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Designing Mathematical Outreach Programs and Activities for Underrepresented Populations

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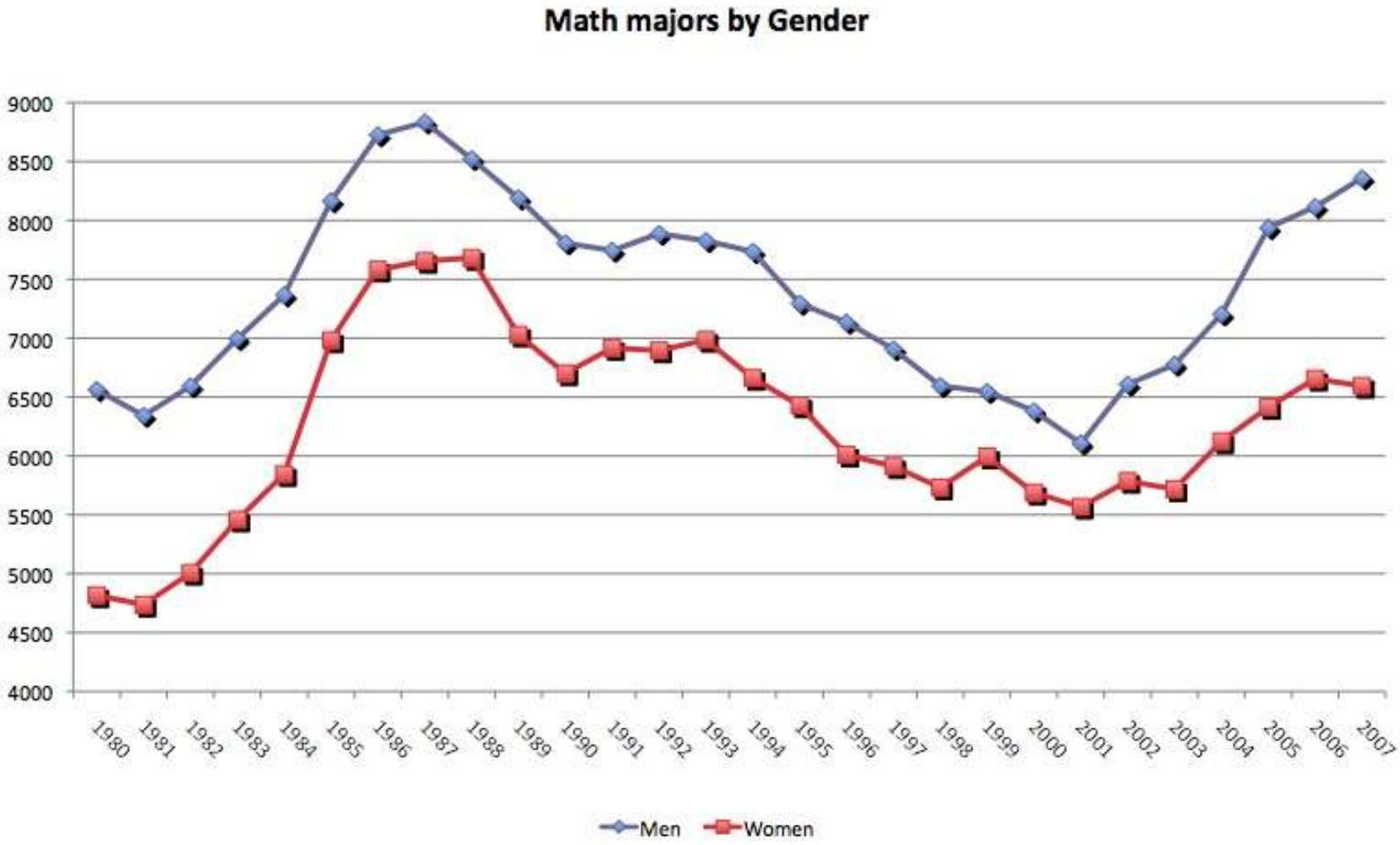
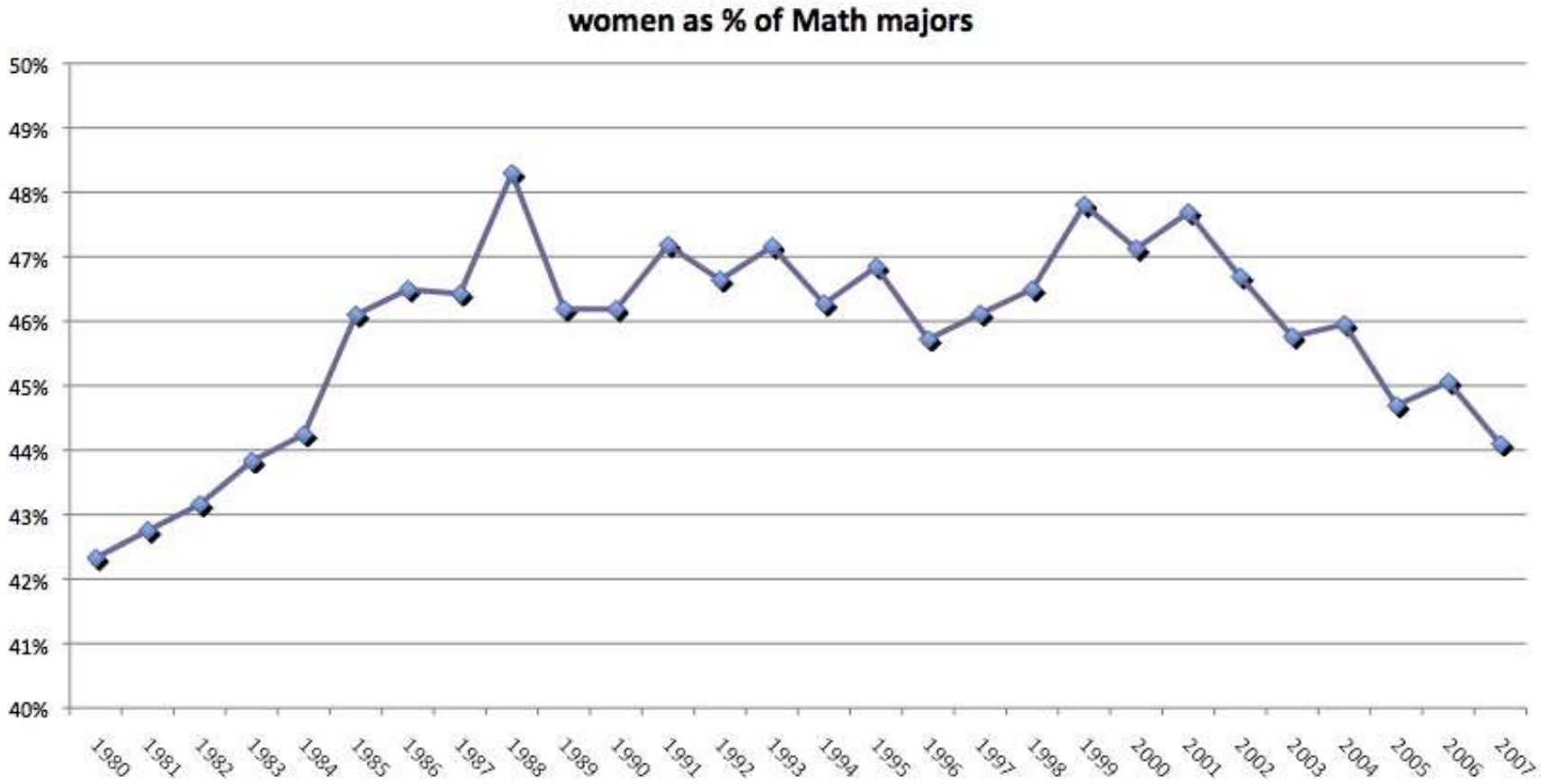
Our Underrepresented Population Focus

