Welcome to Math 102 - Calculus for Life the Sciences

- Information about the course.
- Shapes of cells.
- Power functions and polynomials.

Math 102 - info

- I'm Prof. Cytrynbaum or Eric.
- Course website: http://wiki.math.ubc.ca
- Office hours (MATX 1219)
  - Wed 11 am -12 pm,
  - Thurs 10 - 12 am.

Math 102 - info

- Homework:
  - WeBWorK (online) - 15%
    - Old-School Homework (written) 5%
- Midterms (Oct 3, Nov 5 @ 6pm) - 30%
- Final exam - 50% (“44% rule”)

Math 102 - info

- OSH 1 - due Monday!!
    - Communicating mathematics.
- WeBWorK 1 - due next Thursday 7 am!
    - Last week, this week, spreadsheet.
    - 10%-drop rule.
- Computer lab - optional (for ss help).
- Piazza - online forum for help.

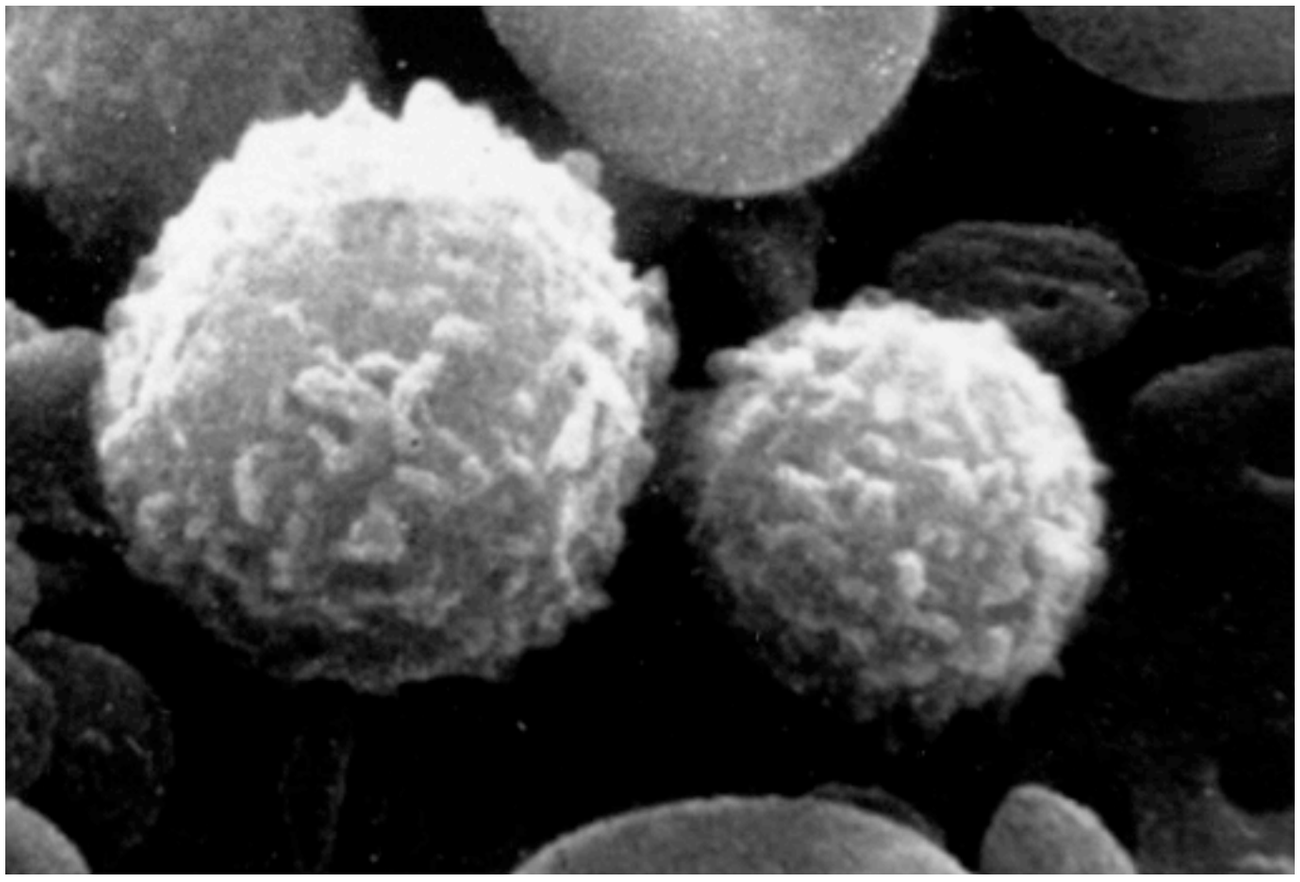
Math 102 - info

- DO LOTS OF PROBLEMS.
- Solutions:
  - WW - immediate yes/no.
  - OSH - you'll get solns.
  - Text - answers at the back, no solns.
  - Anything else - exam training (no solns).

