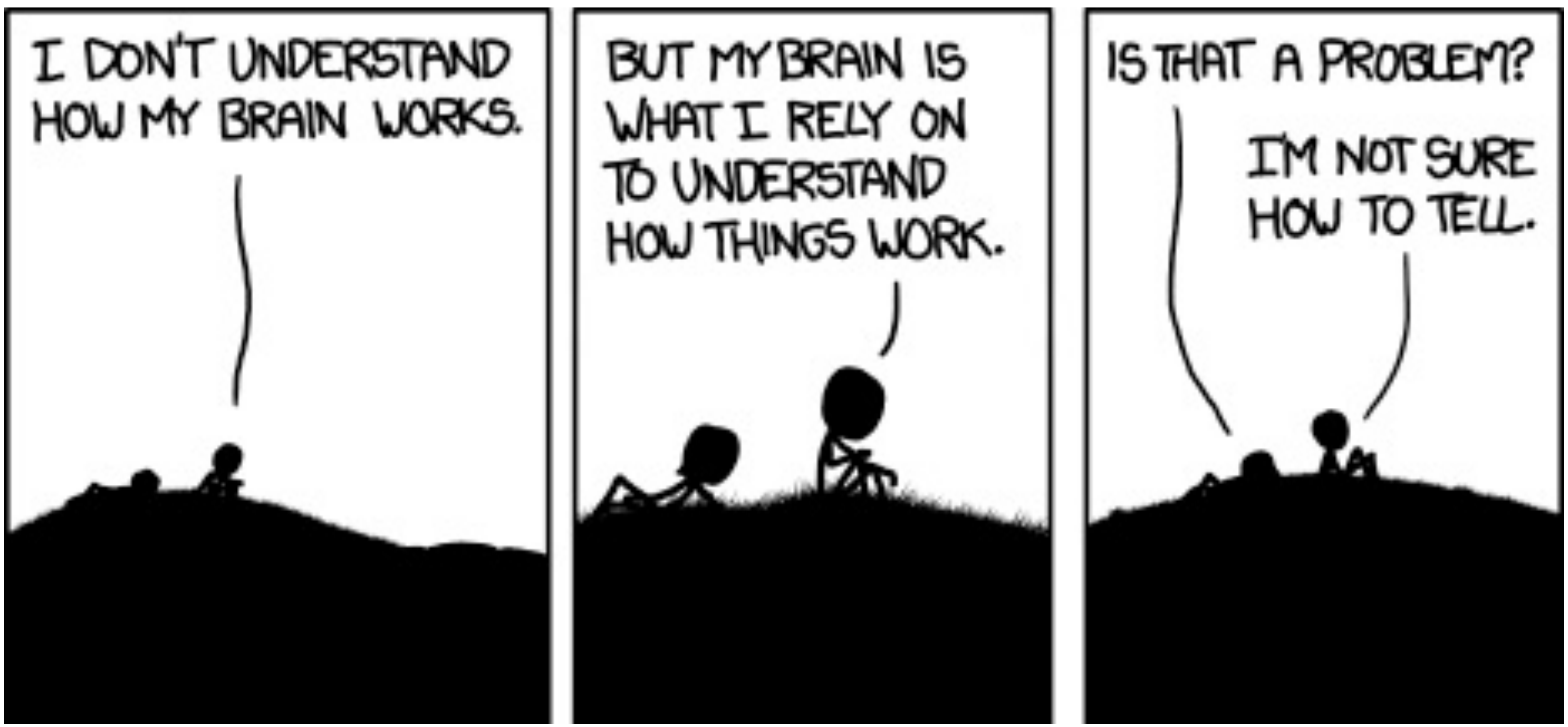
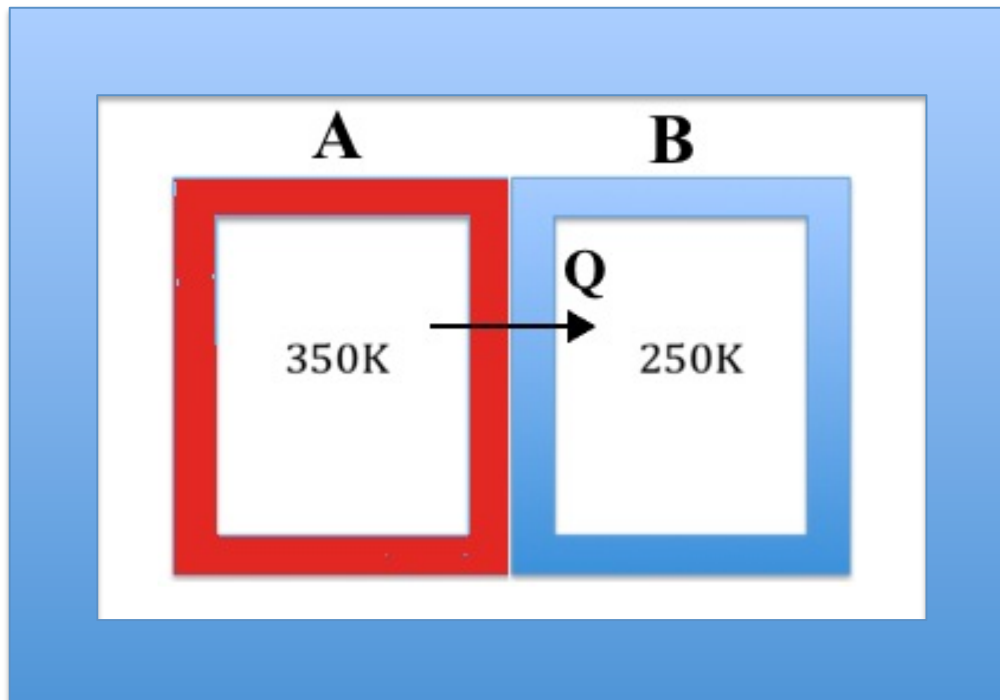
- **<u>Today's Topics:</u>** Diffusion
- **<u>Cartoon:</u>** **Randall Munroe**
  xkcd



