

SUGAR MAKES YOU
HUNGRY

CARBOHYDRATE MAKES YOU

FAT

@thegaryscience

POLYUNSATURATED OILS MAKE YOU
INFLAMED & SICK

NO/**FRUCTOSE**



NO/**FRUCTOSE**



NO / **FRUCTOSE**

SUGAR MAKES YOU
HUNGRY

CARBOHYDRATE MAKES YOU

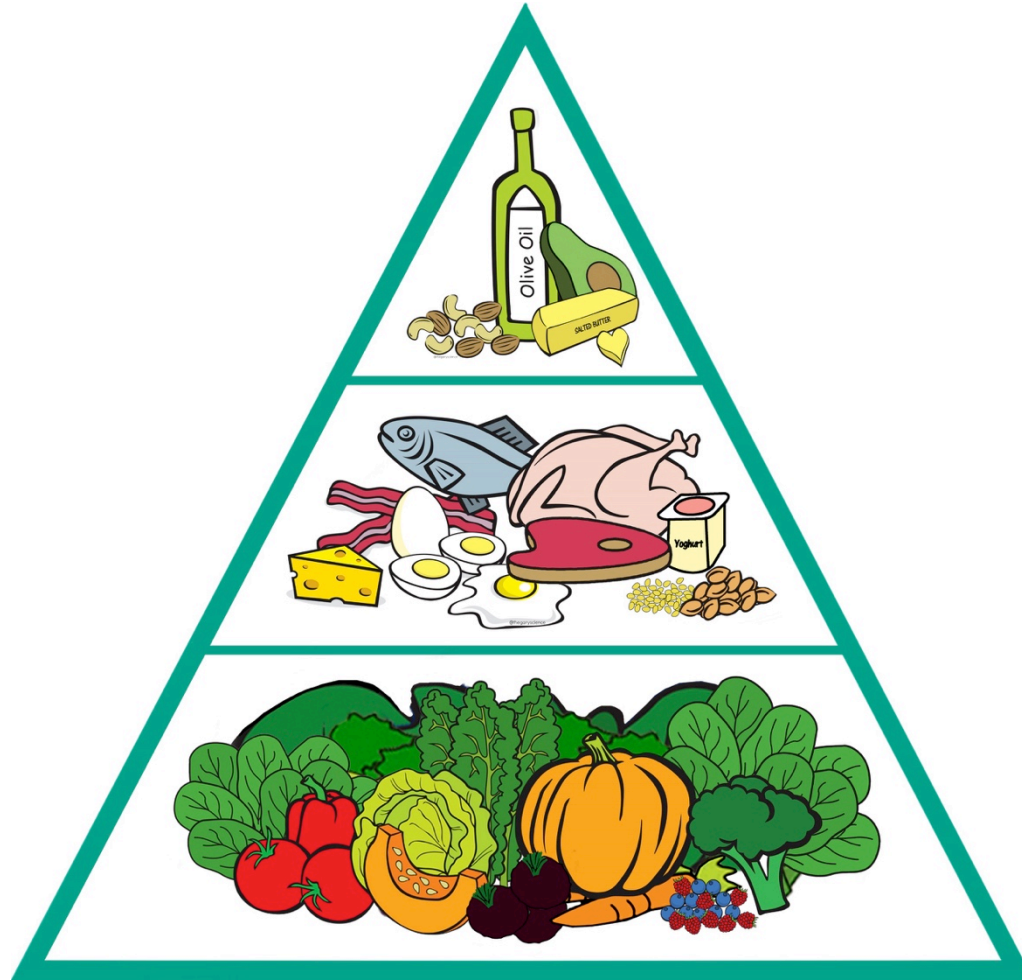
FAT

@thegaryscience

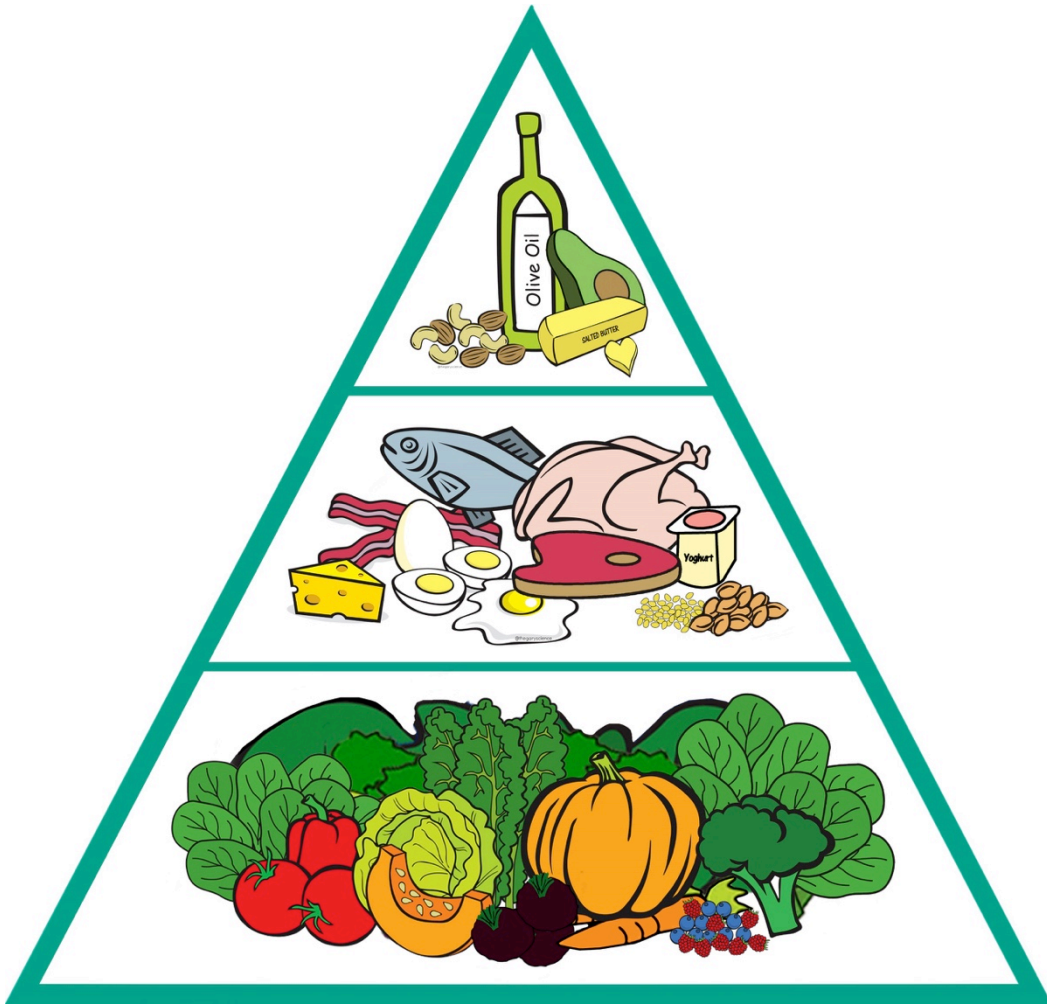
POLYUNSATURATED OILS MAKE YOU
INFLAMED & SICK

NO/**FRUCTOSE**

Low Carbohydrate Healthy Fat



~~NO~~FRUCTOSE



NO/**FRUCTOSE**

Nutrition and Inflammation

Low Carb Breckenridge
Dr Gary Fettke
Orthopaedic Surgeon
MB,BS,FRACS(Ortho),FAOrthoA
American Society for Nutrition
February 2017



~~NO~~FRUCTOSE

Declaration of Interest

- Founder of Nutrition for Life
- No financial interest

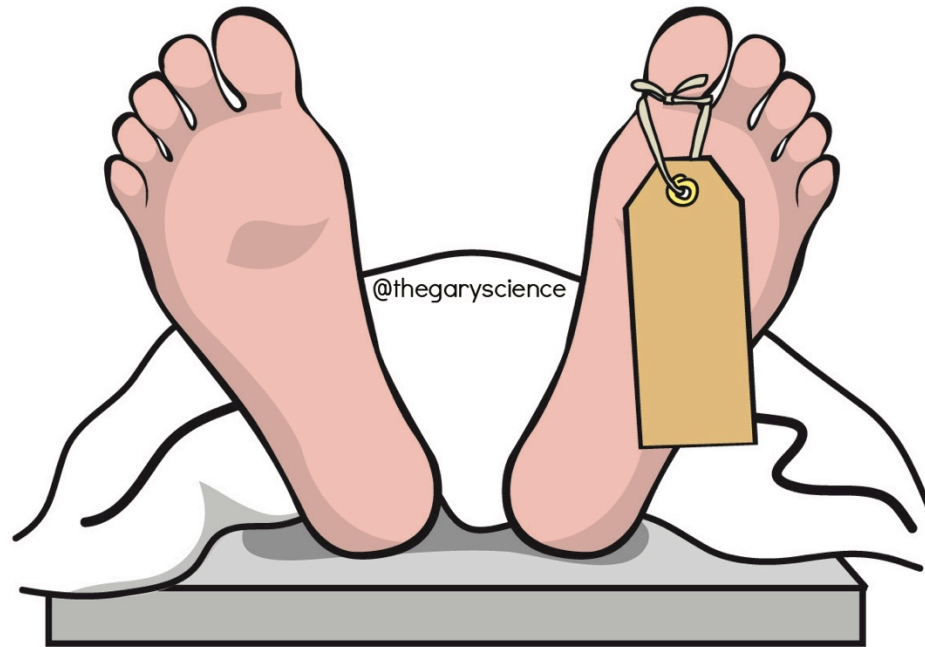
Declaration of Interest

- No financial interest
- Founder of Nutrition for Life

#wecantwait

NO/~~FRUCTOSE~~

Death



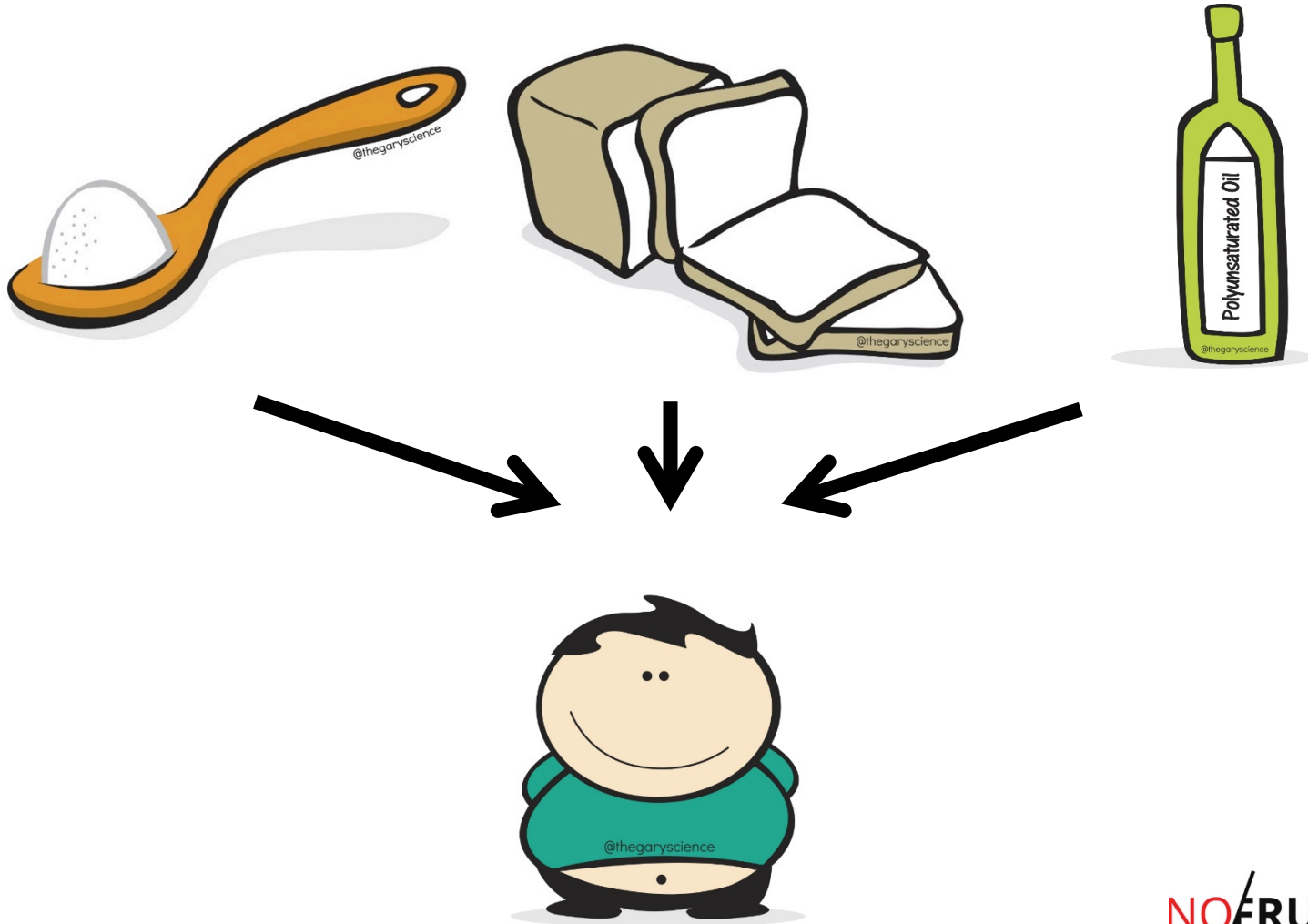
~~NO~~FRUCTOSE

Low Carb Healthy Fat - LCHF



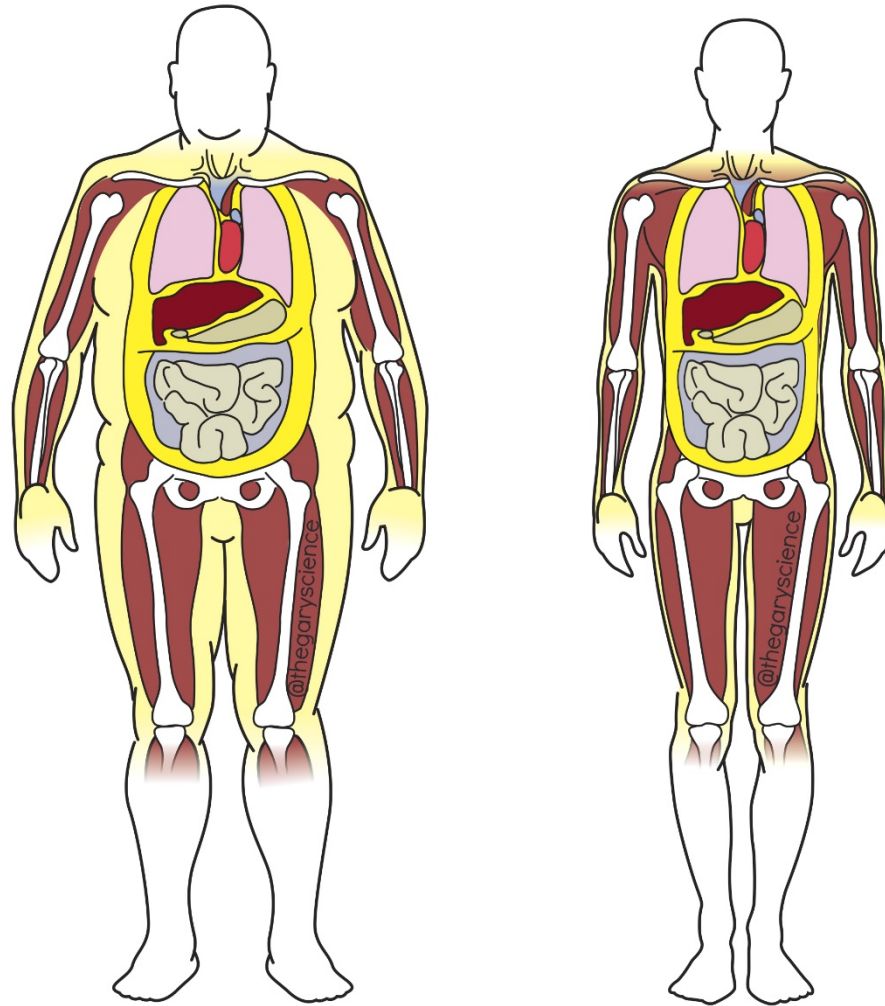
~~NO~~FRUCTOSE

My 'Early' Years



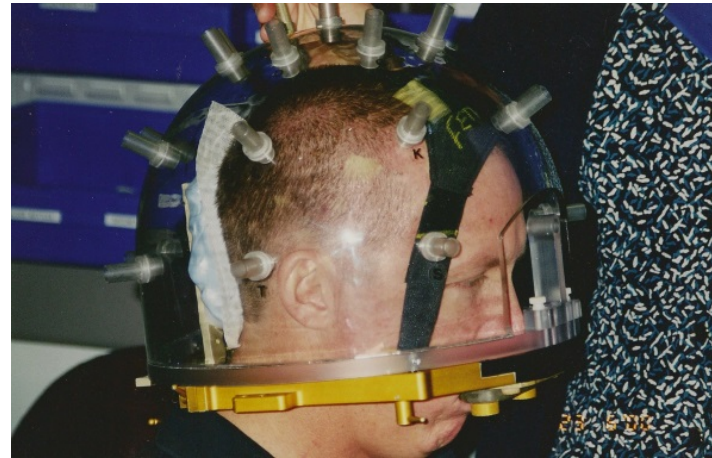
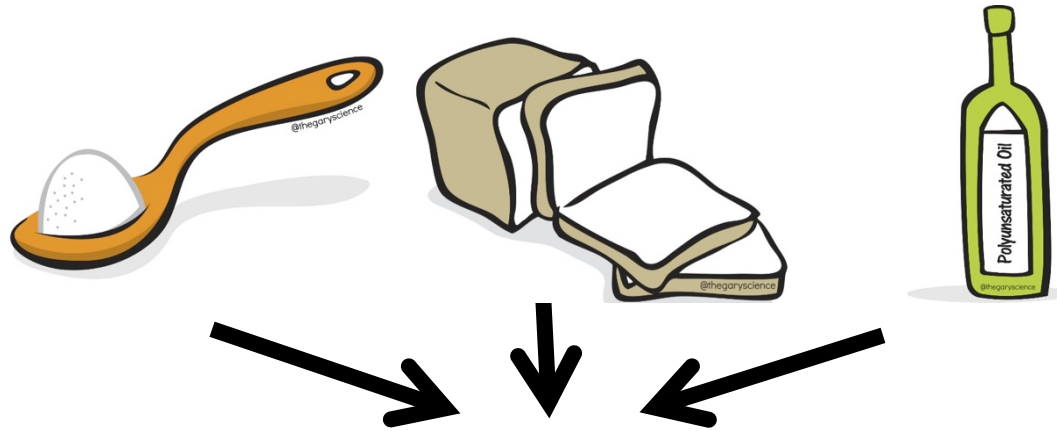
~~NO~~FRUCTOSE

