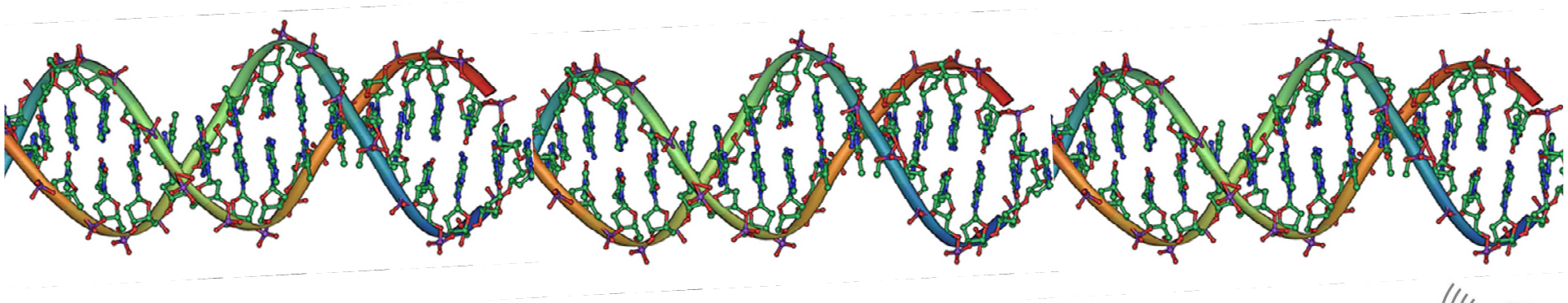
The Genetic Basis of Obesity

Kaitlin Samocha



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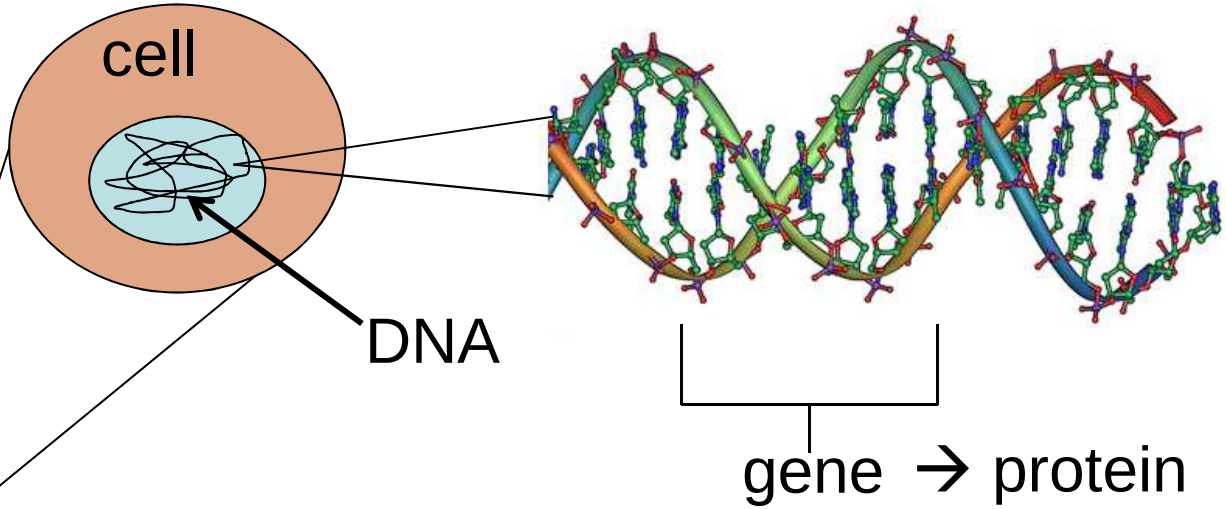
DNA and Genes



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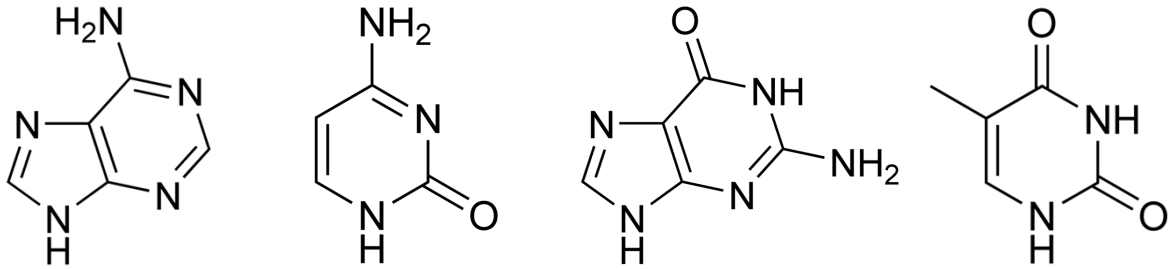
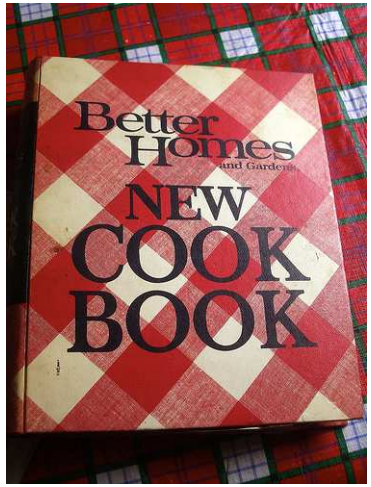
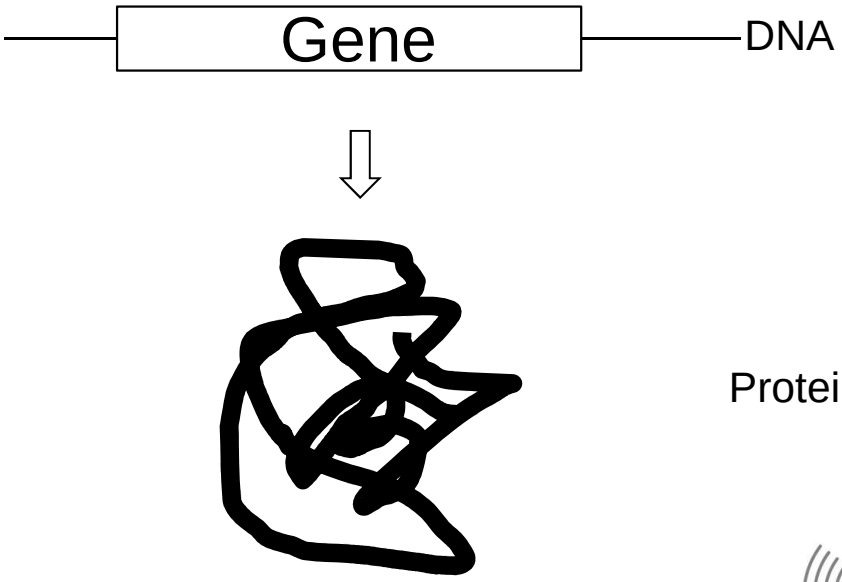


