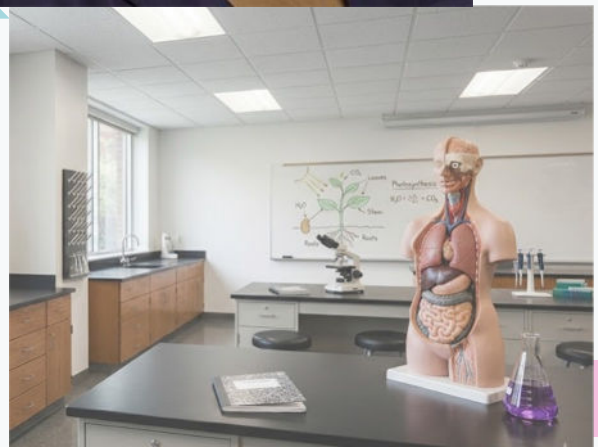
Beyond "Right and Wrong" Answers:

Reimagining Biology Learning Through Model-Based Inquiry

Sarah E. Sarchet
Math & Science Conference 2026
NRSC and DeafTec, NTID
Rochester, NY

NotebookLM





Sarah E. Sarchet

Education

PhD Candidate Teaching & Curriculum, Univ of Roch;
MS Deaf Ed, BS Biology, RIT/NTID

Teaching Context

D/deaf/HH Laboratory Science Technology (LST) Majors, NTID

Research Focus

Intersection of Deaf epistemologies and scientific inquiry

Our Driving Question:
What happens when biology learning moves beyond “right and wrong” answers?

Model-based inquiry: What is it?

In the classroom: What and how did we learn?

Views and values: What do students think?

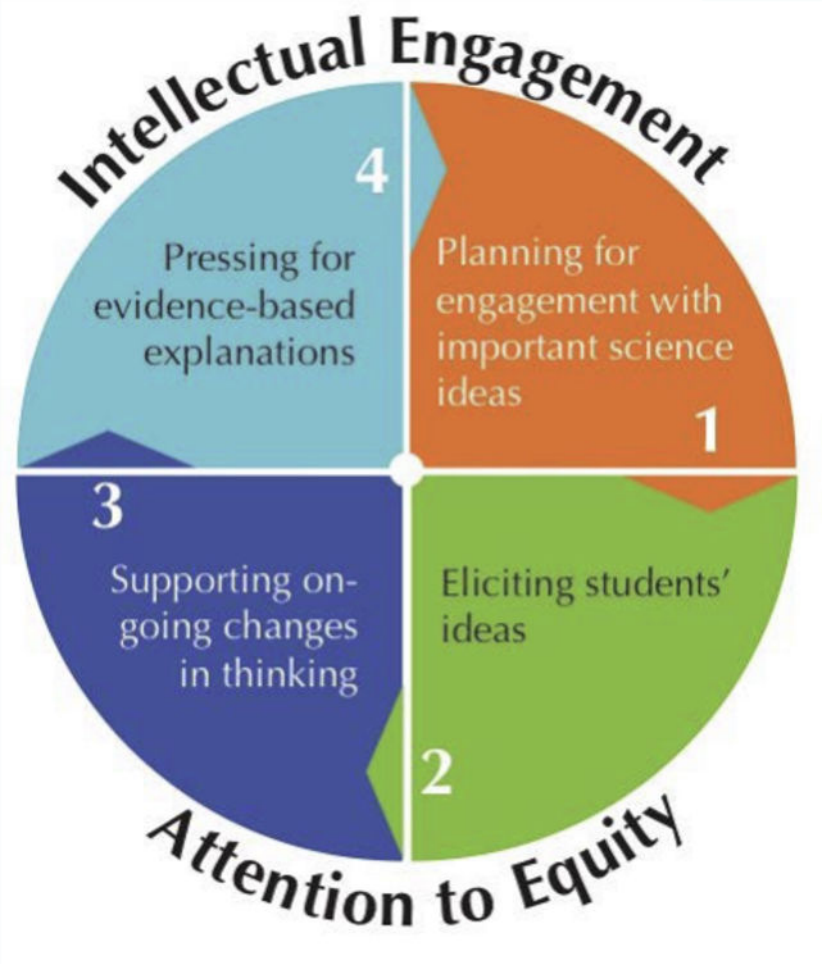
Turning points: What did I learn?

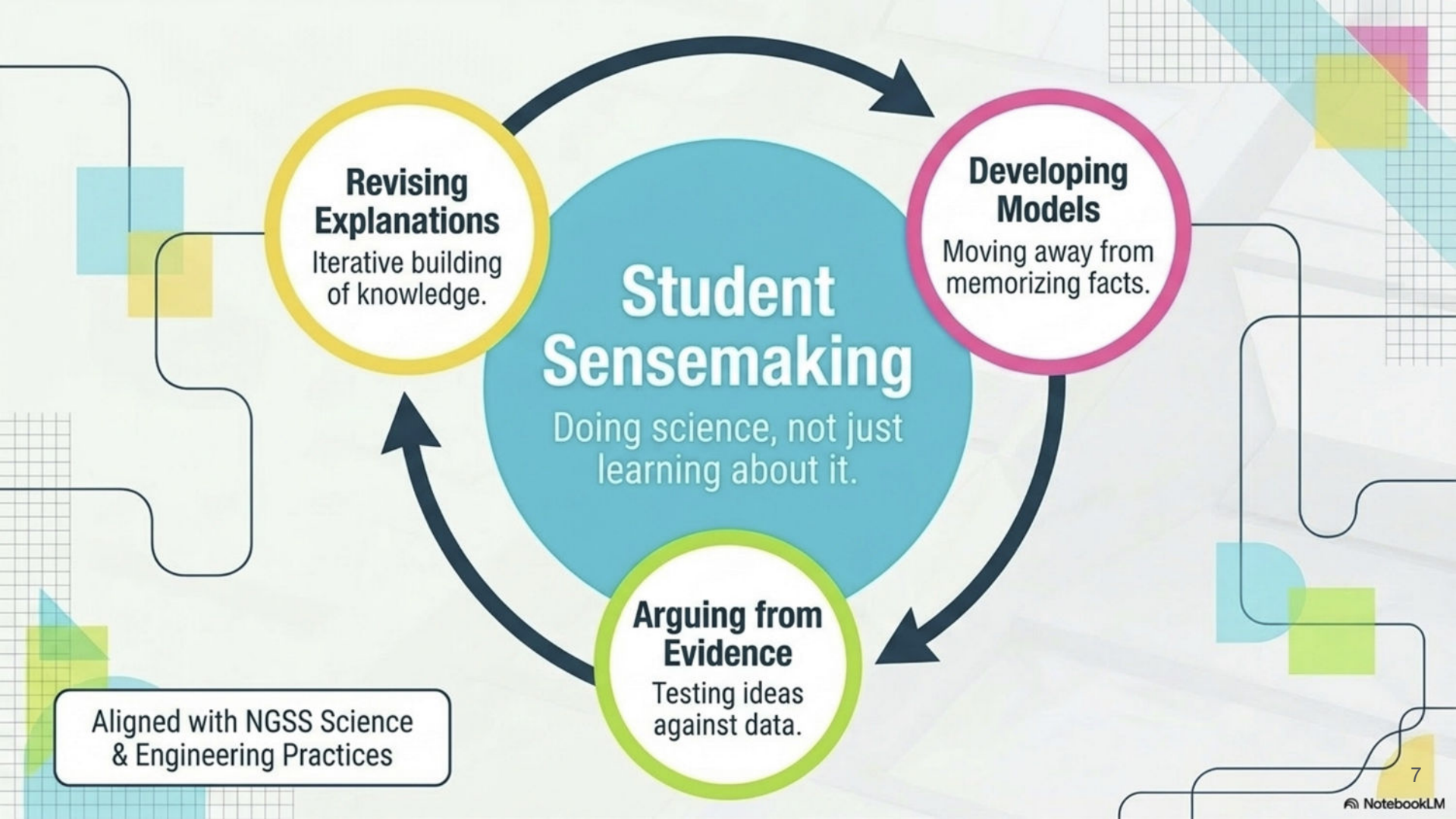


Model-based inquiry:
What is it?