A small amount of heat Q flows out of a hot system A (350K) into a cold system B (250K). Which of the following correctly describes the change in number of microstate changes that result? (The systems are thermally isolated from the rest of the universe.)

A. $|\Delta\#_A| > |\Delta\#_B|$
B. $|\Delta\#_B| > |\Delta\#_A|$
C. $|\Delta\#_A| = |\Delta\#_B|$
D. It cannot be determined from the information given



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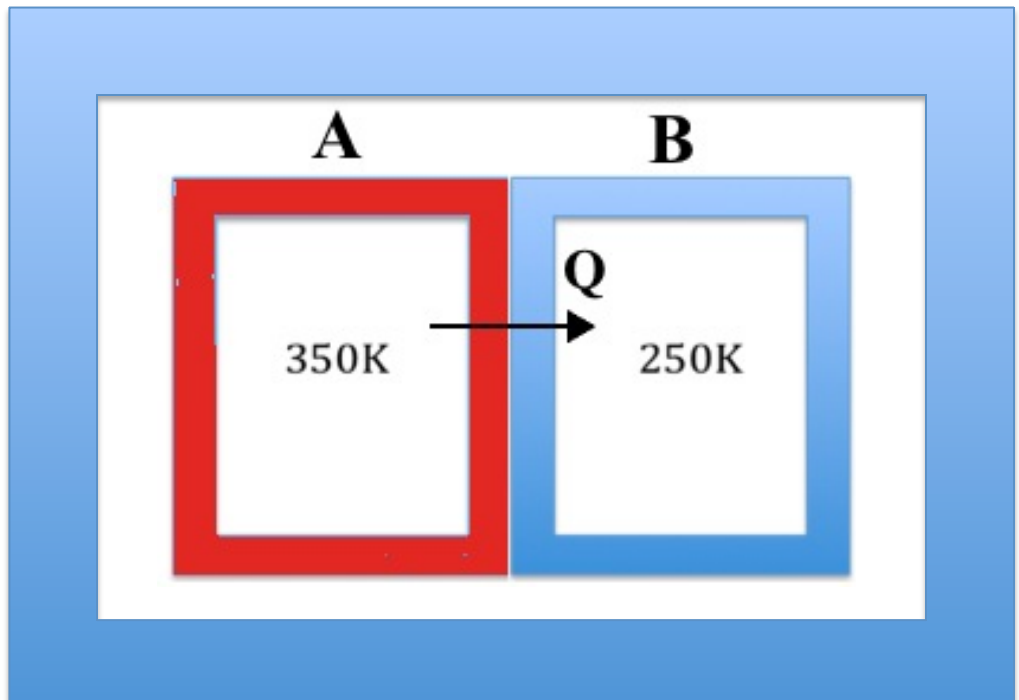