Thin Outside Fat Inside - TOFI



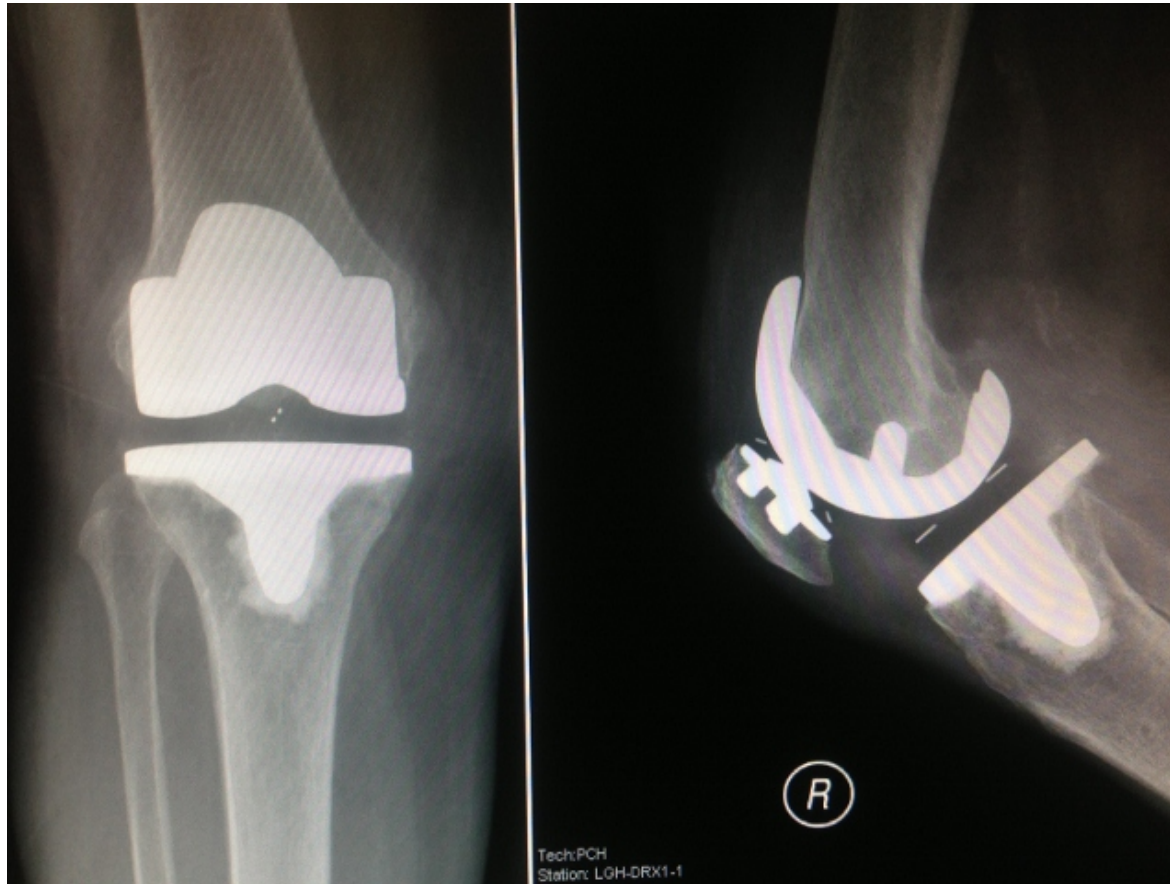
NO / **FRUCTOSE**

The year 2000 ...



NO / **FRUCTOSE**

Arthritis



NO/FRUCTOSE

Diabetes



NO/**FRUCTOSE**

Lifestyle Related Disease



NO/**FRUCTOSE**

Insulin - 1921 Dr Frederick Banting



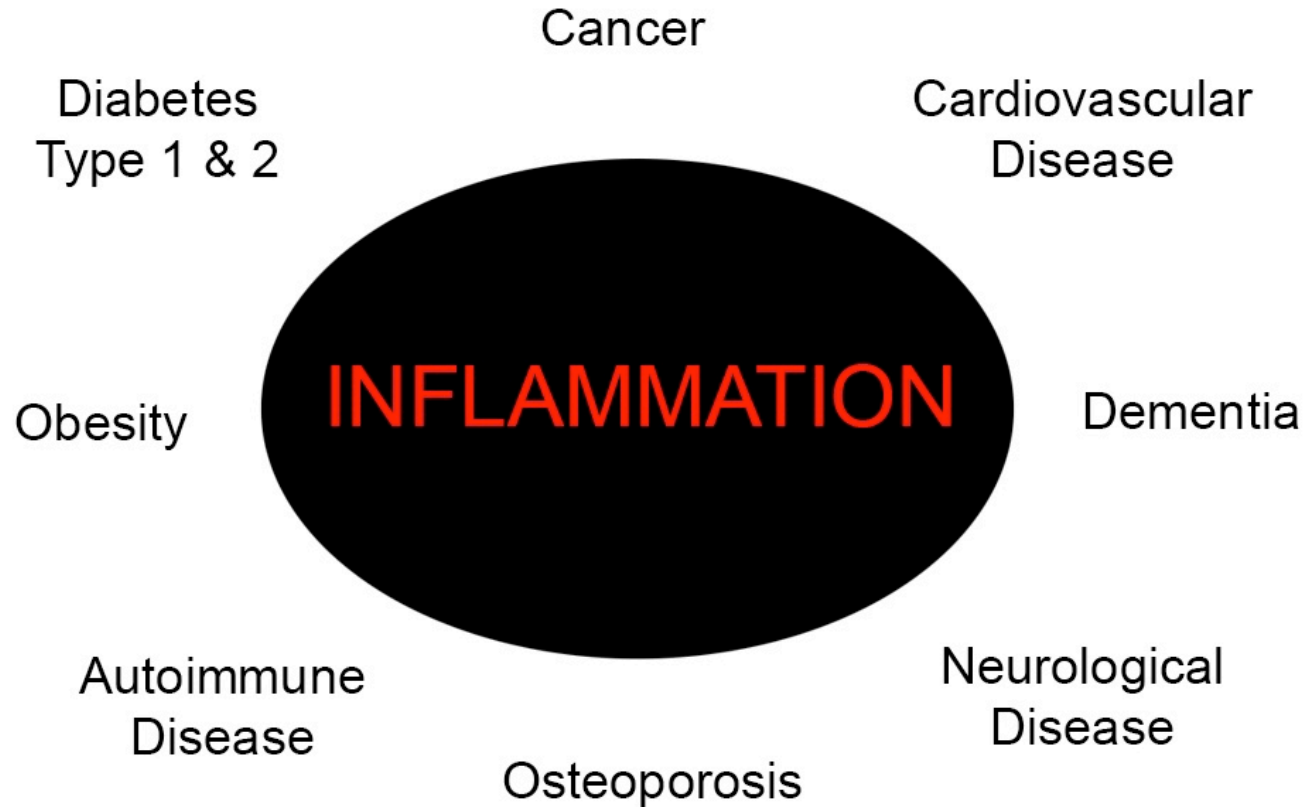
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Lifestyle Related Disease



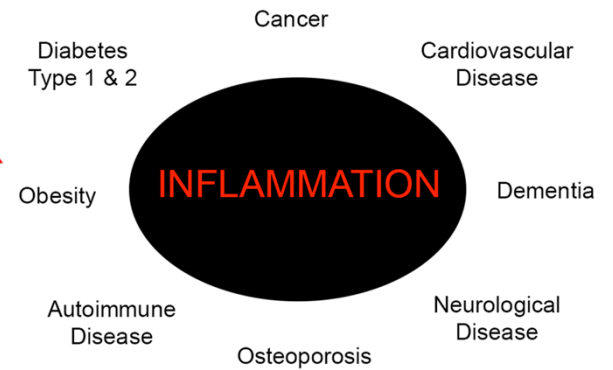
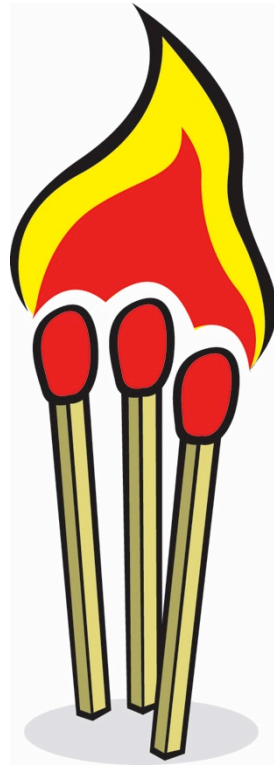
NO/~~FRUCTOSE~~

Modern Disease



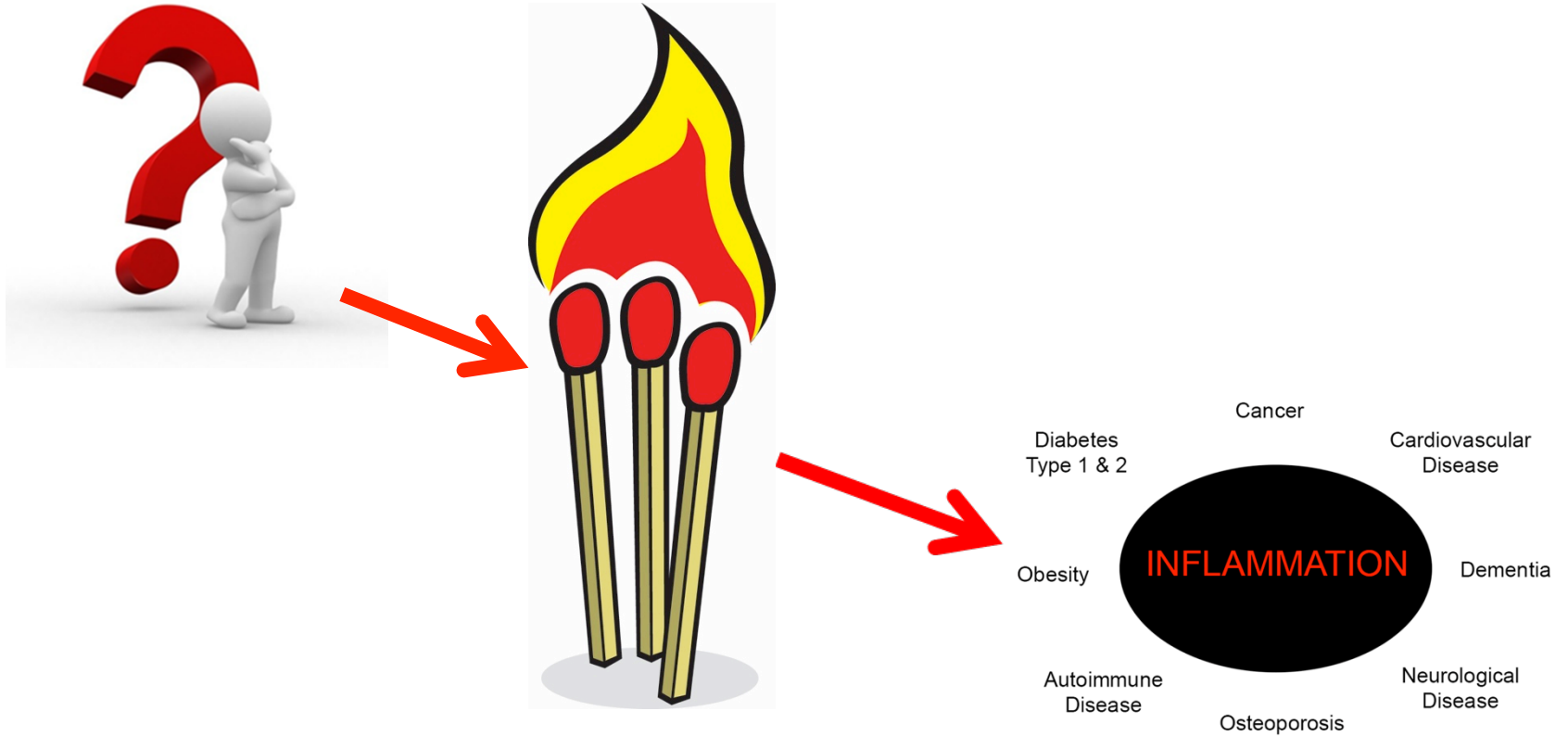
NO / **FRUCTOSE**

Inflammation



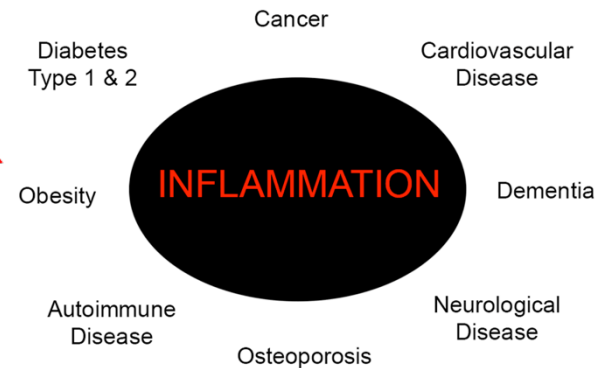
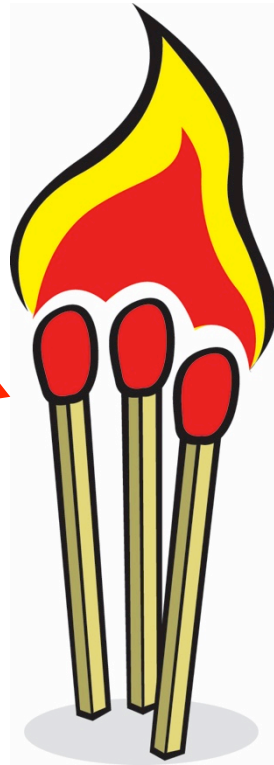
NO / **FRUCTOSE**

