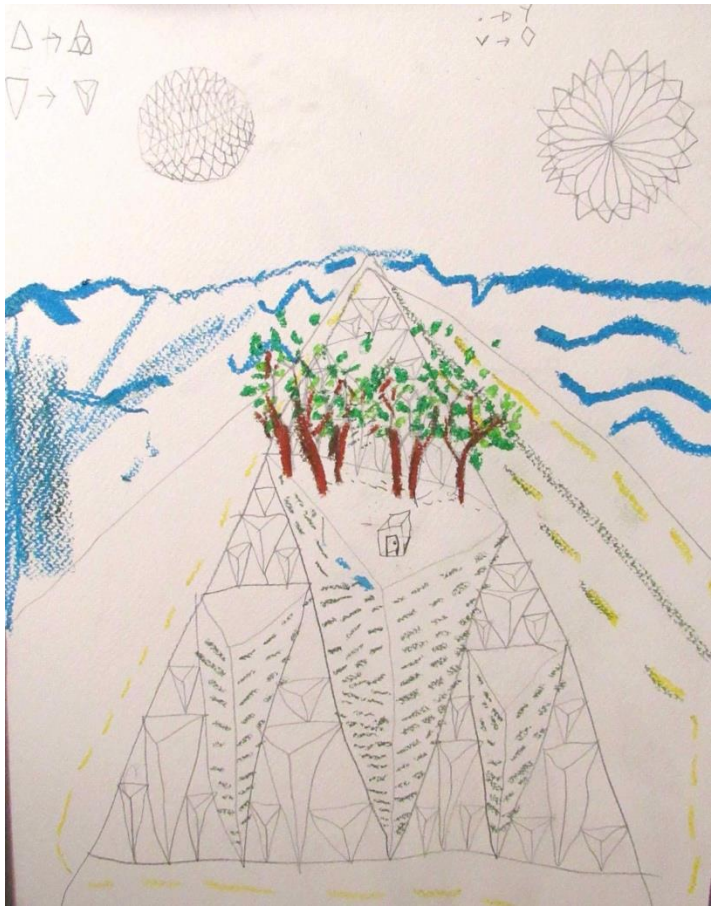
2019. Y Grammar Isolation in Geodesic Sphere. Crayone, watercolour on paper by child of 9 yrs.

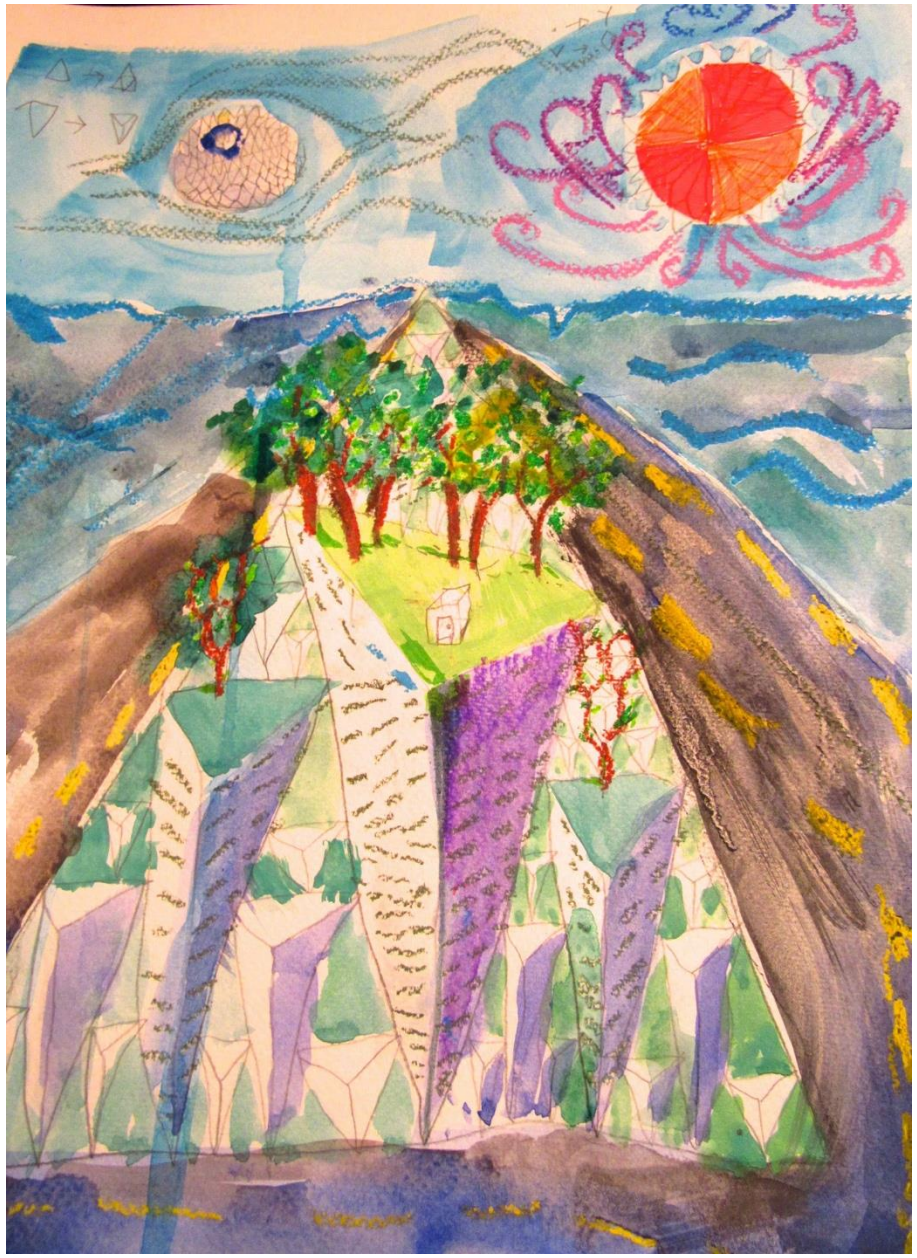
2019. Y Grammar produces cubes on Sphere. Crayone, watercolour on paper by child of 8yrs.