Wikimedia users: Mikael Häggström, GAThrawn22, cacycle



Chocolate Chip
Cookie Recipe

Genome
(All of your DNA)



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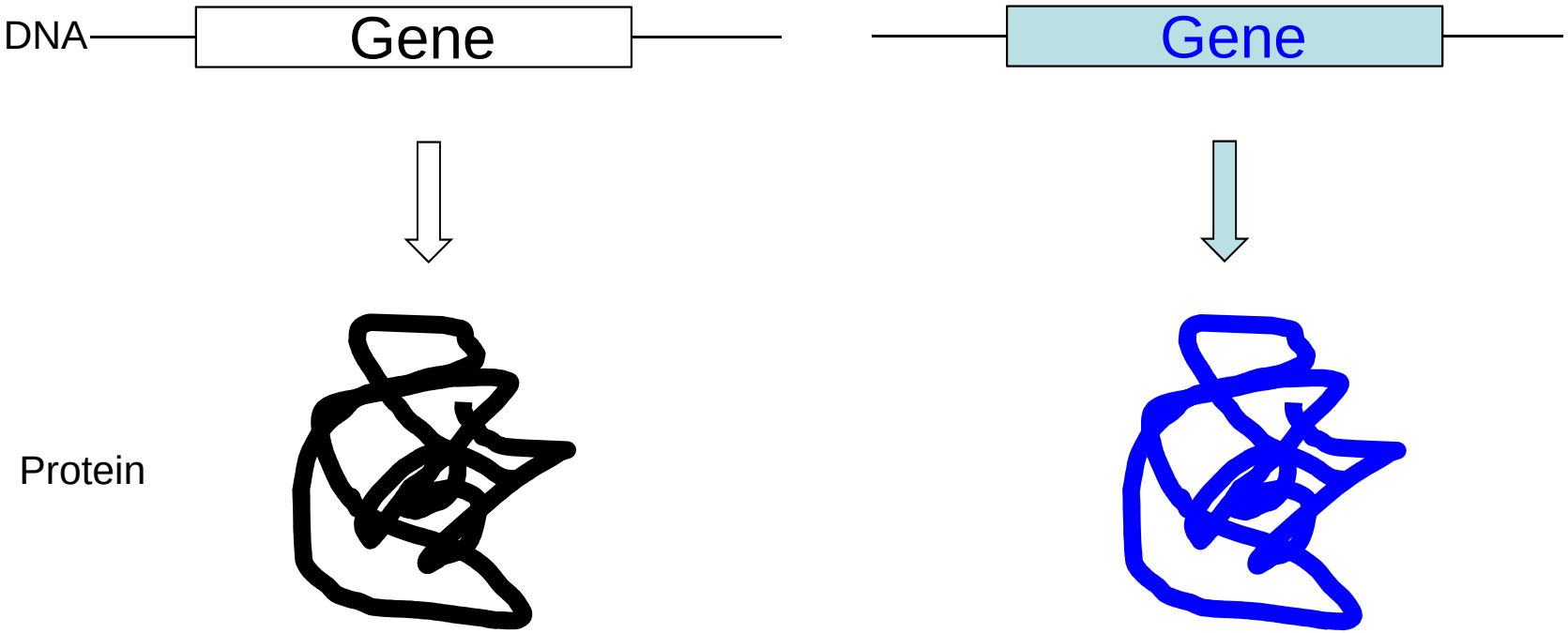
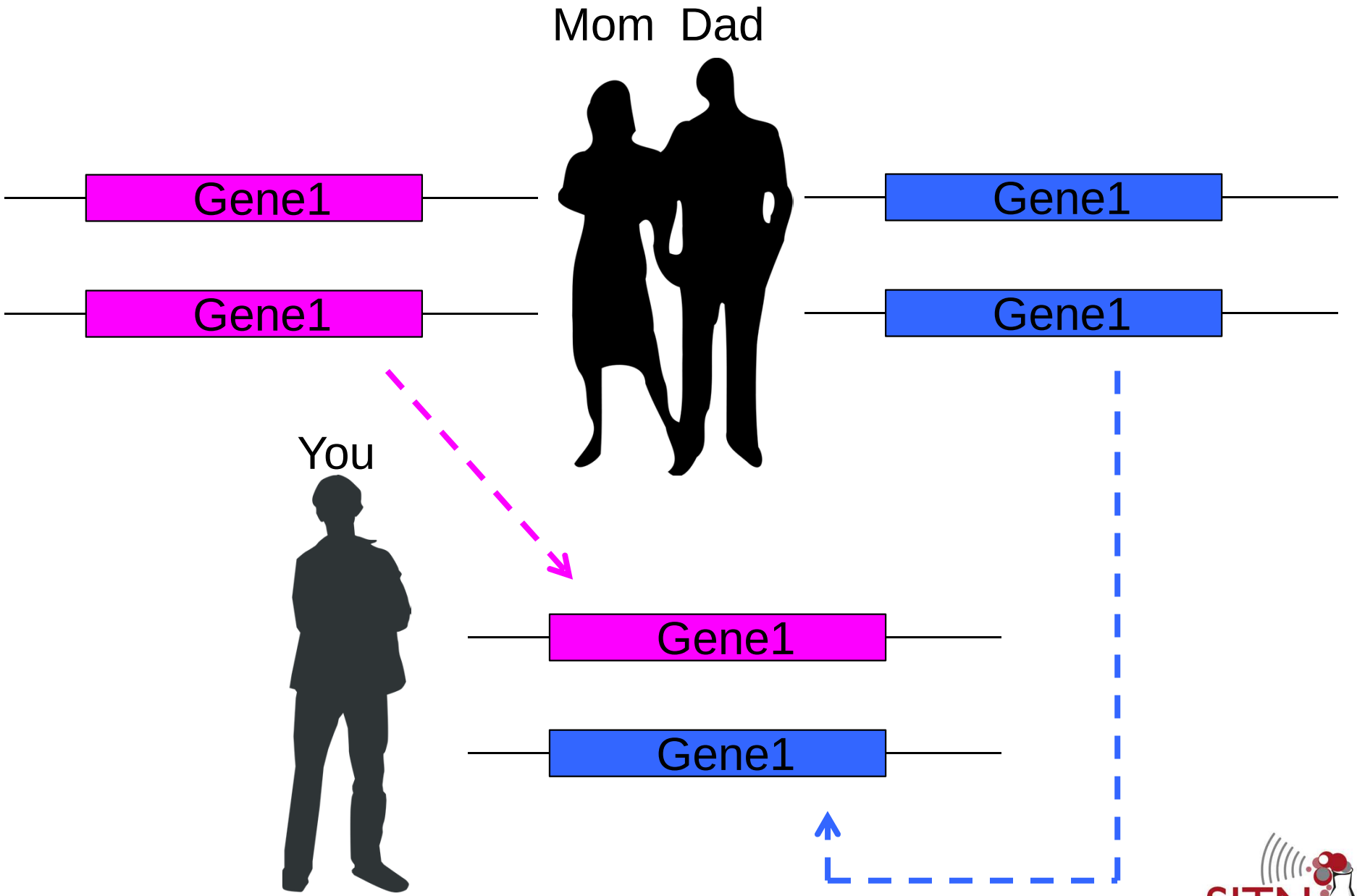
There are different versions of genes