Inflammation



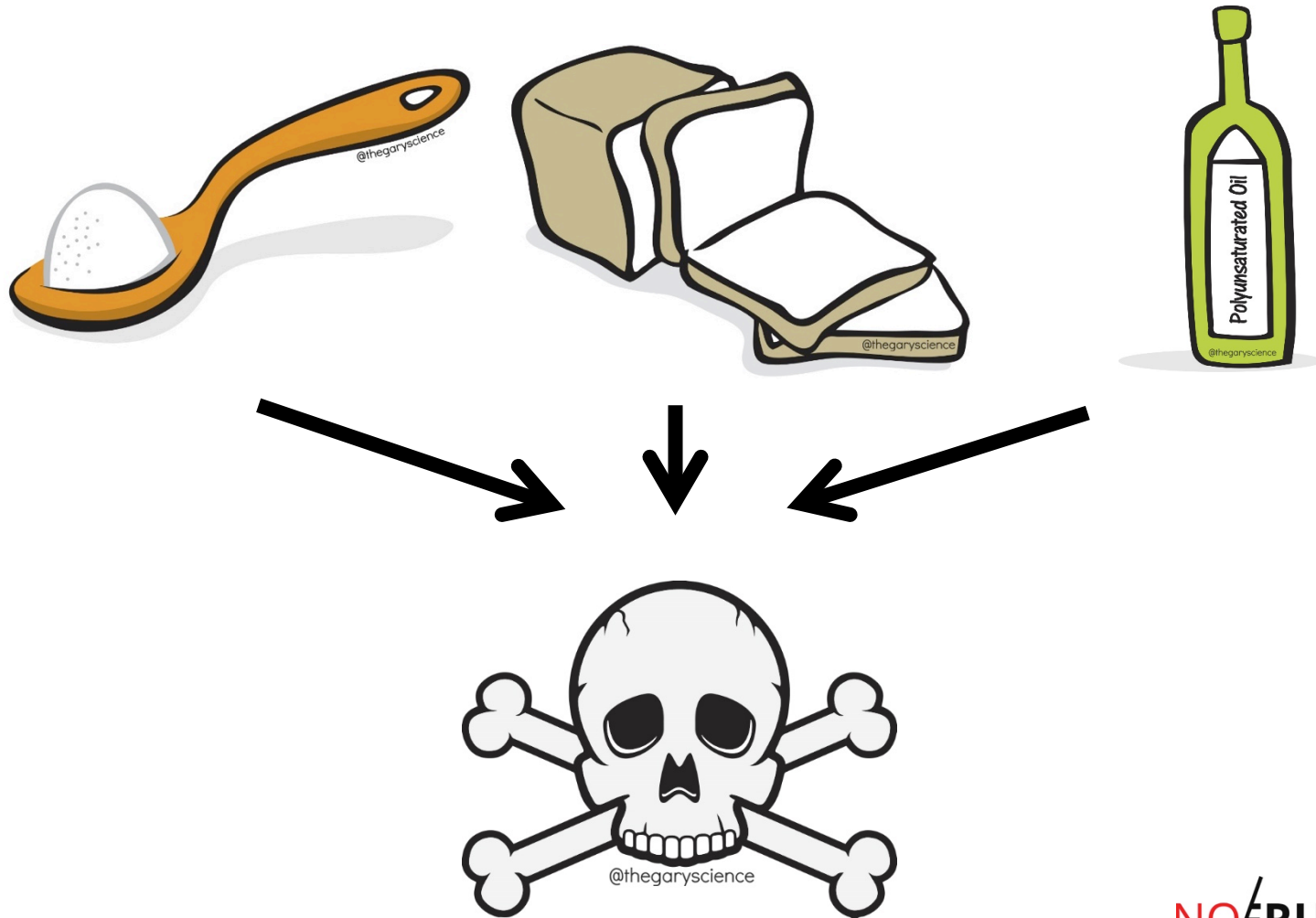
NO / **FRUCTOSE**

Lifestyle Related Disease



NO/FRUCTOSE

'Nutritional' Model of Inflammation



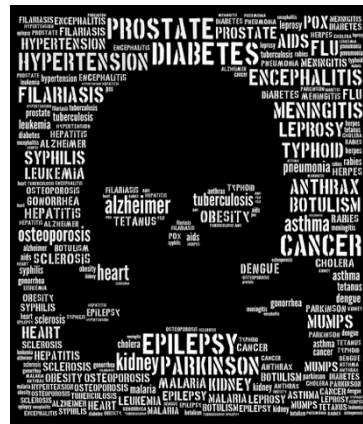
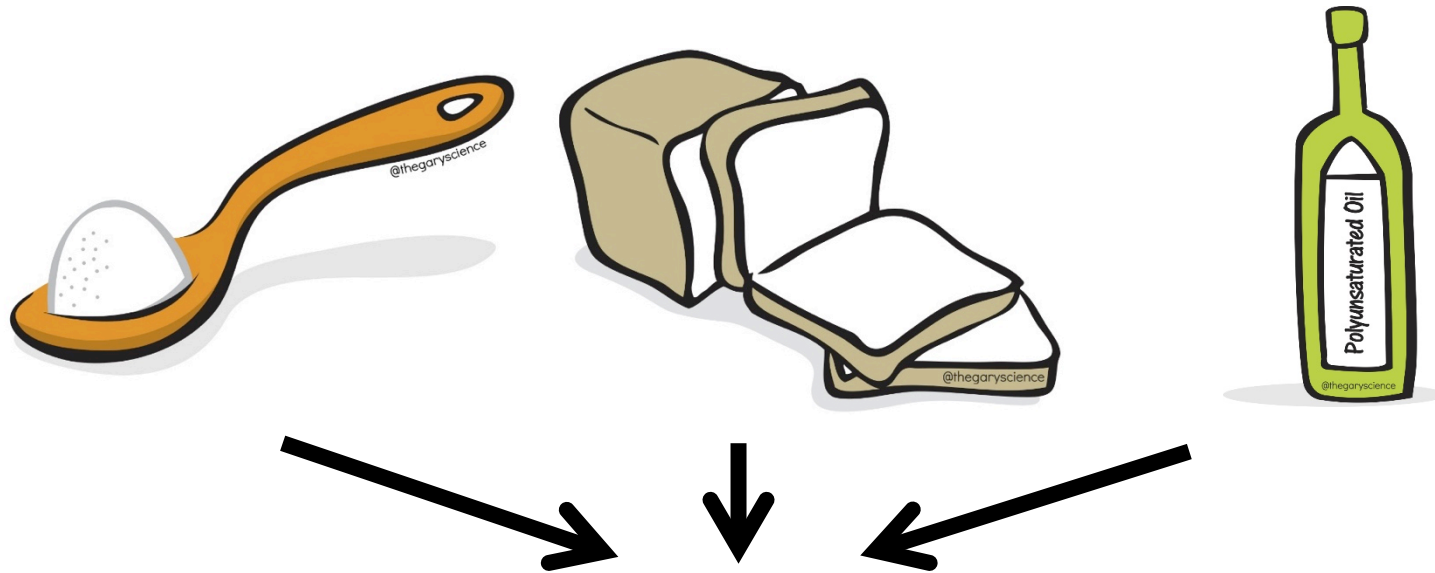
NO / **FRUCTOSE**

Fireworks



NO/**FRUCTOSE**

'Nutritional' Model of *Modern Disease*



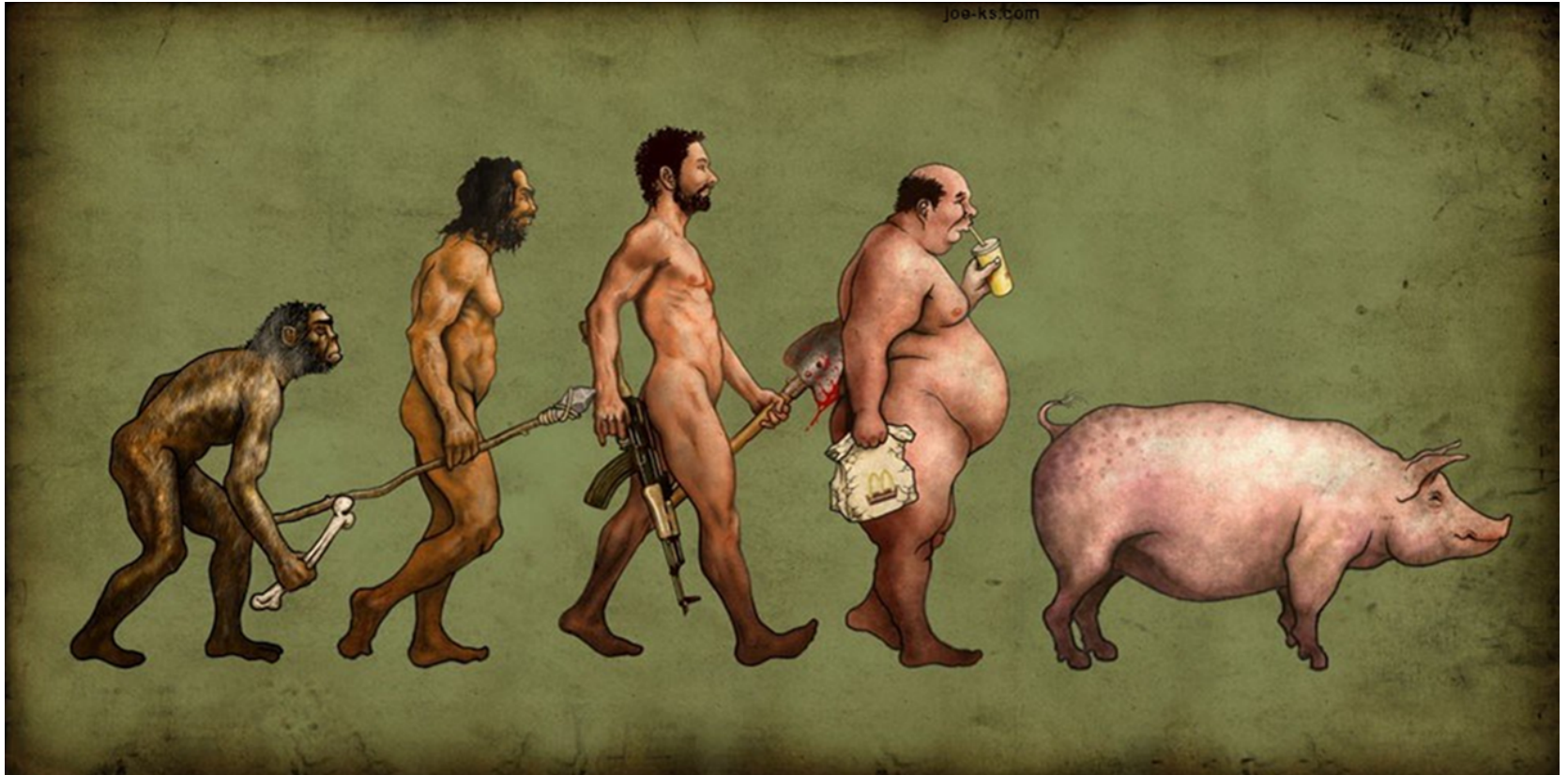
~~NO~~FRUCTOSE

Model of 'Modern' Disease

- Observation
- Hypothesis
- Mechanism
- Pathophysiology
- Association evidence
- Intervention evidence



Observation



NO/**FRUCTOSE**

Obesity



~~NO~~FRUCTOSE

Cancer



~~NO~~FRUCTOSE

Arthritis



NO/~~FRUCTOSE~~

Autoimmune Disease



Autoimmune Disease

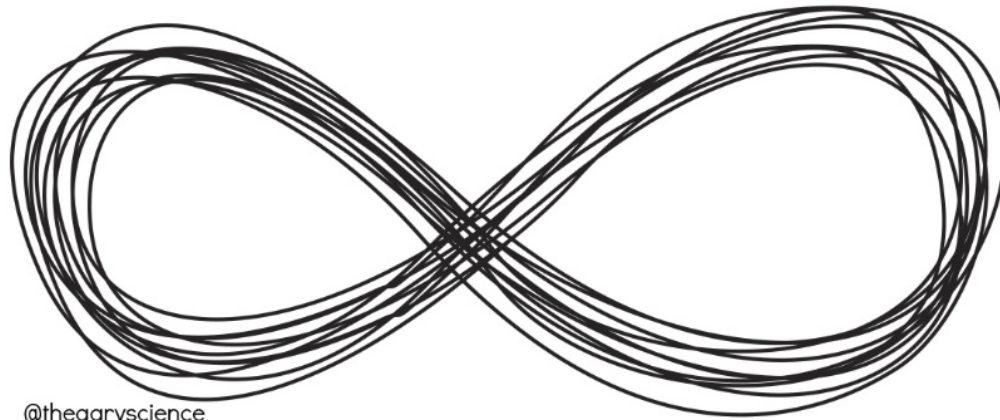


Mental Health Issues



NO/~~FRUCTOSE~~

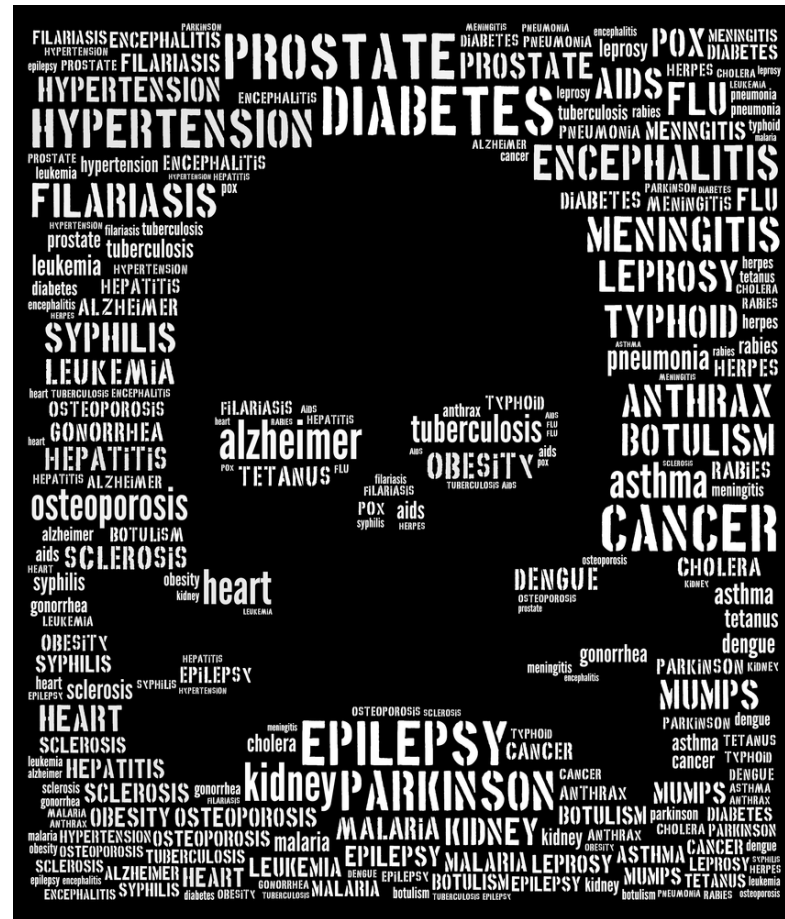
And on and on and on...