# Seeing as you Go

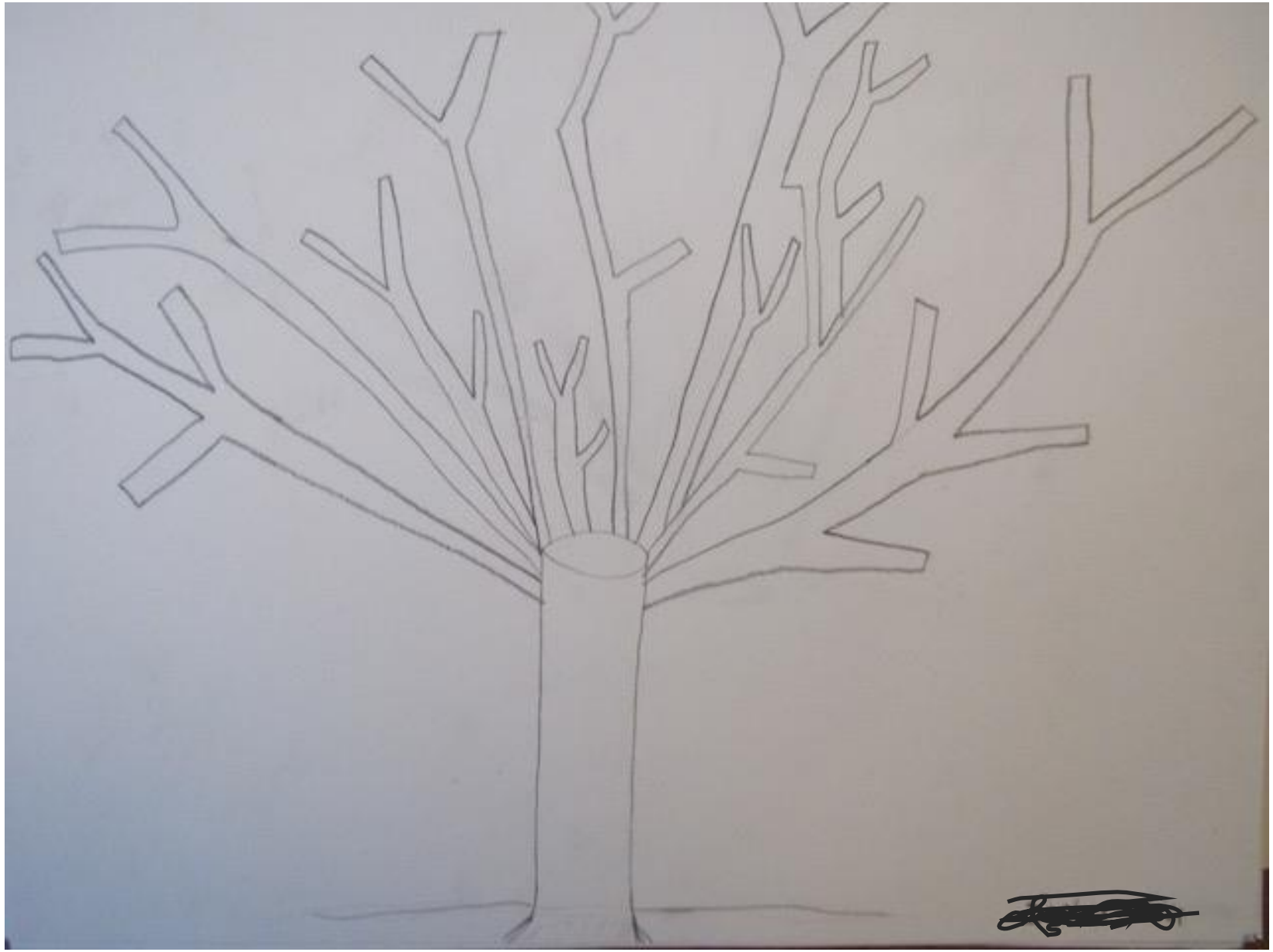






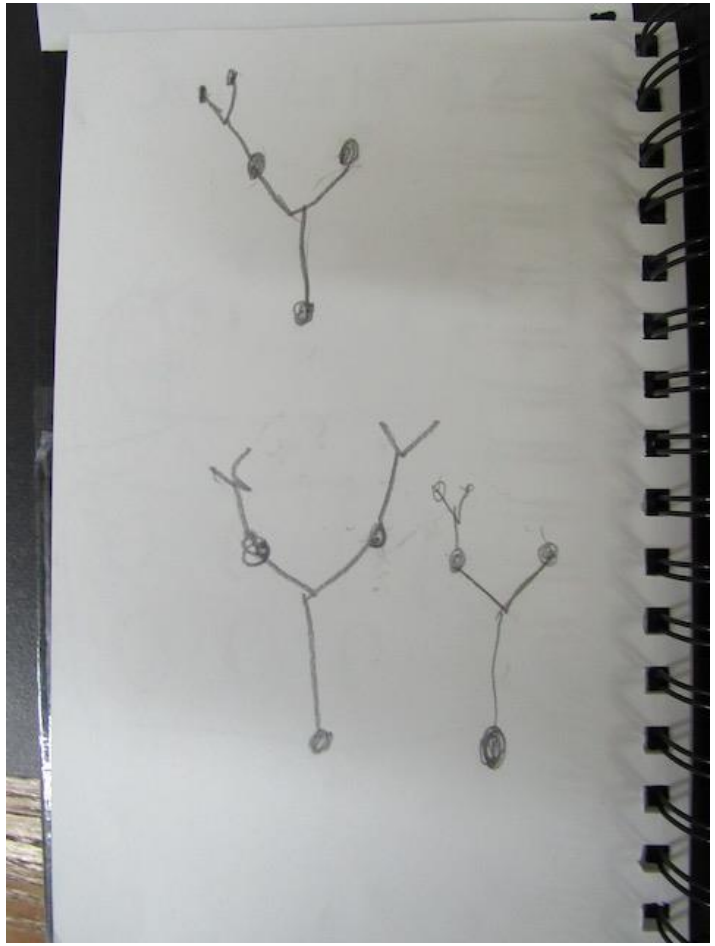


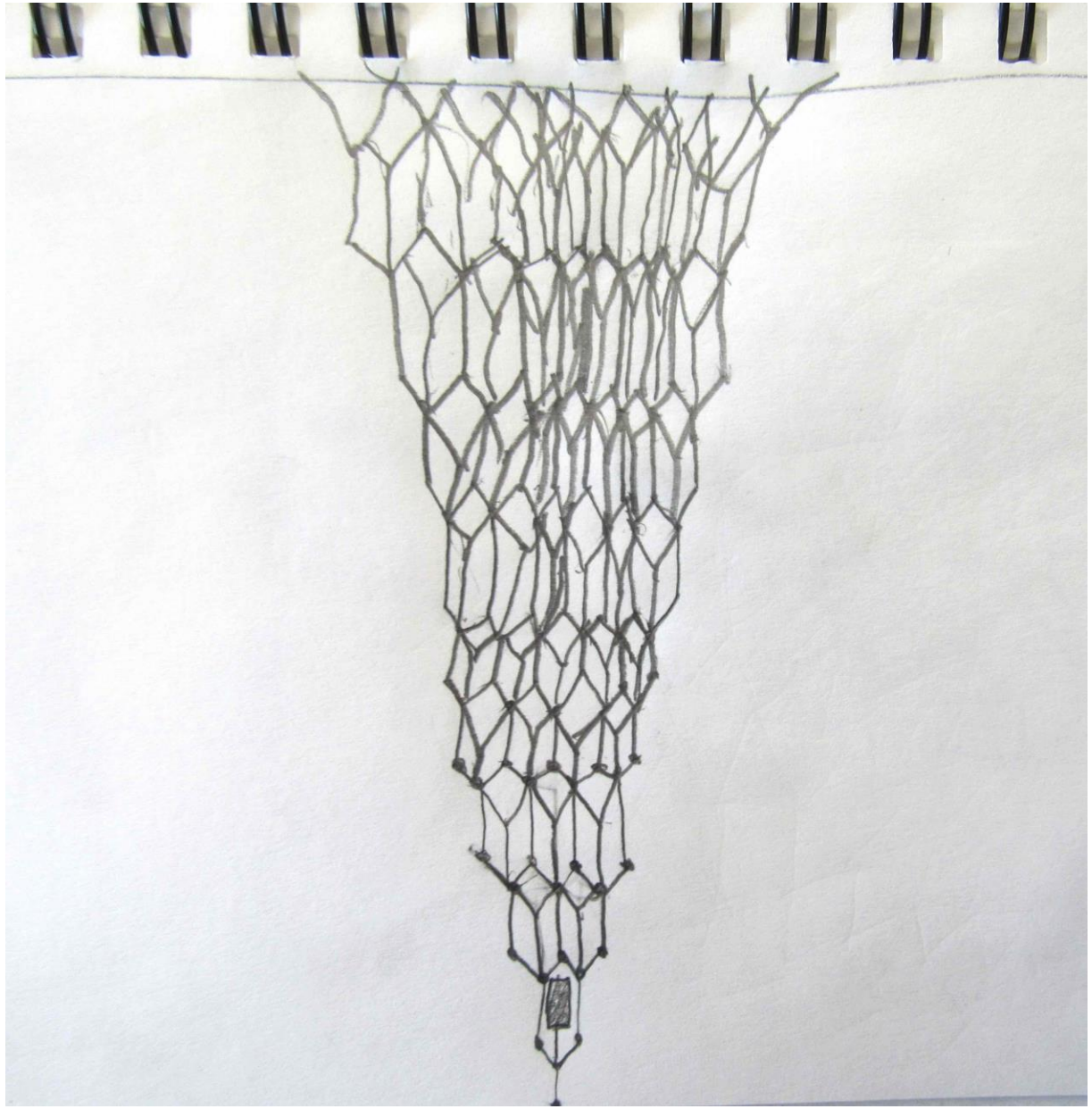
2019. Bridge City. Graphite, watercolour on paper by child of 9 yrs.