Ambitious Science Teaching (AST) Framework

Ambitious Science Teaching is a type of model-based inquiry.




Revising Explanations
Iterative building of knowledge.
Developing Models
Moving away from memorizing facts.
Student Sensemaking
Doing science, not just learning about it.
Arguing from Evidence
Testing ideas against data.
Aligned with NGSS Science & Engineering Practices

NotebookLM

The 8 NGSS Science Practices

1. Asking Questions and Defining Problems
2. Developing and Using Models
3. Planning and Carrying Out Investigations
4. Analyzing and Interpreting Data
5. Using Mathematics and Computational Thinking
6. Constructing Explanations and Designing Solutions
7. Engaging in Argument from Evidence
8. Obtaining, Evaluating, and Communicating Information



In the classroom:

What and how did we learn?

Comparison:

Content-Centered Learning	Model-Based Inquiry Learning
Nature of Science (Science is...)	
View of Knowledge	
Class Topics	
Class Activities	
Demonstration of Learning	
Roles	

MODEL-BASED INQUIRY (MBI) UNIT STEPS

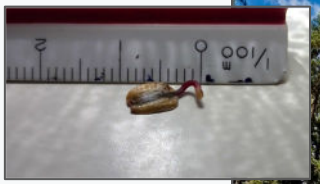


This image was created with RIT Gemini AI.

Example of Model Based Inquiry Cycle

Anchoring Phenomena & Driving Questions

1. “How did General Sherman gain its mass if it started from such a tiny seed?”
2. “What cause Freja’s skin cancer?”
3. “Why did Ana Rodriguez feel fine after running a marathon, but later fell into a coma?”

