GIANT BULLDOG SPOTTED IN BULLDOG STADIUM?

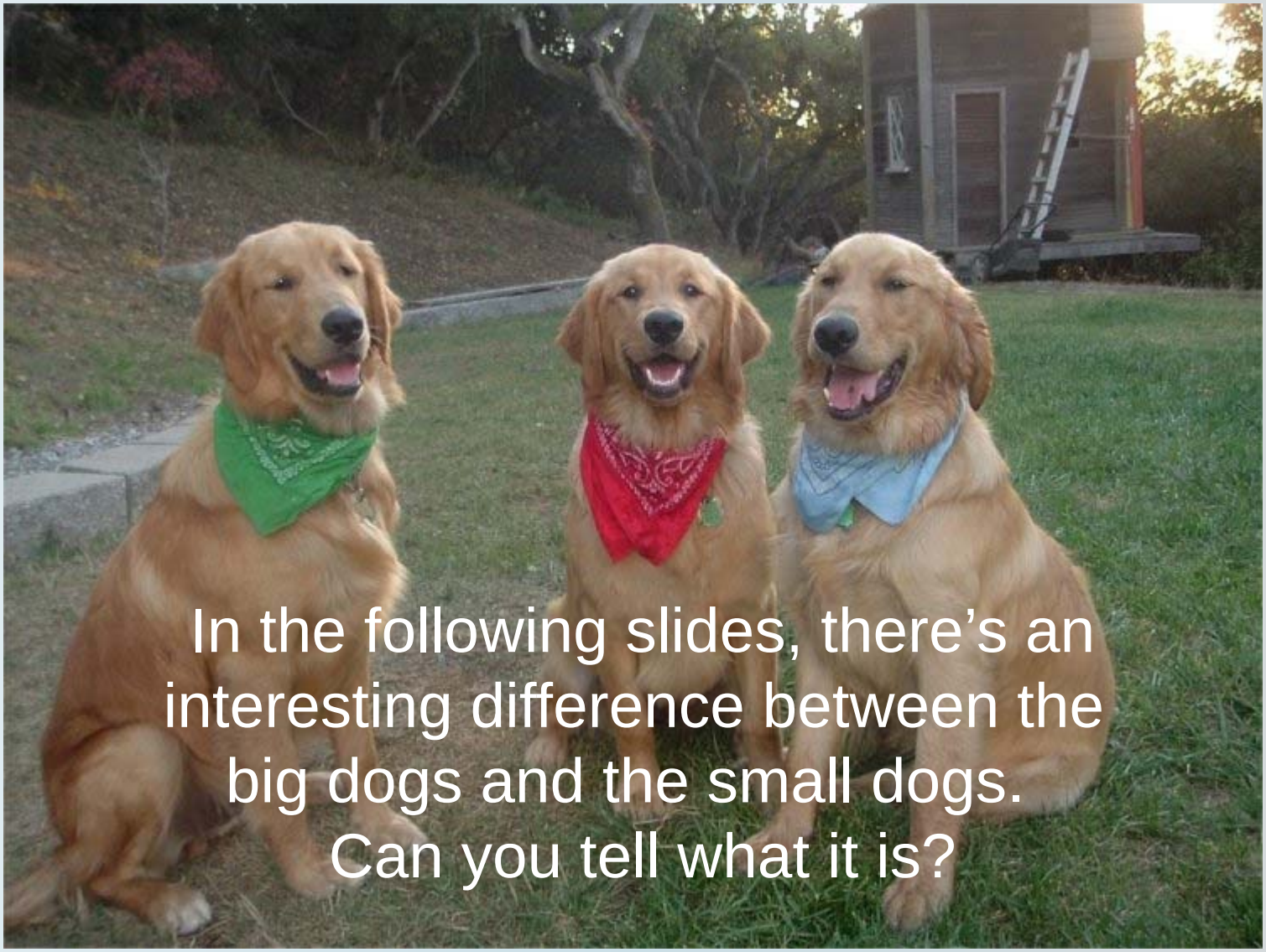
$\left(\frac{SA}{V}\right)$

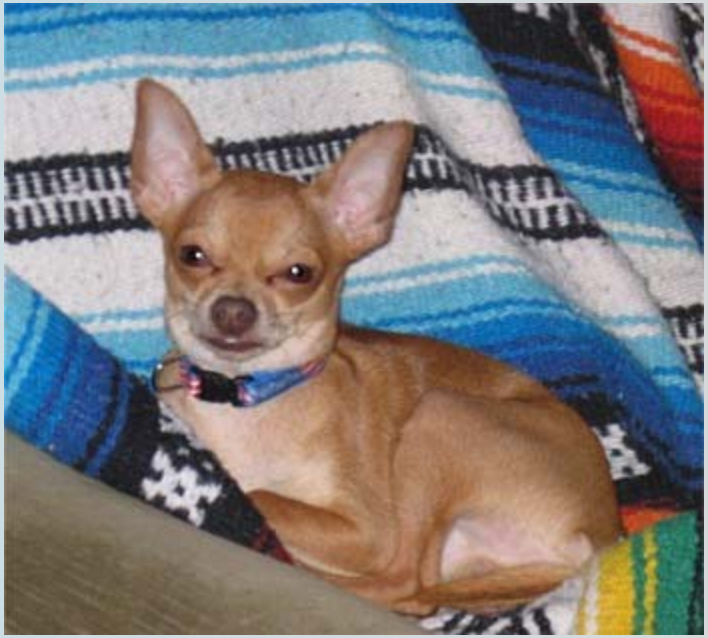
$\left(\frac{SA}{V}\right)$

Math 139
Proportional Reasoning/Scaling Activity
Fall 2015