Young women
(grades 6-12)
Young
Hispanics
(grades 6-8)

Pertinent Statistics



Percentage of Women Math Majors



Emporia State University's Initiatives for Young Women

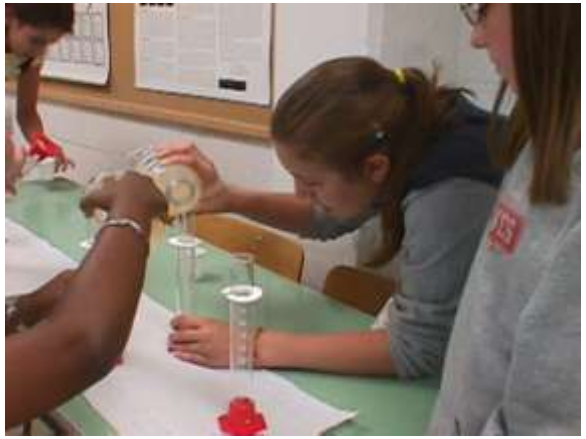
- Expanding Your Horizons (EYH) in Science and Mathematics Conference
- Sonia Kovalevsky Mathematics Day
- MASTER IT: Mathematics and Science to Explore caReers – Investigating Together

Overall Objectives

- Increase awareness of all applications of science and mathematics used in everyday functions, as well as in a variety of workplaces.
- Provide professional female role models in careers that are non-traditional to females.
- Strengthen young women's self-esteem and confidence.
- Show the importance of continuing to take advanced mathematics and science classes in high school.
- Set up a support network among peers and professionals

Common Features of Programs

- Career Discussions
- Hand-on Workshops
- Interaction with Women Professionals



Expanding Your Horizons

- **Day-long Conference** for over 220 middle school girls and their adult sponsors
- **Participant Selection** is by order of receipt of registration
- **Concurrent Adult Program**
- **Special Features**: pasta buffet, door prizes, and T-shirts
- **Funded** by Kansas NSF EPSCoR, private donor, ESU and registration fees

Sonia Kovalevsky Day

- **Day-long Celebration** of mathematics for approximately 60 high school women and their teachers
- **Participant Selection:** Regional mathematics teachers nominate three young women in their junior year who have excelled in mathematics
- **Special Features:** Problem-solving event, professional development workshops for teachers and recognition ceremony
- **Funded** initially by the Association for Women in Mathematics and currently by Wolf Creek Nuclear Operating Corporation.

MASTER IT:
Mathematics and Science to Explore caReers – Investigating Together

- **One-week Summer Residential Program**
- **Participant Selection:** 24 rising 8th and 9th grade girls selected based upon application materials
- **Activities:** led by science and mathematics faculty and women professionals
- **Special Features:** field trips to regional corporations
- **Funded** by a National Science Foundation Grant and Kansas NSF EPSCoR

Filling a Bucket
How Long will it Take?

Water is dripping into a five gallon bucket such that every ten seconds the amount that is added to the bucket doubles. If at the beginning a single drop falls, how long will it take to fill the bucket?

It might be useful to know that there are approximately 16 drops in a mL.