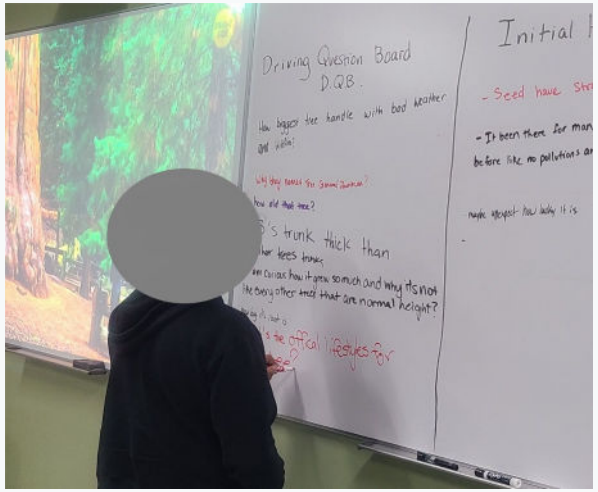


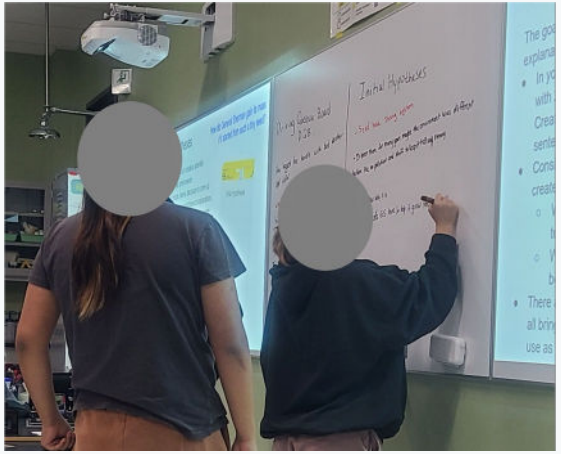


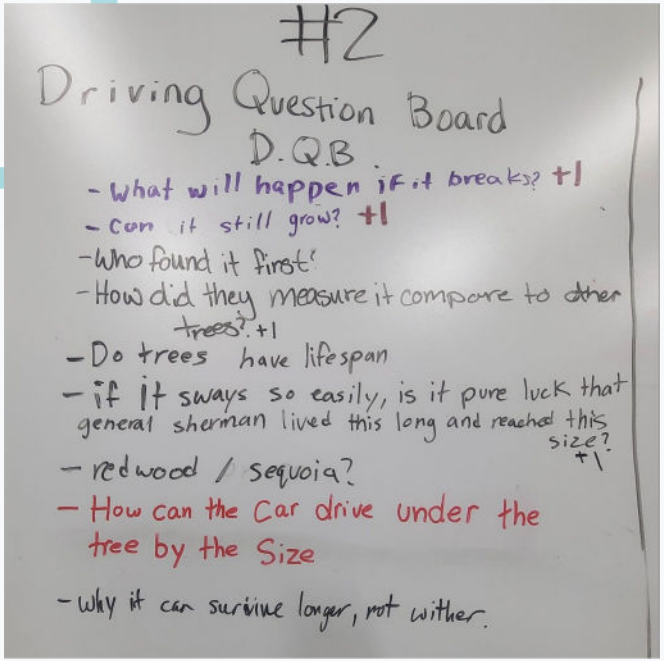


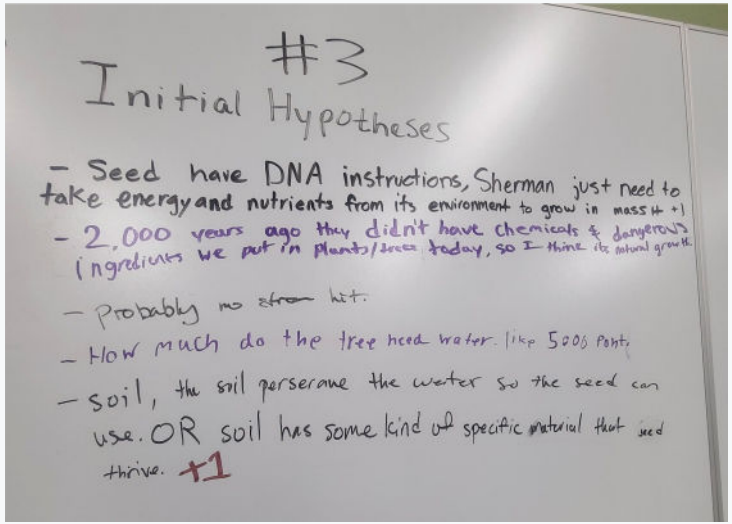


Anchoring Phenomenon Routine: Driving Question Board and Initial Hypotheses



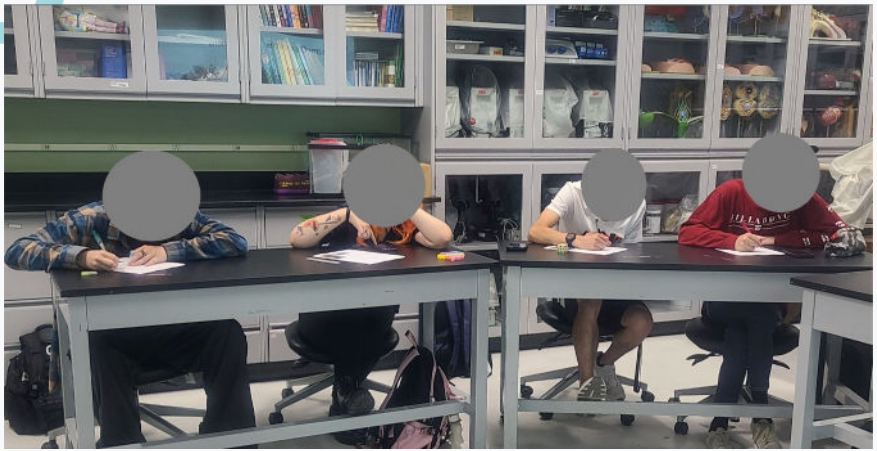


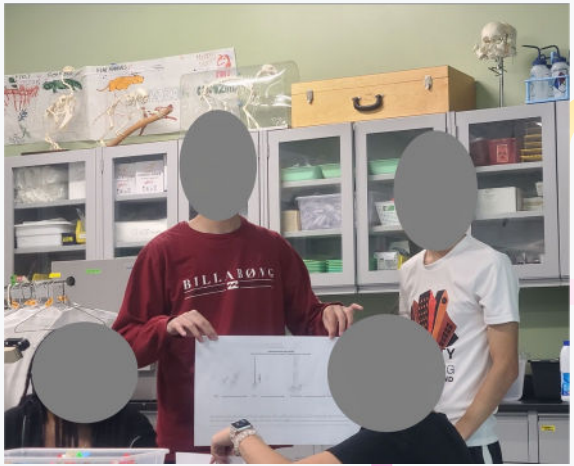




Anchoring Phenomenon Routine: Initial Models and Share-Outs







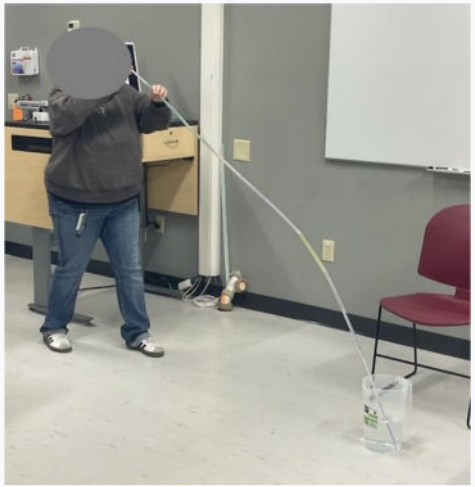
Investigations







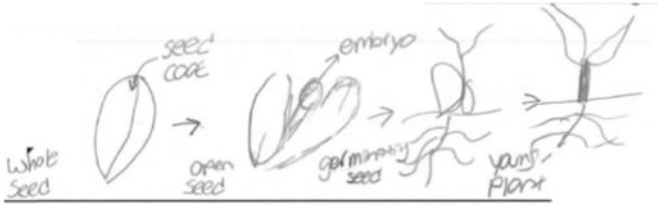




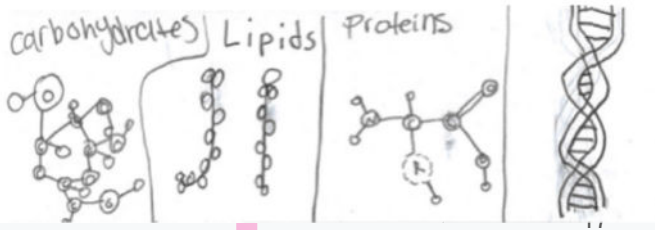


Unit Summary Table

Evidence: Topic, Lab, or Demo	What did we learn? What needs to appear in your model drawing or your evidence-based explanation
Lab 1: What's in a Seed?	3 parts of the seed and 3 functions • seed coat/testa = for protection • endosperm/cotyledon for nutrients • embryo/baby/newborn = baby plant that will grow
Lec 1.2 Biomolecules Lab 2: What's the Function of the Endosperm	4 biomolecules and their functions • carbohydrates/starch/sugar = energy storage and quick energy release • protein = transporting materials, speed up reactions, enzymes, • lipids = high energy storage • Nucleic Acid/DNA/RNA = stores genetic info







General Sherman Initial Model

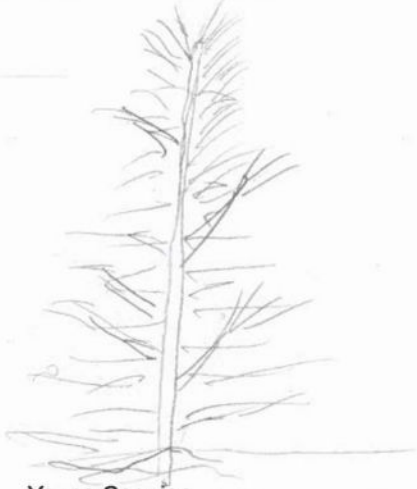
How did General Sherman gain its mass if it started from such a tiny seed?