Announcements

- No LAs will staff the Help Room the week of Thanksgiving
- Homework Ch13 &14 due tonight at midnight
- Algebraic error on Mock Exam solutions #1.B
- Exam on Monday, Nov 24th Ch. 10 – 13, 8.5 & 9.3
- Reading questions for Ch 15 due on Tuesday, Nov 26

Do you have an electronic device with web access that you can bring to class on Wed, Dec 3rd?

A. Yes, I can bring my laptop
B. Yes, I can bring my tablet
C. Yes, I can bring my smartphone
D. No, I don't have anything I can bring to class

If we release a set of gas atoms all on one side of the room, they will spread out until they are approximately uniformly spread throughout the room. Why does this always happen?

A. The force of entropy pushes them into doing this
B. They repel one another
C. Internal pressure makes them fly apart
D. There are more ways to split them up evenly than to keep them all on one side
E. Any given atom has a 50/50 chance of being on one side of the room, so it evens out.

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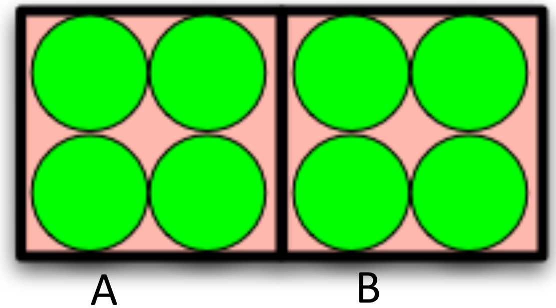
Suppose I have two blocks of matter A and B touching each other. Suppose each block has 4 “Degrees of Freedom” (bins in which to place energy)



I have 4 packets of thermal energy.

Which of the two scenarios are more likely:

A. Four packets in A
B. Two packets in A and two packets in B
C. Need more information

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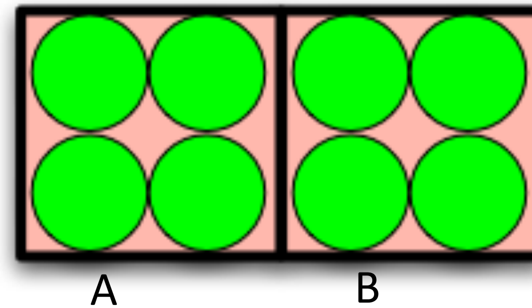