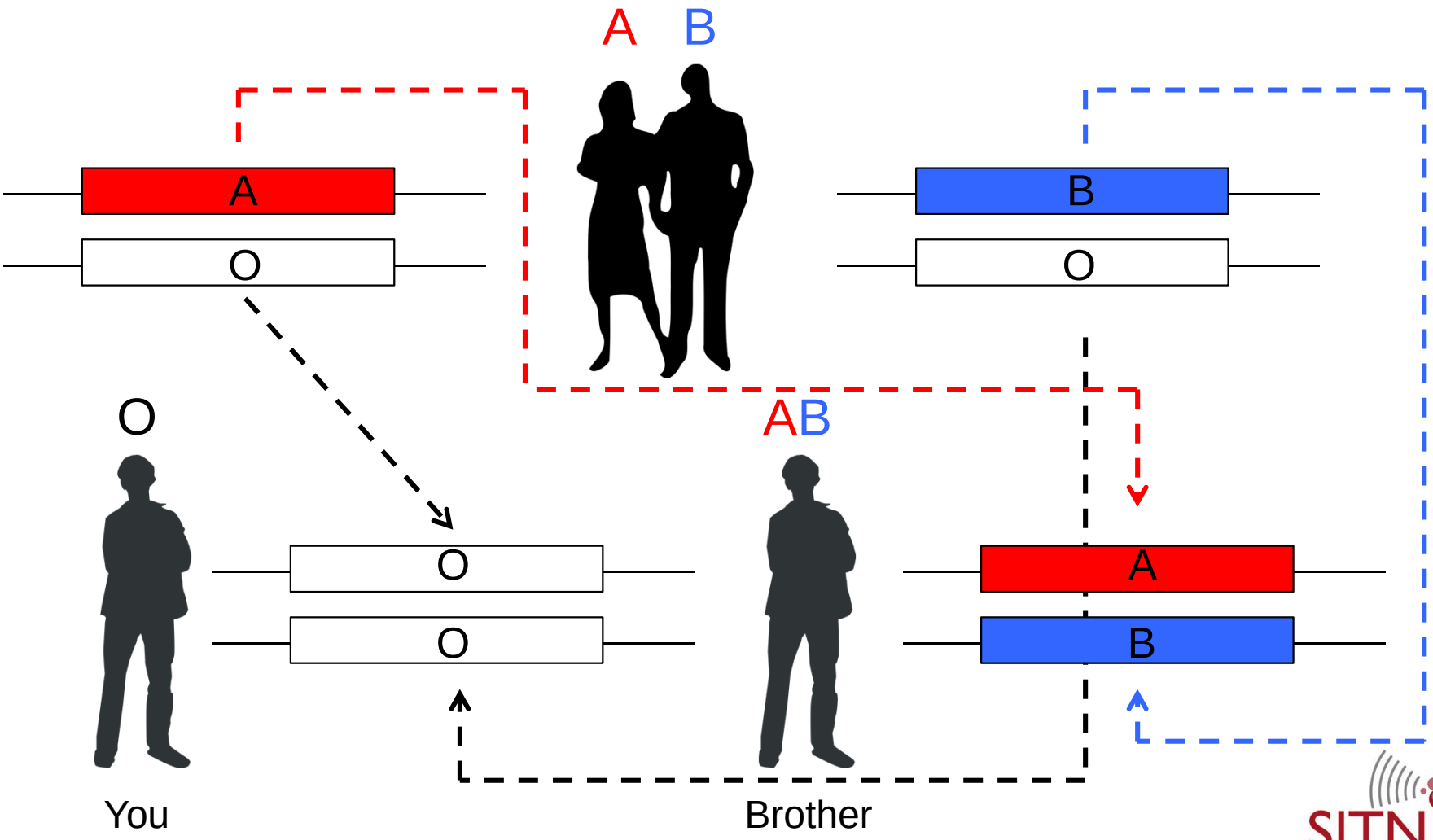
The proteins may function differently, but not necessarily



Wikimedia users: J.delanoy, Mizunoryu

Simple Example: ABO Blood Type

One gene controls blood type. There are 3 versions (A, B, O).

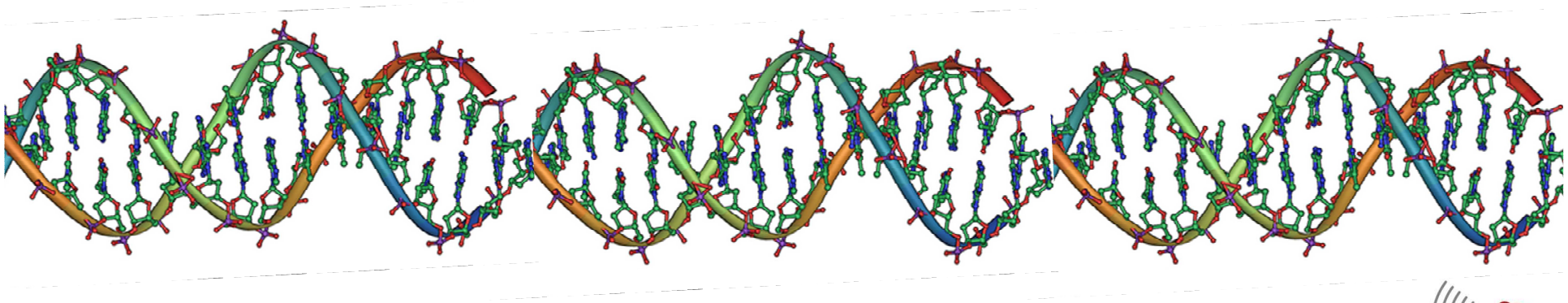


Wikimedia users: J.delanoy, Mizunoryu

Recap

- Genes are sections of DNA that spell out the recipe for proteins
- There are different versions of genes
- Each person has two copies of each gene
  - One from Mom
  - One from Dad

Questions?



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Why do we think genes play a role in obesity?

Obesity tends to ‘run’ in families

- Obese parents tend to have children that grow up to be obese

→ But this could also be environmental (the food that the family eats, amount that family exercises)

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Why do we think genes play a role in obesity?