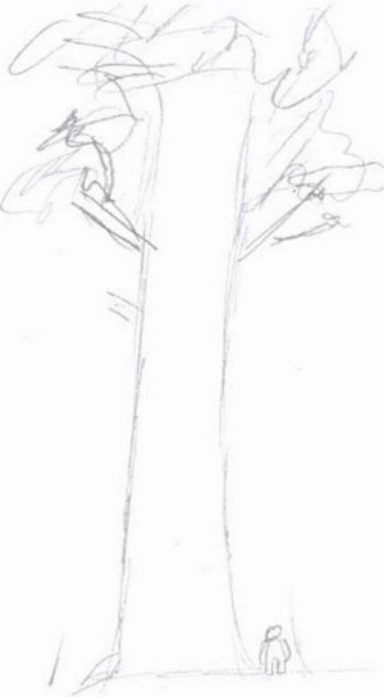
Seed →



Sprout →



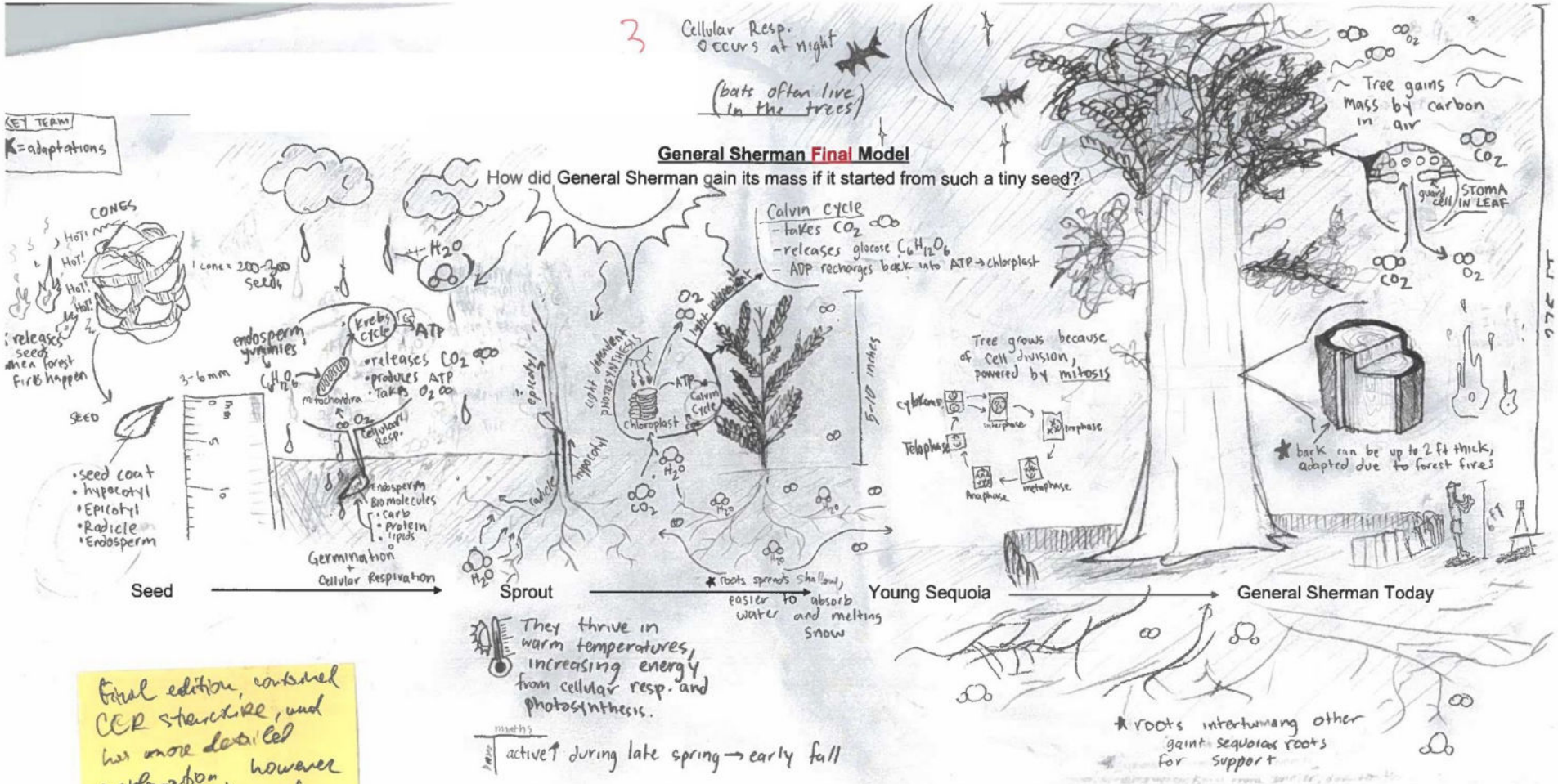
Young Sequoia →



General Sherman Today

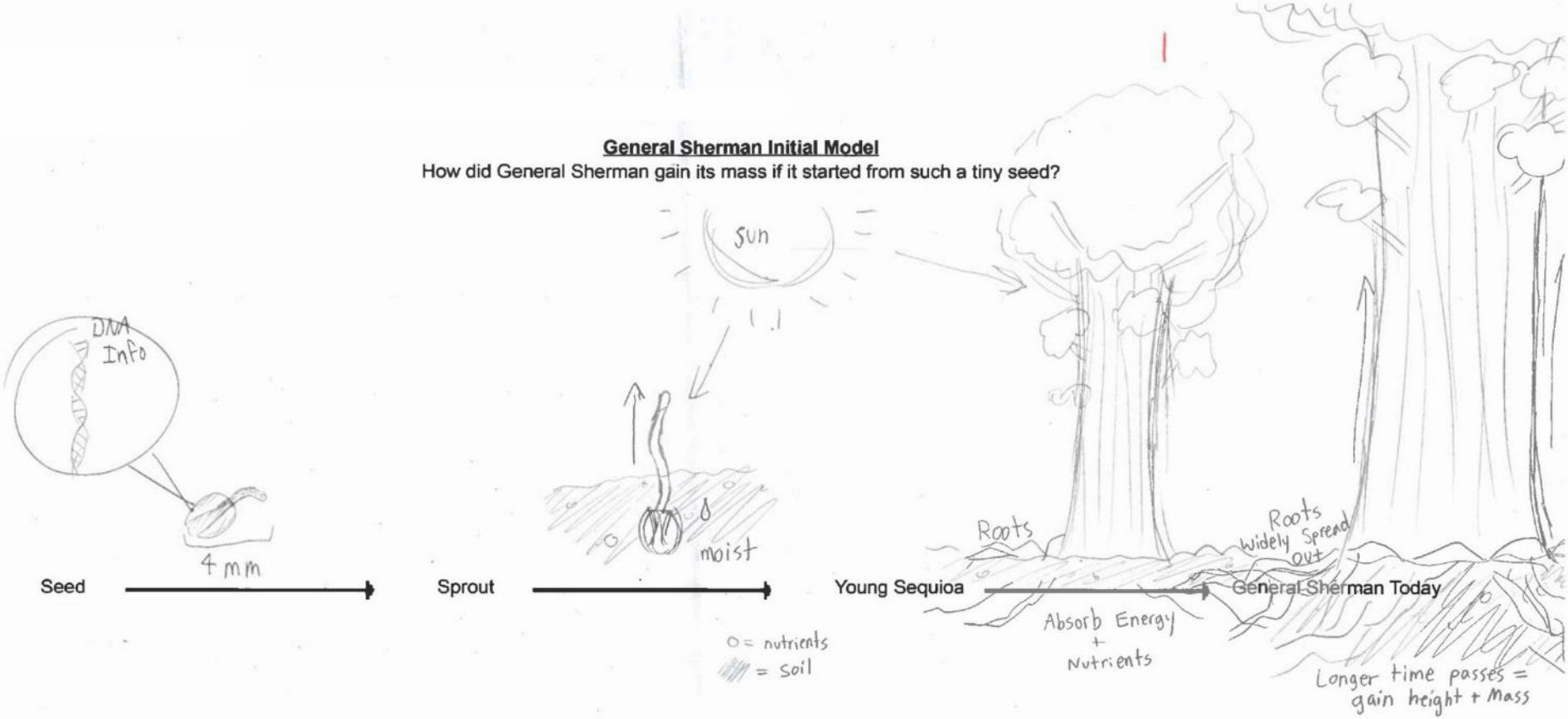
TAKES UP ALOT OF NUTRIENTS AND CONSUMES ALOT MORE ENERGY TO

Initial knowledge is basic and habitat have evidence and Reasoning part, only claim, there...