@thegaryscience

NO/**FRUCTOSE**

Modern Disease



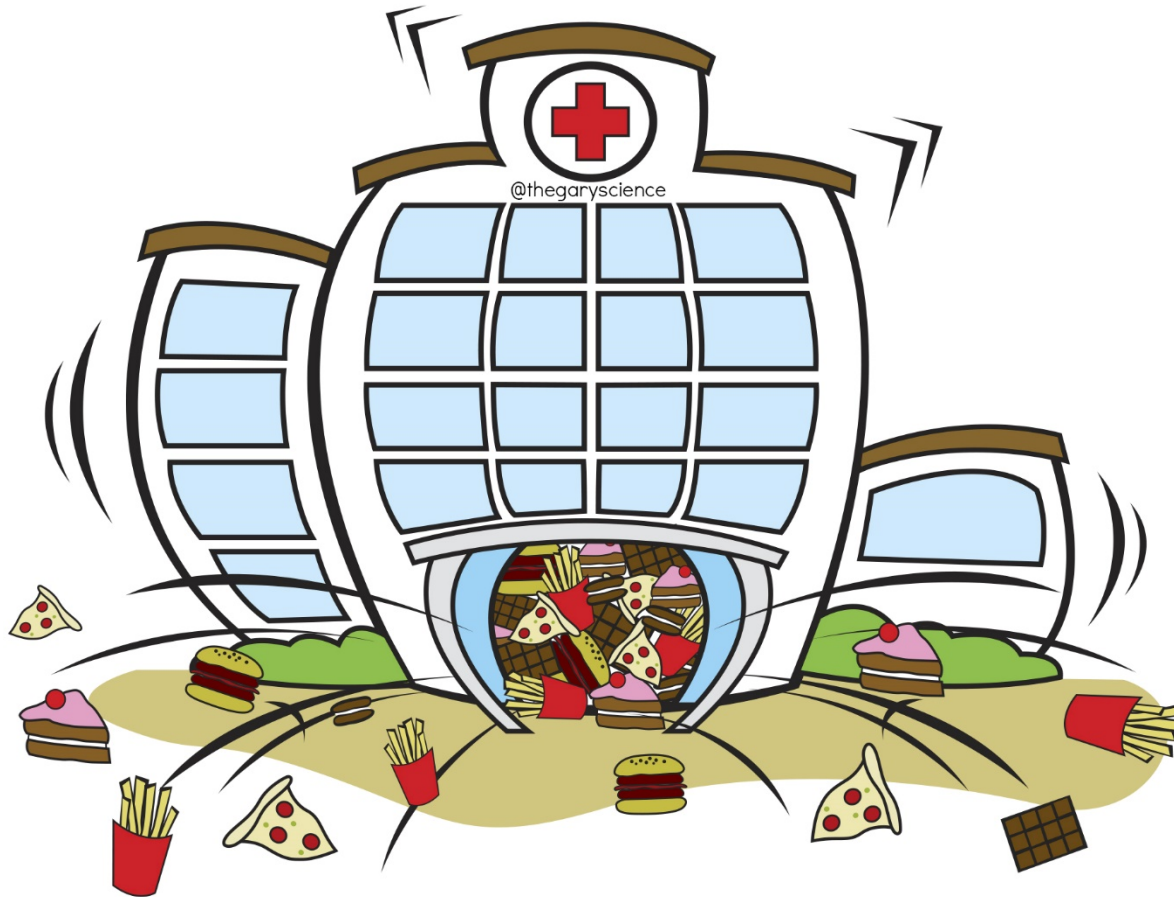
NO/~~FRUCTOSE~~

Reactive 'Modern' Medicine



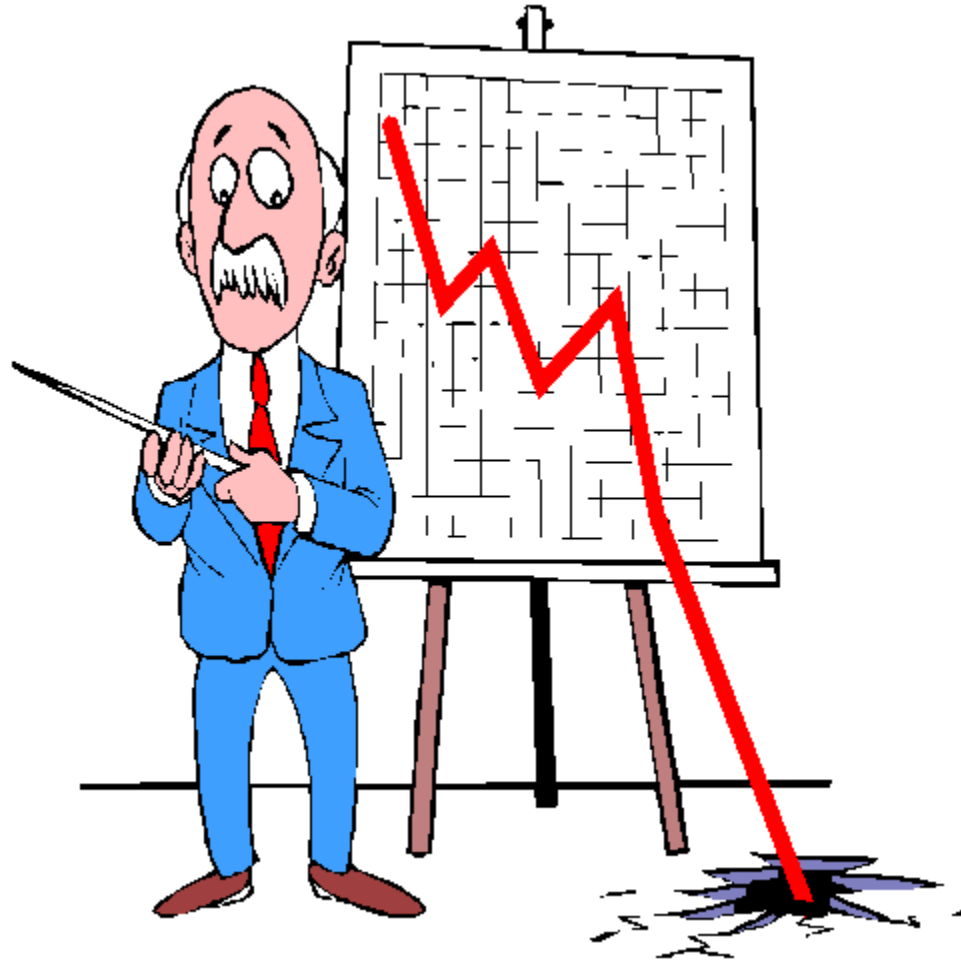
NO/~~FRUCTOSE~~

Personal and Medical Costs



NO / **FRUCTOSE**

Economics



NO/~~FRUCTOSE~~

We are Doomed!



NO/FRUCTOSE

Reactive Medicine



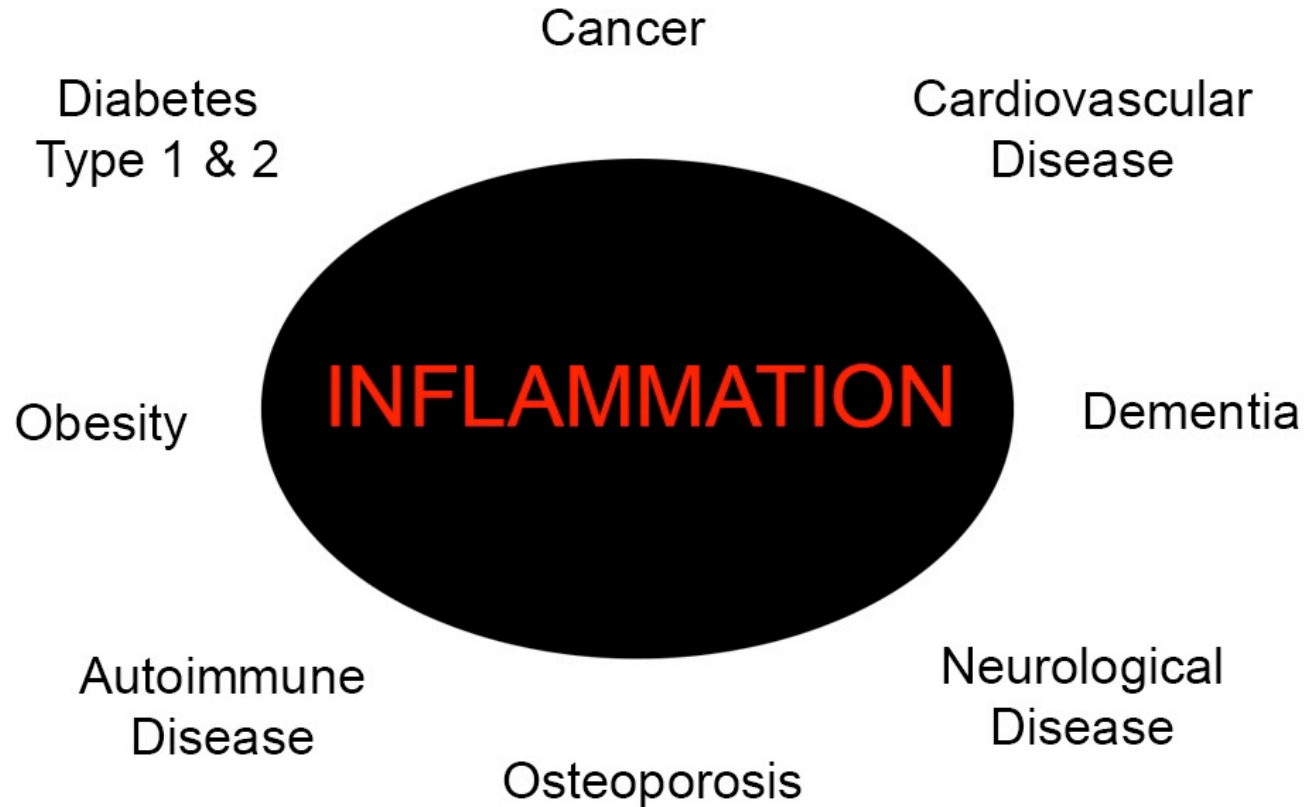
NO/~~FRUCTOSE~~

Model of 'Modern' Disease

- Observation ✓
- Hypothesis
- Mechanism
- Pathophysiology
- Association evidence
- Intervention evidence

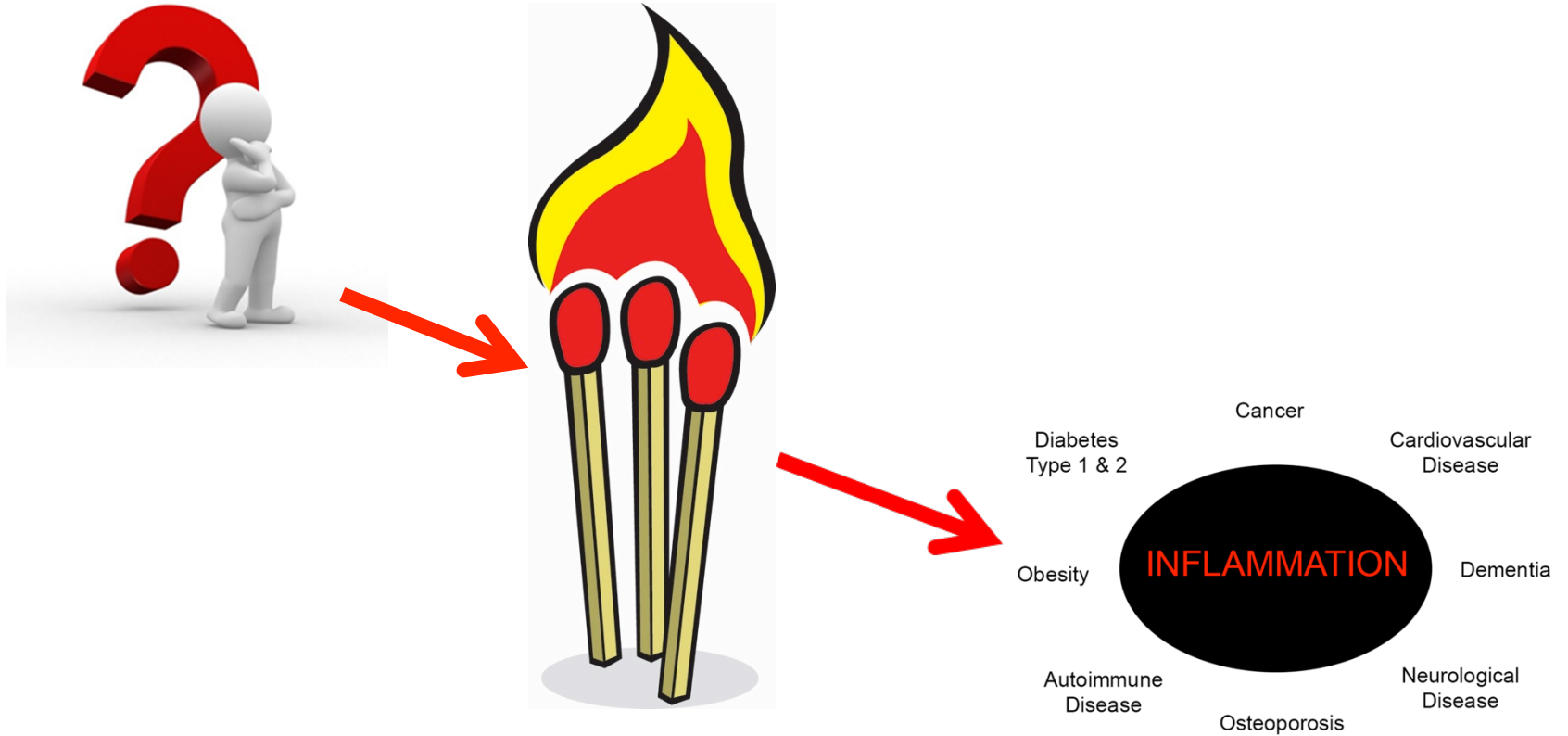


Modern Disease



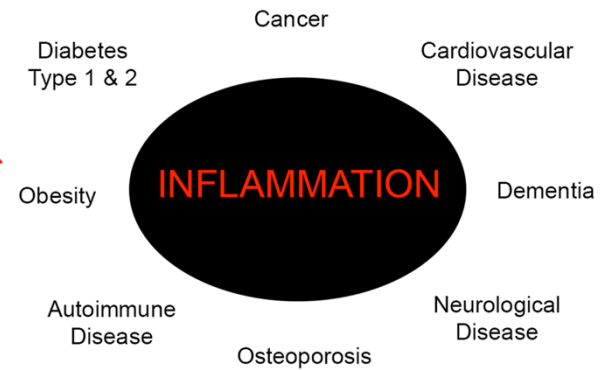
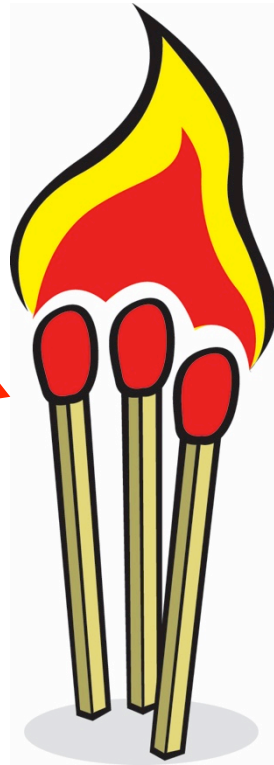
NO/**FRUCTOSE**

Hypothesis



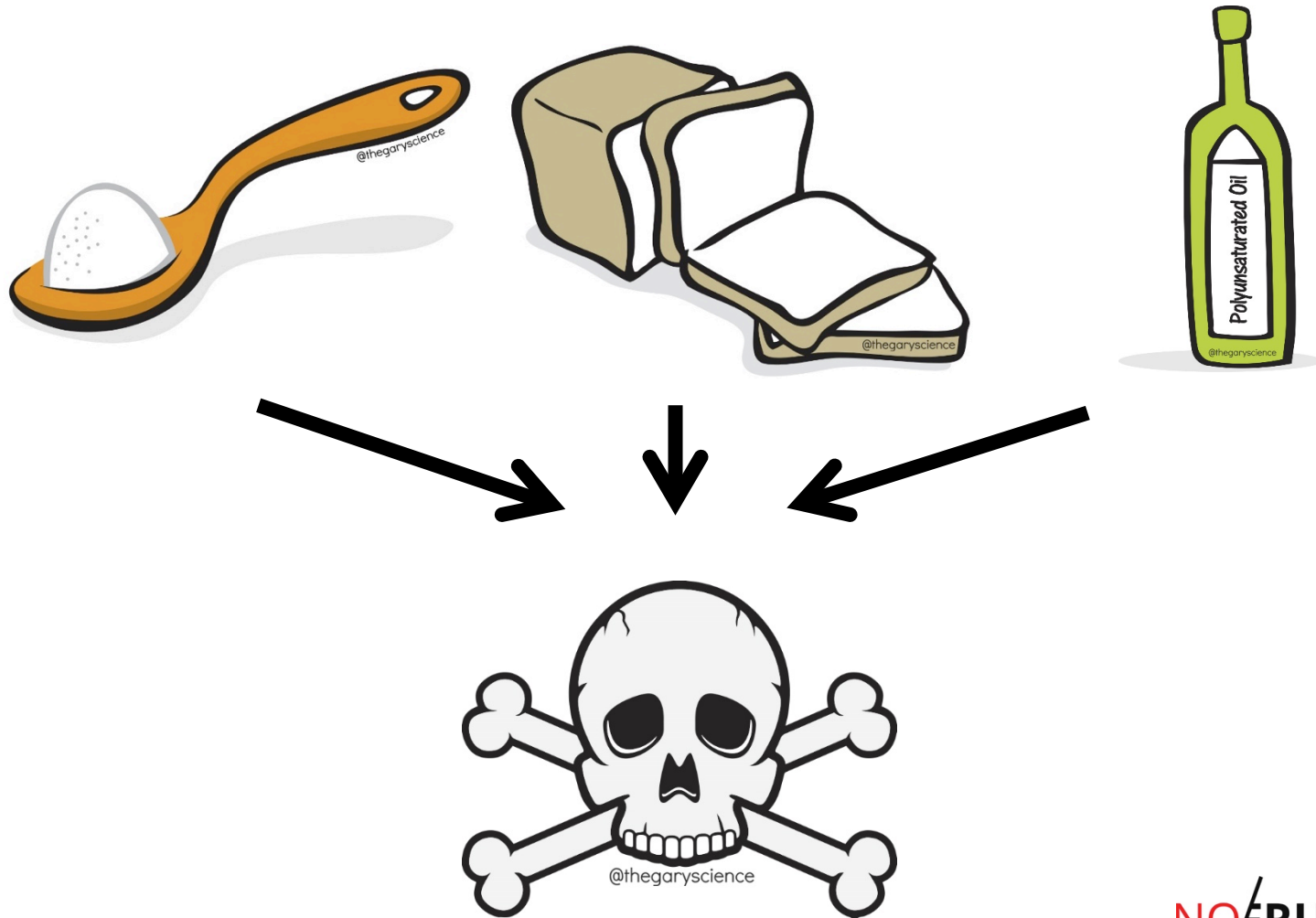
NO/~~FRUCTOSE~~

Hypothesis



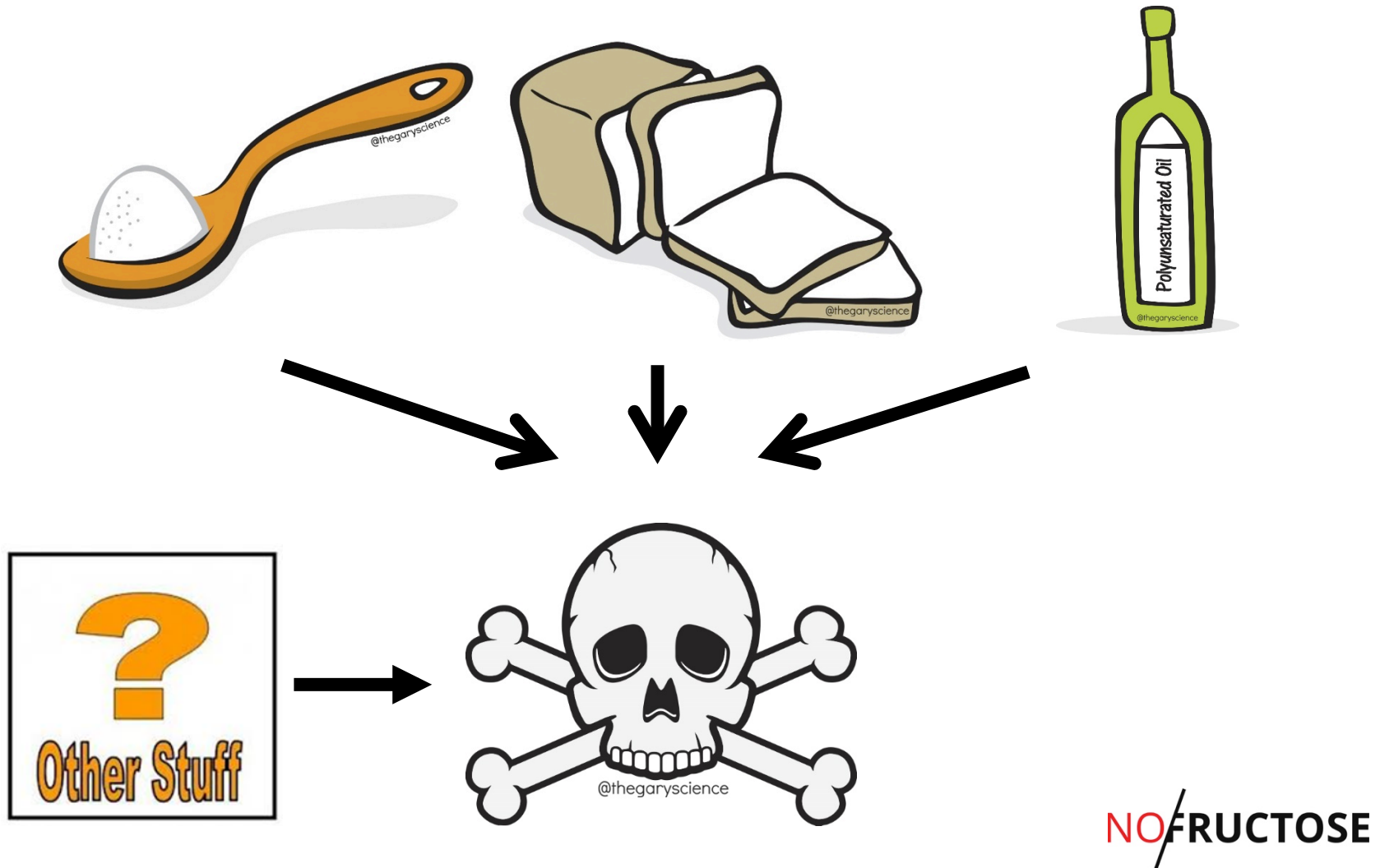
NO/FRUCTOSE

'Nutritional' Model of Inflammation



NO / **FRUCTOSE**

'Nutritional' Model of Inflammation



Other Stuff

- Stress - Cortisol
- Genetics
- Chemicals
- Bowel organisms
- Exercise
- Latitude / Longitude
- Sleep
- Vitamin D
- Artificial Lighting