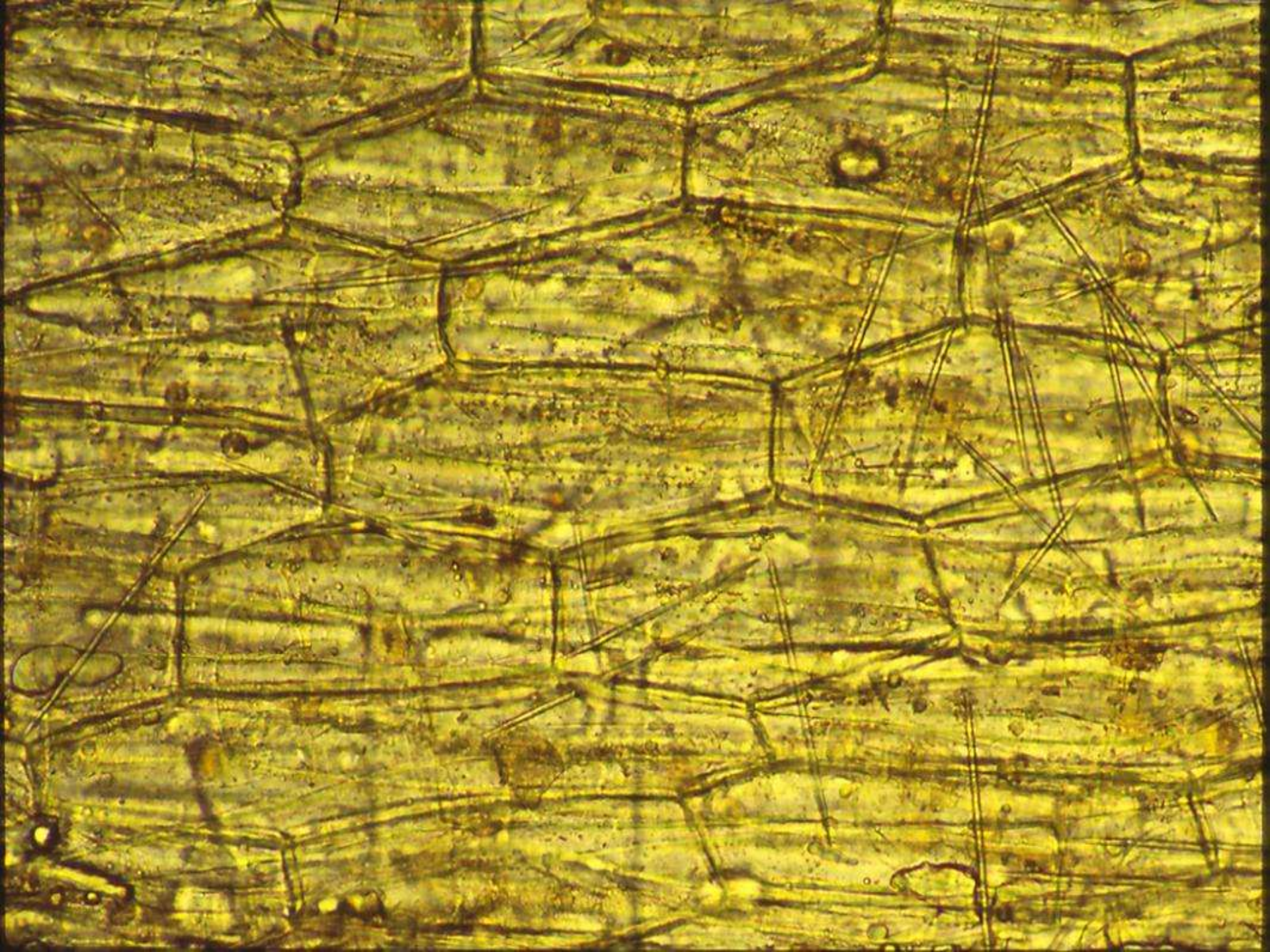
Exponential Growth

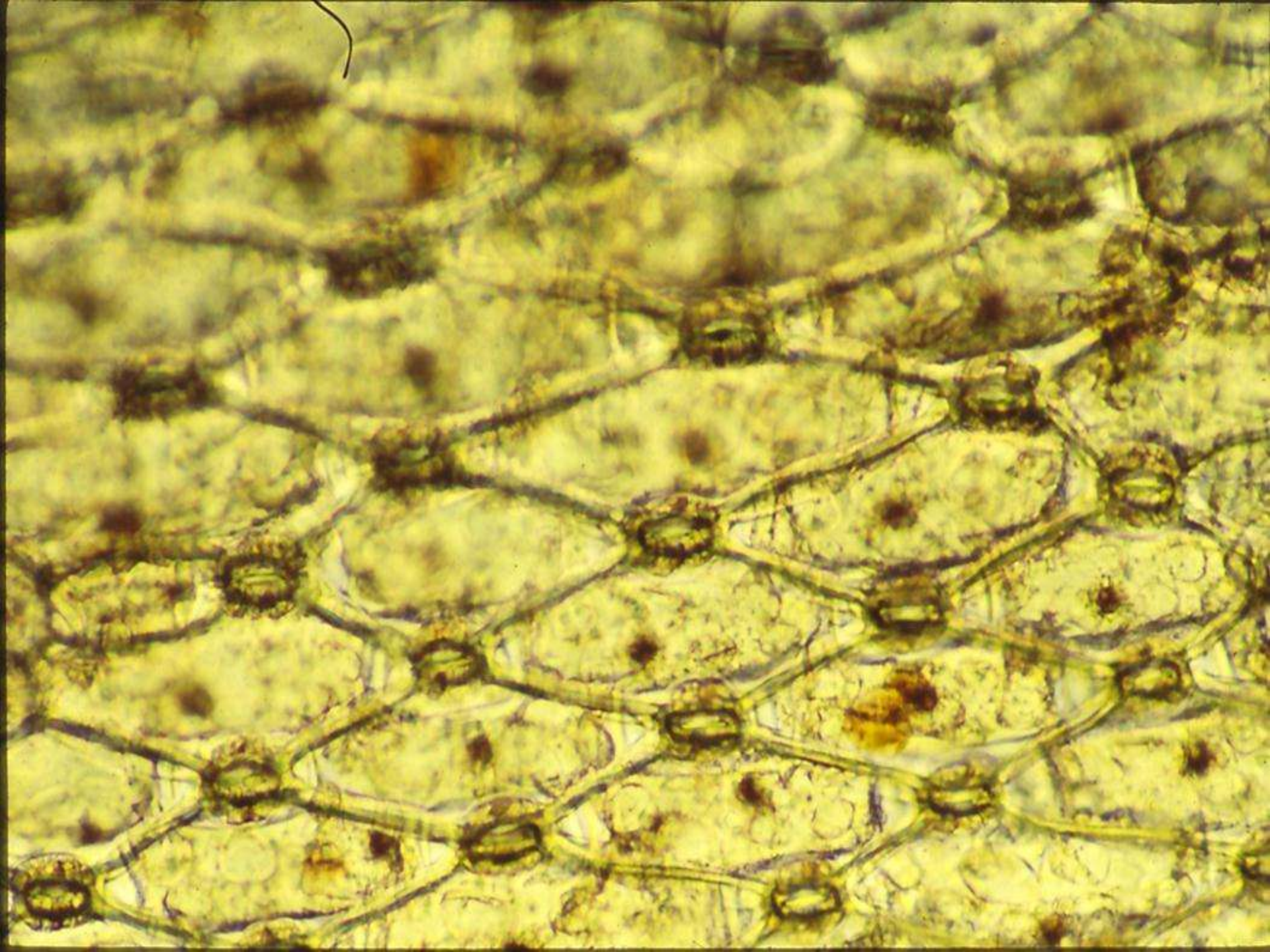
Time(s)	Amount	Time	Amount
0	1 drop	100	64 mL
10	2 drops	110	128 mL
20	4 drops	120	256 mL
30	8 drops	130	512 mL
40	1 mL	140	1.024 L
50	2 mL	150	2.048 L
60	4 mL	160	4.096 L
70	8 mL	170	8.192 L
80	16 mL	180	16.384 L
90	32 mL		