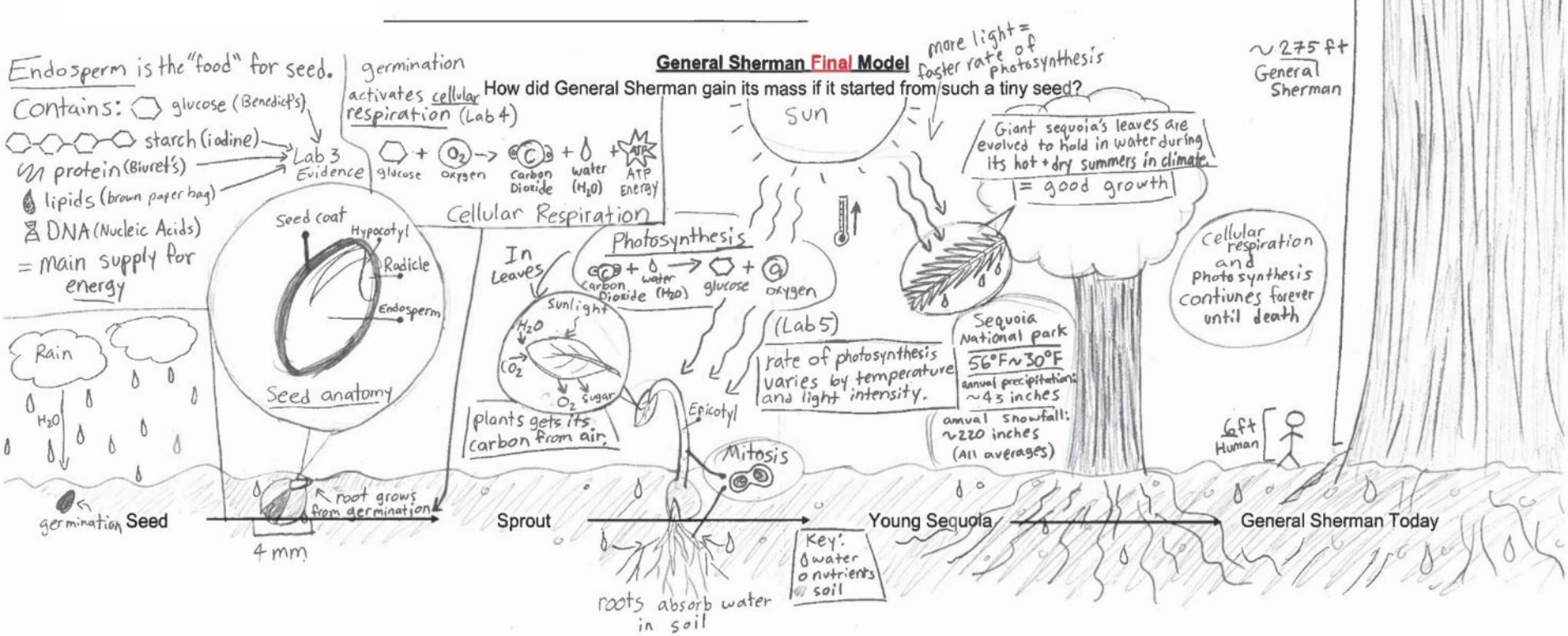

3
Cellular Resp. occurs at night
(bats often live in the trees)
ET TEAM
K=adaptations
General Sherman Final Model
How did General Sherman gain its mass if it started from such a tiny seed?
CONES
releases seeds when forest fire happen
1 cone = 200-300 seeds
SEED
3-6mm
seed coat
hypocotyl
Epicotyl
Radicle
Endosperm
endosperm
Krebs cycle
ATP
releases CO_2
produces ATP
Takes O_2
$C_6H_{12}O_6$
mitochondria
O_2
Cellular Resp.
Endosperm Biomolecules
carb
protein
lipids
Germination + Cellular Respiration
Seed
epicotyl
hypocotyl
radicle
H_2O
CO_2
Sprout
light dependent photosynthesis
ATP
Calvin Cycle
chloroplast
O_2
Calvin cycle
- takes CO_2
- releases glucose $C_6H_{12}O_6$
- ADP recharges back into ATP → chloroplast
5-10 inches
roots spreads shallow, easier to absorb water and melting snow
Young Sequoia
Tree grows because of cell division, powered by mitosis
cytokinesis
interphase
prophase
Telophase
metaphase
anaphase
General Sherman Today
Tree gains mass by carbon in air
CO_2
guard cell
STOMA IN LEAF
O_2
bark can be up to 2 ft thick, adapted due to forest fires
roots intertwining other giant sequoias roots for support
They thrive in warm temperatures, increasing energy from cellular resp. and photosynthesis.
months
active↑ during late spring → early fall
final edition, contained CER structure, and has more detailed explanation, however its hard to read, without story line on the bottom.

General Sherman Initial Model

How did General Sherman gain its mass if it started from such a tiny seed?



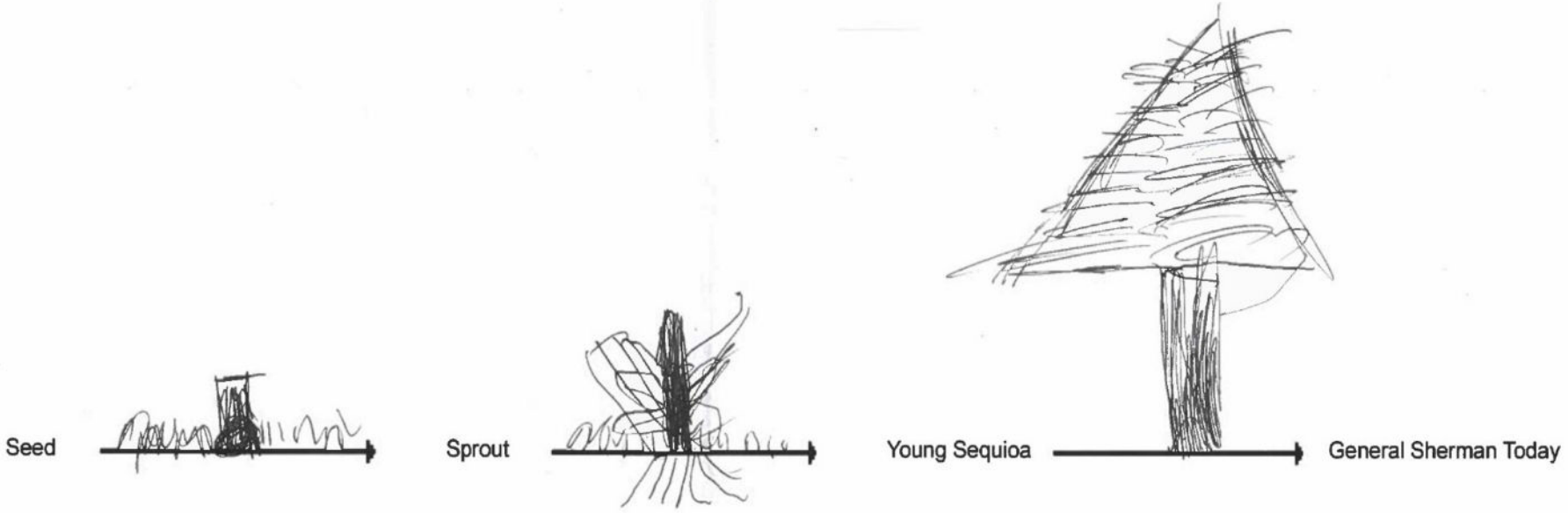
The seed have DNA instructions implemented. General Sherman takes in the energy and nutrients from its environment in order to grow. Survives long enough to reach this mass. possibly in perfect conditions, habitat, and chemical-free — away from humans for long time.



General Sherman first gained mass from the endosperm inside the seed, which provided starch, glucose, protein, and lipids for germination and early growth through cellular respiration. As the seed sprouted, photosynthesis began. This cycle of process helped General Sherman to keep performing mitosis and gain mass over the years.

General Sherman Initial Model

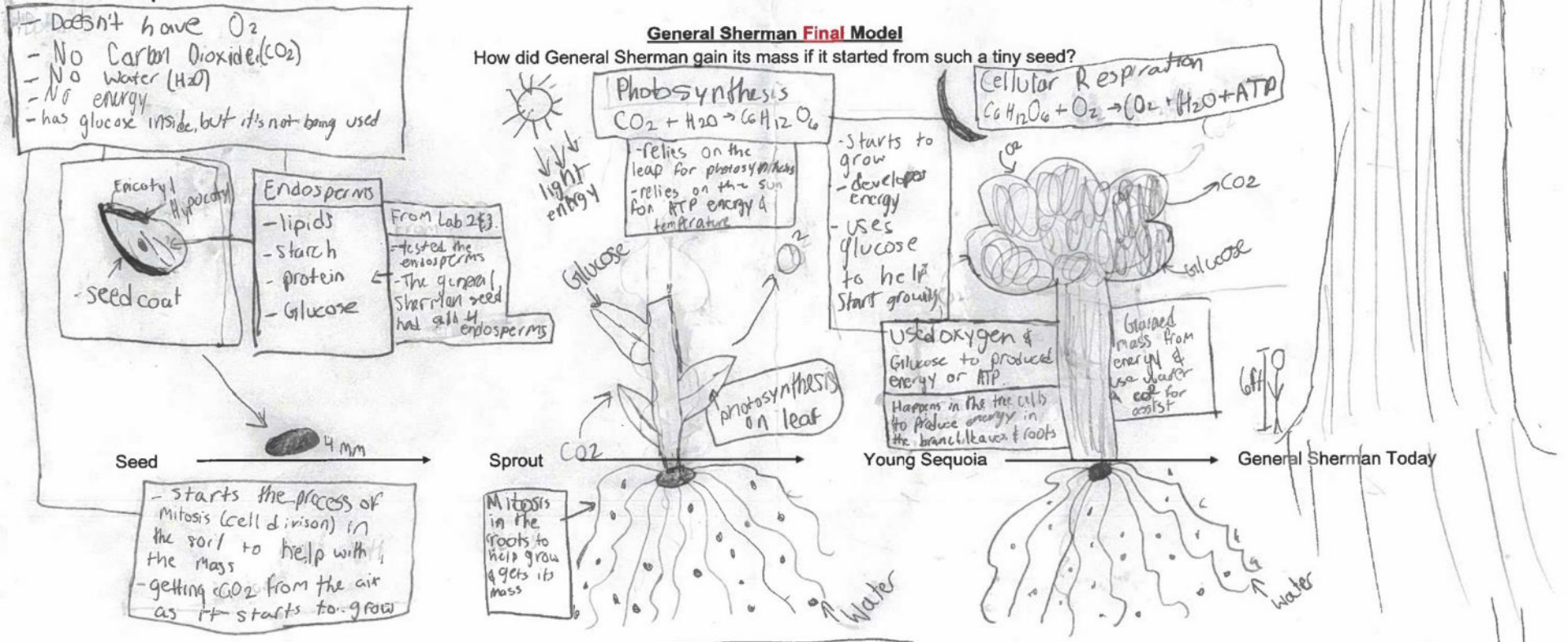
How did General Sherman gain its mass if it started from such a tiny seed?



