

# How can we use math to identify hair?

March 5, 2014

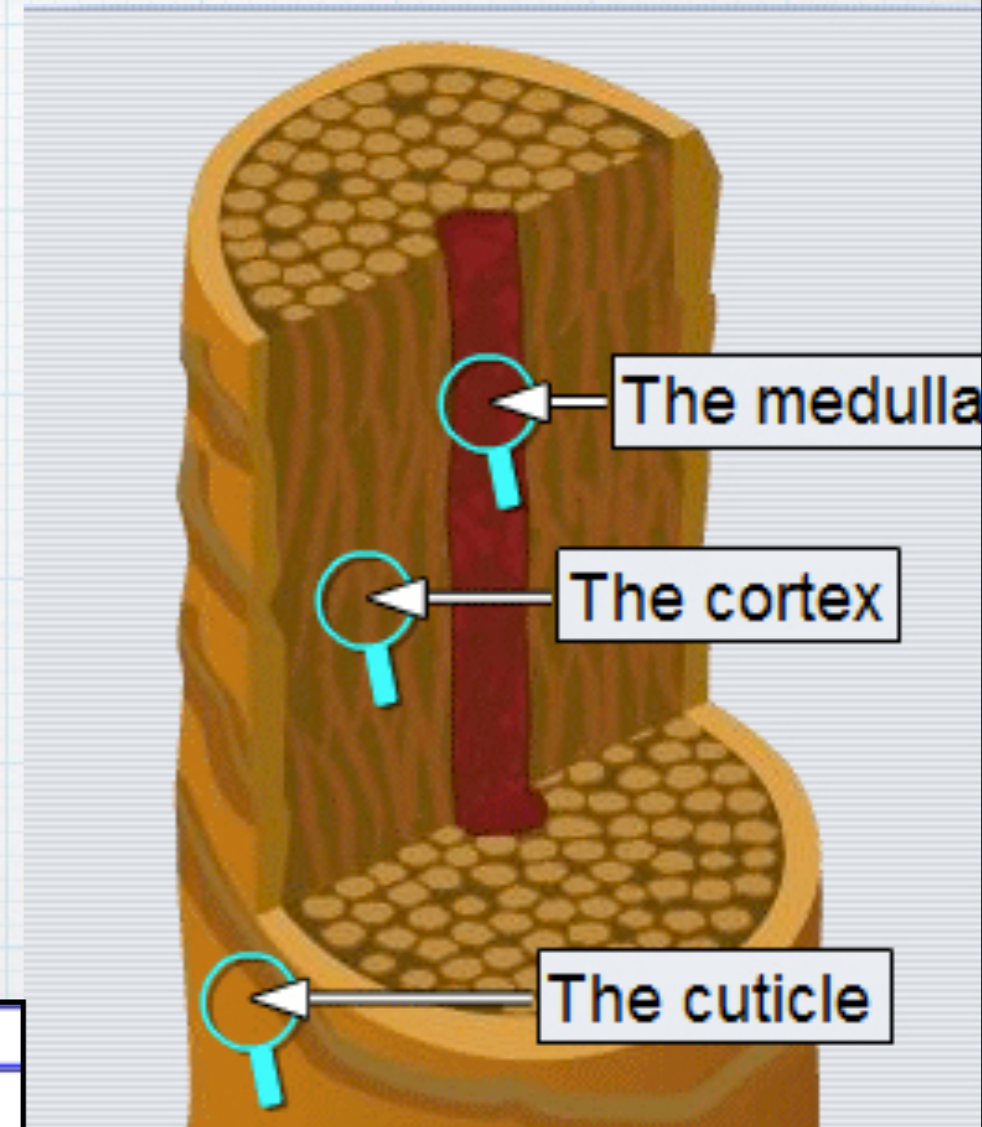
**Do Now:** What is the medulla of the hair? How did you use the medulla to classify hair yesterday?

# Agenda

- \* **Medullary Index**
- \* **Medullary Index Practice**

# Medulla

- \* Center of the hair
- \* Hollow or filled with cells
- \* Use patterns to identify



TYPES:	
Continuous	
Intermittent or interrupted-- even breaks in the medulla	
Fragmented--breaks that are unevenly spaced	
Absent	

# Medullary Index

- \* Ratio that helps determine if a hair is human or not



Cattle hair



Human hair

## Medulla of hairs



Human  
with  
medulla



Human no  
medulla



Black  
Bear



Horse



Cow

# The Medullary Index

- \* The ratio

- \* Diameter of Medulla: Diameter of Hair Shaft

- \* Example:

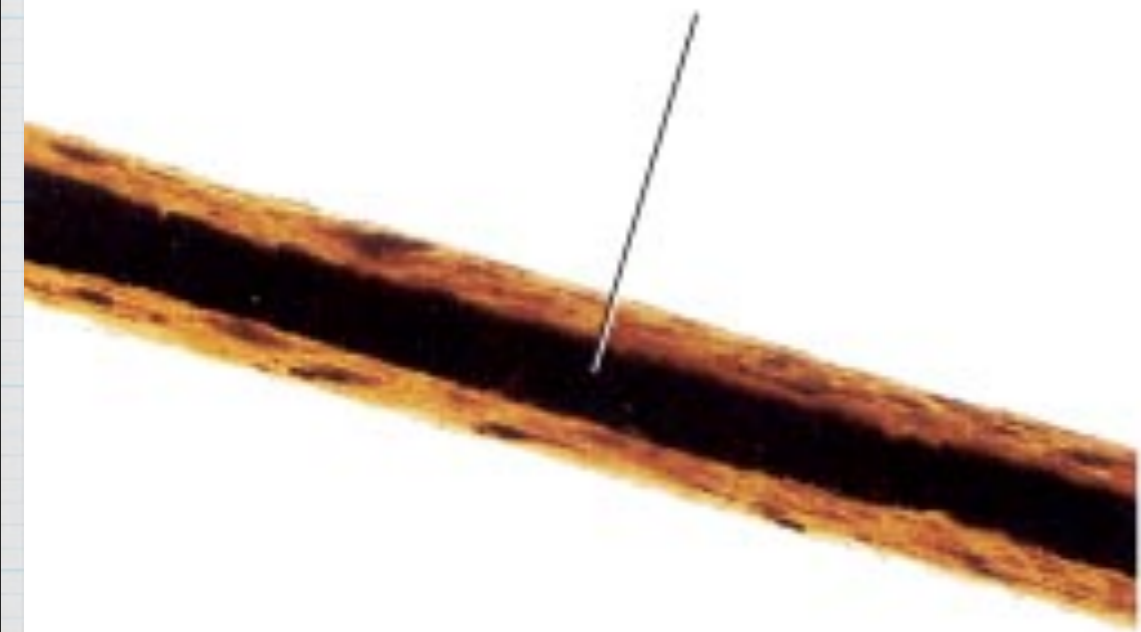
- \* Diameter of Medulla = 60  $\mu\text{m}$

- \* Diameter of Hair Shaft = 100  $\mu\text{m}$

- \* Medullary index =  $60 \mu\text{m} / 100 \mu\text{m} = .6$

# Medullary Index

Index = 0.50 or more



Cattle hair

Index = 0.33 or less



Human hair

# Medullary Index

- $(\text{diameter medulla}) / (\text{diameter of hair}) = \text{medullary index}$
- If the ratio is .5 or greater, then it came from an animal.
- If the ratio is .33 or less, then it is human



# Practice

A hair at the scene of the crime is found. Upon measurement, forensic scientists find the diameter of the hair shaft to be 120  $\mu\text{m}$ . The diameter of the medulla is 80  $\mu\text{m}$ . Does this hair belong to a human or animal?



# Solution

Given hair diameter: 120  $\mu\text{m}$

Given medulla diameter: 80  $\mu\text{m}$

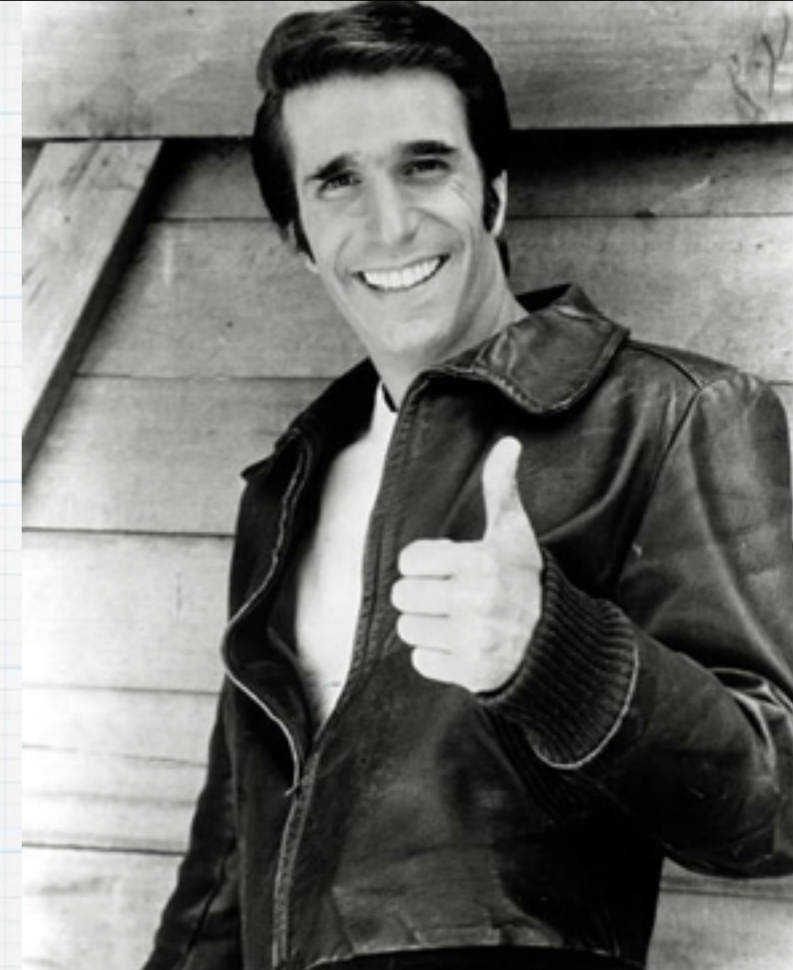
Set up ratio - medulla diameter : hair diameter