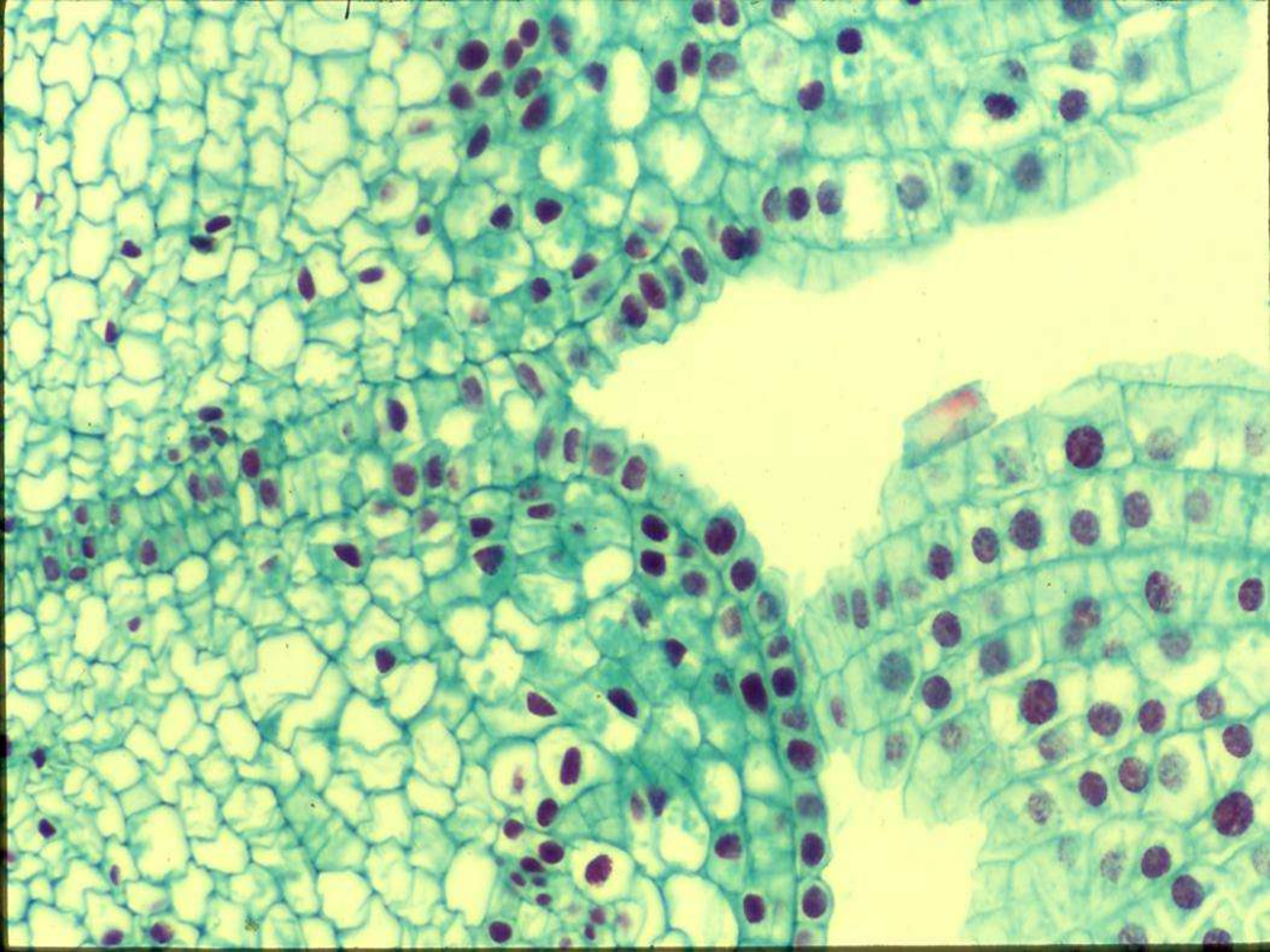
Tilings in Nature

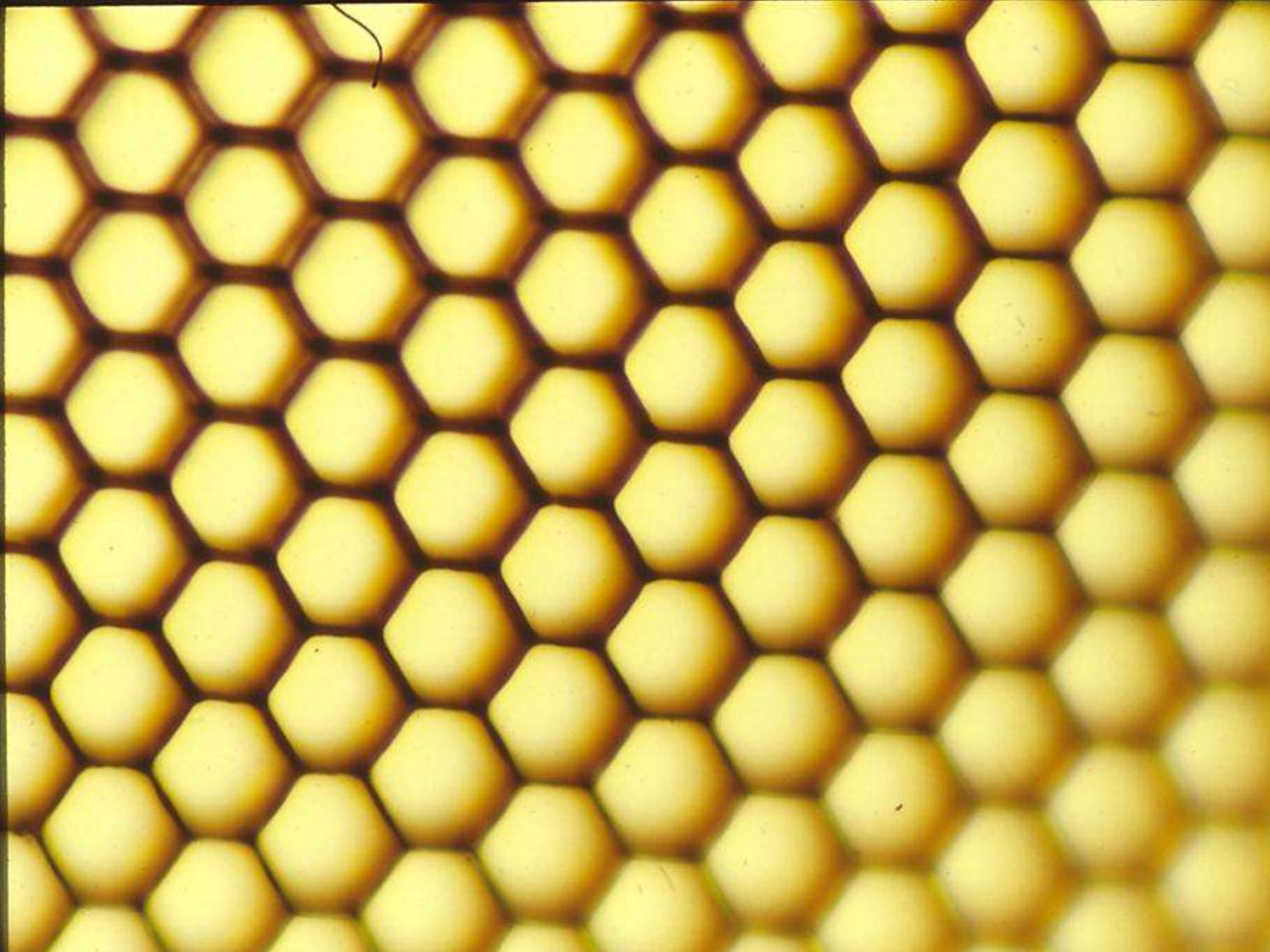
For this activity, you will need to visit each of the eight microscope stations and look at the photograph of part of a muscle at station 9. At each of these stations, determine if part of the object can be duplicated and used to tile the plane. For each geometric figure that will tile the plane, draw what the tile looks like. For the others, explain why they will not tile the plane. Remember that in nature, things are not perfect. Think of these shapes, however, as being congruent when they seem to have the same general shape.