Identical twins are much more likely to have the same body size than siblings

- Environment is the same for both twins and siblings
- Identical twins share all of their genes, where siblings only share roughly half of their genes

http://www.flickr.com/photos/oskay

http://www.flickr.com/photos/e3000

SCIENCE

LIKES TO MAKE THINGS

BLACK AND WHITE

WHEN POSSIBLE

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science in the news

Is there a version of a single gene that explains why some people are obese?

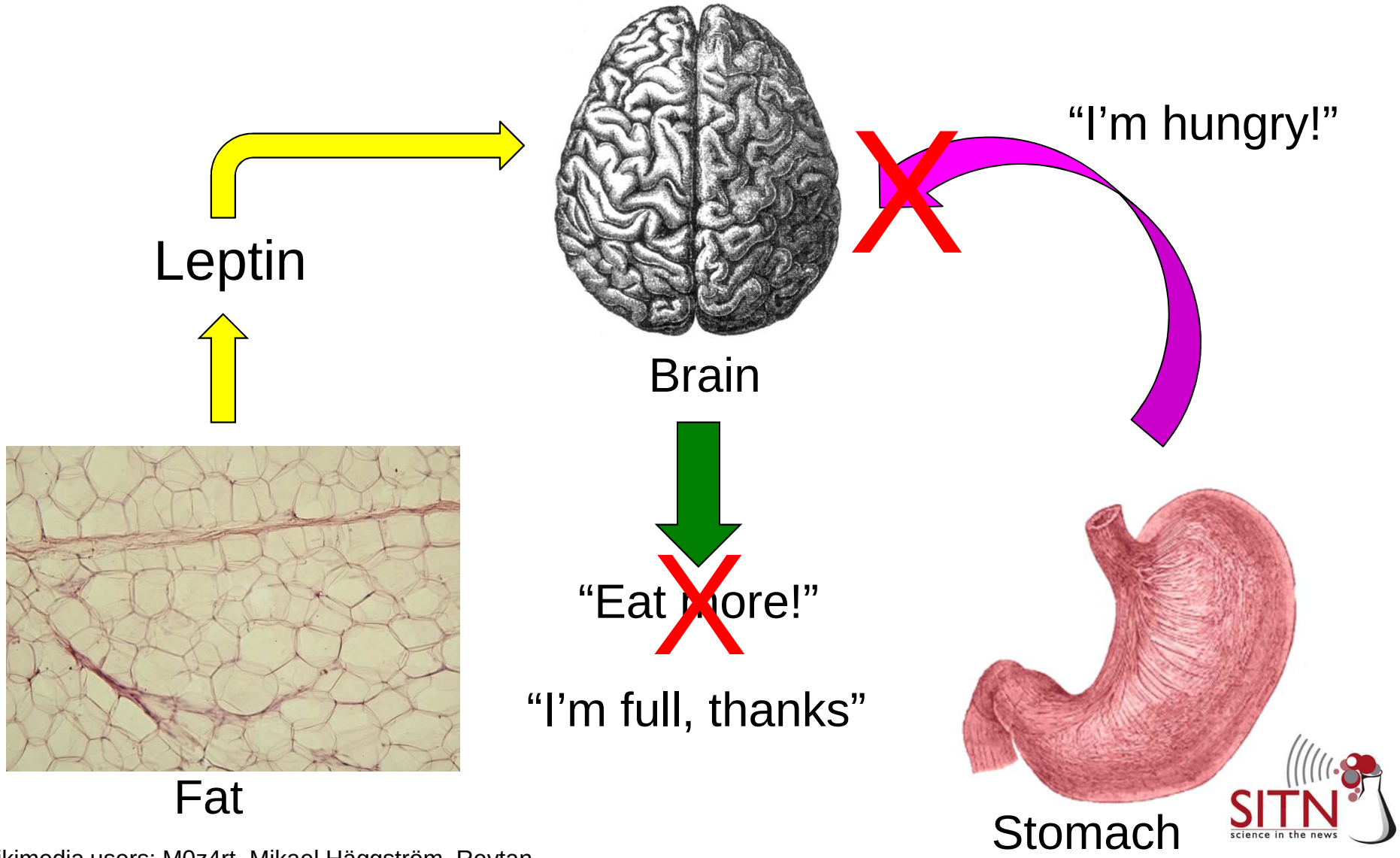
YES!*

In 1949, researchers found mice that were born a normal size, but quickly became very obese