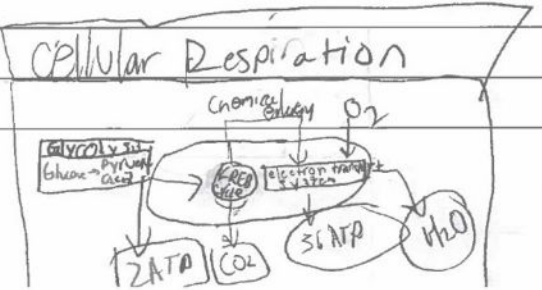
I ~~hypothesize~~ hypotheses that this happen from all natural resources with only using water, & sunlight. I don't think ~~they~~ they had chemicals to rely on with the mass and just used all natural resources

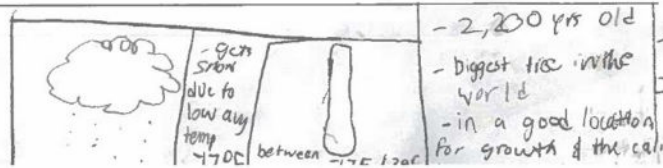
General Sherman Final Model

How did General Sherman gain its mass if it started from such a tiny seed?



Cellular Respiration

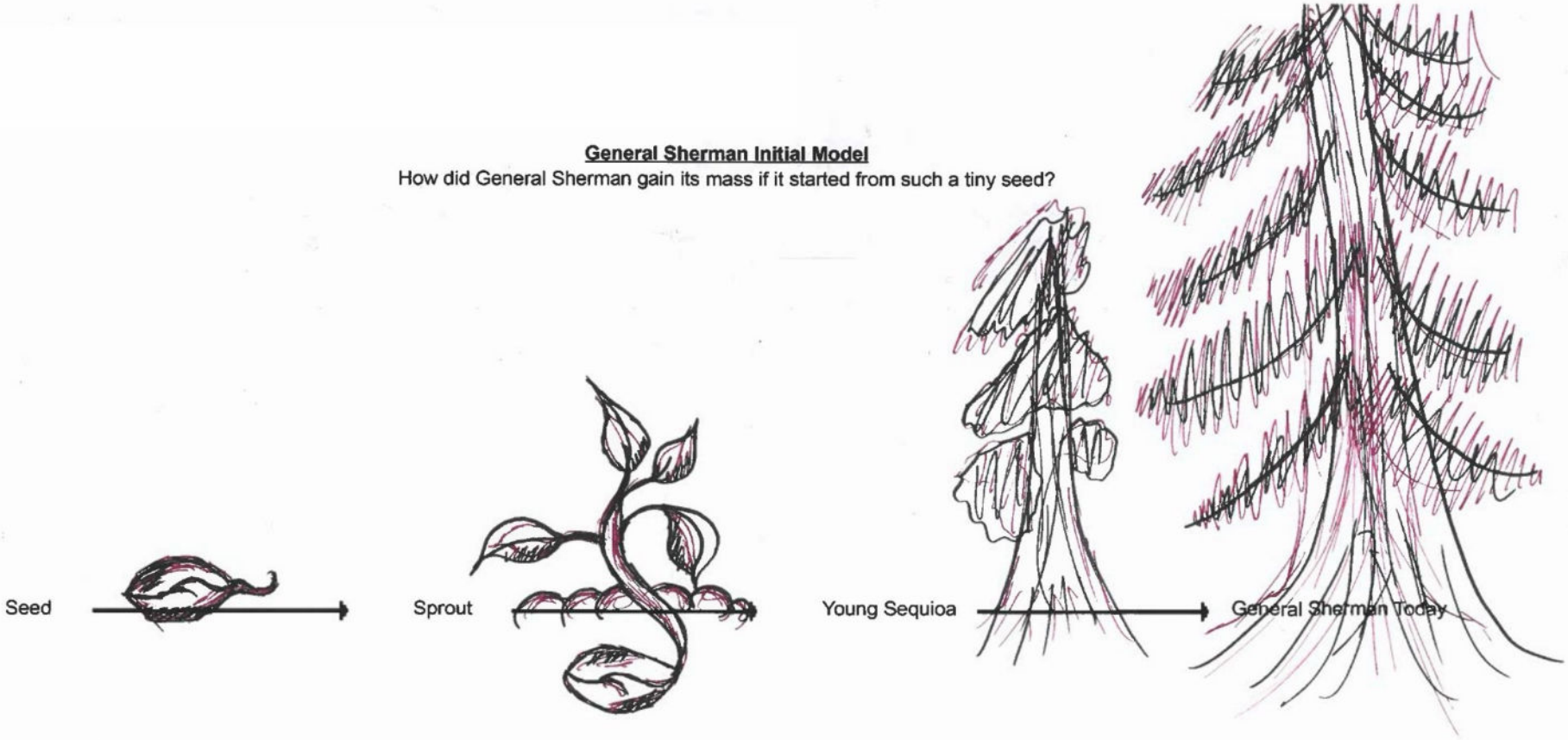




- 2,200 yrs old
- biggest tree in the world
- in a good location for growth & the california

General Sherman Initial Model

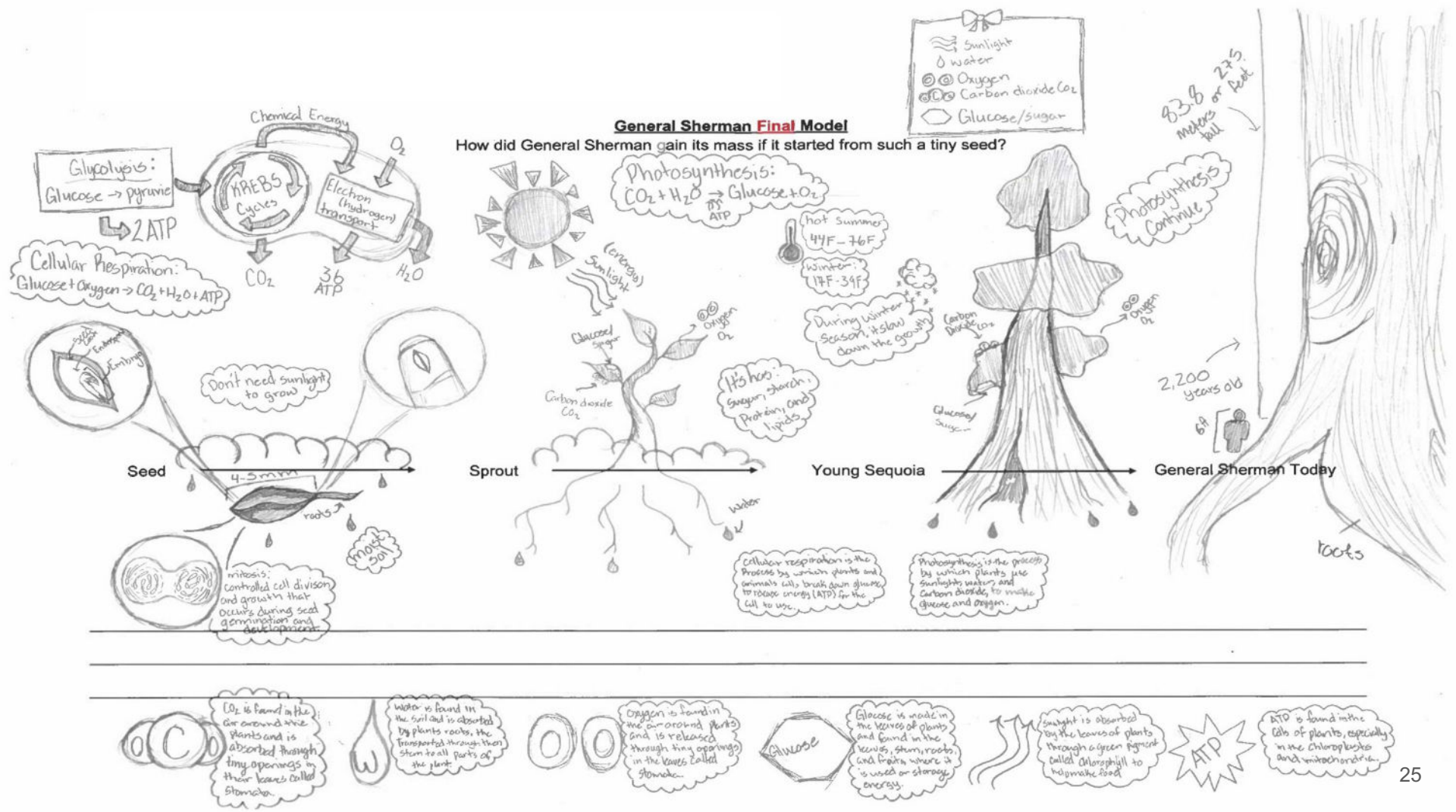
How did General Sherman gain its mass if it started from such a tiny seed?