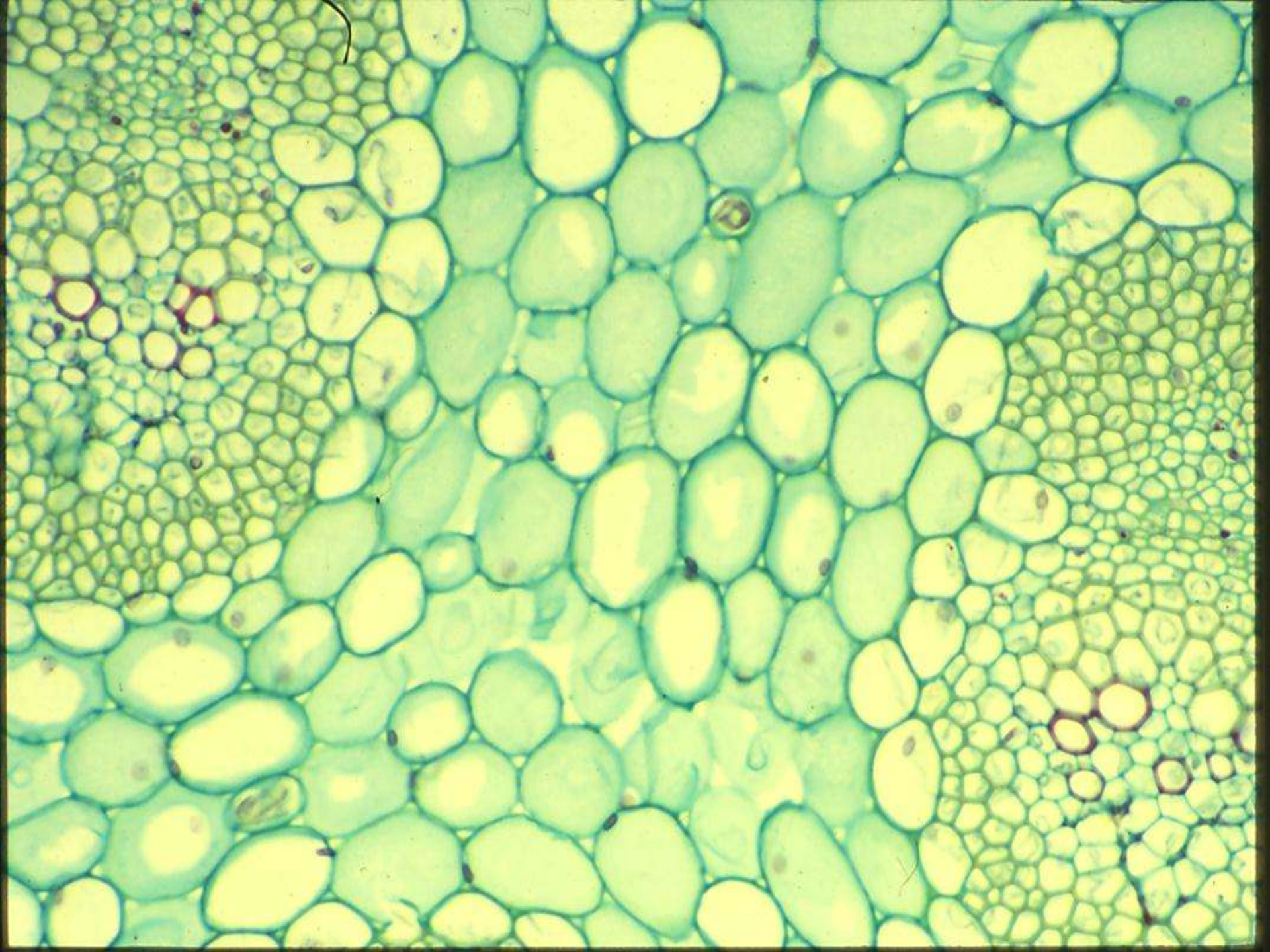
Specimen	Does the shape tile the plane?	If so, draw a tile. If not, explain why not.
Spider plant microscope 1		
Wandering Jew microscope 2		
Lily ovary microscope 3		
Dragonfly eye microscope 4		
Yucca leaf microscope 5		
Snail radula microscope 6		
Sphagnum moss microscope 7		
Onion root tip microscope 8		
Photo of a vertebrate striated Muscle at station 9		