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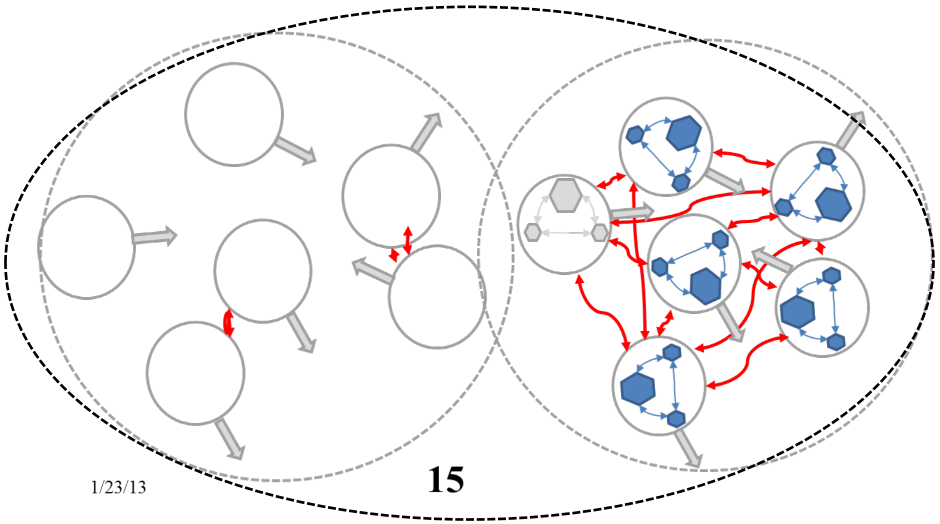
Consider a “joint” system with 6 gas atoms and 6 water molecules.
We put in 8 packets of thermal energy