$\left(\frac{SA}{V}\right)$


Could a bulldog this size really exist?
It’s over 30 feet tall!

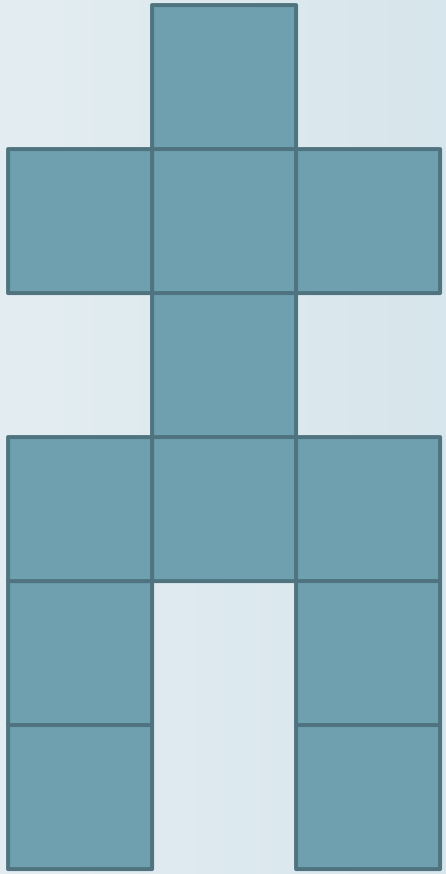

In the following slides, there’s an interesting difference between the big dogs and the small dogs.
Can you tell what it is?