Math 102 - info

- Course notes - two sets (Leah Keshet's and Paul Dawkins's)
- Read over website - lots of info there.
- A quick view of the course site, Piazza, WeBWorK...

Shapes of cells



White blood cells (spheres)

Shapes of cells

- Cellular metabolism - cells use energy/ nutrients proportional to volume but absorb them proportional to surface area.
- Need absorption rate > consumption rate to survive.
- For different shapes, this balance scales better or worse as size increases...

Nutrient balance in a spherical cell

- Absorption is proportional to surface area:

$$S = 4\pi r^2 \qquad A = k_1 S = 4k_1 \pi r^2$$

- Consumption is proportional to volume:

$$V = \frac{4}{3}\pi r^3 \qquad C = k_2 V = \frac{4}{3} k_2 \pi r^3$$

where k_1 and k_2 are positive constants.

Which of the following is true?

$$C = \frac{4}{3} k_2 \pi r^3 \qquad A = 4 k_1 \pi r^2$$

(A) Absorption is greater than consumption for sufficiently large cells and vice versa for small cells.

(B) Consumption is greater than absorption for sufficiently large cells and vice versa for small cells.

(C) Both A and B are possible - it depends on k_1 and k_2 .

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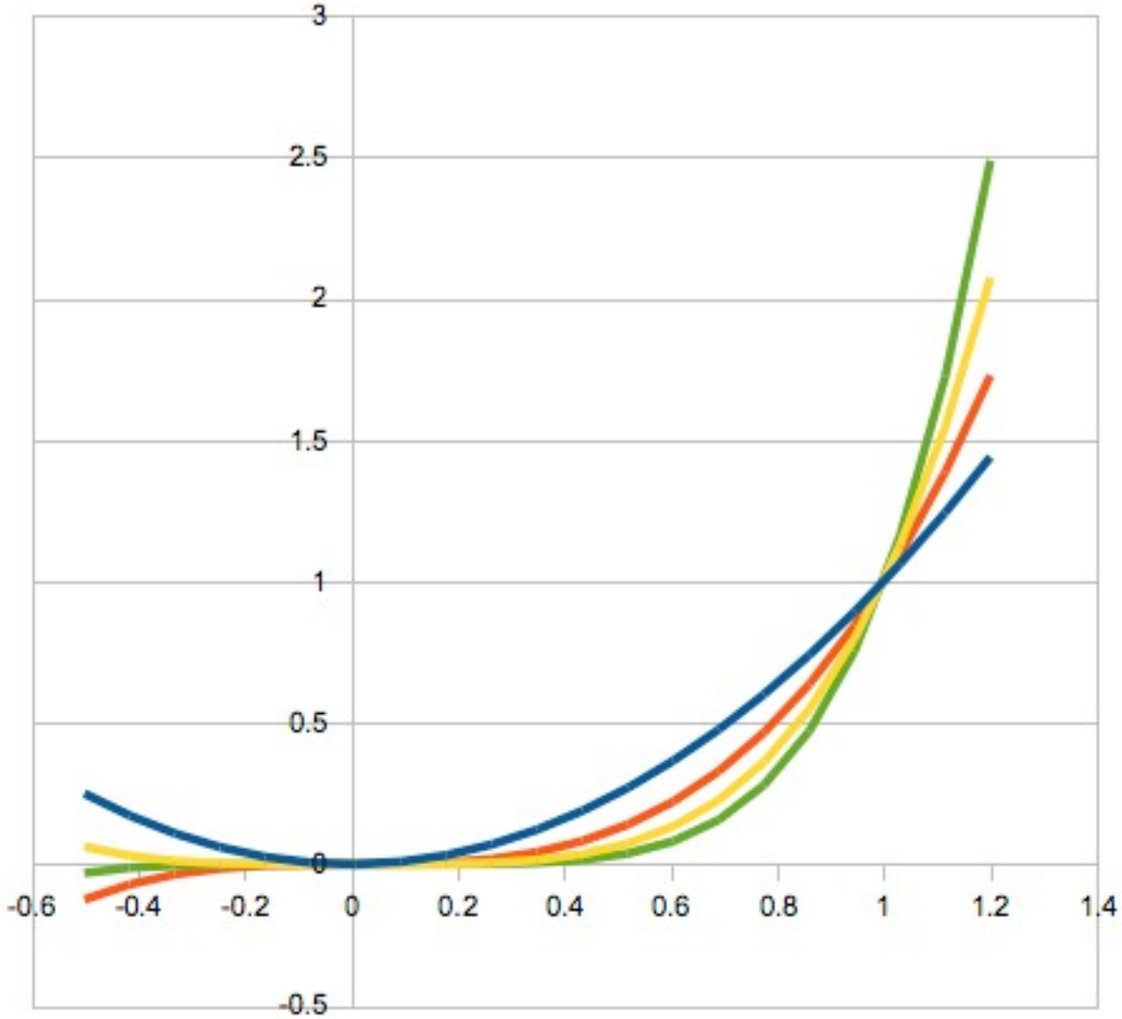
Power functions