A. They are more likely to be in the gas

B. They are more likely to be in water

C. They are equally likely to be in any atom/molecule



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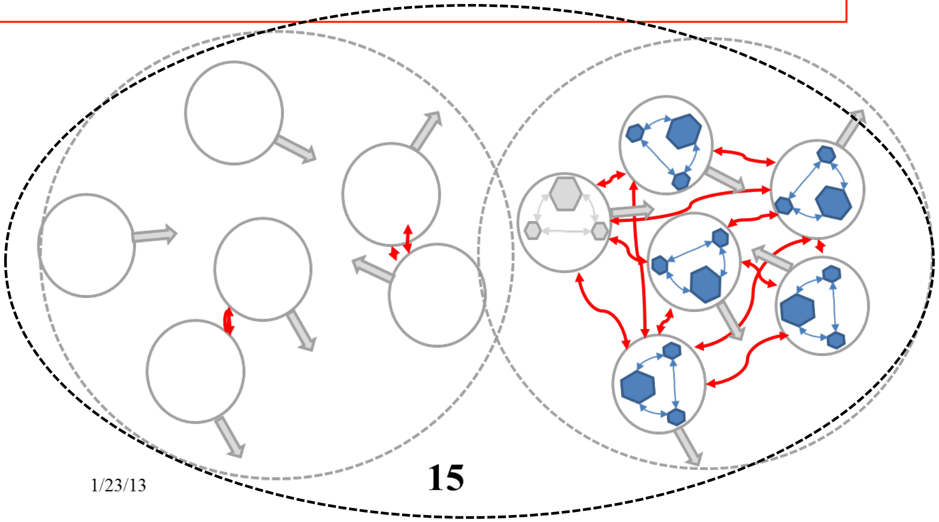
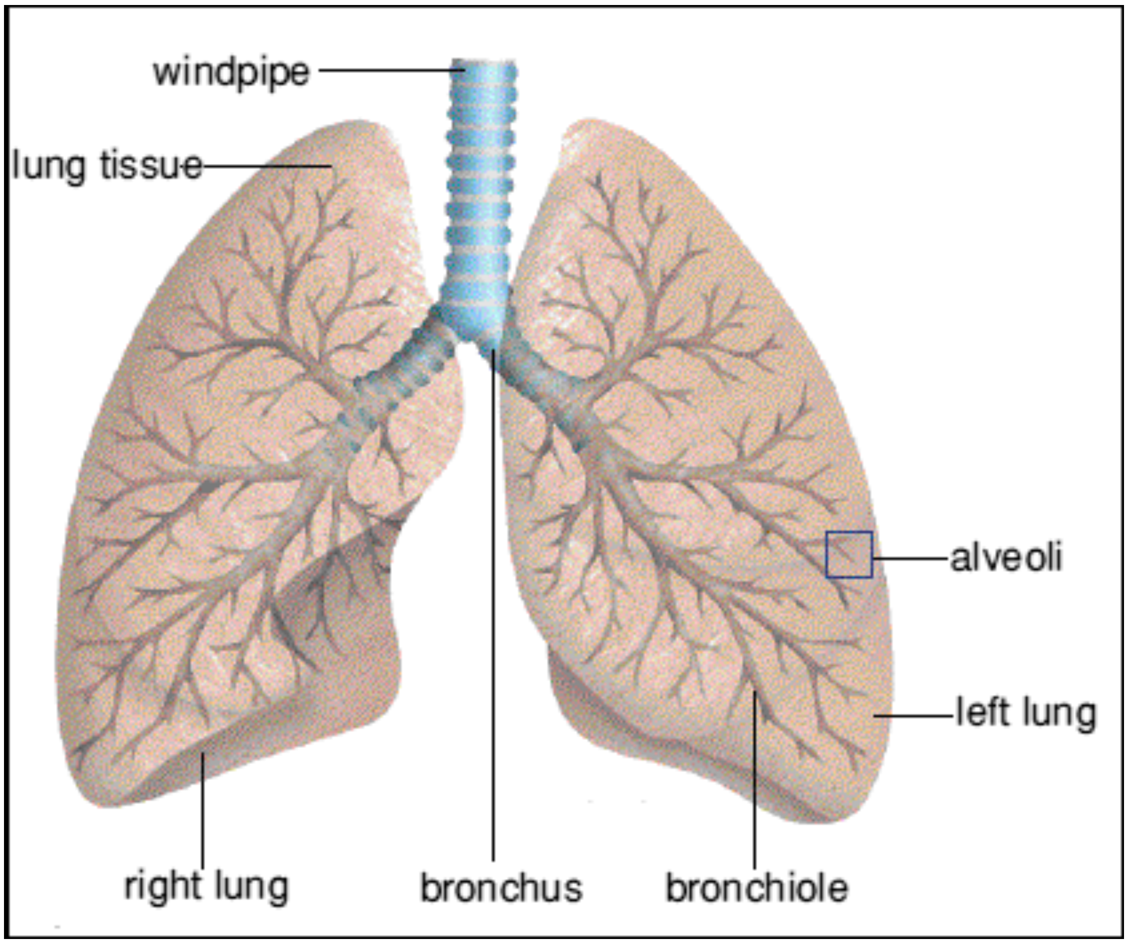
There are more places for the packets of energy to go in the water.