They traced the problem to ONE gene, the one that makes leptin

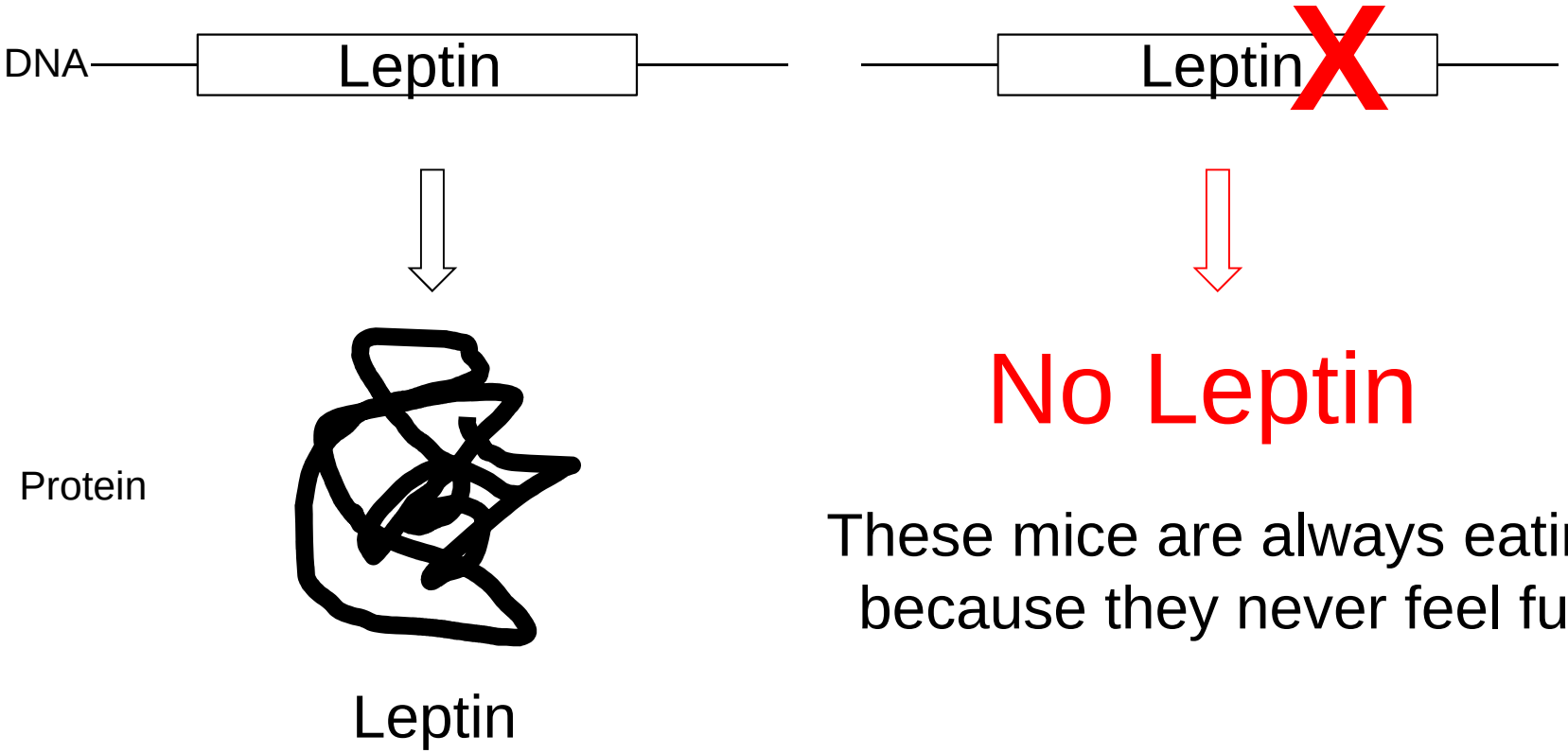
Wikimedia user: SchuminWeb

Leptin Is Important in Appetite Control



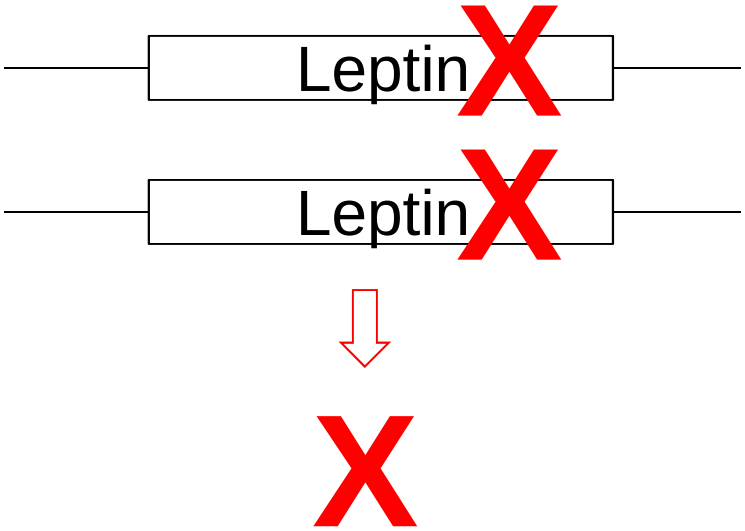
Wikimedia users: M0z4rt, Mikael Häggström, Reytan

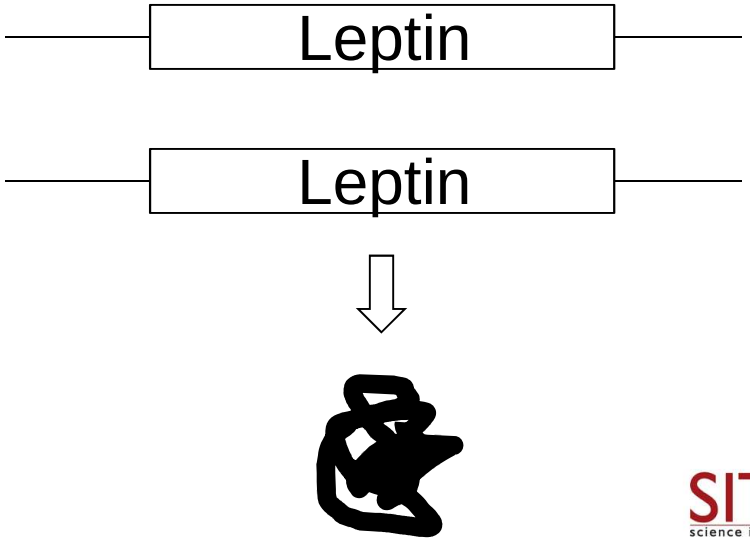
No Leptin is Made in the Obese Mice



These mice are always eating because they never feel full

No Leptin is Made in the Obese Mice





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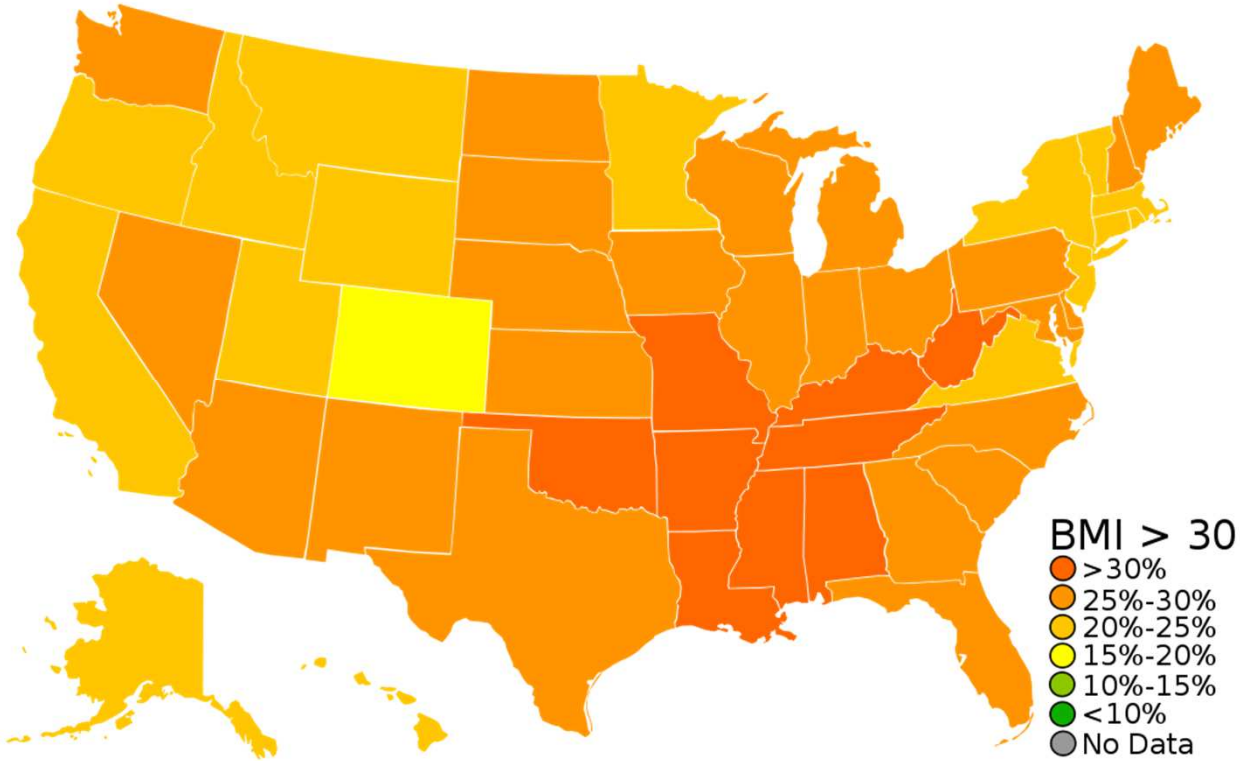
Only found a few people in the world that were unable to make leptin