(A) Green: x^3, yellow: x^4, red: x^5, blue: x^6.

(B) Green: x^5, yellow: x^4, red: x^3, blue: x^2.

(C) Green: x^6, yellow: x^5, red: x^4, blue: x^3.

(D) Either (B) or (C) (not enough info).



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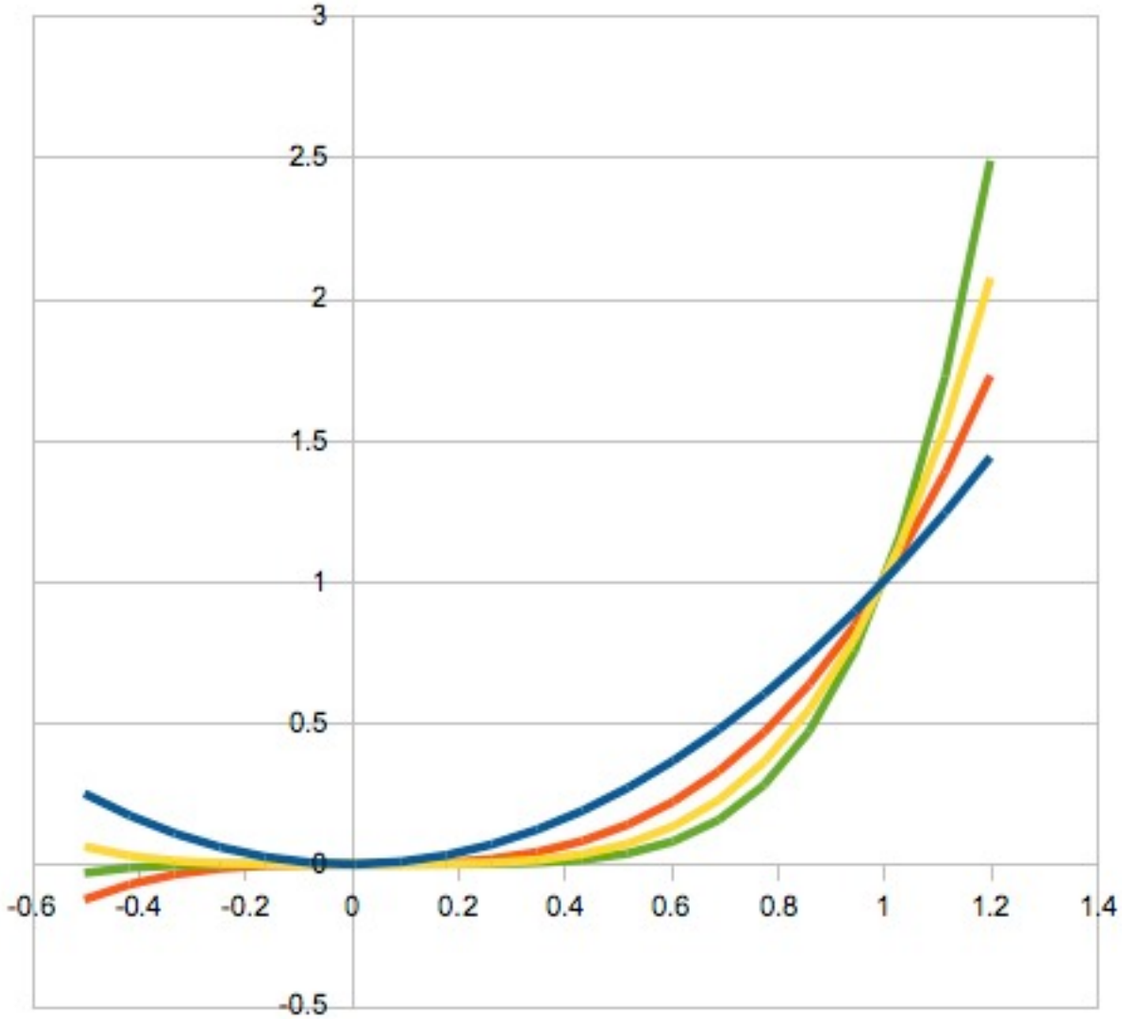