Ch 14 - Diffusion

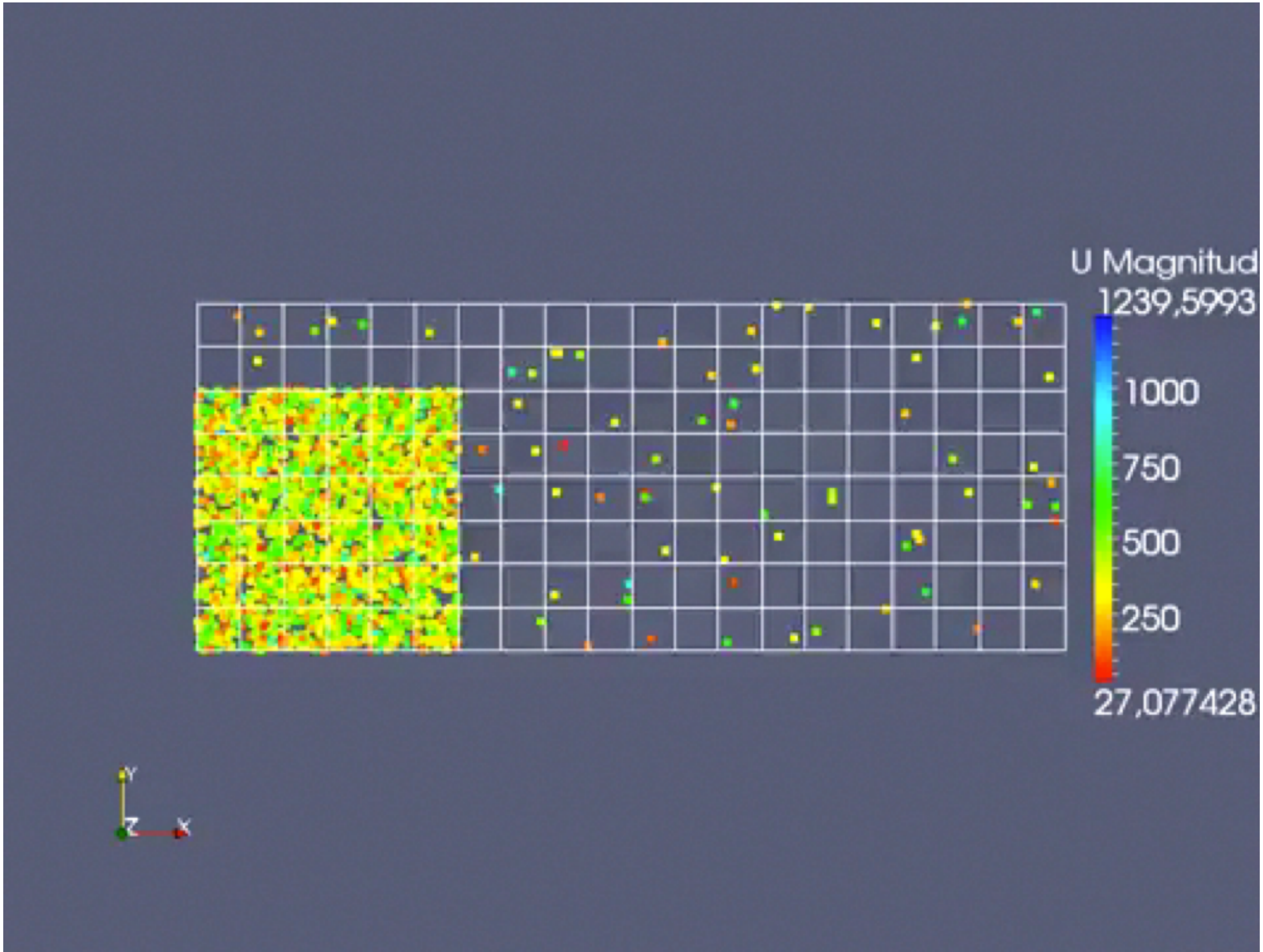


Penny Demo

- 12 volunteers
- Flip a penny and move Right if Heads, Left if Tails
- See what happens after a few flips

How to describe this motion?