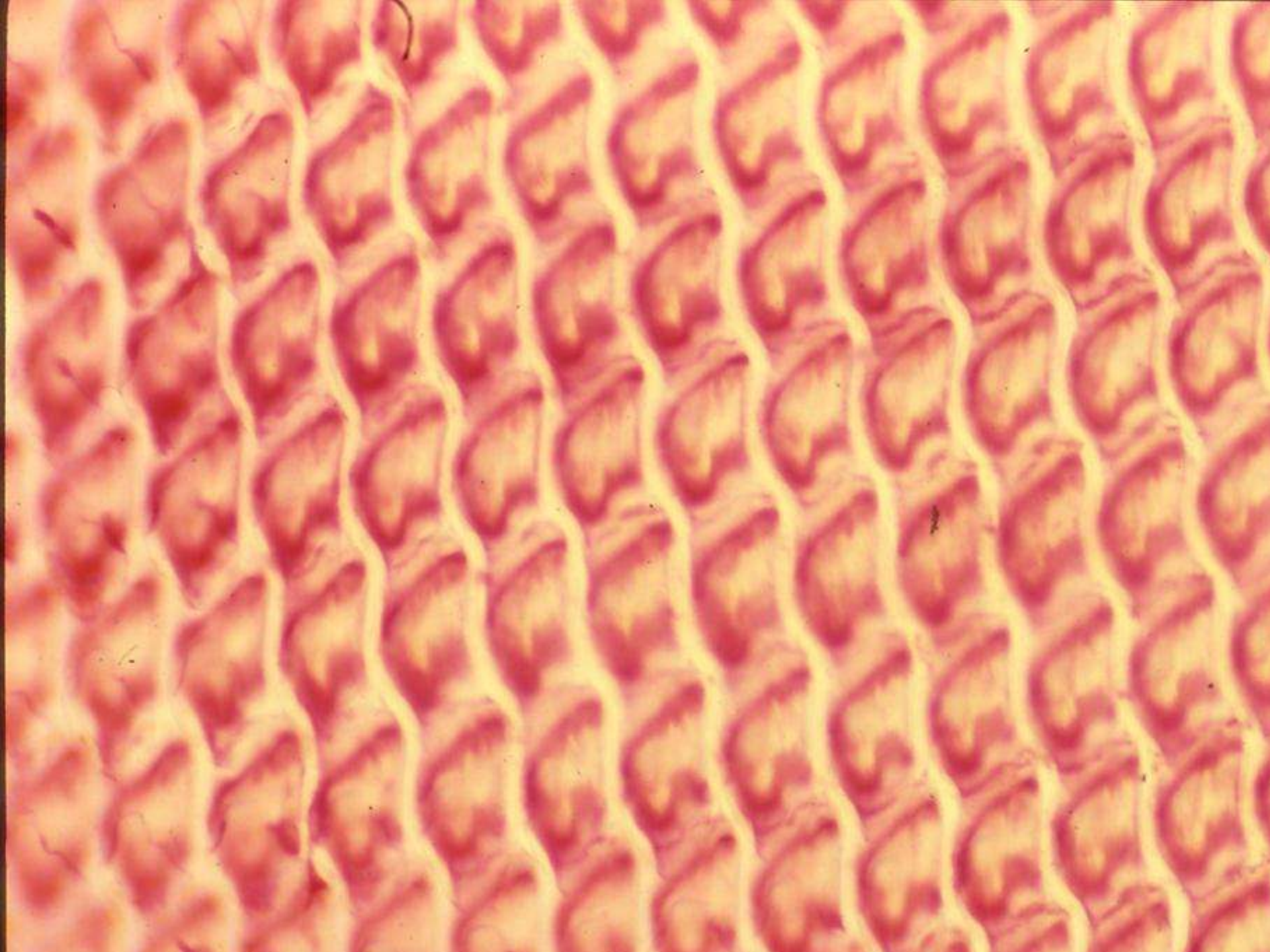


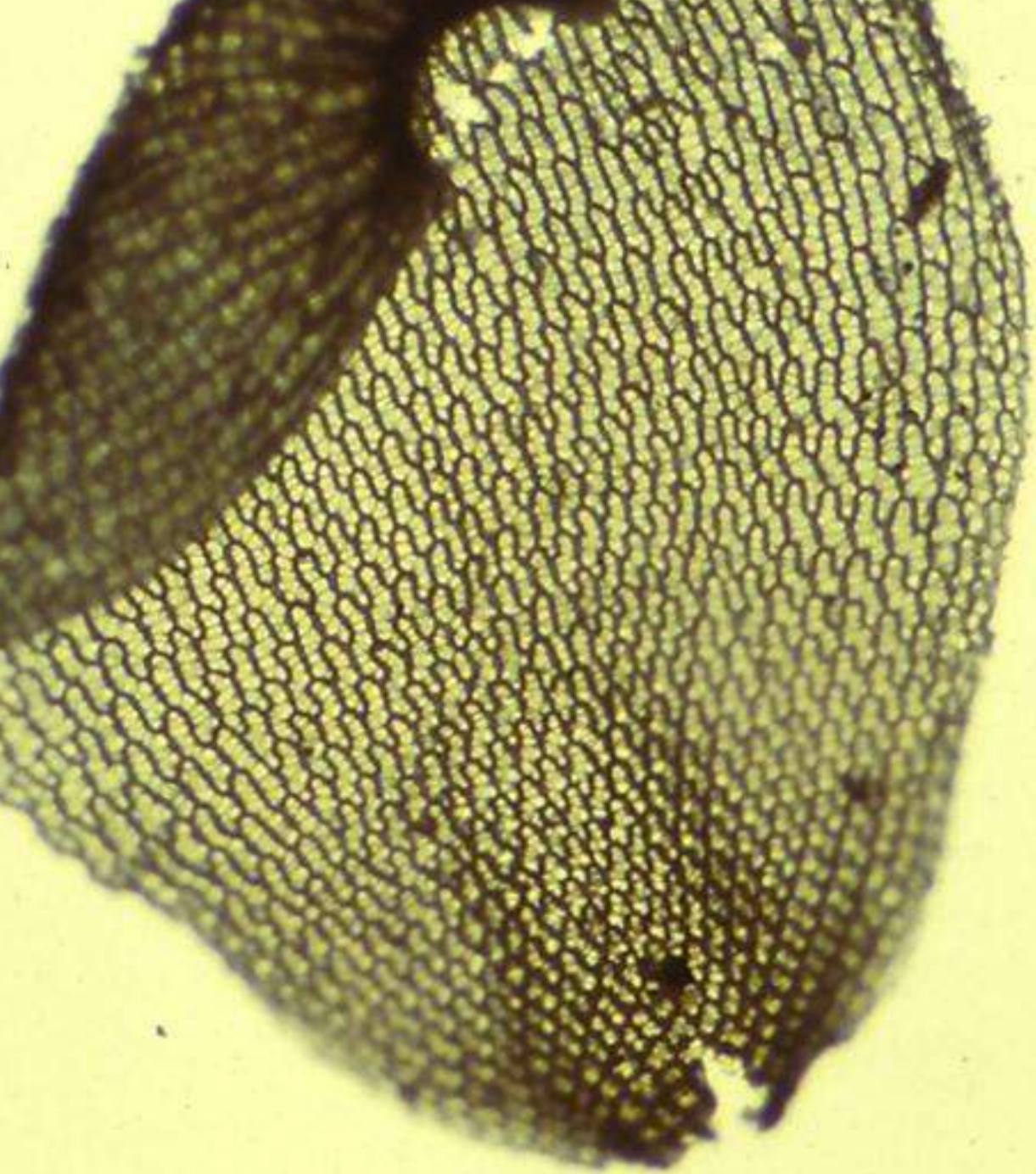


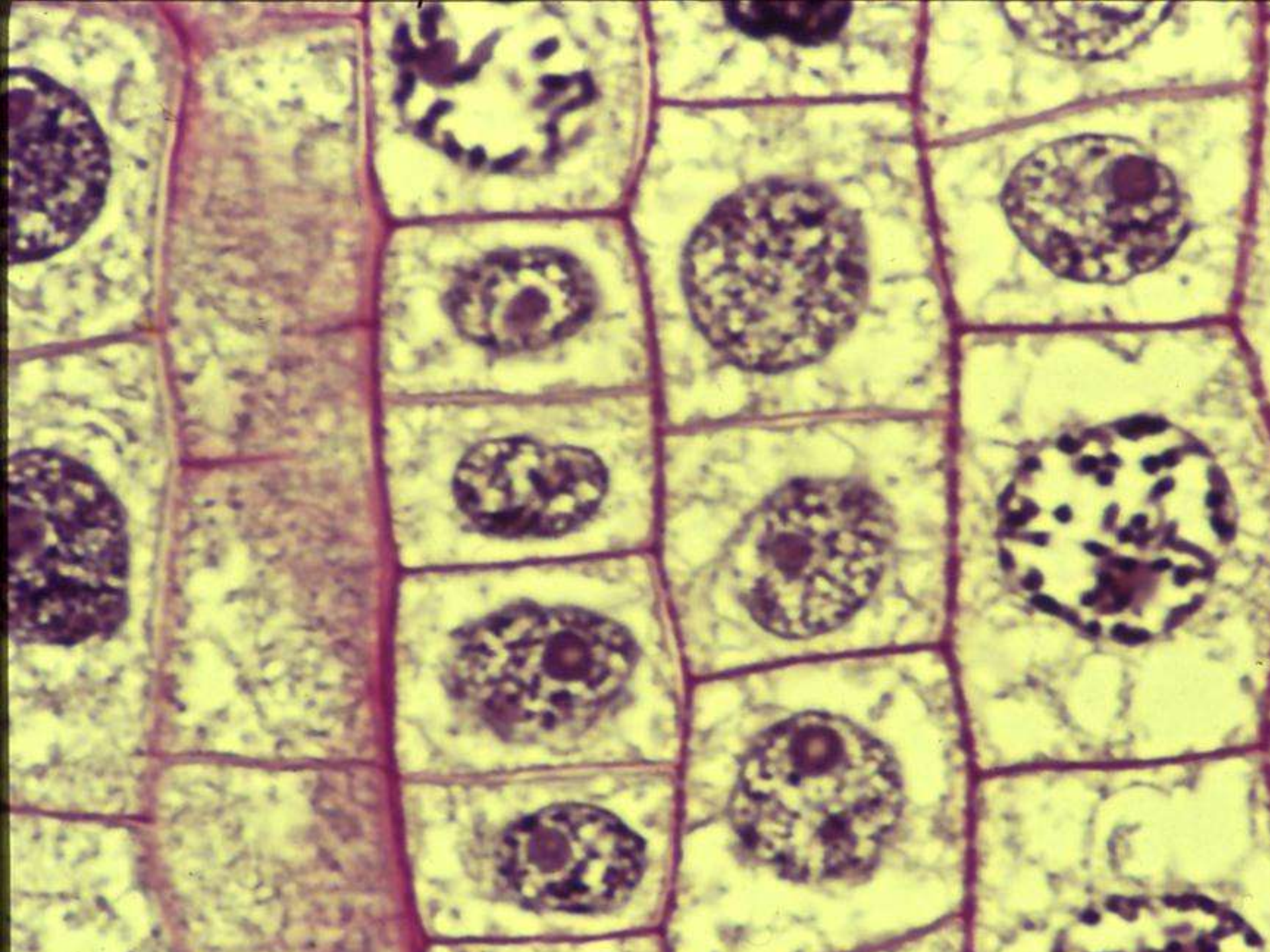


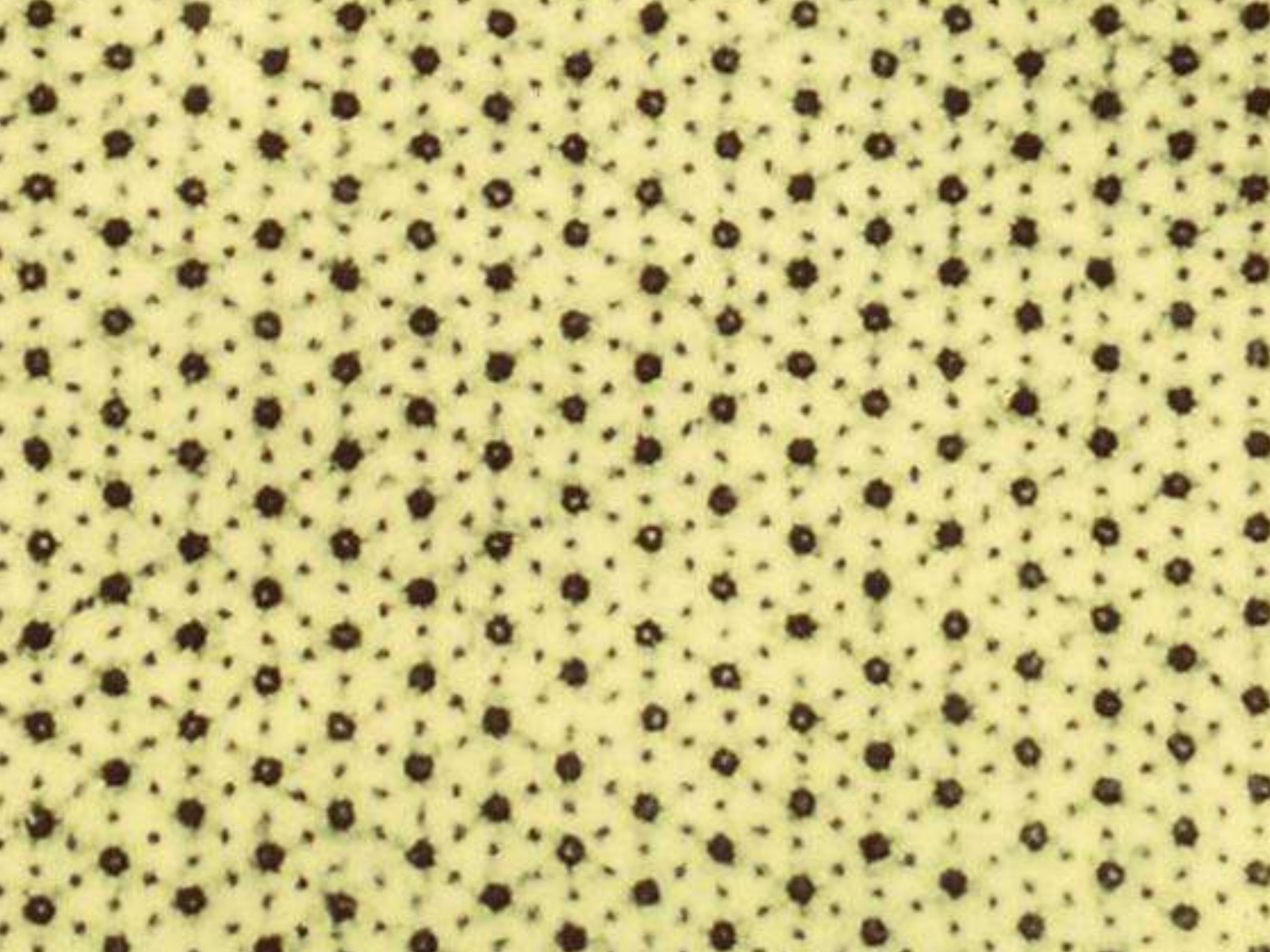












The Water and Wine Problem

Take two glasses, one filled with wine and the other filled with water. Take one teaspoon of wine from the wine glass and put it into the water glass. Stir and take one teaspoon from the mixture and add it to the glass of wine and stir.

Once this is completed, is there more water in the wine mixture or more wine in the water mixture?

Algebraic Solution

Let ***x*** = amount of water in water goblet initially

Remove z amount of wine from wine goblet and place in water goblet.

Percent of wine in water goblet is now $\frac{z}{x+z}$.