2019. Initial Tree Design. Graphite on paper by child of 8 yrs.

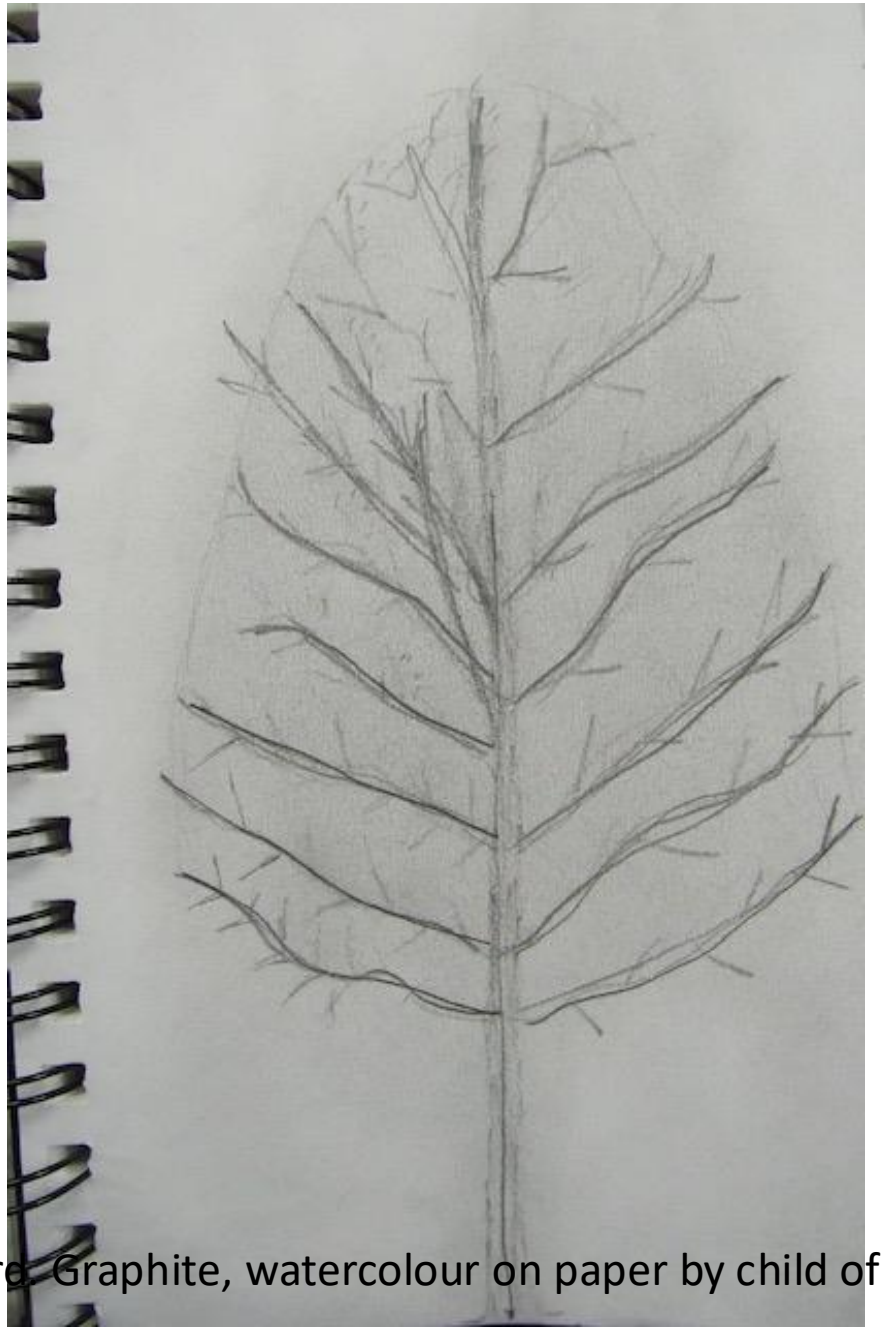
2019. Final Painting of Tree with Treehouse. Graphite, watercolour on paper by child of 8 yrs.