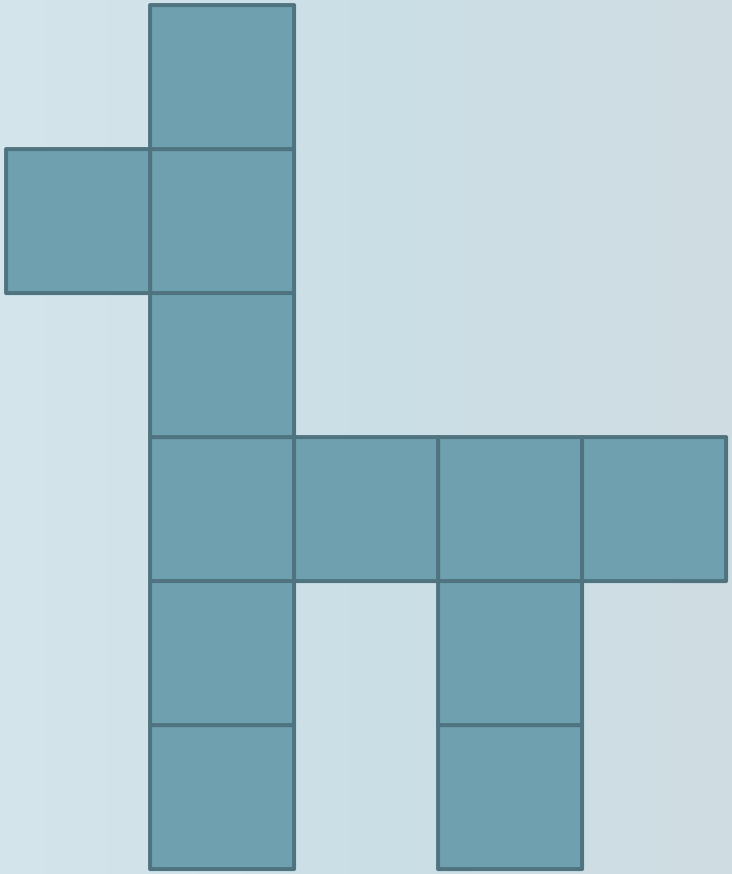

Packire.

Cognitive Disequilibrium Question #1:

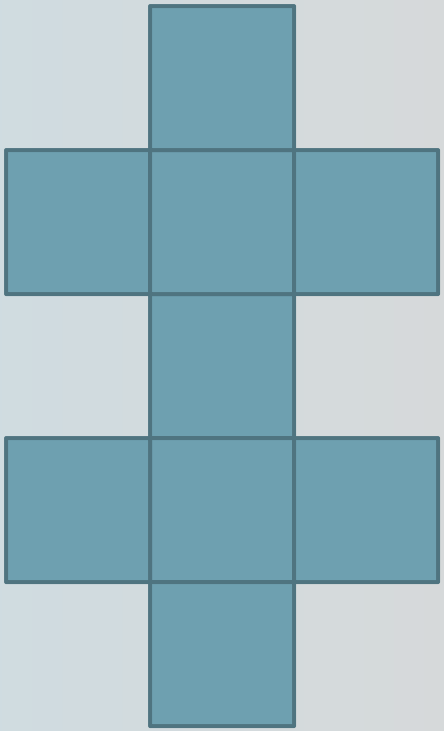
Q. Why do large dogs seem to pant more than small dogs?