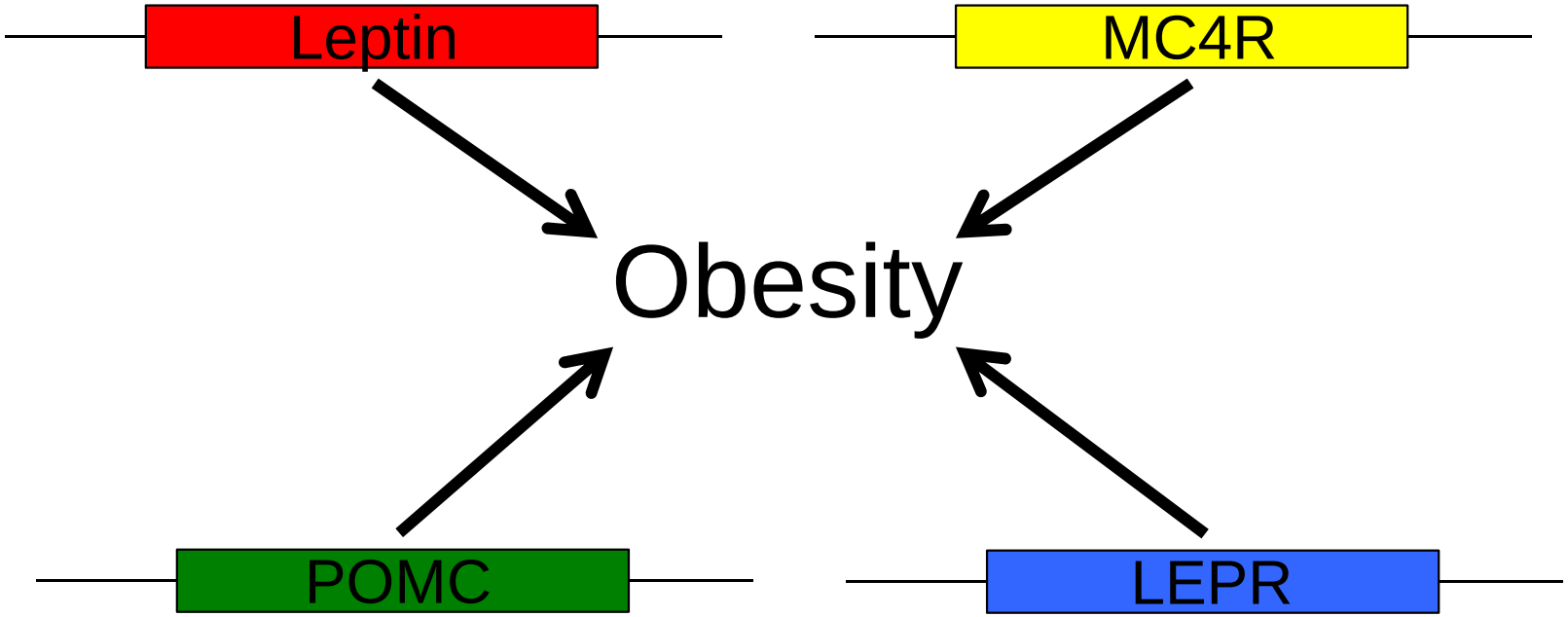


This doesn't explain why most people are obese

Centers for Disease Control

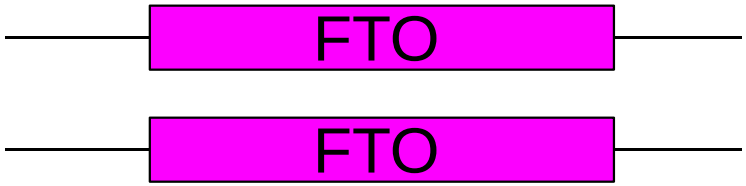
Complicating Genetic Factors

- More than one gene is involved



Complicating Genetic Factors

- More than one gene is involved
- There are genes that increase your *chance* of becoming obese



Those with 2 copies of this version are 1.67 times higher than those with no copies of this version

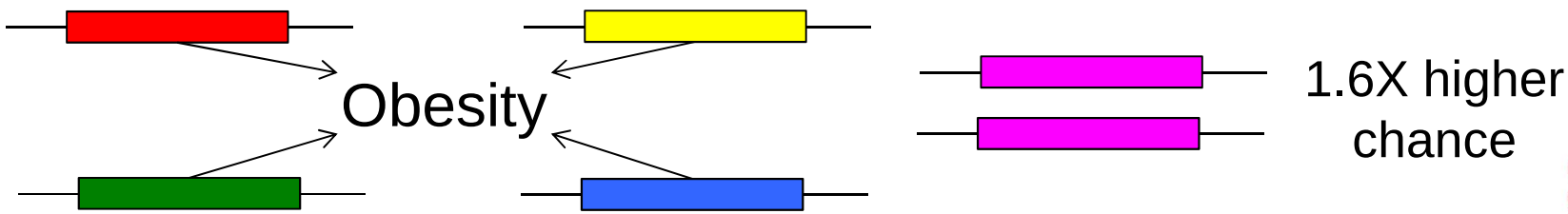
Those with 1 copy of this version are 8.6 lbs heavier than those with no copies of this version

Complicating Genetic Factors

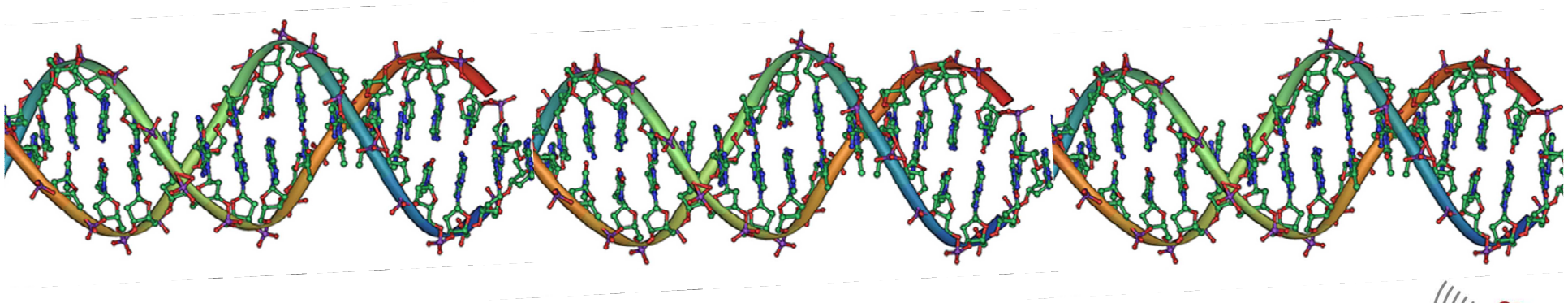
- More than one gene is involved
- There are genes that increase your *chance* of becoming obese

→Evidence that it is both of these combined

There are a lot of genes that each have a small effect on body size



Questions?