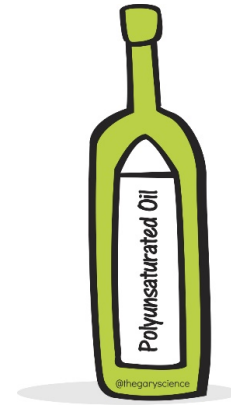
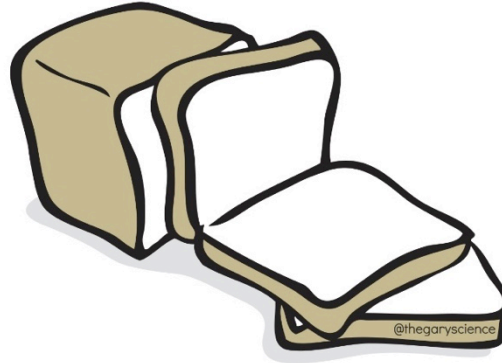
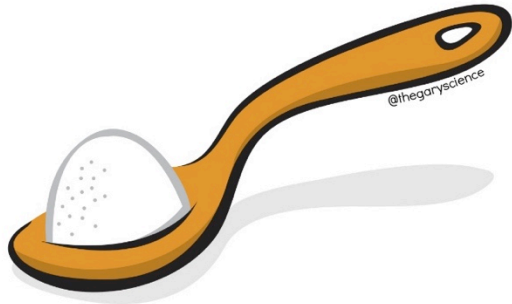


Model of 'Modern' Disease

- Observation ✓
- Hypothesis ✓
- Mechanism
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- Association evidence
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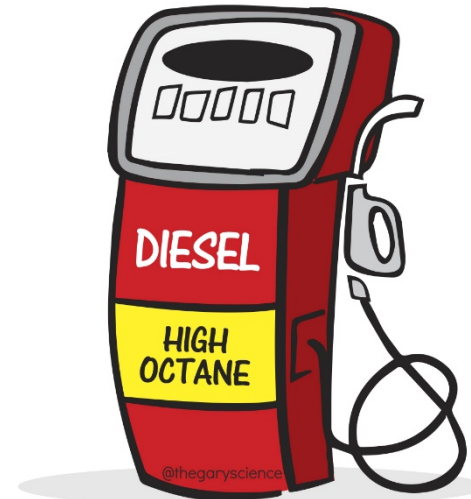
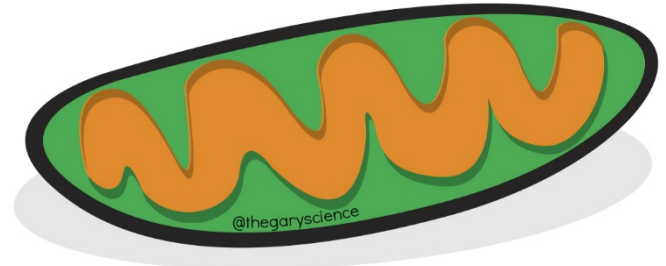
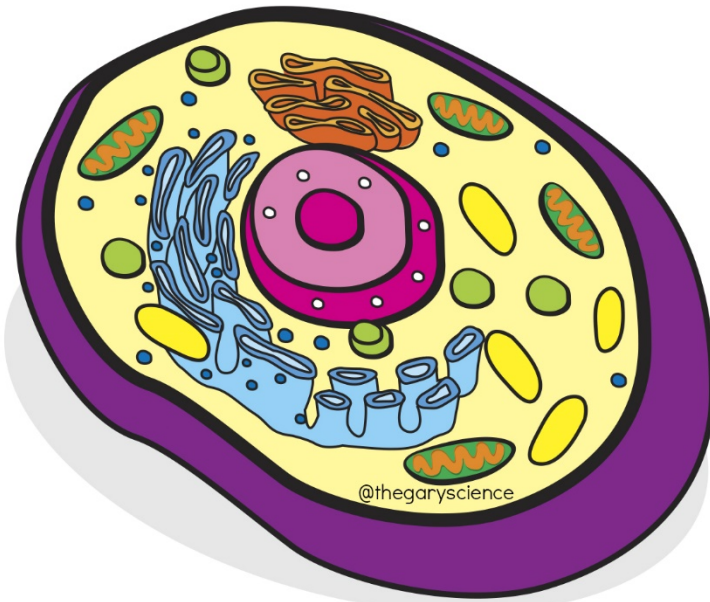


'Nutritional' Model



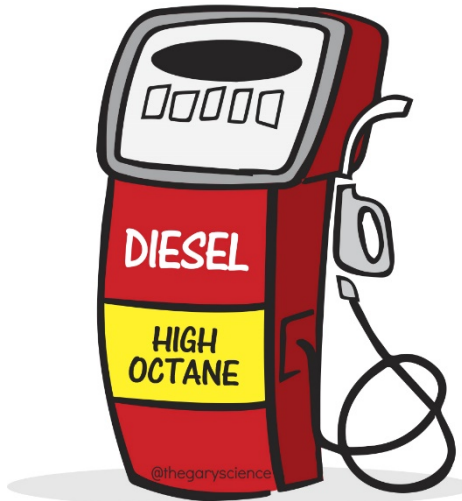
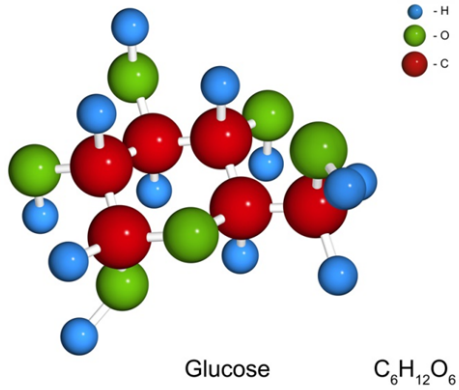
~~NO~~FRUCTOSE

Mitochondria



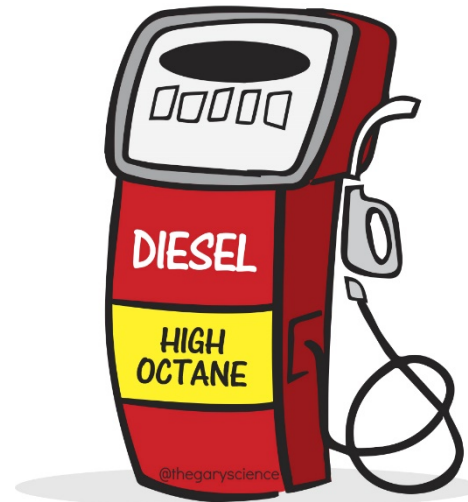
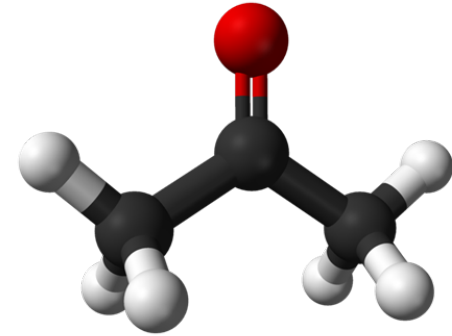
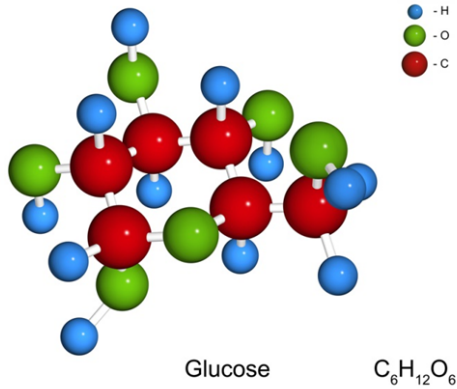
~~NO~~FRUCTOSE

Hybrid Engine



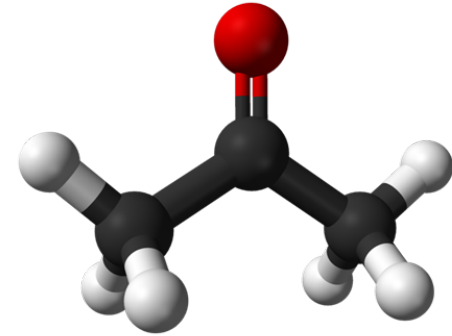
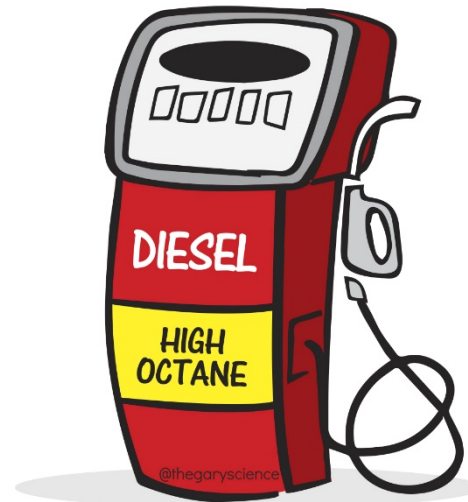
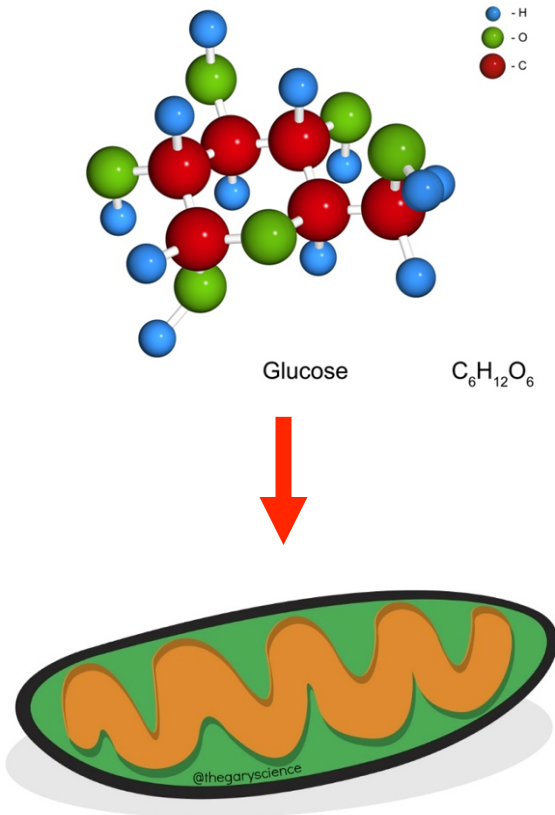
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Hybrid Engine



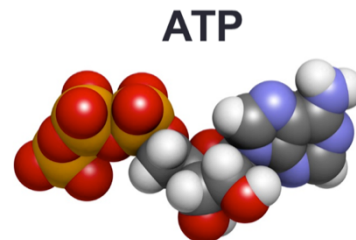
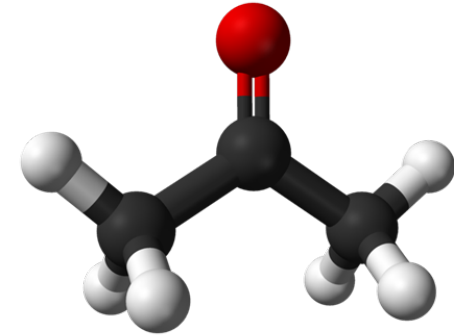
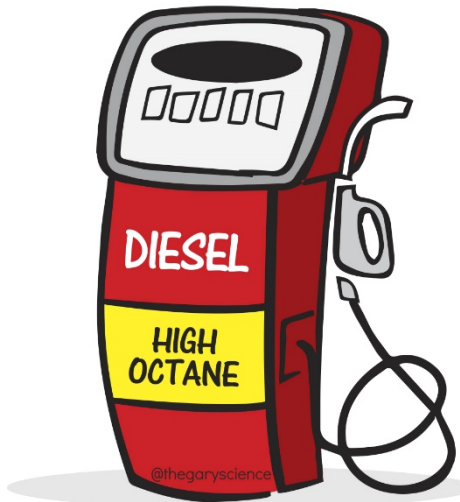
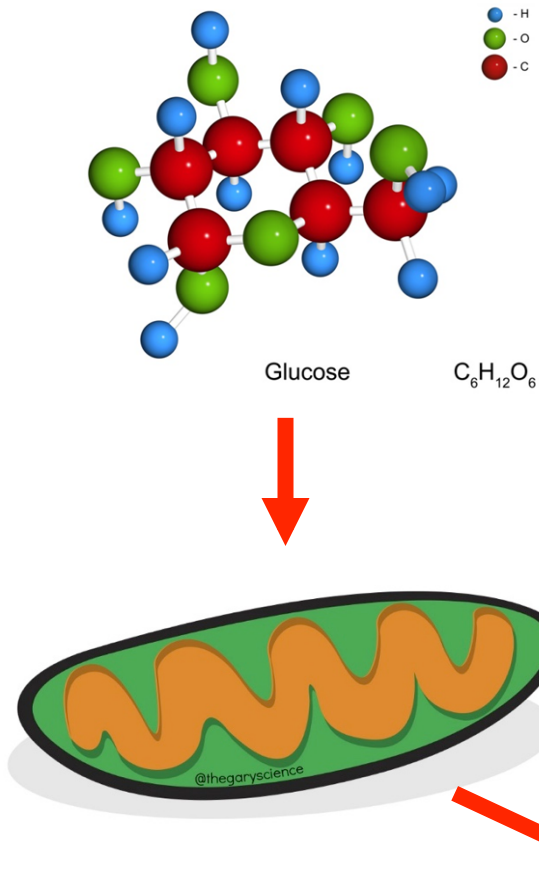
~~NO~~FRUCTOSE