I think it has everything it need to grow, the sun, soil, water, and room to grow.

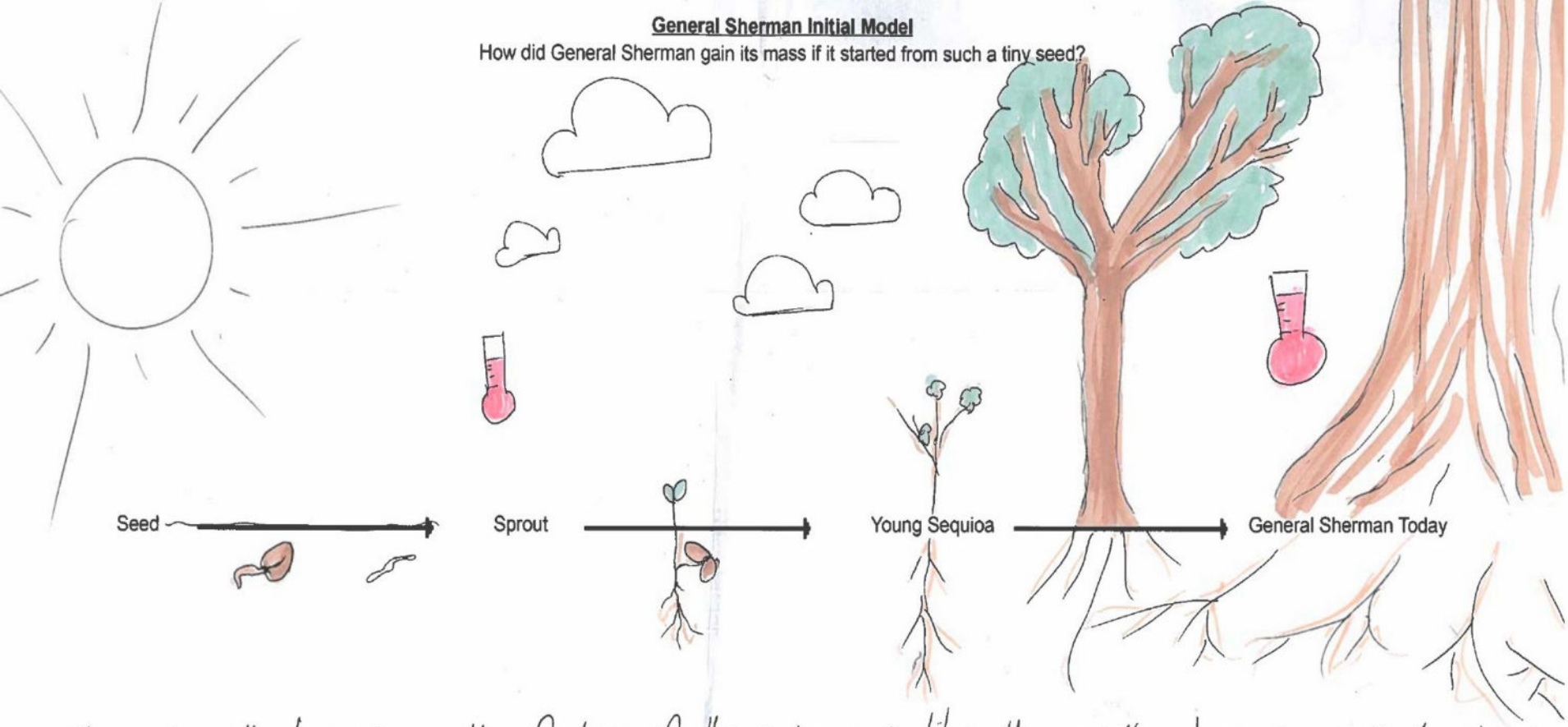
General Sherman Final Model

How did General Sherman gain its mass if it started from such a tiny seed?

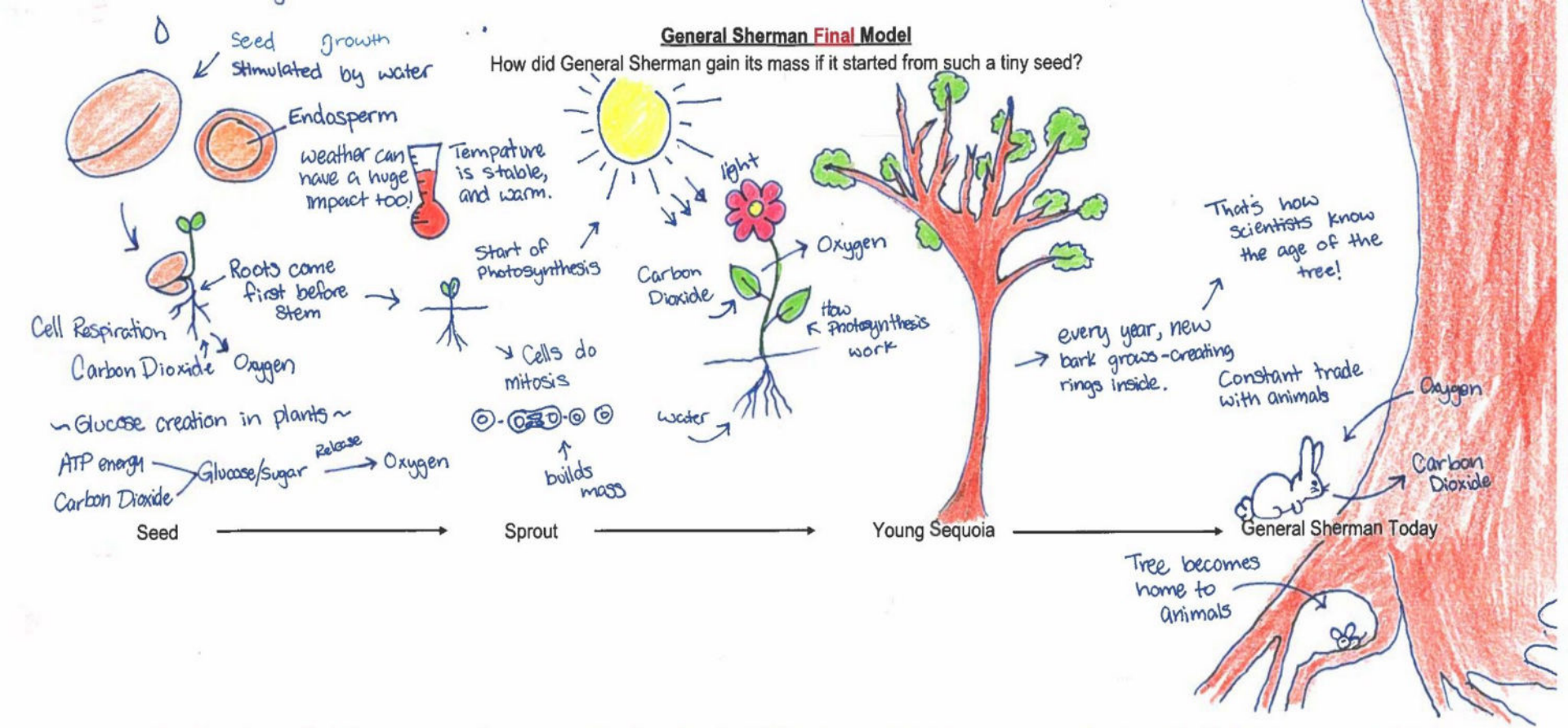


General Sherman Initial Model

How did General Sherman gain its mass if it started from such a tiny seed?