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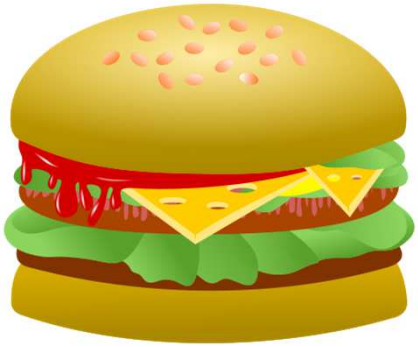
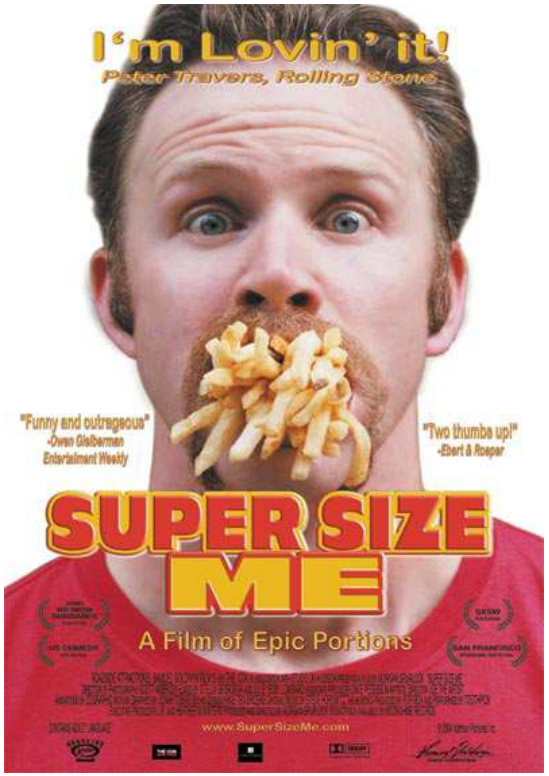
There are also non-genetic factors!



Wikimedia users: Garfieldairlines, Tebu.an, Nv8200p

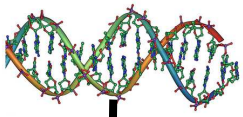
The Environment Plays a Role

- Your diet matters!
  - Balance of the calorie equation
- The filmmaker gained 24.5 pounds in one month while only eating fast food



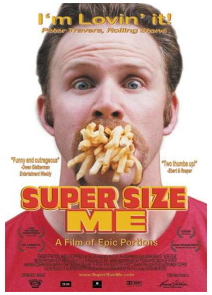
http://www.flickr.com/photos/gauravonomics

Most people fall on the scale between completely environmental and completely genetic



Completely environmental

Completely genetic



You and Me

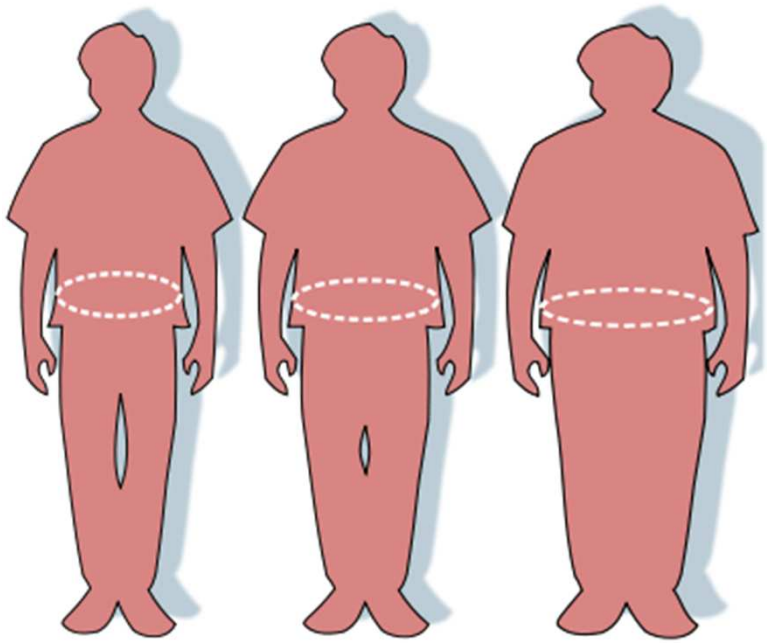
Genes have been estimated to explain 40-70% of the variability in body size

http://www.flickr.com/photos/gauravonomics

Wikimedia users: Tebu.an, GAThrawn22, SchuminWeb

Looking for General Body Size Genes

Scientists decided to look for the genes that affect variation in body size and not just those that cause obesity



Normal Overweight Obese

Wikimedia users: Victovoi

Looking for General Body Size Genes

Analyzed across the genome in a large number of people (>200,000) to find regions that seem to be associated with variation in body size

→Found **32** different potential locations

Association analyses of 249,796 individuals reveal 18 new loci associated with body mass index