- Root mean square
- Mean free path

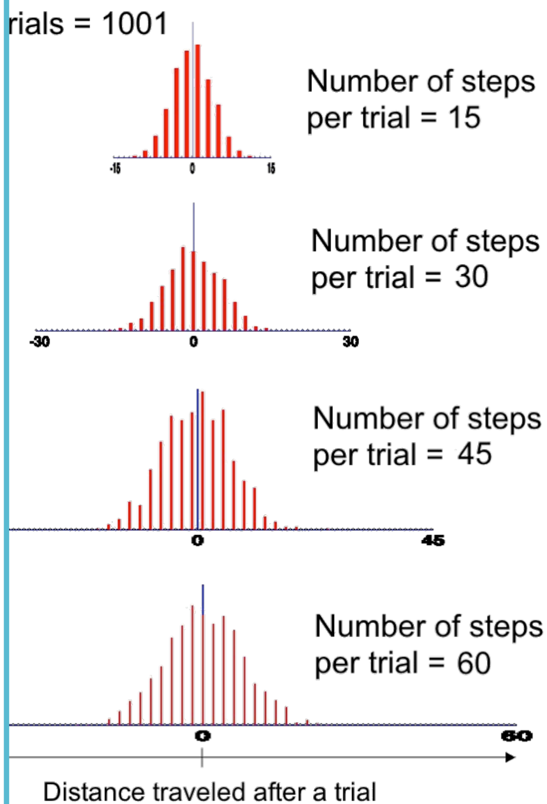

U Magnitud
1239,5993
1000
750
500
250
27,077428
Y
Z
X

Foothold ideas: Random walk in 1D

- As a result of random motion, an initially localized distribution will spread out, getting wider and wider. This phenomenon is called *diffusion*
- The width of the distribution will grow like

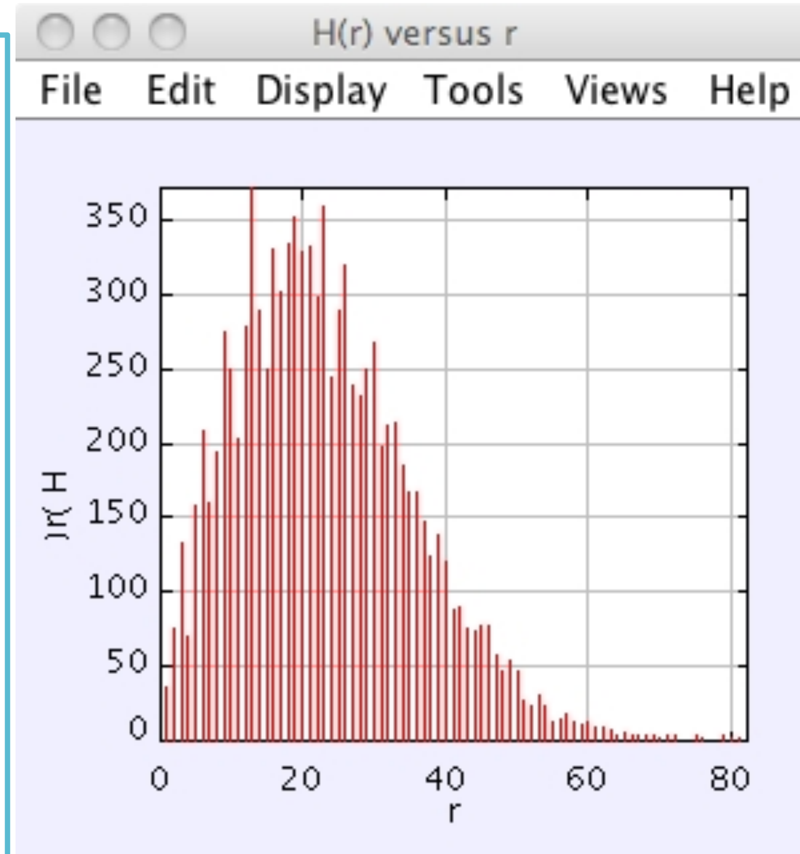
$$\left\langle (\Delta x)^2 \right\rangle = 2Dt$$

- *D* is called *the diffusion constant* and has dimensionality $[D] = L^2/T$



Foothold ideas: Random walk in 2D

- The density of walkers decreases uniformly as you get farther from the source.
- The total number within a given radius peaks – since the area within a radius r decreases to 0 as r gets small. ("phase space")
- The width of the peak grows with the square root of time.
- In 2D:



$$\langle (\Delta r)^2 \rangle = \langle (\Delta x)^2 \rangle + \langle (\Delta y)^2 \rangle = 4Dt$$

In the 1-D equation for diffusion ($\langle x^2 \rangle = 2Dt$) where is the thickness of material being diffused across?

A. In the $\langle x^2 \rangle$
B. In the D
C. In the t
D. Something else