FRONT & BACK

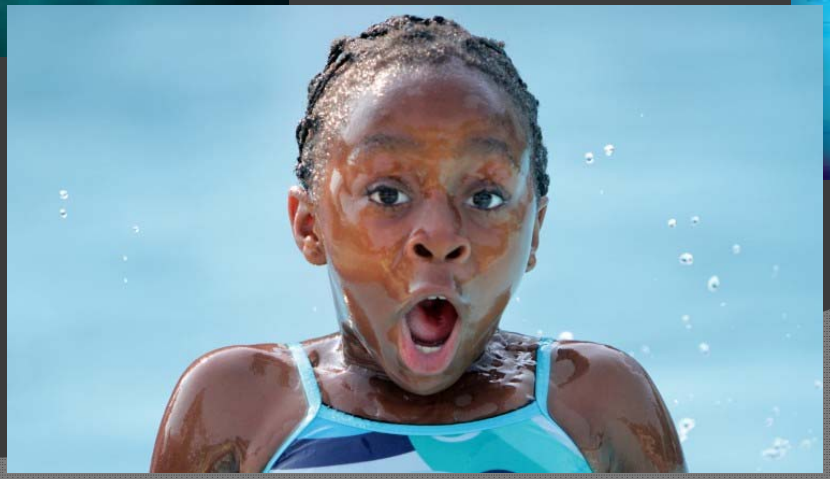


SIDES



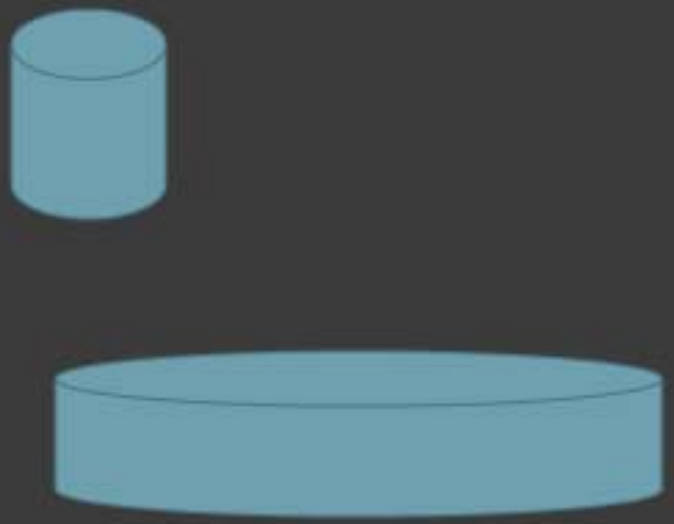
TOP & BOTTOM

What about Surface Area and Heat Transfer?



A demonstration about cooling:

Equal volumes of 100C water are placed in containers having different areas of exposure:

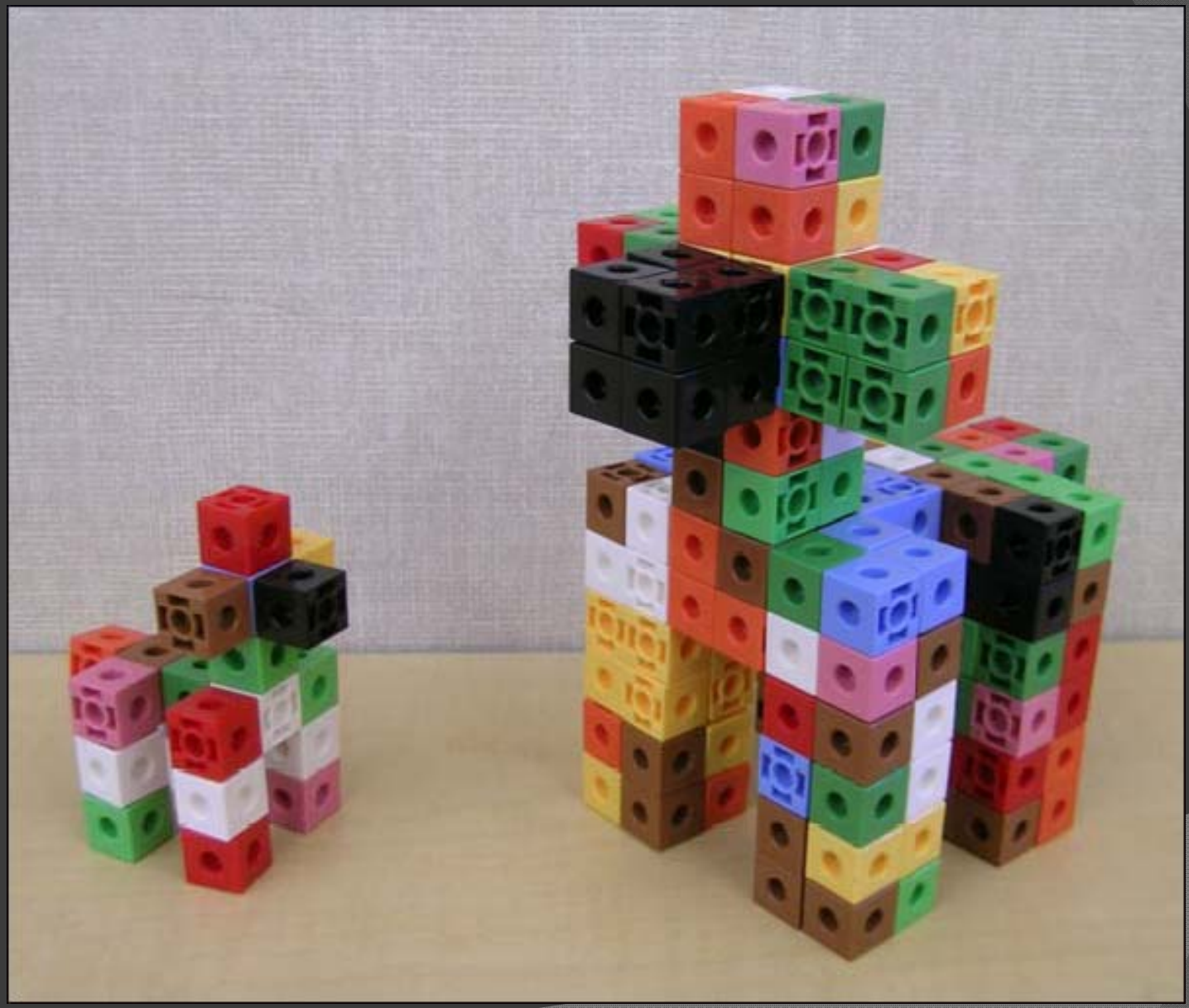


After several minutes measure the respective water temperatures with thermometers, significant differences in temperatures are seen.

Cognitive Disequilibrium Question #2:

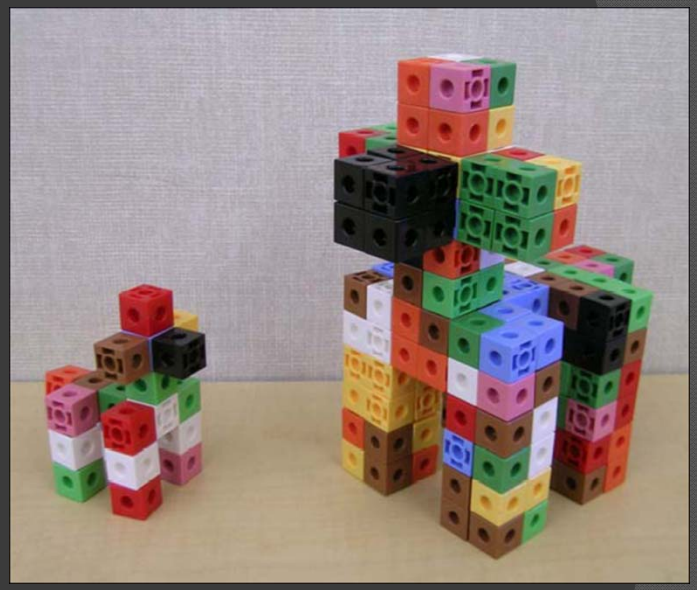
- If more surface area produces better cooling, then why do large dogs appear hotter,…, they have more surface area than a small dog!

Maybe its time to let the big DOGS OUT! … I said WHO let the DOGS out?????



Puppy Surface Area = $90u^2$

Puppy Volume = $22u^3$



Doubled Dog Surface Area = $4 \cdot 90 = 360u^2$

Puppy Volume = $8 \cdot 22 = 176u^3$

An Important Ratio for all Life!

Surface Area → think ‘Skin and Cooling’

Volume → think ‘Body size and Metabolism which makes Heat.

$$\left(\frac{SA}{V}\right)_{large} = \frac{360u^2}{176u^3} = \frac{4 \cdot 90u^2}{8 \cdot 22u^3} = \frac{1}{2} \cdot \left(\frac{SA}{V}\right)_{small}$$