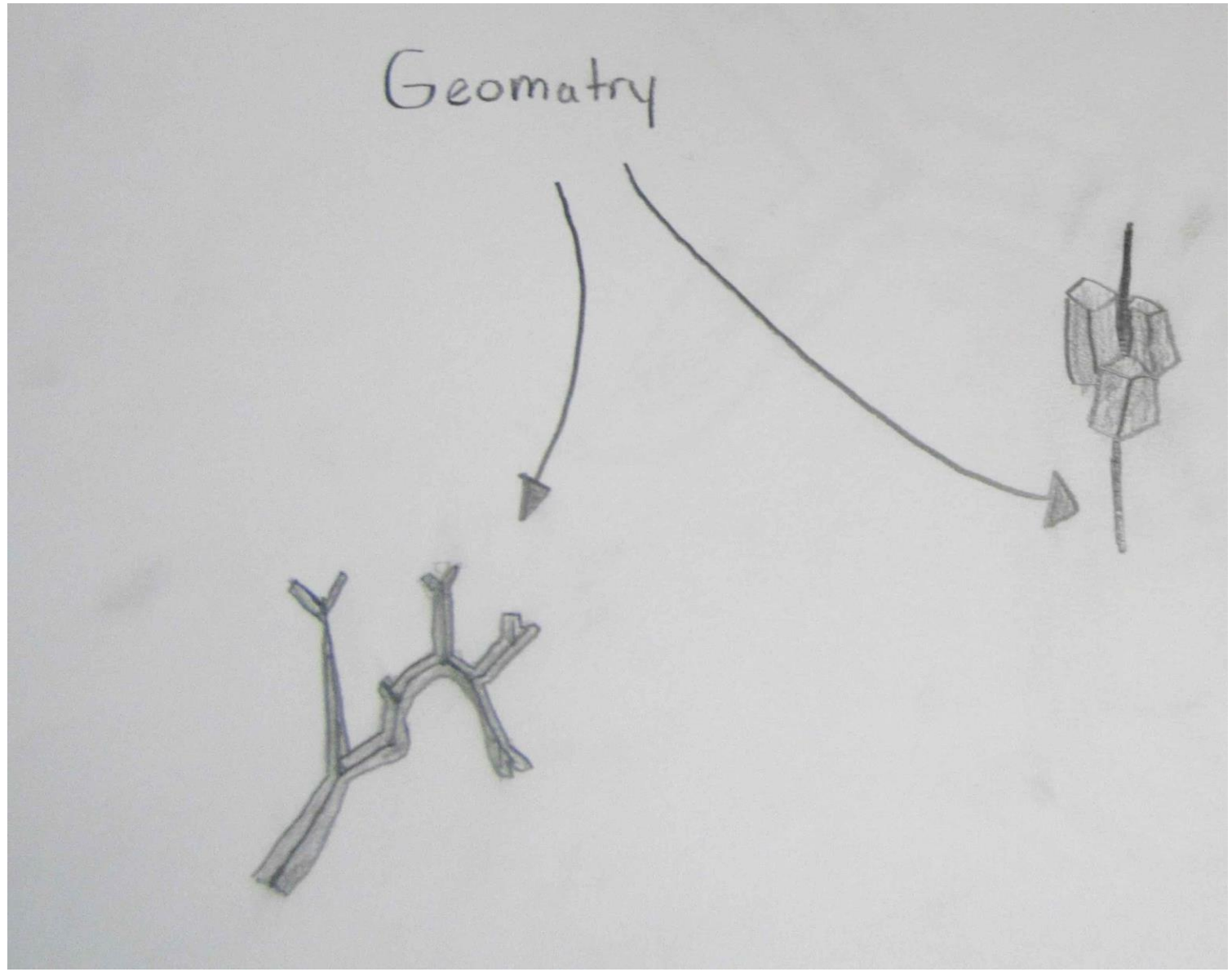


2019. Calculating Cubes in sketchbook. Graphite, on paper by child of 9 yrs.

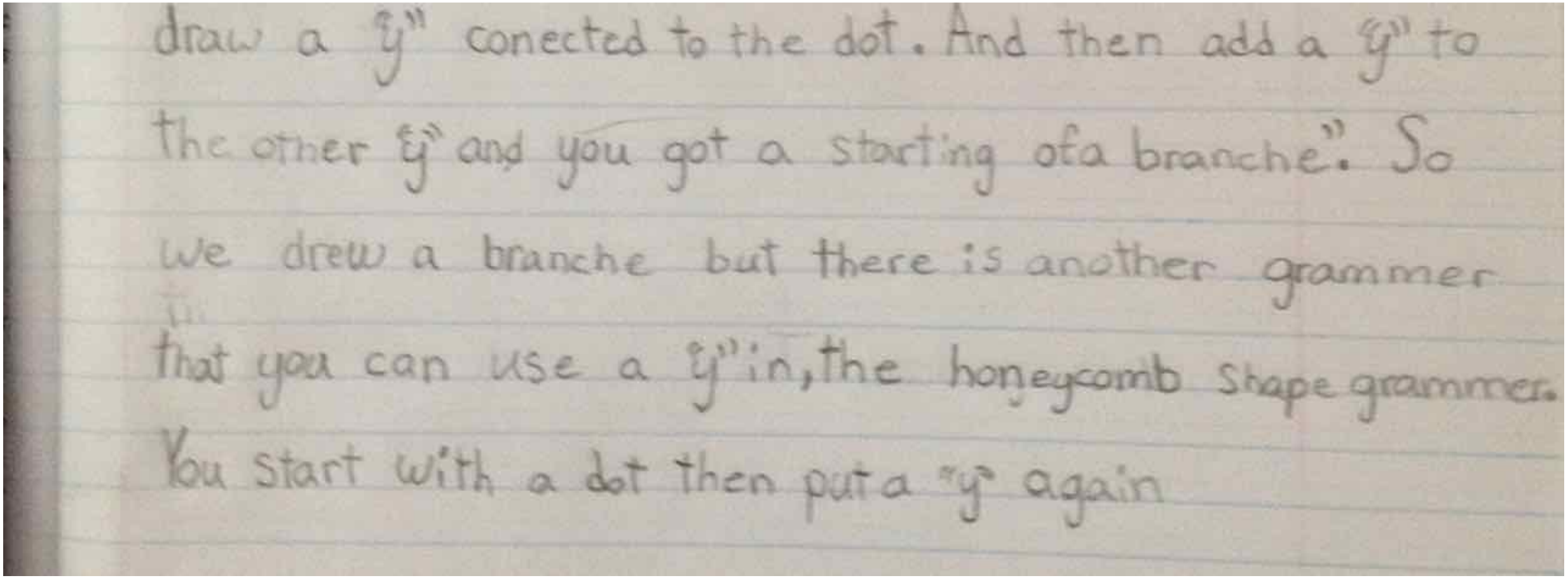
# Sketchbooks



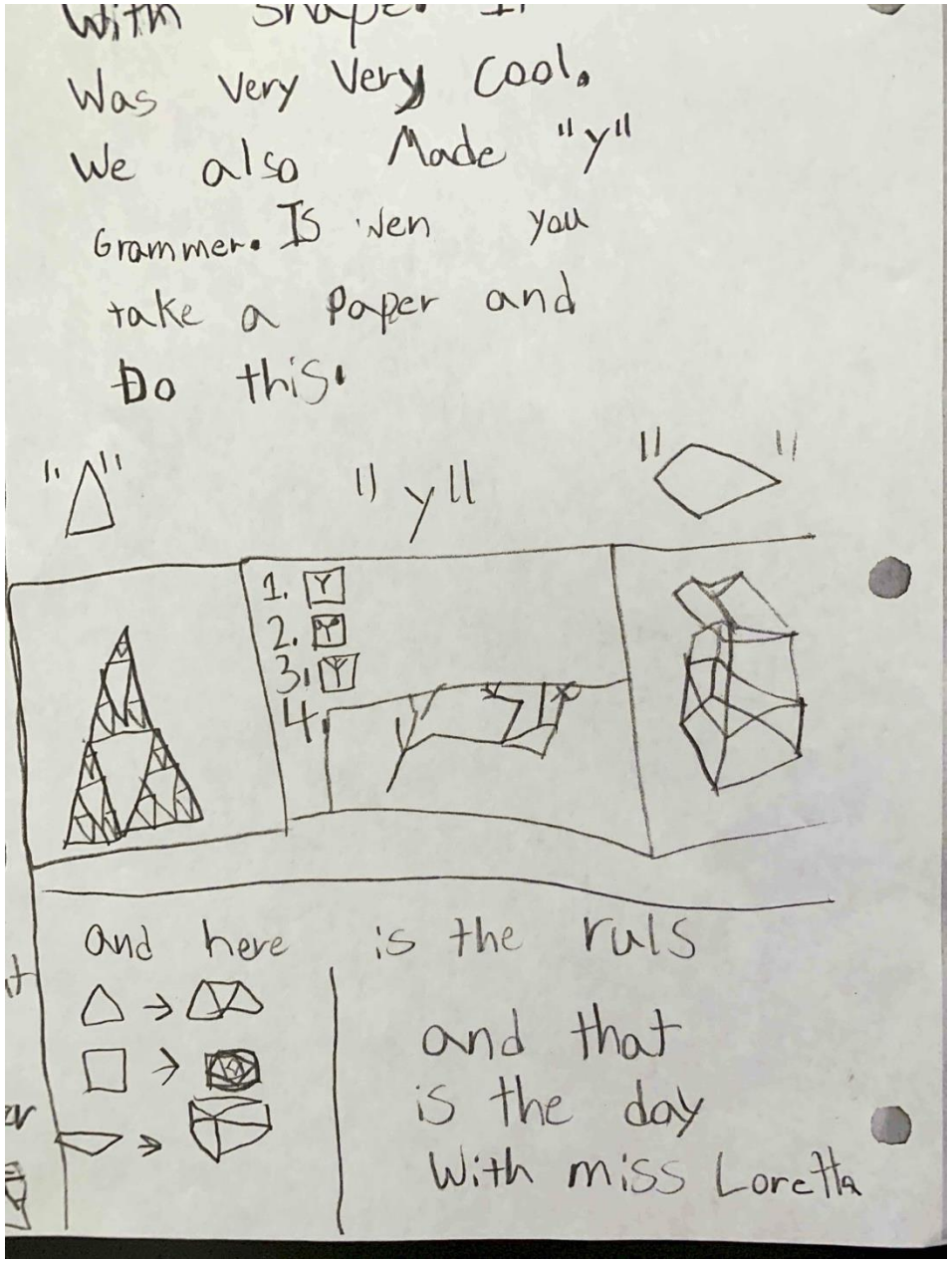
2019. Female Ruby-Throated Hummingbird. Graphite, watercolour on paper by child of 9 yrs.


Geomatry

# Children's Reflections


draw a "y" conected to the dot. And then add a "y" to the other "y" and you got a starting of a branche". So we drew a branche but there is another grammer that you can use a "y" in, the honeycomb Shape grammer. You start with a dot then put a "y" again