Hybrid Engine



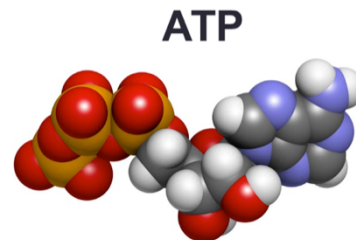
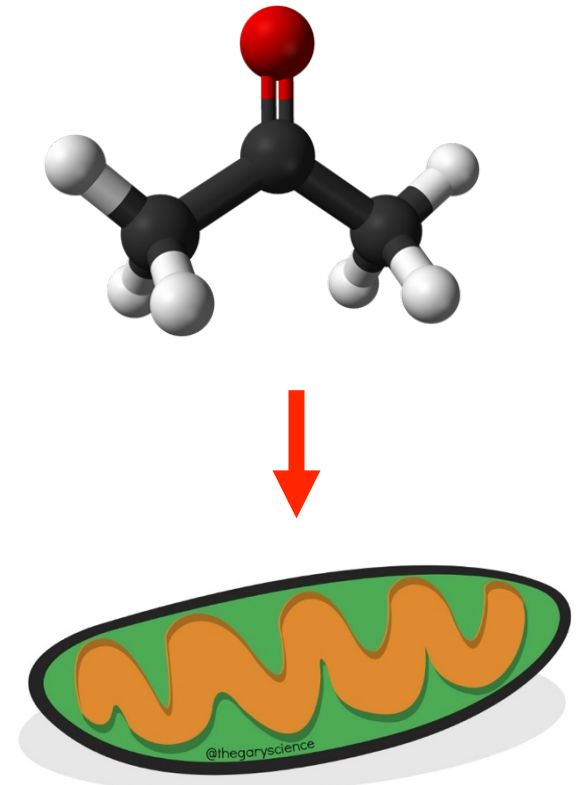
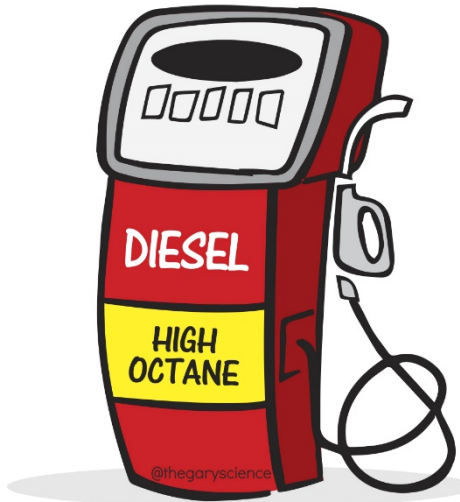
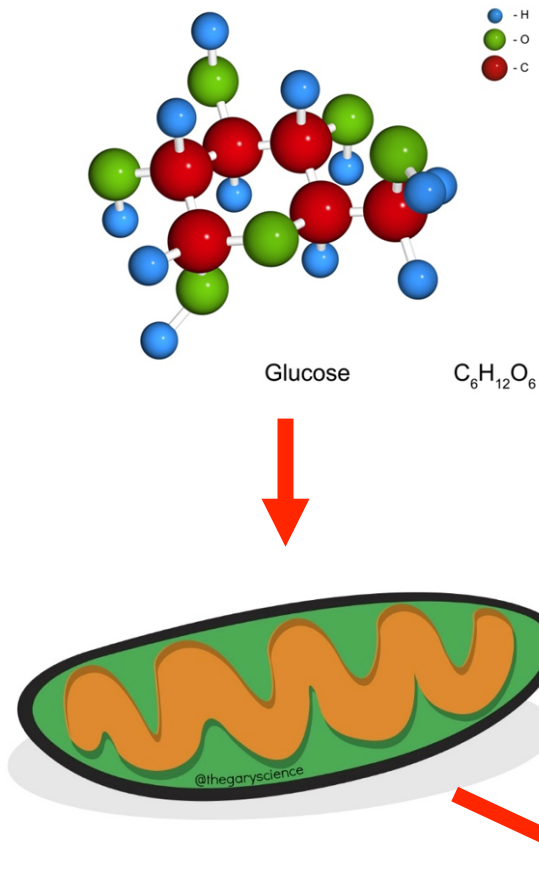
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Hybrid Engine



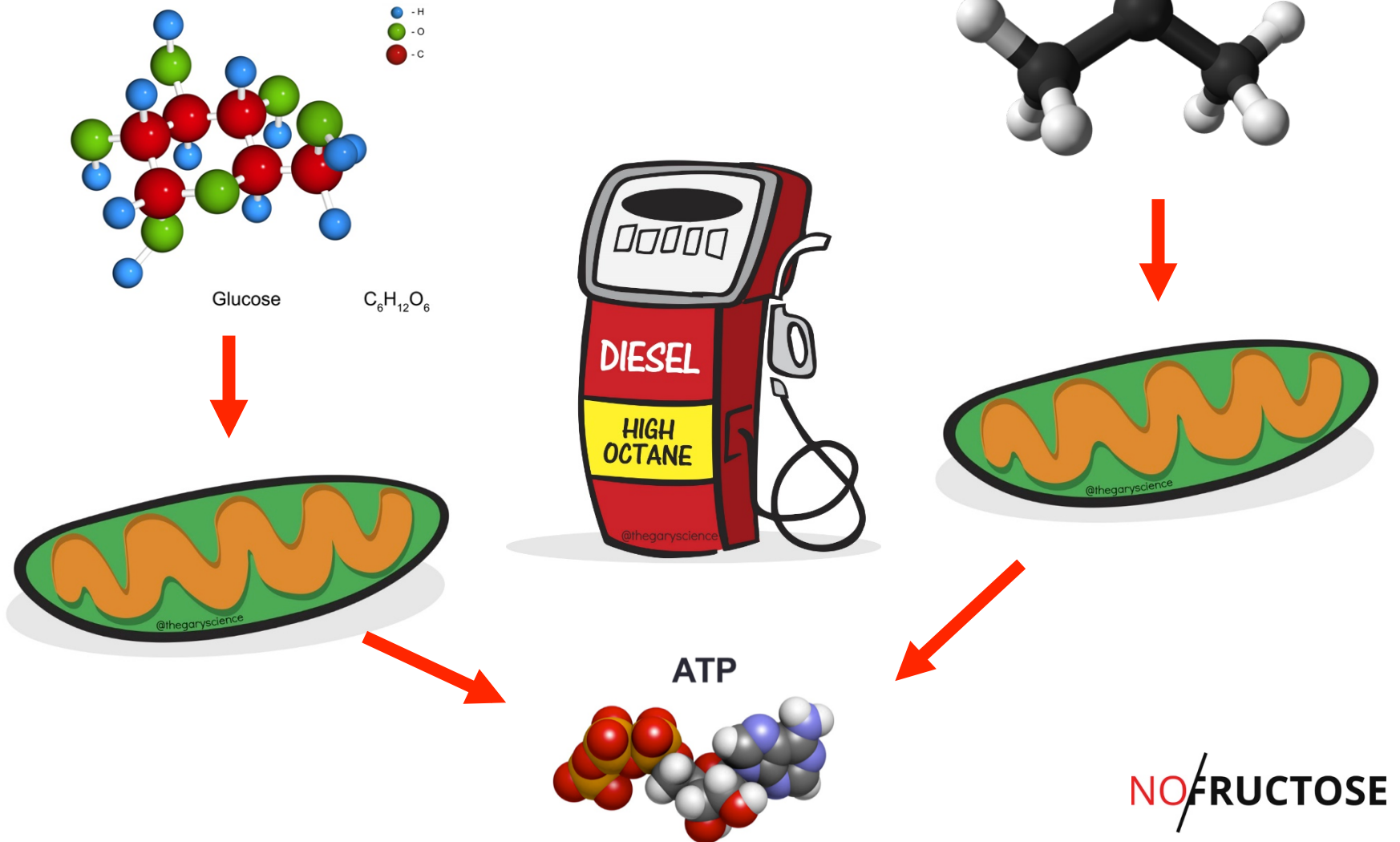
~~NO~~FRUCTOSE

Hybrid Engine

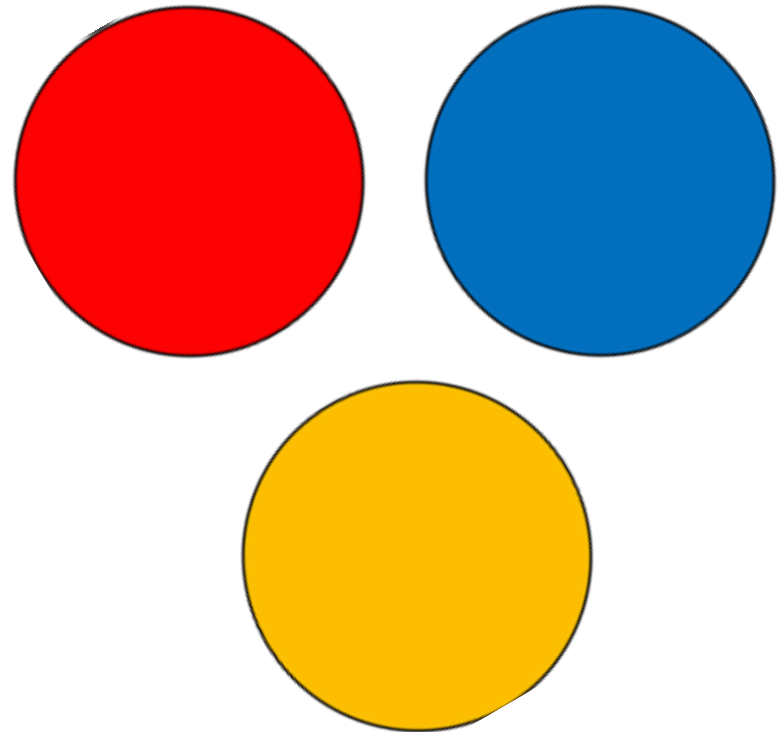


~~NO~~FRUCTOSE

Hybrid Engine

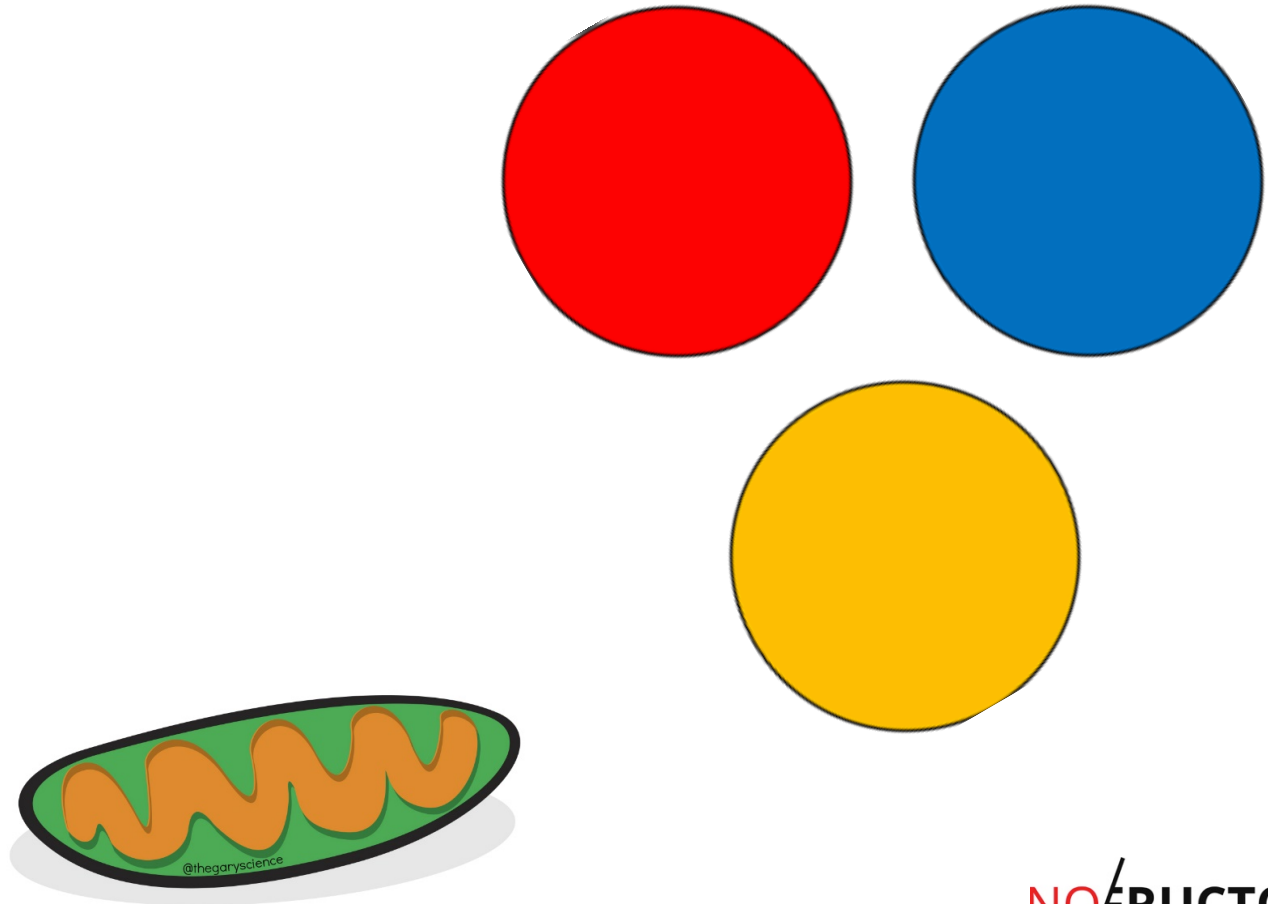


Primary Colours - Primary Foods



~~NO~~FRUCTOSE

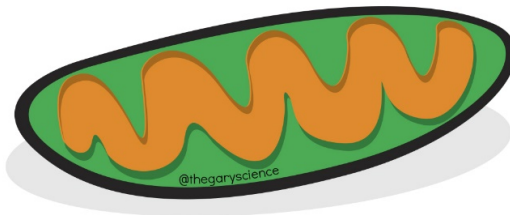
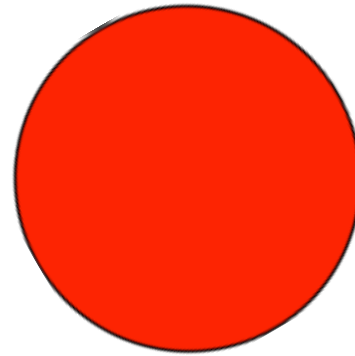
Primary Colours - Primary Foods



~~NO~~FRUCTOSE

Primary Fuels

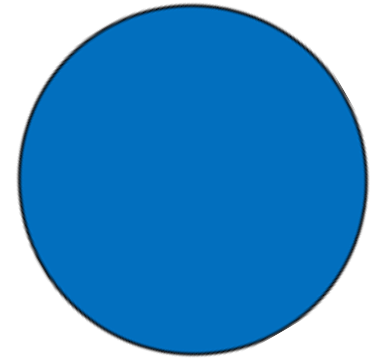
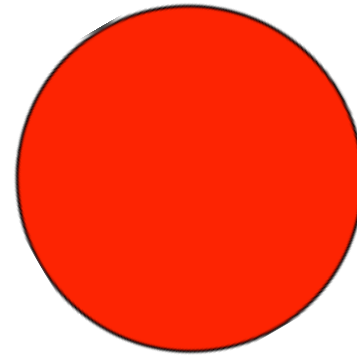
Carbohydrate



~~NO~~FRUCTOSE

Primary Fuels

Carbohydrate



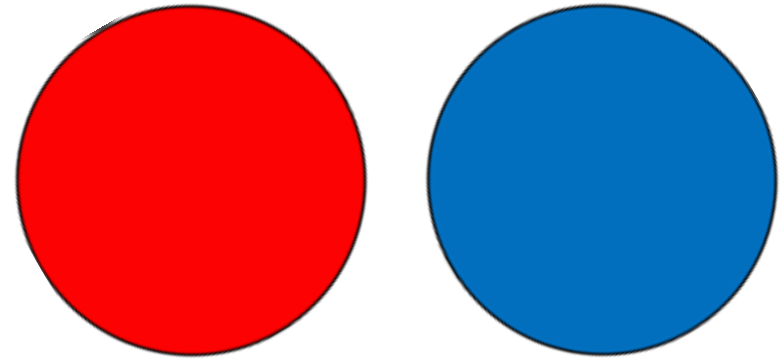
Protein



~~NO~~FRUCTOSE

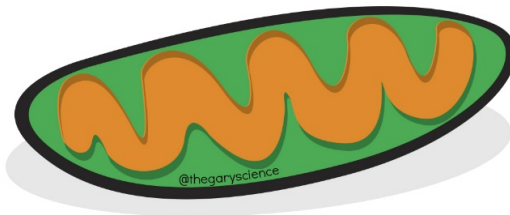
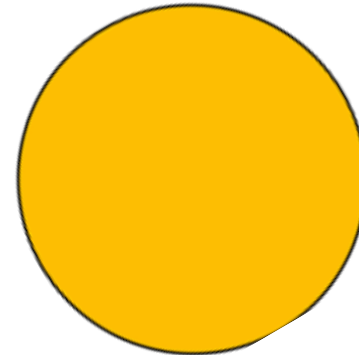
Primary Fuels

Carbohydrate



Protein

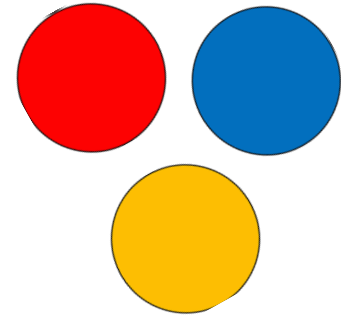
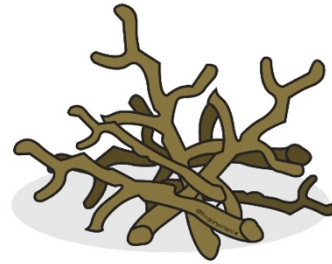
Fat



~~NO~~FRUCTOSE

Primary Fuels

Carbohydrate



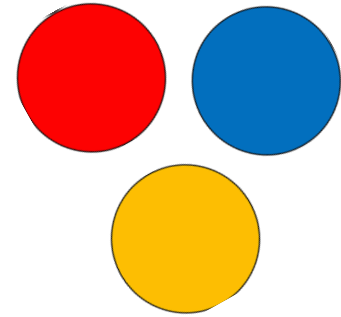
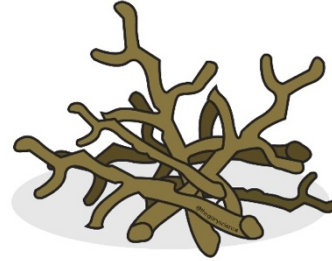
Protein