$$= \frac{\frac{1}{2} \cdot SA_{small}}{V_{small}}$$

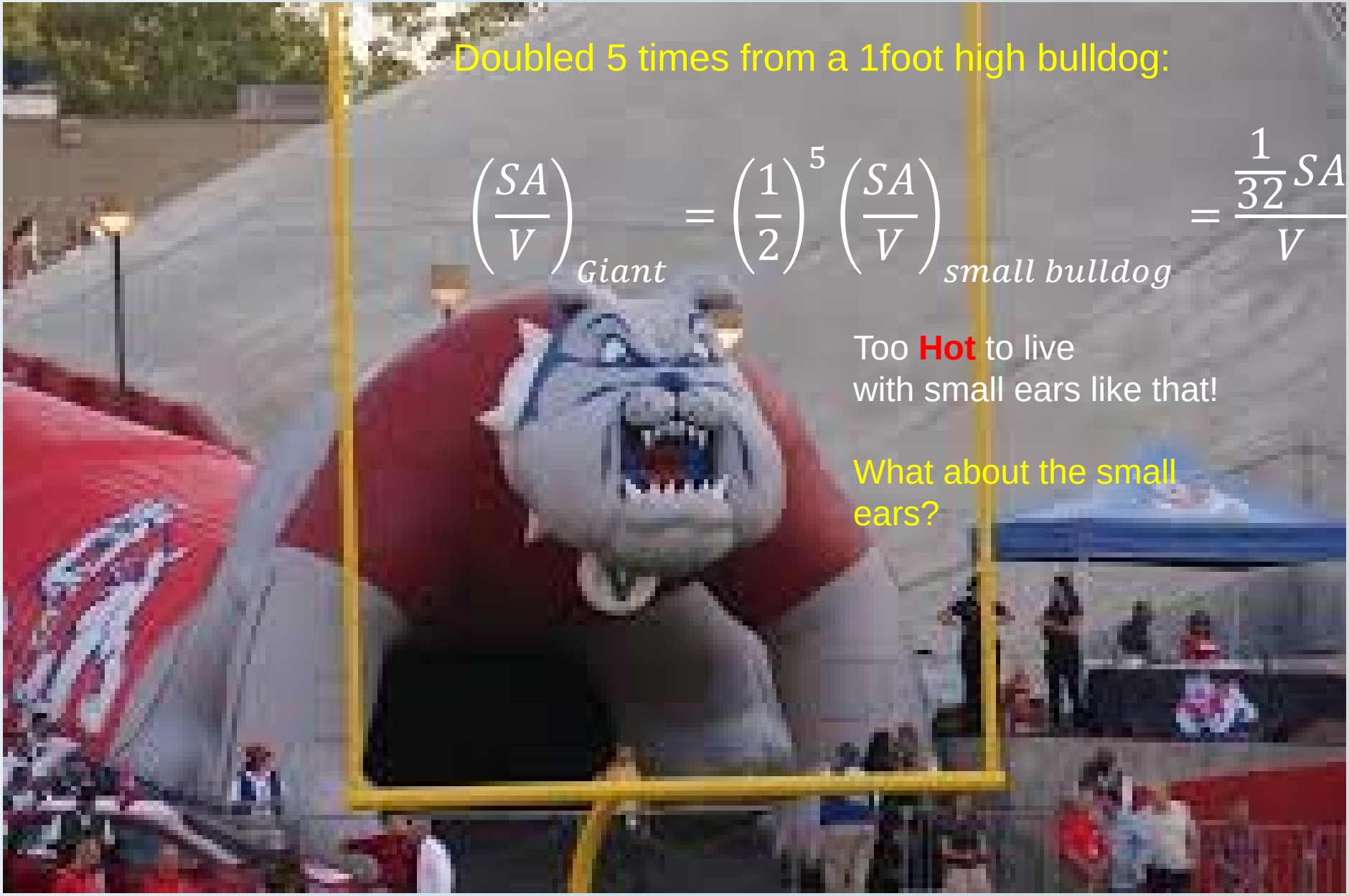
$$\left(\frac{1}{m}\right)^n \left(\frac{S}{V}\right)_{old} = \left(\frac{S}{V}\right)_{new}$$

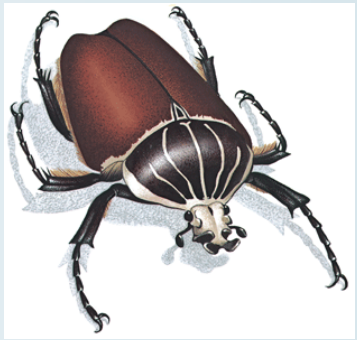
Doubled twice!

Giant has $\frac{1}{4}th$ the skin
relative to the smallest dog.