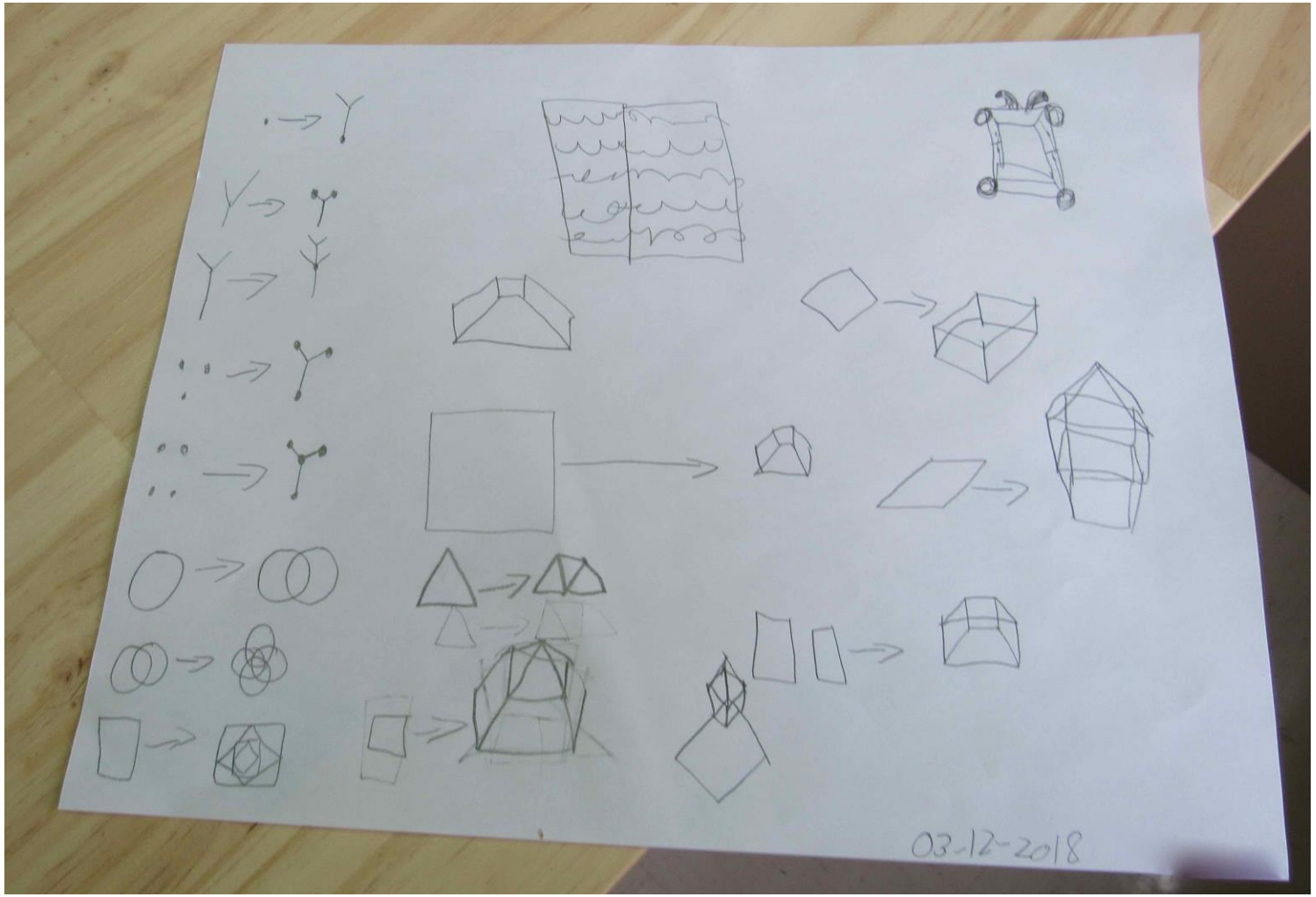
2019. Participant reflection of the 12-week program on paper. 9 yrs.



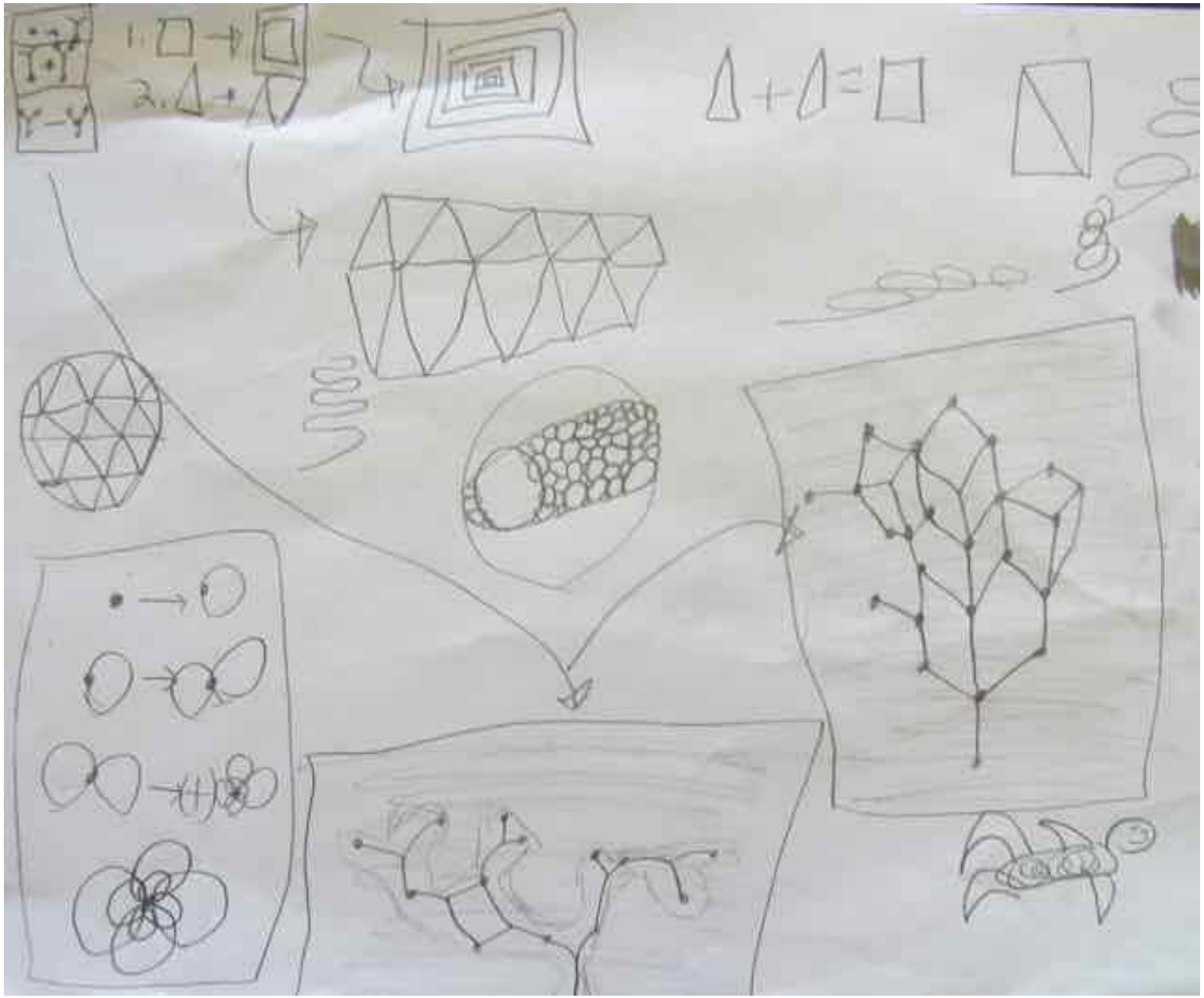

2019. Participant reflection of the 12-week program on paper. 8 yrs.

# Children’s Reflections

- Drawn




2019. Female Ruby-Throated Hummingbird. Graphite, watercolour on paper by child of 9 yrs.


1.
2.
+ = 

# This Drawing Curriculum

- Illustrates how geometry education can and might be well served cross the hall and be taught in the art room.
- Introduces non-numerical computational thinking strategies like shape grammars in an emergent manner that children could comprehend and embody.
- Improves each child’s ability to draw from observation. ☺