Fat

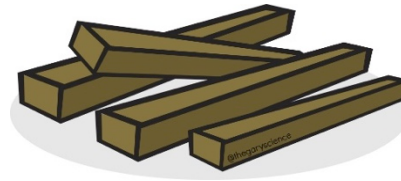
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Primary Fuels

Carbohydrate



Protein

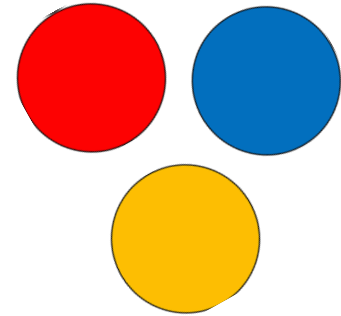
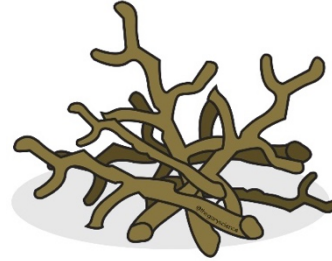


Fat

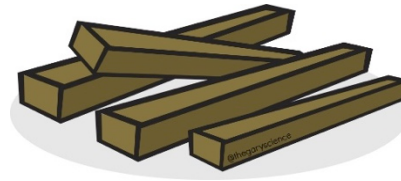
~~NO~~FRUCTOSE

Primary Fuels

Carbohydrate



Protein

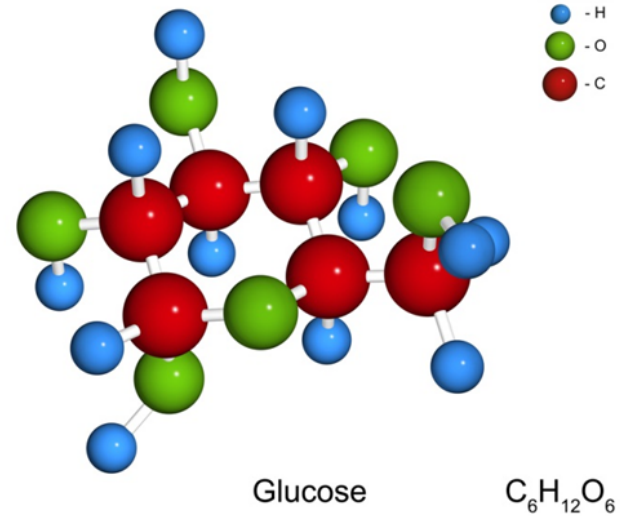
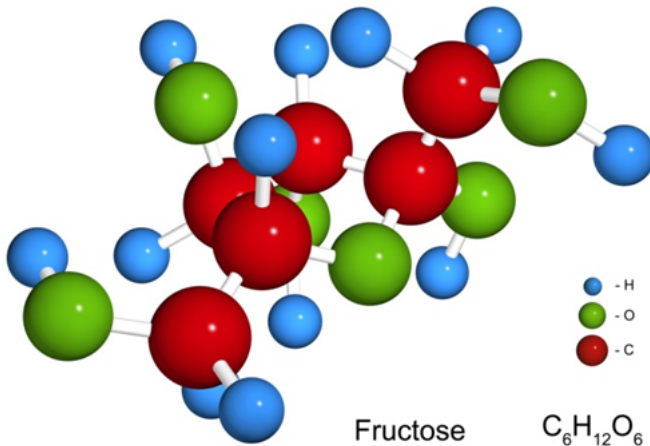


Fat



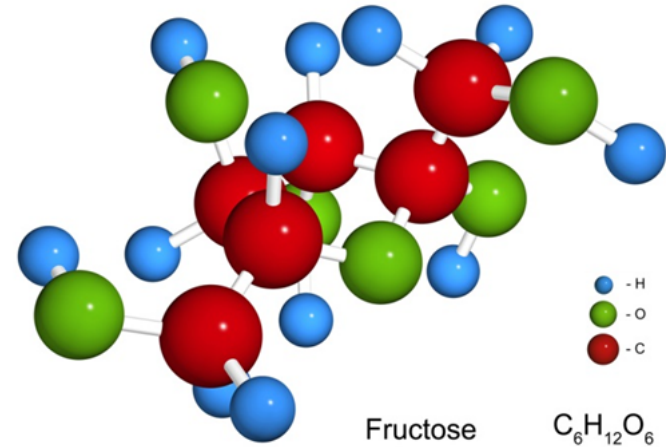
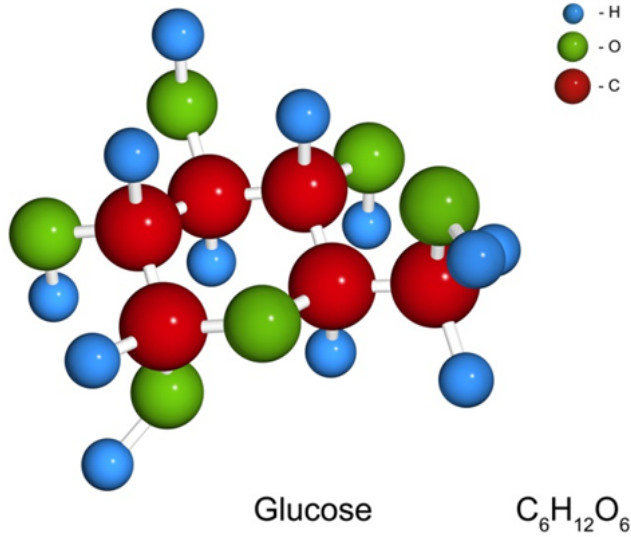
~~NO~~FRUCTOSE

Carbohydrates



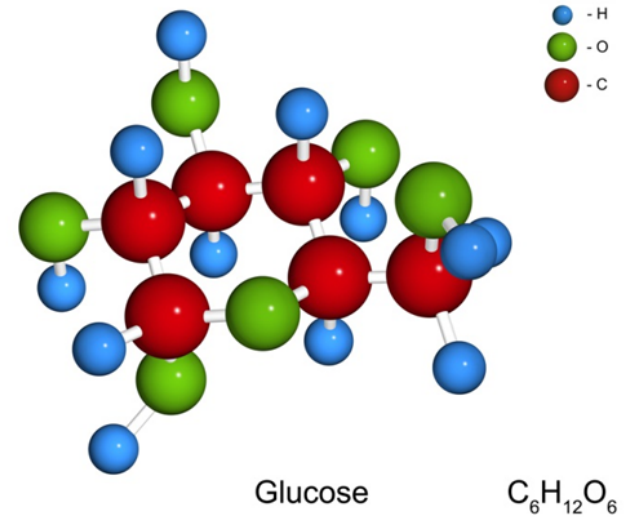
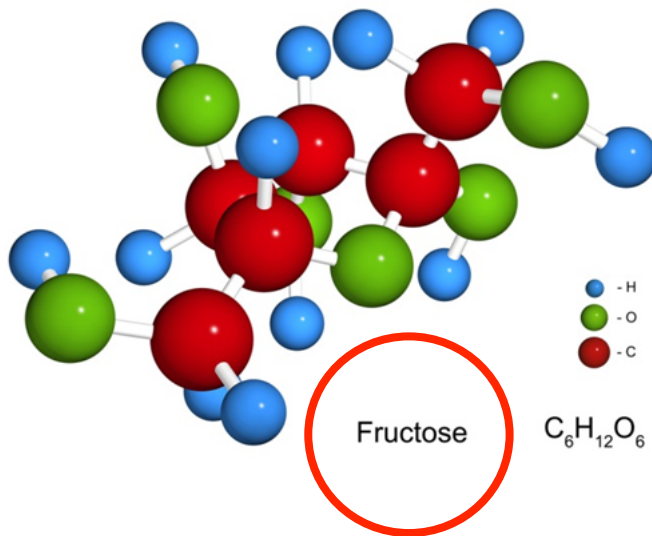
~~NO~~FRUCTOSE

Carbohydrates



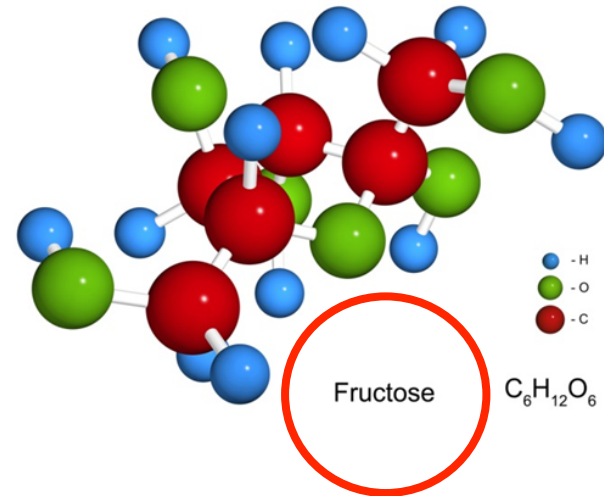
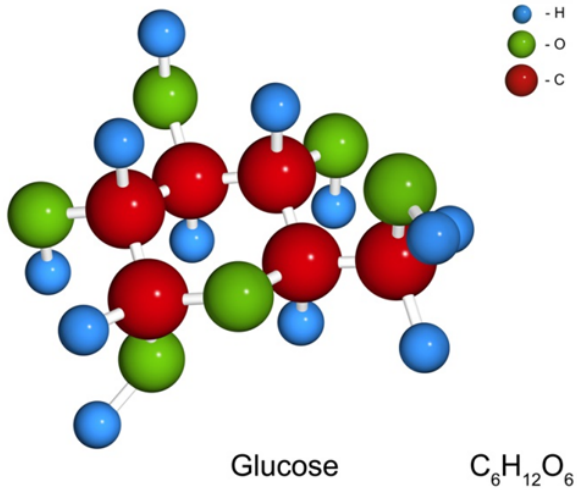
~~NO~~FRUCTOSE

Fructose



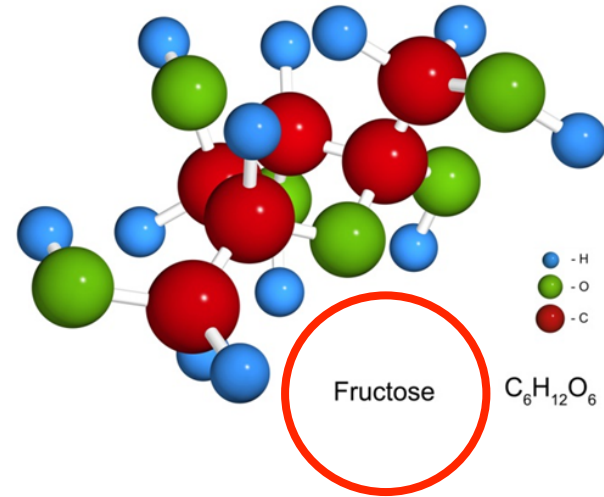
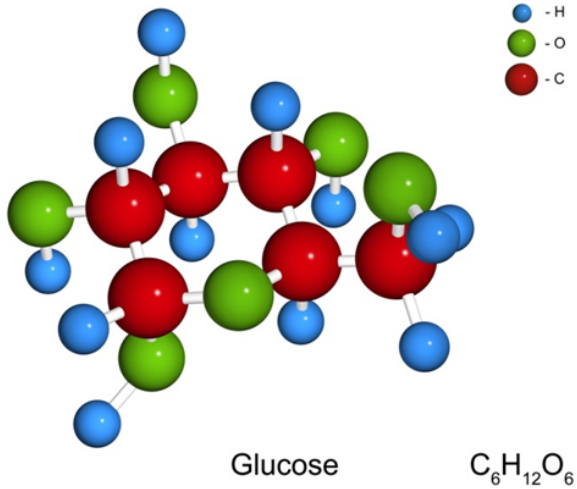
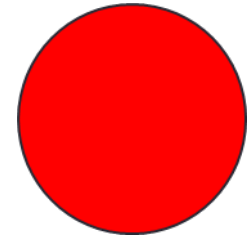
~~NO~~FRUCTOSE

Sugar



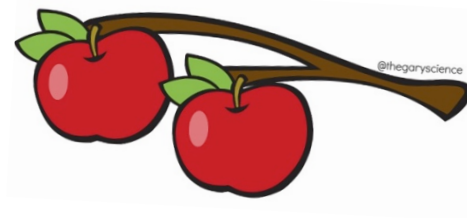
~~NO~~FRUCTOSE

Sugar



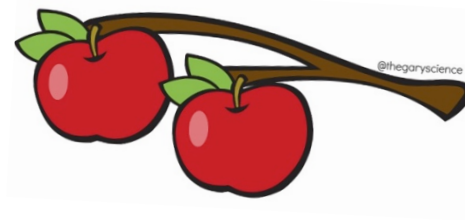
~~NO~~FRUCTOSE

Fructose



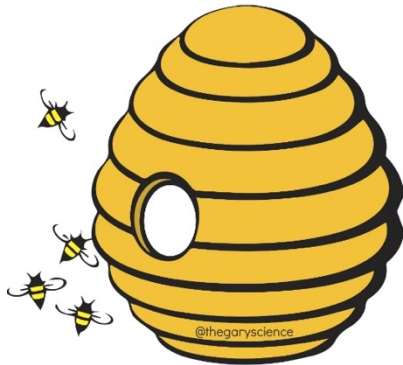
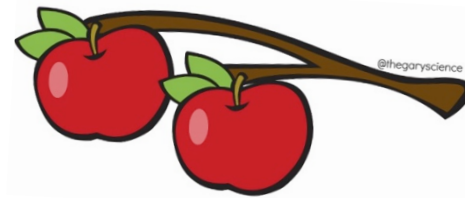
~~NO~~FRUCTOSE

Fructose



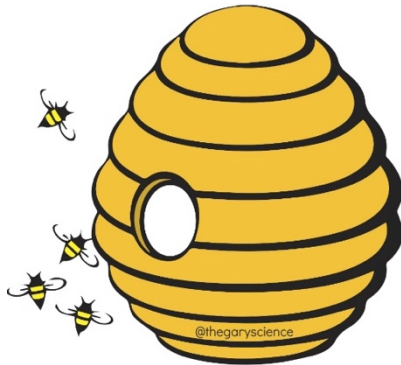
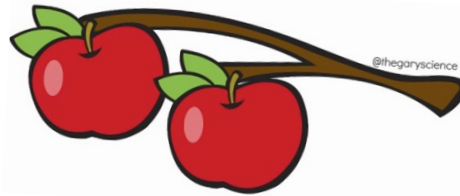
~~NO~~FRUCTOSE

Fructose



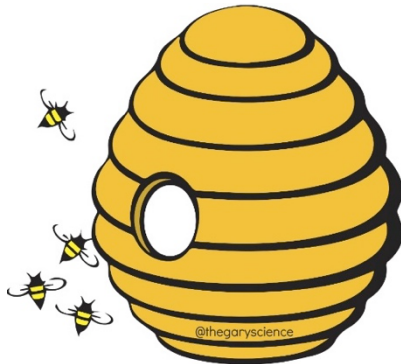
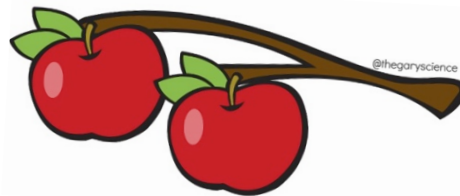
~~NO~~FRUCTOSE

Fructose



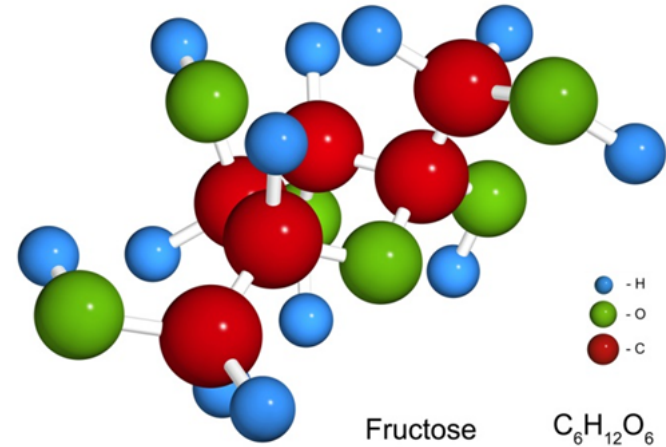
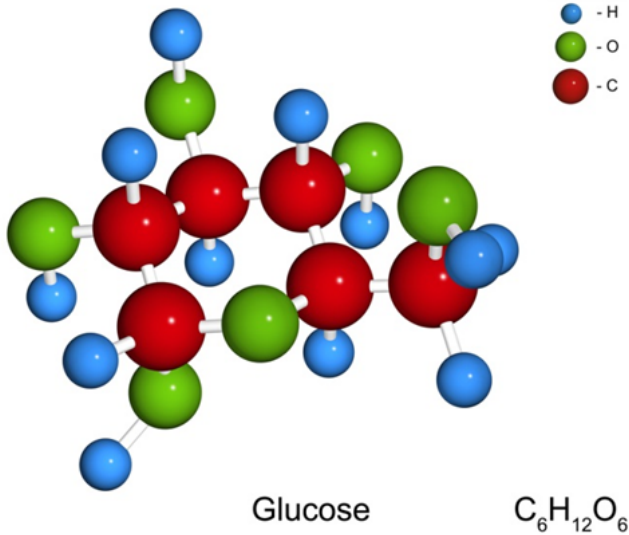
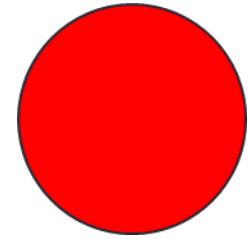
~~NO~~FRUCTOSE