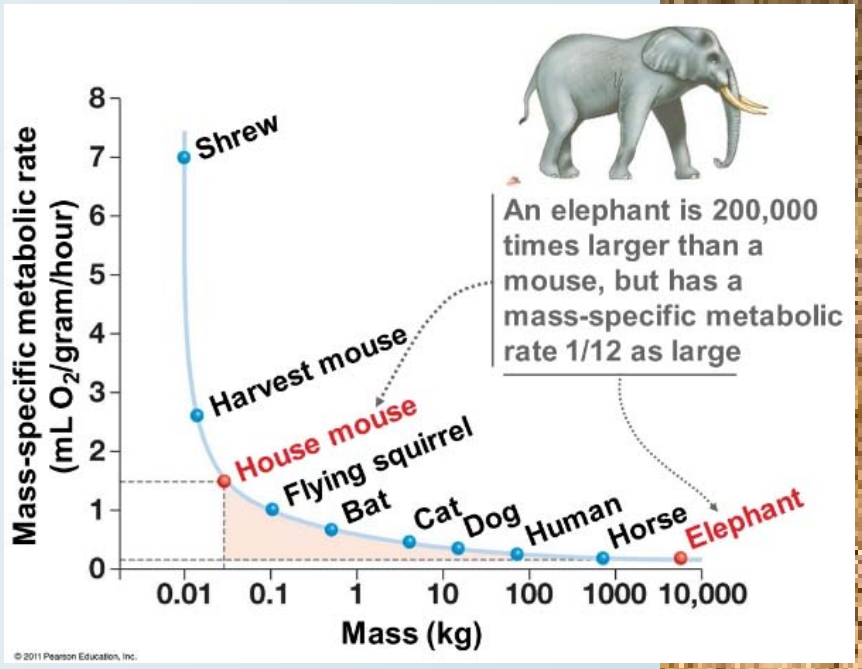
To get to 32 feet from 1 foot would

take $2^5 \cdot 1 = 32$, five doublings!


Doubled 5 times from a 1foot high bulldog:
$\left(\frac{SA}{V}\right)_{Giant} = \left(\frac{1}{2}\right)^5 \left(\frac{SA}{V}\right)_{small\ bulldog} = \frac{\frac{1}{32}SA}{V}$
Too **Hot** to live
with small ears like that!
What about the small ears?



And how might metabolic rates fit in?

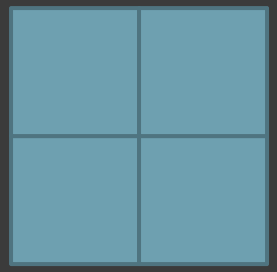


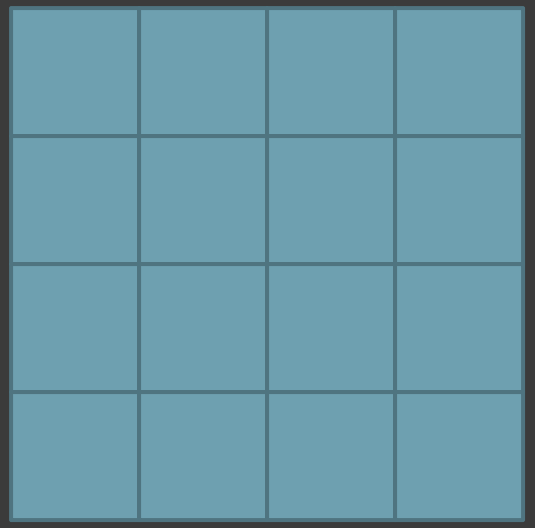
The Principle works the same in 2d for Perimeter ‘enclosing’ area!

$$\left(\frac{SA}{V}\right)_{large} = \frac{360u^2}{176u^3} = \frac{4\cdot 90u^2}{8\cdot 22u^3} = \frac{1}{2}\cdot\left(\frac{SA}{V}\right)_{small} = \frac{\frac{1}{2}\cdot SA_{small}}{V_{small}}$$