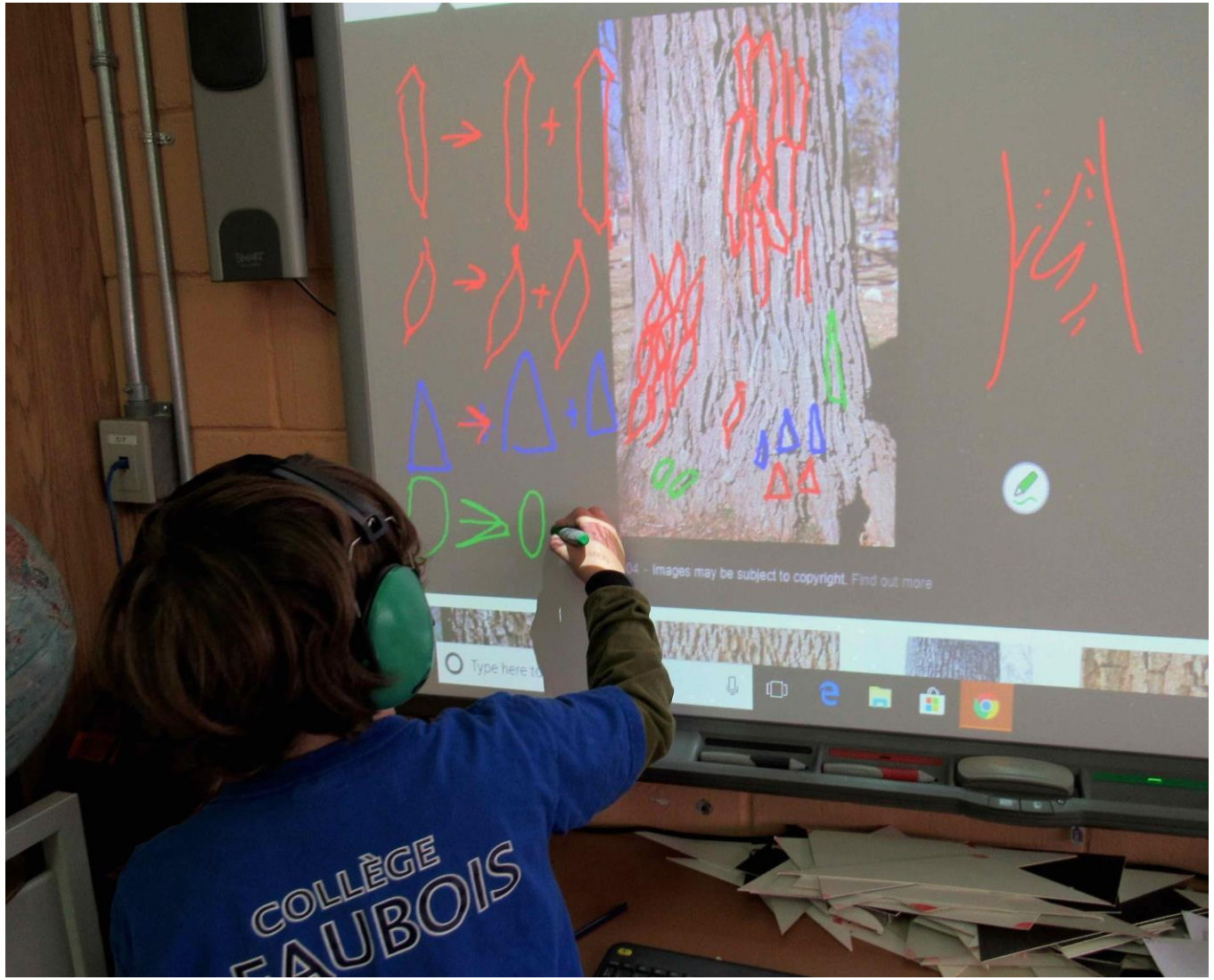
*“There’s no part I can see that a rule can’t find.”* (Stiny, G. 2005)

**In terms of mathematics:**

- Recursion and embedding
- Introducing computational thinking and doing in a very real way.

**In terms of visual art:**

- Children began to realise that they could calculate towards something, perceive it, and creatively engage with the process of drawing, “seeing and doing”. (2006, Stiny)




Decomposing Nature: Finding shape rules and grammars in Oak tree bark, child of 8 years

# Intervention – Weekly Curriculum Design

| **Activity** | **Minutes** | **Description of Inquiry** | **Materials** |
|---|---|---|---|
| Warm Up | 10 | Drawing warmups/games | Pencil, paper |
| Inquiry | 50-70 | Learning to calculate what we see | |
| Reflection | 5-10 | Class debrief/viewing each others work | |

# Pre/Post Testing using Mixed Methods Design

| **Activity** | **Time** | **Description of Inquiry** | **Materials** |
|---|---|---|---|
| Beery Buktenica Visual Motor Integration V.6 | 15-20 | Drawing Test | Booklet provided Berry VMI, ballpoint pen |
| Bruce & Hawes QuickDraw | 15 | Drawing Test | Drawing Test, blank paper, ballpoint pen |
| Children's Mental Transformation Task (CMTT) | 10 | Choosing correct shape out of four choices. | Test Booklet, pencil or ballpoint pen |
| Goodenough Draw-A-Person Test | 20 | Draw a person as best you can | Paper and pencil |

# Beery Buktenica Visual Motor Integration and Visual Perception V. 6

| **Cycle 2** | **Mean pre-test (SD)** | **Mean post-test (SD)** | **P** | **Effect Size** |
|---|---|---|---|---|
| n=45 | 91.22 (10.13) | 102.04 (11.07) | 3.46 E-11<br>or <0.0001 | 1.02 |

Note. Small effect size, d = 0.2 – 0.3; medium effect size, d = 0.5; large effect size, d = 0.8 (Cohen, 1988)

# Children's Mental Rotation Task

| **Grade** | **Mean pre-test (SD)** | **Mean post-test (SD)** | **P** | **Effect Size** |
|---|---|---|---|---|
| 3 (n=15) | 14.33 (1.39) | 15 (1) | 0.01 | 0.55 |