NATURE GENETICS VOLUME 42 | NUMBER 11 | NOVEMBER 2010

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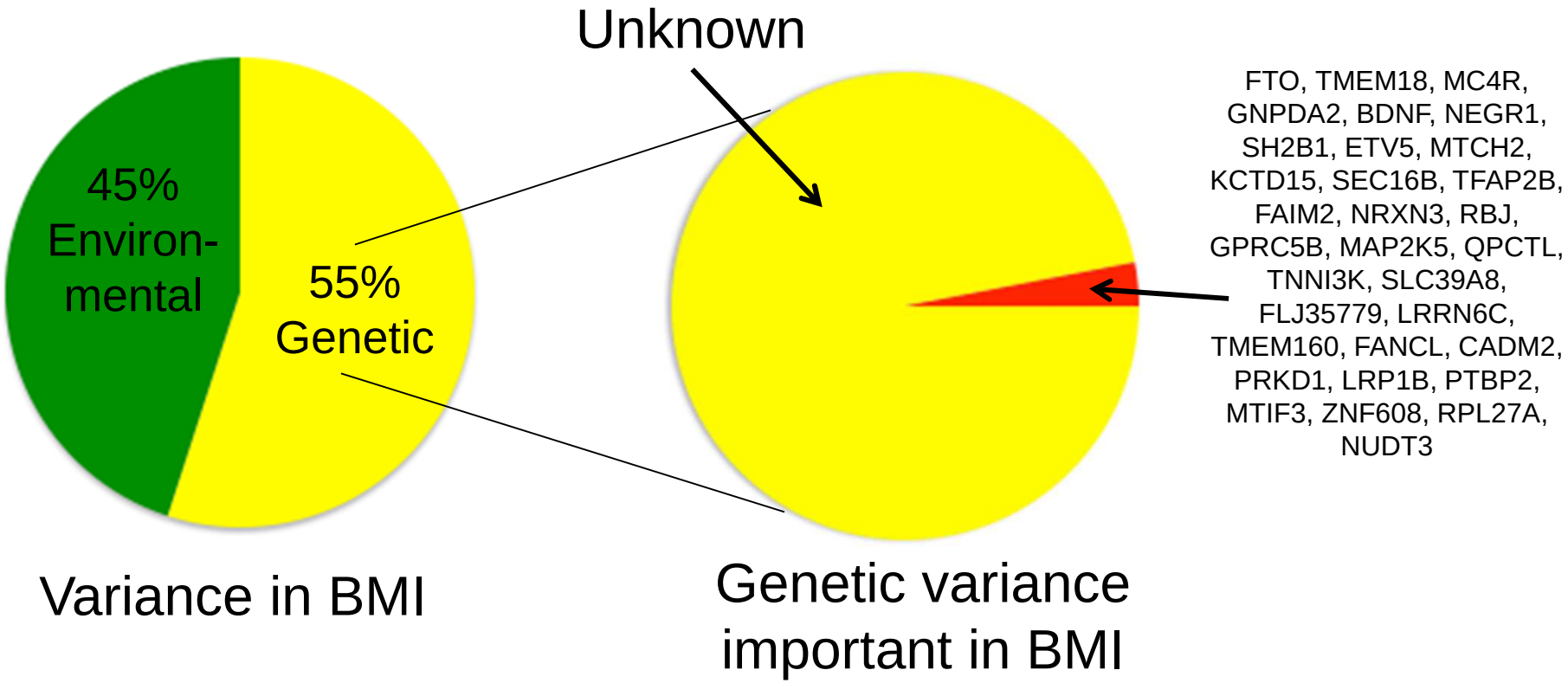
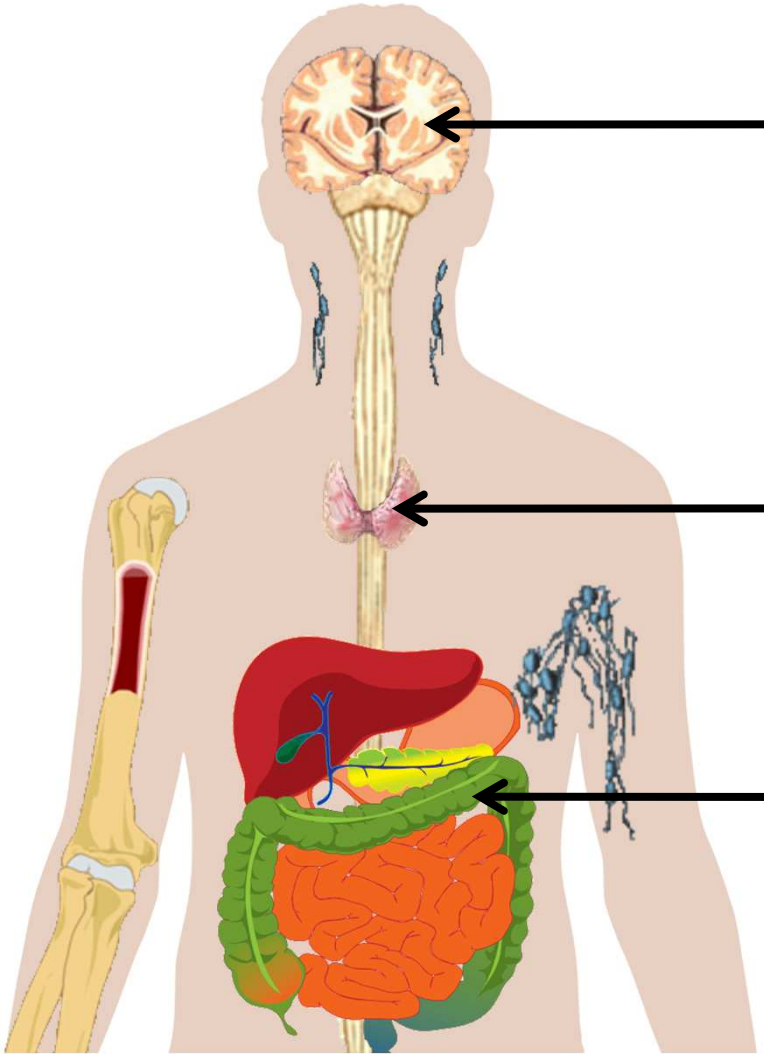
We Still Don't Have the Whole Picture



The 32 locations only explain 1.45% of the total variance in BMI

List from Speliotes et *al.* 2010

Unexpected Directions: New Avenues for Research



Nervous system

Immune system

Gastrointestinal system

Wikimedia user: Mikael Häggström

Summary

- Genes are regions of DNA that contain the recipe for proteins
- A single gene can cause obesity, but this is very rare
- Obesity is due to a play between environmental factors and a number of genes that each have a small effect

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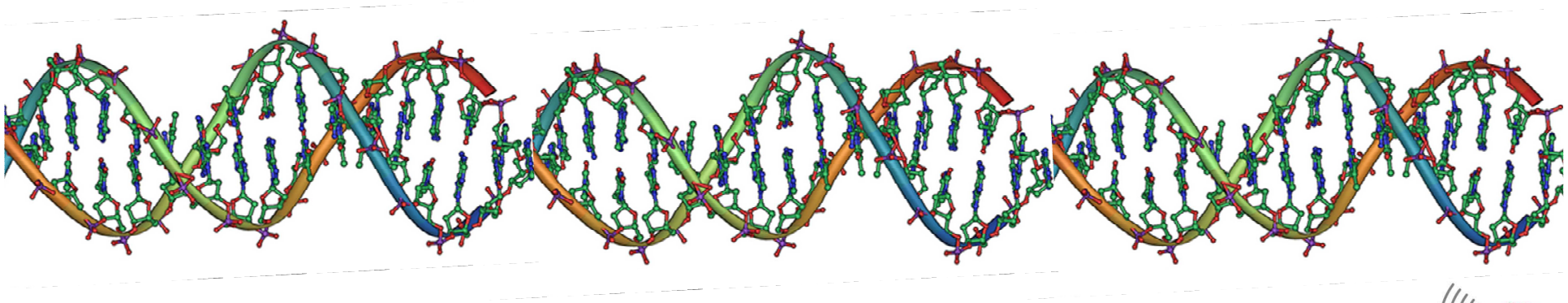
Thanks!
Questions?



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