When we remove z amount from the mixed solution in the water goblet, we have in this the spoonful $\left(\frac{x}{x+z}\right)z$ of water and $\left(\frac{z}{x+z}\right)z$ of wine.

Amount of wine in water goblet= $z-\left(\frac{z}{x+z}\right)z=\frac{(x+z)z-z^2}{x+z}=\frac{xz}{x+z}$

Amount of water in wine goblet=$\left(\frac{x}{x+z}\right)z=\frac{xz}{x+z}$

STEM Needs and Hispanic Populations

National Demographics

- Between 2000 and 2015 the Hispanic pop. is projected to grow by 45% (compared to 1% for whites)
- Percentage of Hispanics receiving Bachelor's in STEM areas is around 7%

Local Demographics

- Percentage of Hispanic students in Emporia schools is 42%
- Very small number of Hispanic high school graduates go on to college

Emporia State University's Initiatives for Hispanic Students

Si Se Puede (5 years)

- Day-long Saturday conference for students in grades 6-8
- Participant selection is by order of receipt of registration
- Career discussions and hands-on workshops conducted by Hispanic professionals
- Special Features: banquet, door prizes, and t-shirts at conclusion

Mineral Name	Polyhedron[1]	No. of Faces	No. of Vertices	No. of Edges
Beryl	Hexagonal Prism			
Calcite (cleaved)	Rhombo-hedral			
Chalco-Pyrite	Tetrahedron			
Fluorite (cleaved)	Octahedron			
Garnet	Rhombic Dodeca-hedron			
Pyrite	Cube			
Quartz	Octadeca-hedron (18-hedron)			

[1]Many minerals may appear in more than one crystal form.

M & Ms and Half-life Procedure Sheet

1. Using an individual size package of M & Ms, place each piece of candy with the M & M logo facing upward; you may eat any pieces lacking the logo.

2. Count the number of M & Ms remaining and record this information on your data sheet as the number of M & Ms at time zero (i.e., before any radioactive decay takes place).

3. Place the pieces of candy in the styrofoam cup, shake them, and then pour them out on a table top.

4. Separate the candies with the logo up from the candies with the logo down and record on your data sheet the number of candies with the "M" up, and you may eat all pieces of candy with the "M" down (these serve as the decayed portion of our radioactive material).

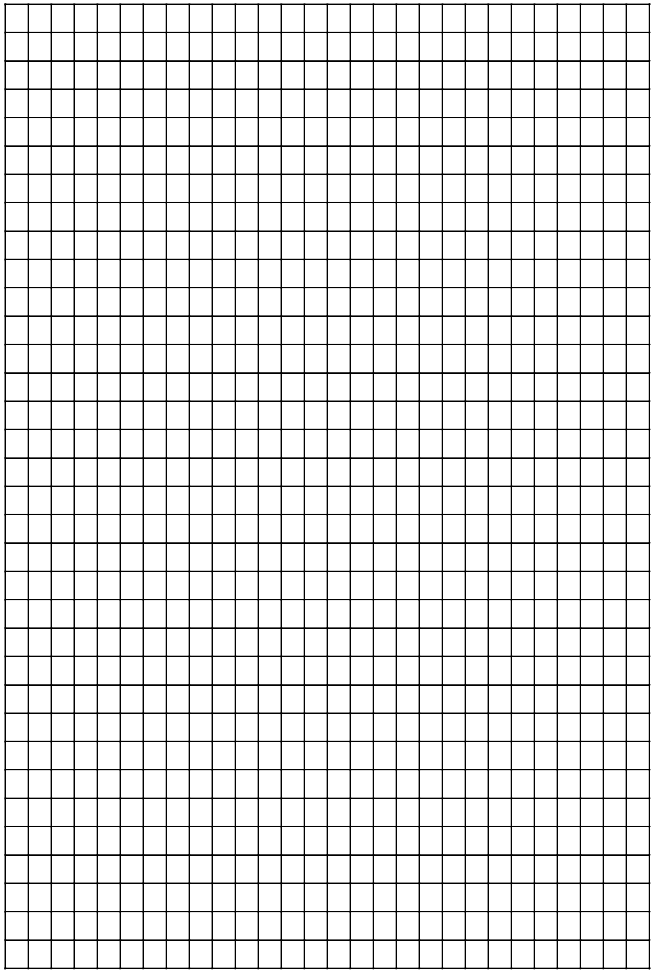
5. Using the pieces of candy with the logo up, again place them in the cup, shake them, and pour them out. As before, separate the M & Ms into two groups, logos up (undecayed) and logos down (decayed). Record the number of M & Ms which represents the undecayed material.

6. This process is repeated until all M & Ms at some time land logo side down.

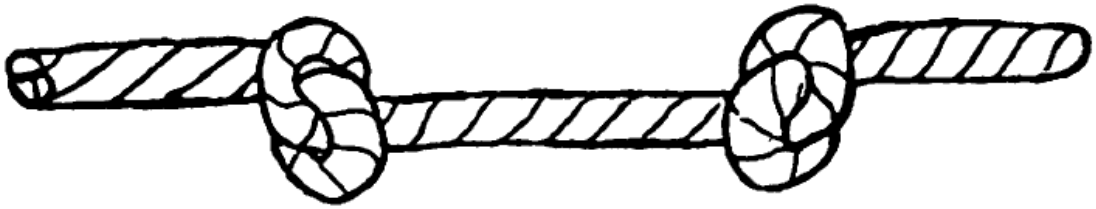
7. On your data sheet construct a graph which approximates a half-life curve.

M & Ms and Half-life **Name** _____

Time	Number of M & Ms With Logo Up
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	



Sierpinski's Triangle



Multi-Knotted Rope Worksheet

I n your groups of four, each person will have a particular task. One person will be a recorder, another will be a knot tier, and the other two will take the measurements.

1. Rope measurers need to measure the unknotted rope length first. Length = _____

2. Complete the following chart by tying additional knots in the rope and measuring the resulting lengths. Tie your knots at least a hand's width apart.

Number of Knots	Length of Unknotted rope (from #1)	Length of Knotted rope	Original length - Knotted length
1			
2			
3			
4			

3. On graph paper, plot the number of knots along the horizontal axis and the differences in the lengths along the vertical axis.

4. Draw a line which you believe comes closest to passing through all the points.

5. Find two points on your line.

Point A: (_____, _____)

Point B: (_____, _____)

6. Find the slope of your line.

7. Find the equation of your line.

8. Using your equation, what should be the difference between the unknotted rope and the rope with 5 knots? Remember that 5 is the x-value.

9. Check your results by tying an additional knot in your rope.

Unknotted length =_____
Length of the rope with 5 knots =_____
Unknotted length - knotted length =_____

10. If someone has given you the difference between the length of an unknotted rope and the length of the knotted rope, explain how you can find the number of knots in the rope.

Get Involved!

- Consider establishing similar programs for underrepresented groups