It really all depend on the factors of the enviroment like the weather, tempature and animals. nutrients are constantly passed around. Ex: The hollows in the roots provide homes for moles. Their Carbon Dioxide exhale and their droppings, the tree takes and ~~use~~ use



It really depend on what the enviroment can provide for the tree like the weather, tempature and animals. Nutrients are essentials for the plants and it keeps growing, goes through the mitosis process and grow mass, eventually it will be around two thousand years old just like our general sherman here. All of them are factors of going from a tiny seed to one of the biggest tree.

Evidence-Based Explanation: ASL

The video clip here has been removed to ensure student anonymity. For any questions about what an evidence-based explanation looks like in ASL or to see an example of one, contact Sarah E. Sarchet at sesnca@rit.edu

Key

Evidence

Vocabulary

Science mechanisms

Evidence-Based Explanation: English

General Sherman started as a seed with stored materials inside. In Lab 2, we dissected seeds and identified the seed coat, hypocotyl, and endosperm. The seed coat helped absorb water, and the endosperm stored food. In Lab 3, we tested the endosperm and found starch, protein, and lipids. These molecules gave the seed energy to grow before it could make its own food. Sherman used this stored energy to grow roots and a stem, even in foggy conditions with little sunlight. That's how it began its journey.

In Lab 4, we used cabbage juice to test for carbon dioxide. The juice changed color, showing that the seed was doing cellular respiration. This means Sherman's seed was breaking down stored food to release energy. That energy helped the seed grow before photosynthesis started. It didn't need sunlight right away—it used what was already inside. This explains how Sherman survived the early days in a dark, damp forest.

Key

Evidence

Vocabulary

Science mechanisms

Evidence-Based Explanation: English

In Lab 2, we learned the seed anatomy: seed coat, hypocotyl, epicotyl, radicle, and endosperm. Seed coat protects the seed from coarse textures like dirt, pebbles and bugs that chew. The seed stays dormant until a rainstorm comes by, or any moisture that activates the germination. When the seed starts to germinate, it does the process called cellular respiration. In Lab 4, we used cabbage juice as pH to test if seeds were releasing carbon dioxide (CO_2). We saw the color change to pink, which meant they were doing cellular respiration. When the seed germinates with water (H_2O), it begins to take in oxygen (O_2) from the soil. In Lab 3, we learned that the endosperm of the seed, including carbohydrates, proteins and lipids, is used to convert these biomolecules into glucose ($C_6H_{12}O_6$) which is then fed into the mitochondria. It then goes through the Krebs cycle, producing energy (ATP) and releasing carbon dioxide (CO_2). While this process is happening, the radicle emerges from the seed to absorb water. As it grows, it develops into shallow roots, which is also an adaptation that helps to absorb more [THL Part 5]. The hypocotyl pushes the seed upwards through the soil, then the epicotyl begins to shoot upward to form a stem.



Views and values:
What do students think?

1. First Impressions
What was confusing or uncomfortable at first?

2. Doing Science
What did designing your own research experiments teach you?

5. Looking Back
What was memorable or stayed with you since last year?

3. Being a Scientist
When did you feel most like you were doing science?

4. New Mindset
At what point did you realize this class wasn't about finding the "right answer" anymore?



Turning points:
What did I learn?

4. Redefining Success
Seeing changes in student thinking as the ultimate demonstration of learning.

3. Shifting the Question
Asking probing questions promote investigation, not giving answers.

2. Valuing the Incomplete
Models = thinking tools.
Leverage models + revision to directly see students' thoughts.

1. Deaf Ways of Knowing
Multi-modality + multi-linguality unleashes student creativity and encourages innovation.

Three Principles to Reimagine Biology Learning

1

Start with students, not textbooks.

Anchor instruction in initial ideas and lived experiences, not pre-packaged facts.

2

Make learning visible.

Leverage models, explanations, and assessments as tools for student sensemaking.

3

Process, not product.

Facilitate student sensemaking with many opportunities for collaboration and revision in thinking.

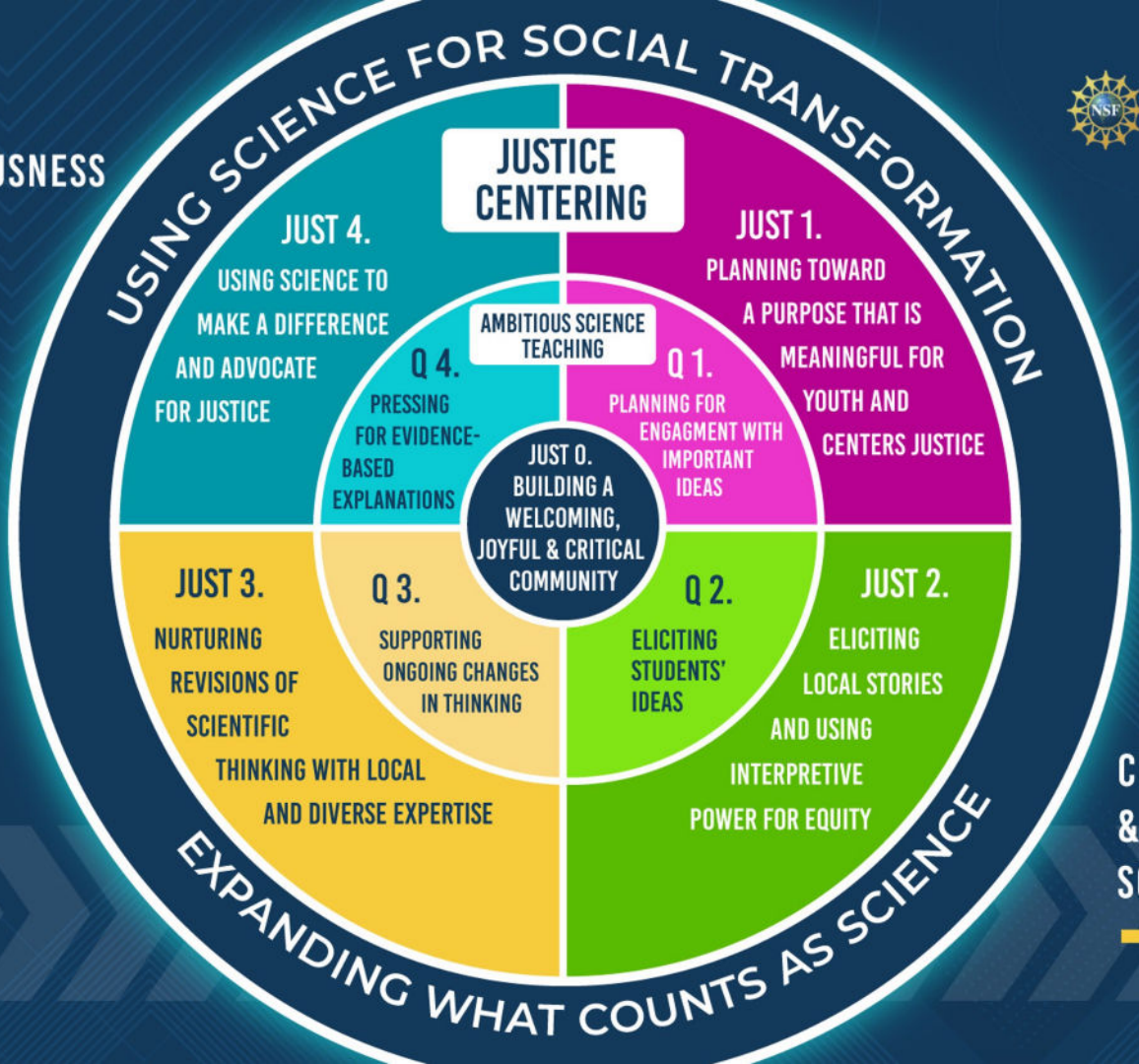
Questions & Discussion

JUSTICE-CENTERED AMBITIOUS SCIENCE TEACHING

CRITICAL CONSCIOUSNESS

SCIENCE

CHALLENGED & CHANGED SCIENCE



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Scan to keep in touch with me →

Thank you.

Sarah E. Sarchet sesnca@rit.edu