Limit on cell size

- When is absorption > consumption?

stretch r^2 vertically

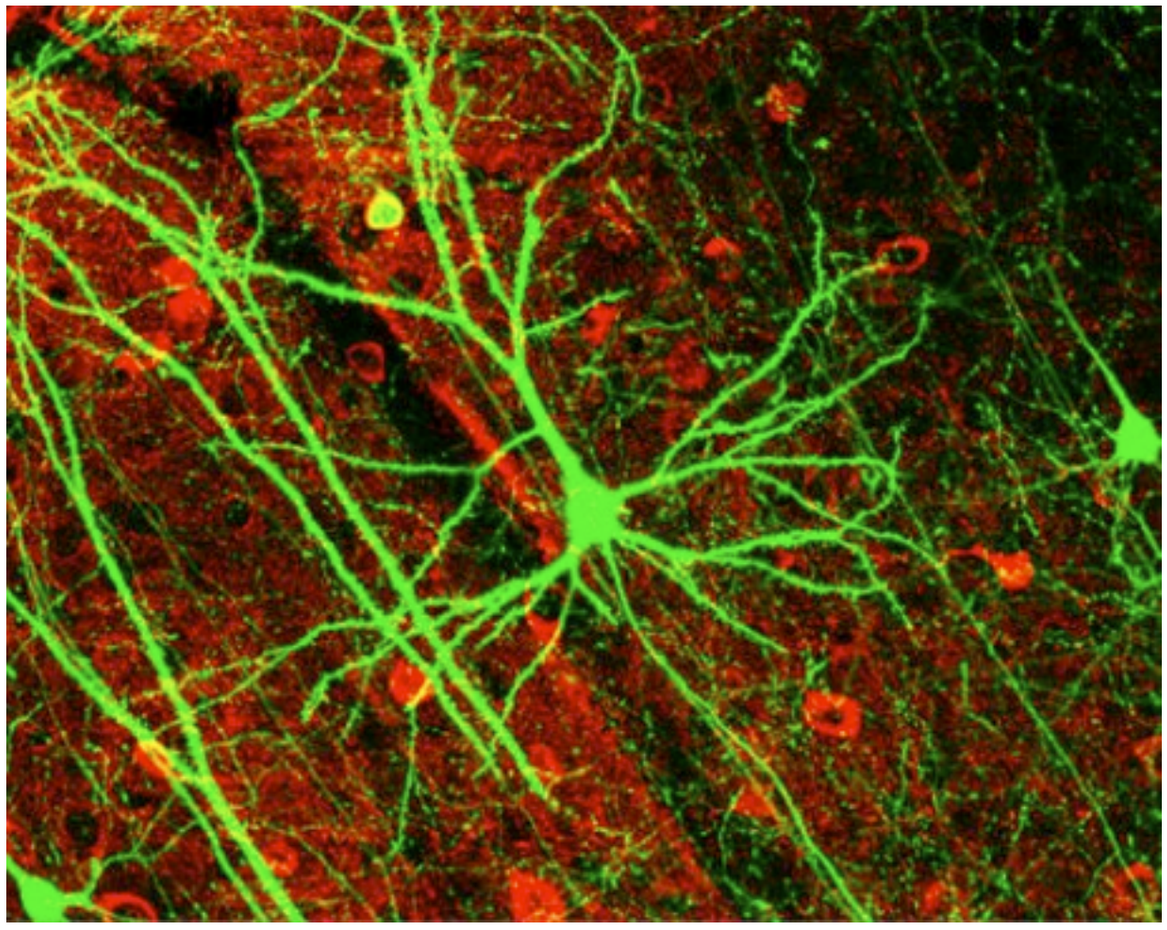
stretch r^3 vertically

$$A = 4k_1\pi r^2 > \frac{4}{3}k_2\pi r^3 = C$$

- Solve for r in terms of other parameters:

$$r < 3\frac{k_1}{k_2}.$$

The “biggest” cells around



Neuron (1 meter)