80  $\mu\text{m}$  : 120  $\mu\text{m}$

$80/120 = .667$

$.667 > .5$

The hair belongs to a non-human mammal



# Practice

A hair strand is found at the scene of a crime. The hair is measured, and found to have a diameter of 80  $\mu\text{m}$ . The diameter of the medulla is 15  $\mu\text{m}$ . Is this hair human, or some other mammal?



# Solution

Given hair diameter: 90  $\mu\text{m}$

Given medulla diameter: 15  $\mu\text{m}$

Set up ratio - medulla diameter : hair diameter

15  $\mu\text{m}$  : 90  $\mu\text{m}$

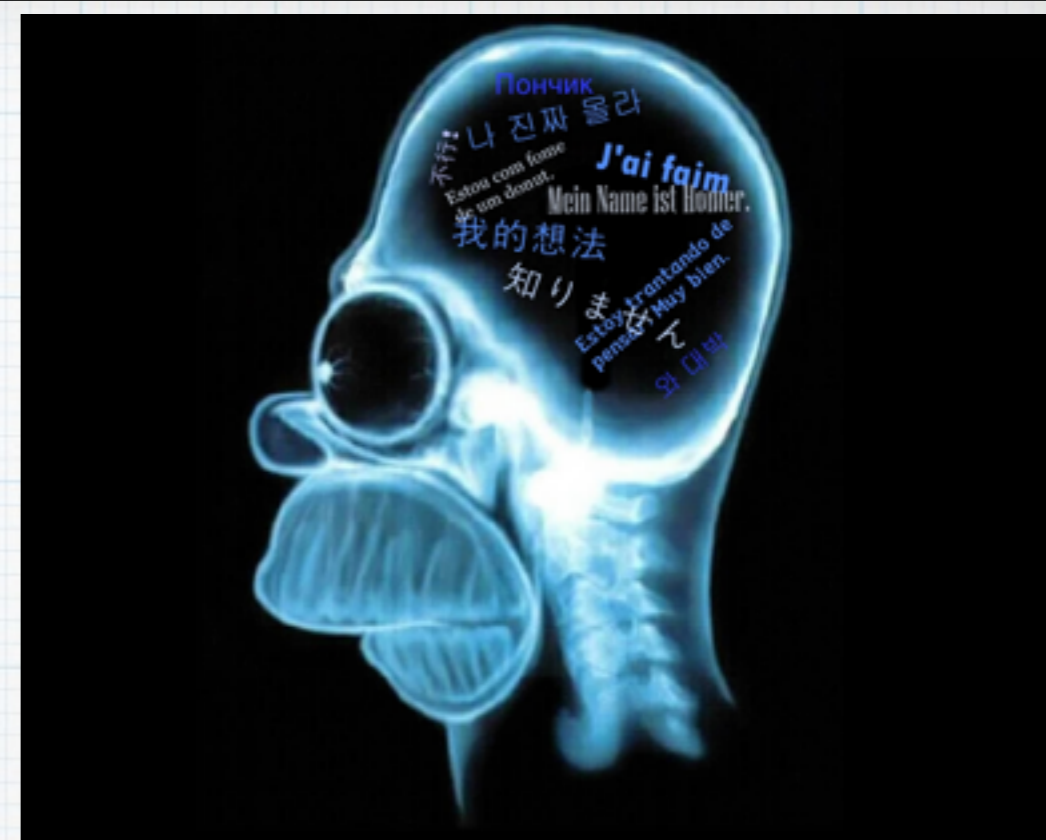
$15/90 = .167$

$.167 < .5$

The hair belongs to a human



# Practice



- \* A hair found at the scene of an assault. The diameter of the medulla is 32  $\mu\text{m}$ , while the diameter of the shaft is 80  $\mu\text{m}$ . Does this hair belong to a human or an animal?

# Solution



Given hair diameter: 80  $\mu\text{m}$

Given medulla diameter: 32  $\mu\text{m}$

Set up ratio - medulla diameter : hair diameter

32  $\mu\text{m}$  : 80  $\mu\text{m}$

$32/80 = .4$

$.4 < .5$ , but  $.4 > .33$  ???

The source of hair cannot be determined