$p = 8$
$a = 4$

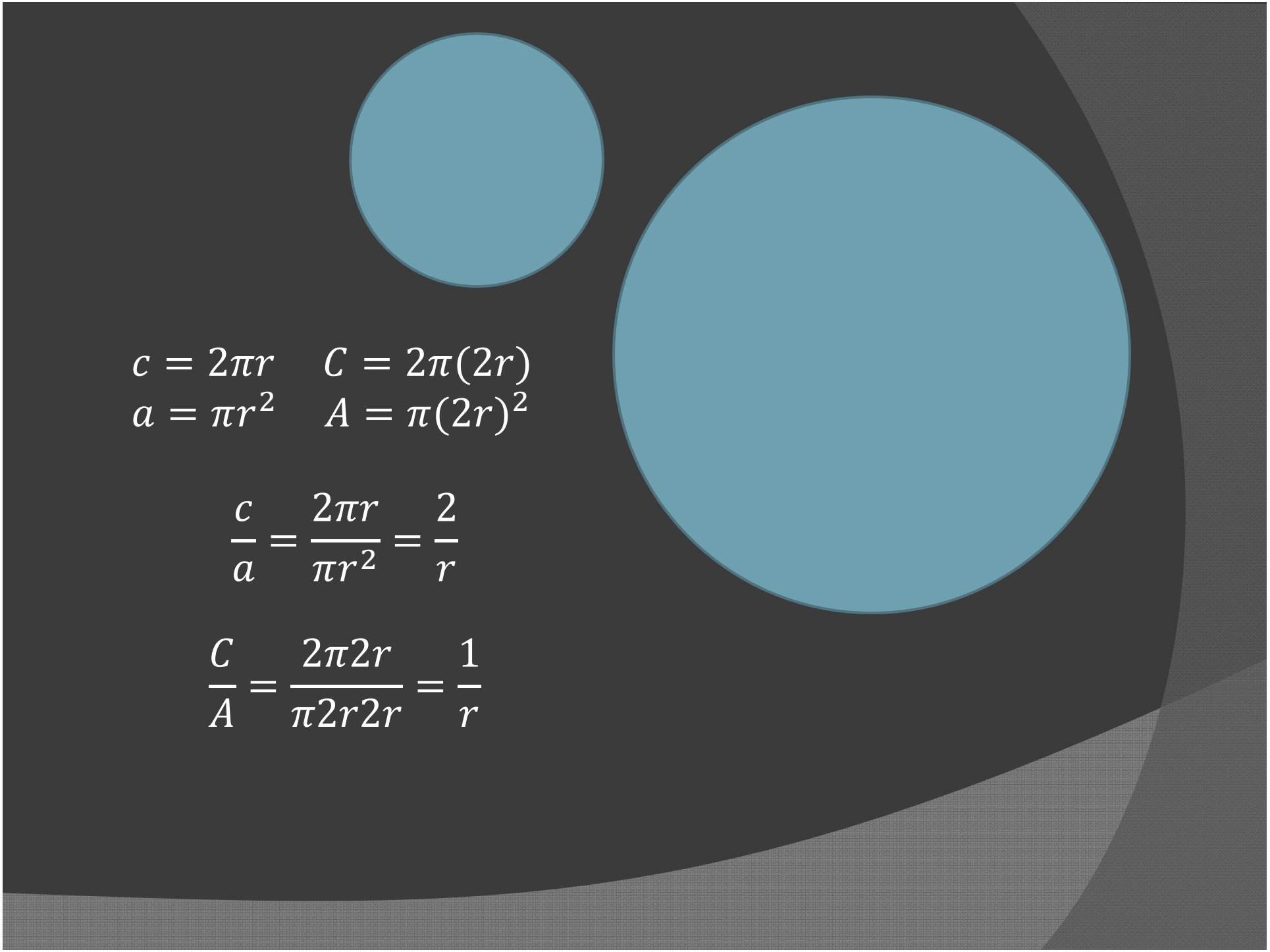
$\mathrm{P} = 16$
$\mathrm{A} = 16$





$$\frac{p}{a} = \frac{8}{4} = 2$$

$$\frac{P}{A} = \frac{16}{16} = 1$$



$$c = 2\pi r \quad C = 2\pi(2r)$$
$$a = \pi r^2 \quad A = \pi(2r)^2$$

$$\frac{c}{a} = \frac{2\pi r}{\pi r^2} = \frac{2}{r}$$

$$\frac{C}{A} = \frac{2\pi 2r}{\pi 2r 2r} = \frac{1}{r}$$

Thank You for coming to the lounge!

FRESNO STATE

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