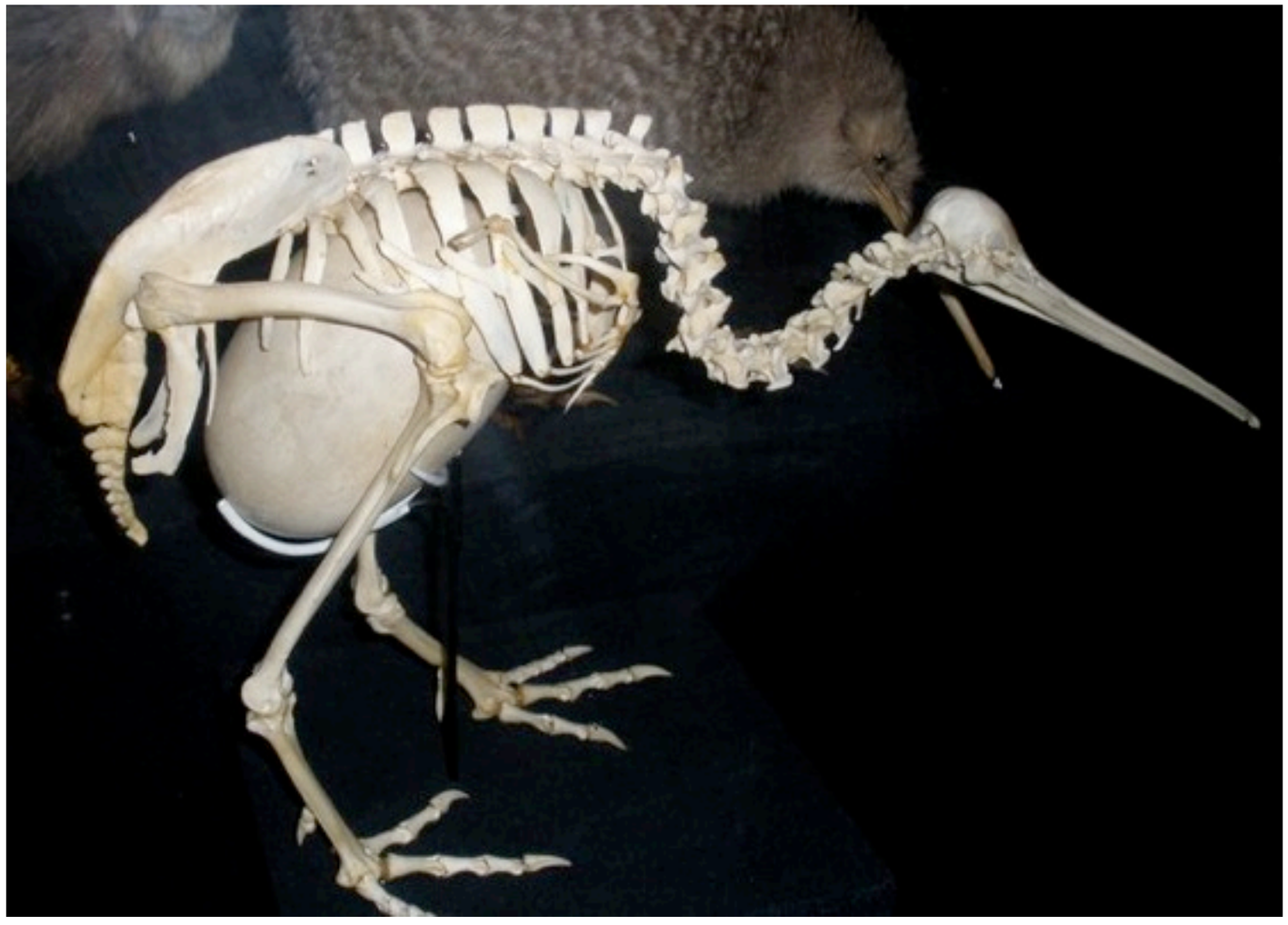
The “biggest” cells around

Caulerpa prolifera (single cell, 1 meter)

Getting around S:V issues

- Don’t be spherical if you want to be big.

“Exceptions”



Kiwi egg (not the biggest but remarkable)

“Exceptions”

Ostrich egg

Bad examples in this context - why?

Coming up next class...

- Even and odd functions
- Hill functions
- Saturating functions (asymptotes).
- Shape of graph.
- Shape near origin.