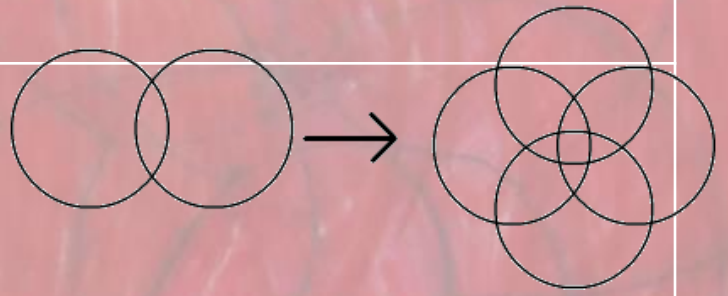
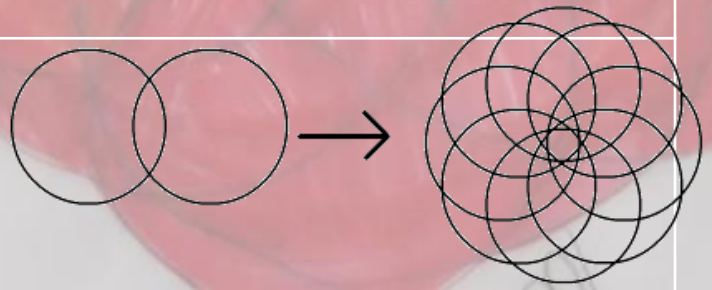
Note. Small effect size, d = 0.2 – 0.3; medium effect size, d = 0.5; large effect size, d = 0.8 (Cohen, 1988)

# Quick Draw Task

| Grade | Mean pre-test (SD) | Mean post-test (SD) | P | Effect Size |
|---|---|---|---|---|
| 3/4 (n=42) | 1.4 (0.9) | 2.6 (0.99) | 3.72E-10 or <0.0001 | 1.26 |
| 3 (n=25) | 1.2 (0.83) | 2.5 (1.04) | 1.32E-5 or <0.0001 | 1.39 |
| 4 (n=17) | 1.5 (1) | 2.7 (0.91) | 5.41E-6 or <0.0001 | 1.25 |

Note. Small effect size, d = 0.2 – 0.3; medium effect size, d = 0.5; large effect size, d = 0.8 (Cohen, 1988)

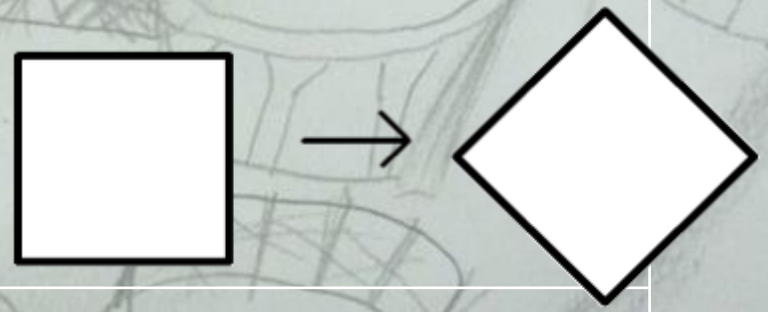
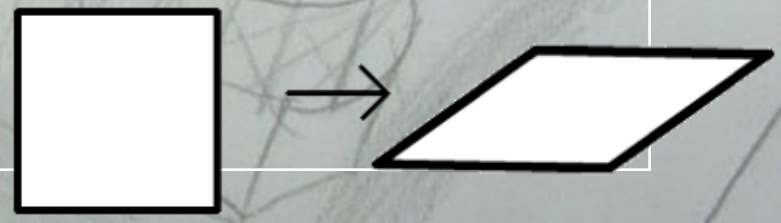
# Helios Grammar – Flower and Plants

| | |
|---|---|
| X⟹X+(t)X ;<br>(t) = translation |  |
| X⟹X+(t)X ;<br>(t) = rotation 90 |  |
| X⟹X+(t)X ;<br>(t) = rotation 45 |  |

# Geodesic Spheres –

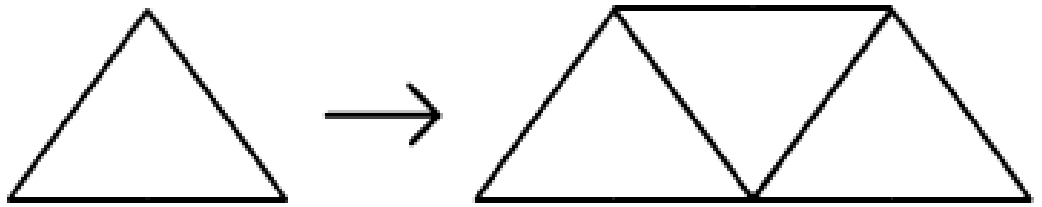
| | |
|---|---|
| **X⟹X+(t)X ;**<br>**(t) mirror/flip/reflect** |  |
| | **another possibility…**<br>  |

# Axonometric Projections

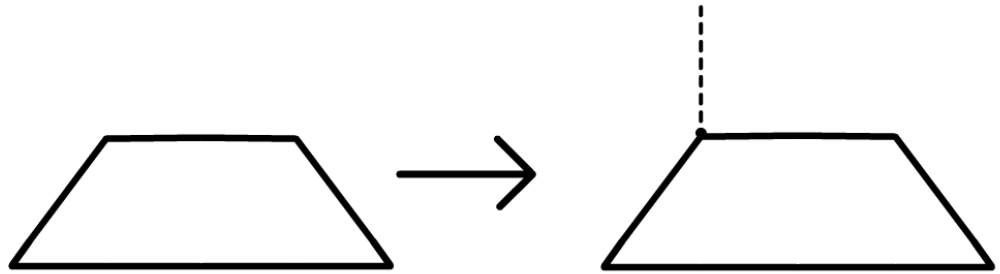
| | |
|---|---|
| X⟹X+(t)X<br>t = diagonal symmetry |  |
| X⟹X+(t)X<br>t = rotate |  |
| X⟹X+(t)X<br>t = skew |  |

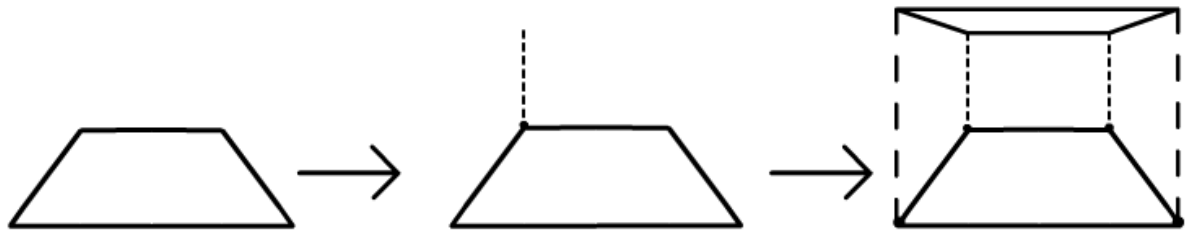
# Derivation/Computation – Room Grammars

$X \Longrightarrow X + (t)X$



$X \Longrightarrow X + Y$





**Shape Derivation**