Fructose



NO / **FRUCTOSE**

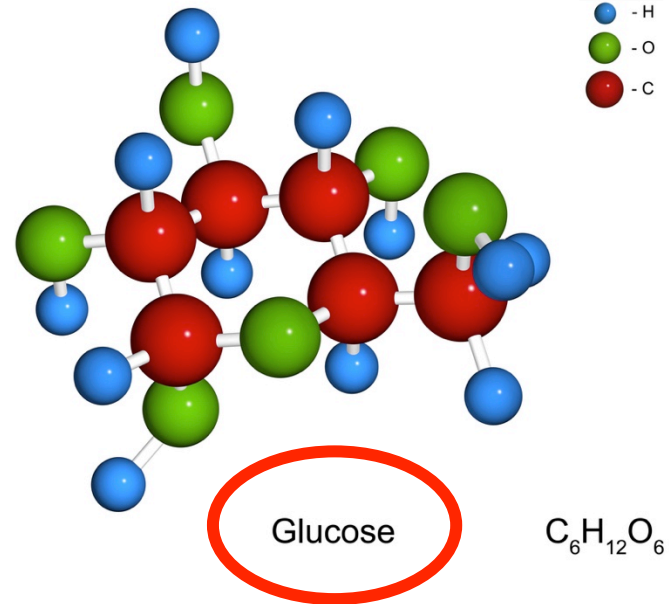
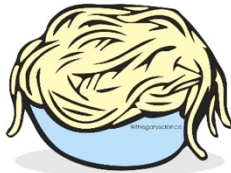
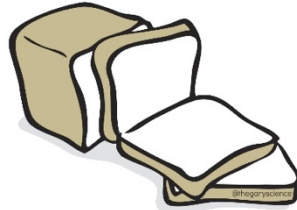
Carbohydrates



~~NO~~FRUCTOSE

Carbohydrate - Glucose

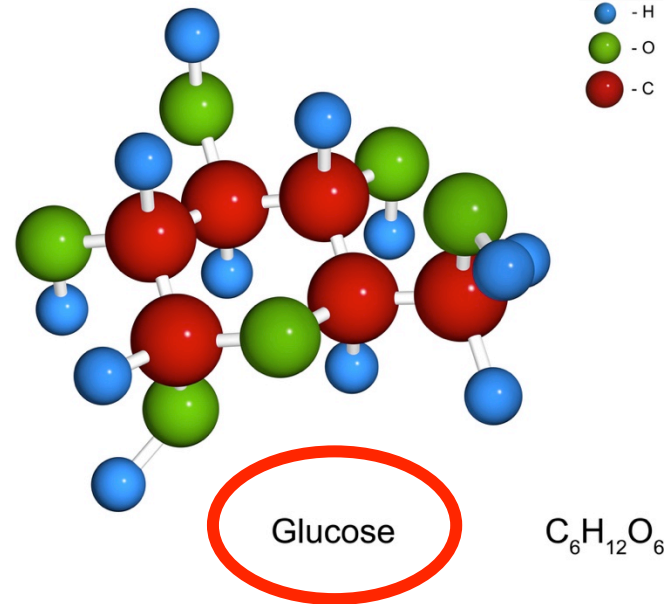
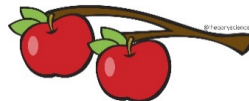
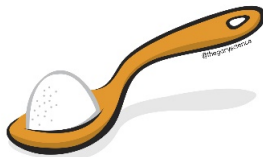
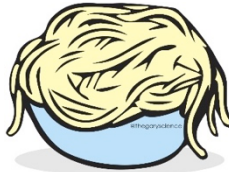
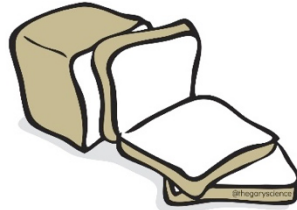
- Glucose
- Starches
 - Bread
 - Rice
 - Pasta
 - Cereal
 - Potato
- Maltose
- Lactose
- Dextrose
- ?



~~NO~~FRUCTOSE

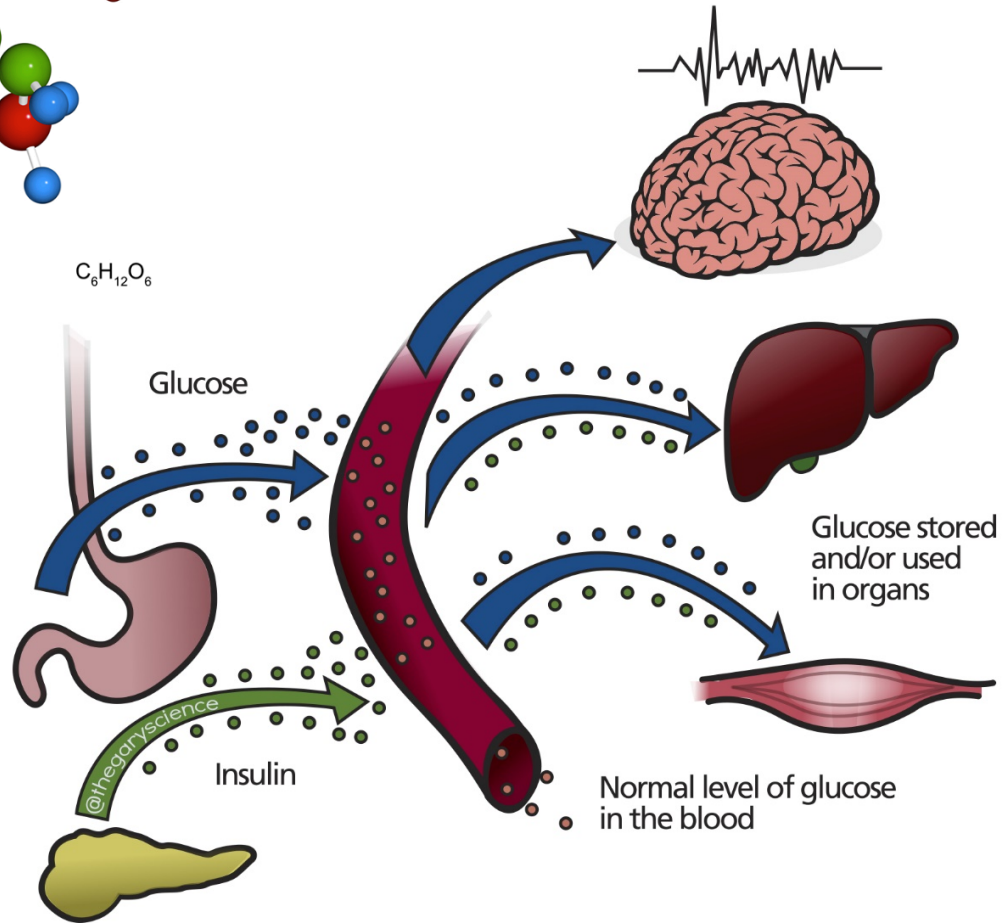
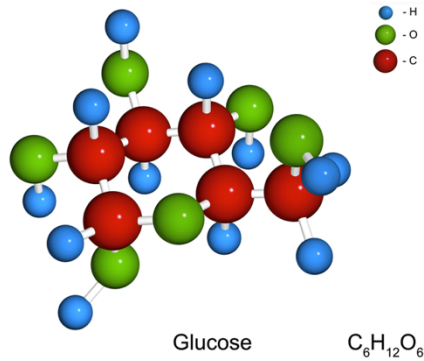
Carbohydrate - Glucose

- Glucose
- Starches
 - Bread
 - Rice
 - Pasta
 - Cereal
 - Potato
- Maltose
- Lactose
- Dextrose
- "Fructose"

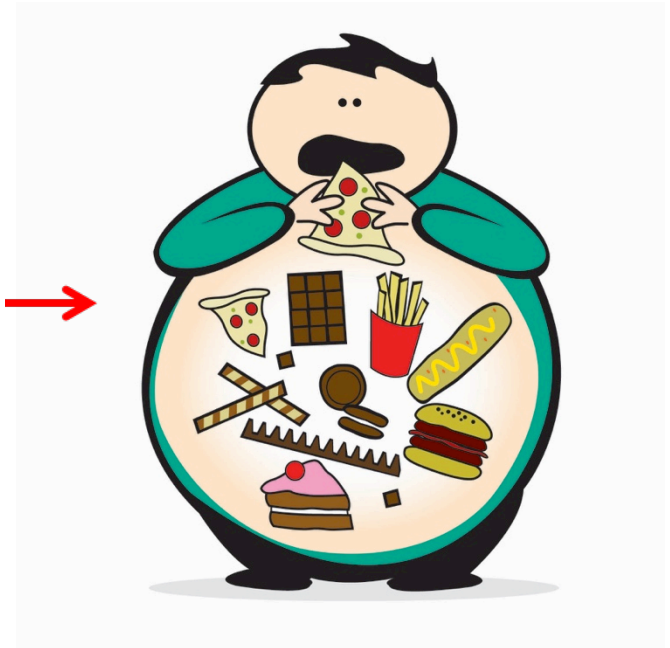
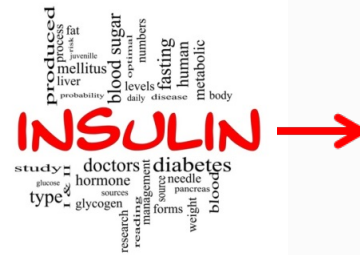
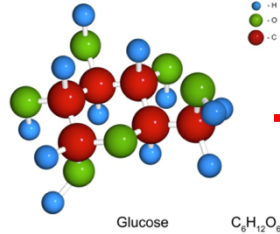
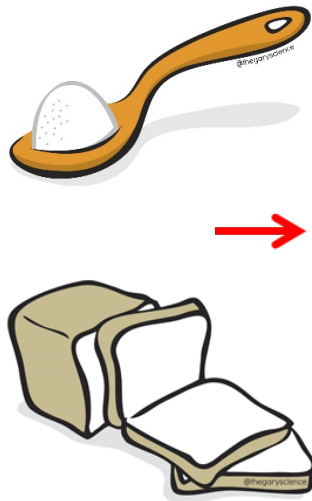


~~NO~~FRUCTOSE

Glucose Metabolism

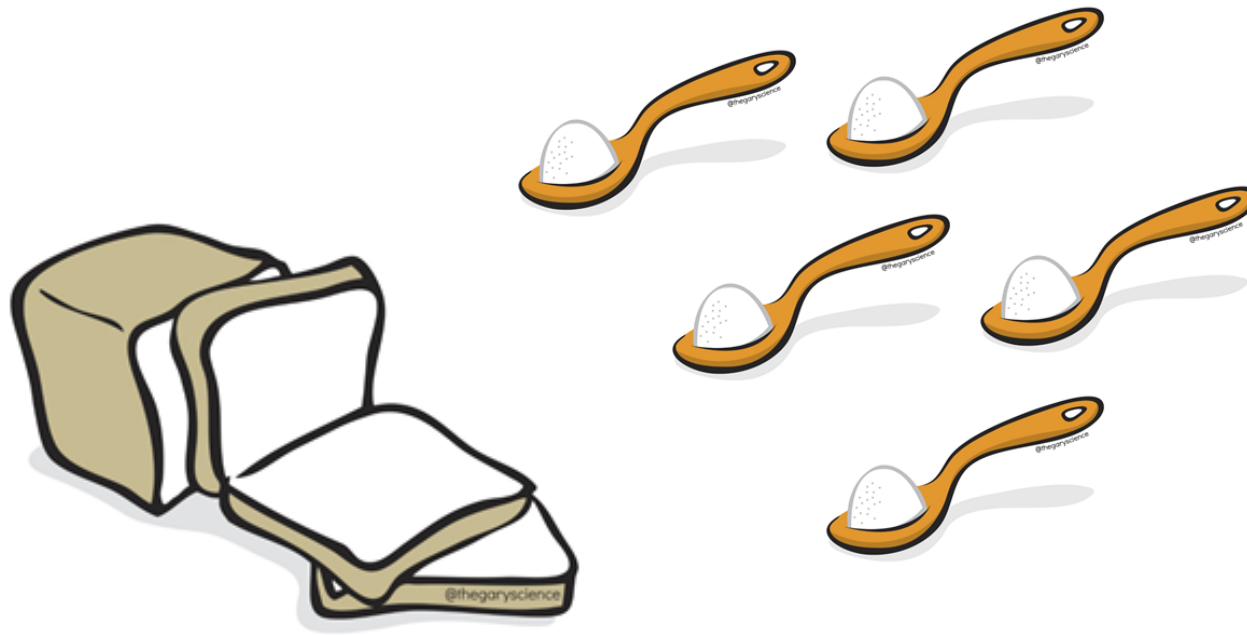


Refined Carbs (Glucose)



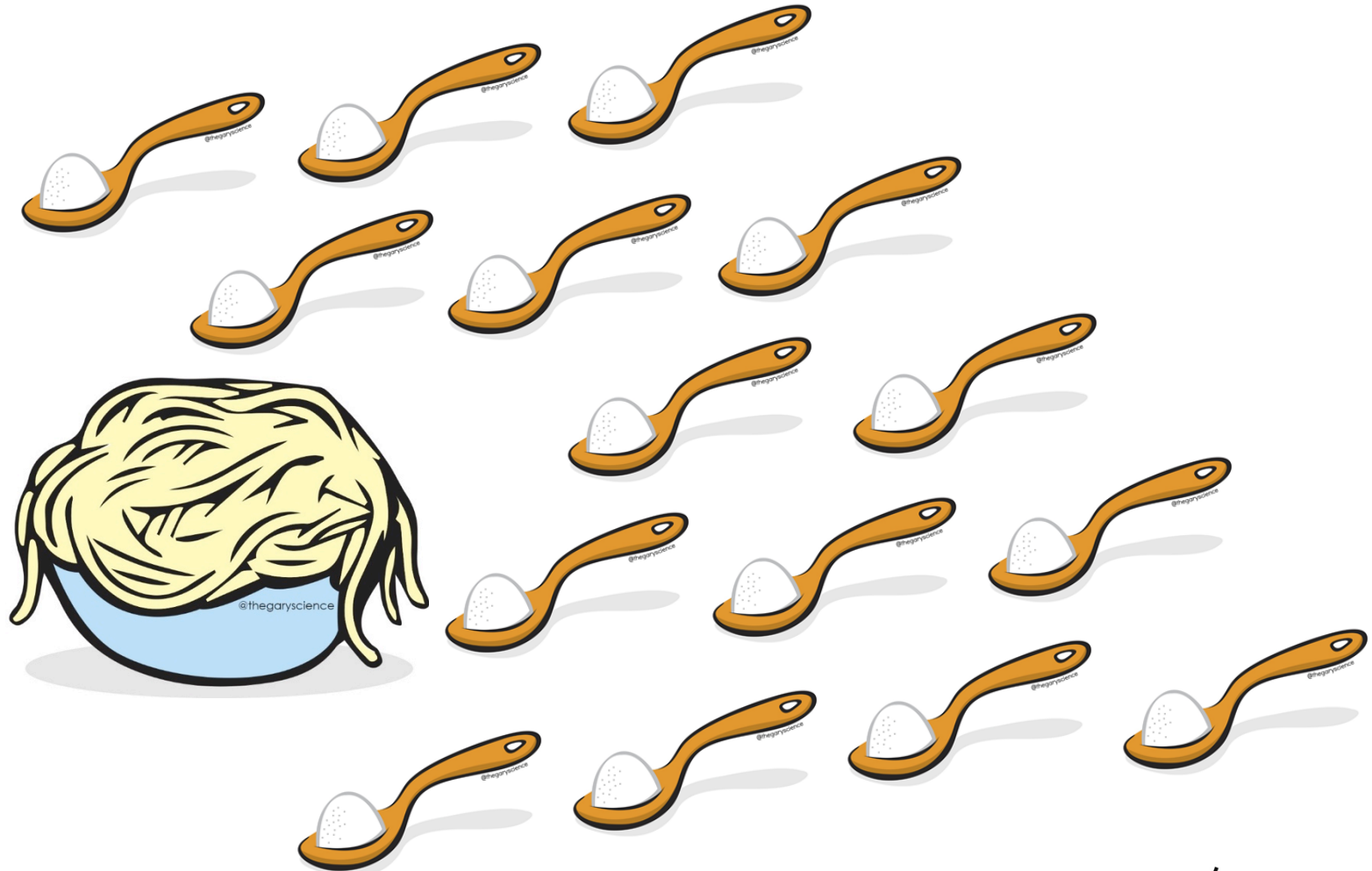
~~NO~~FRUCTOSE

Bread



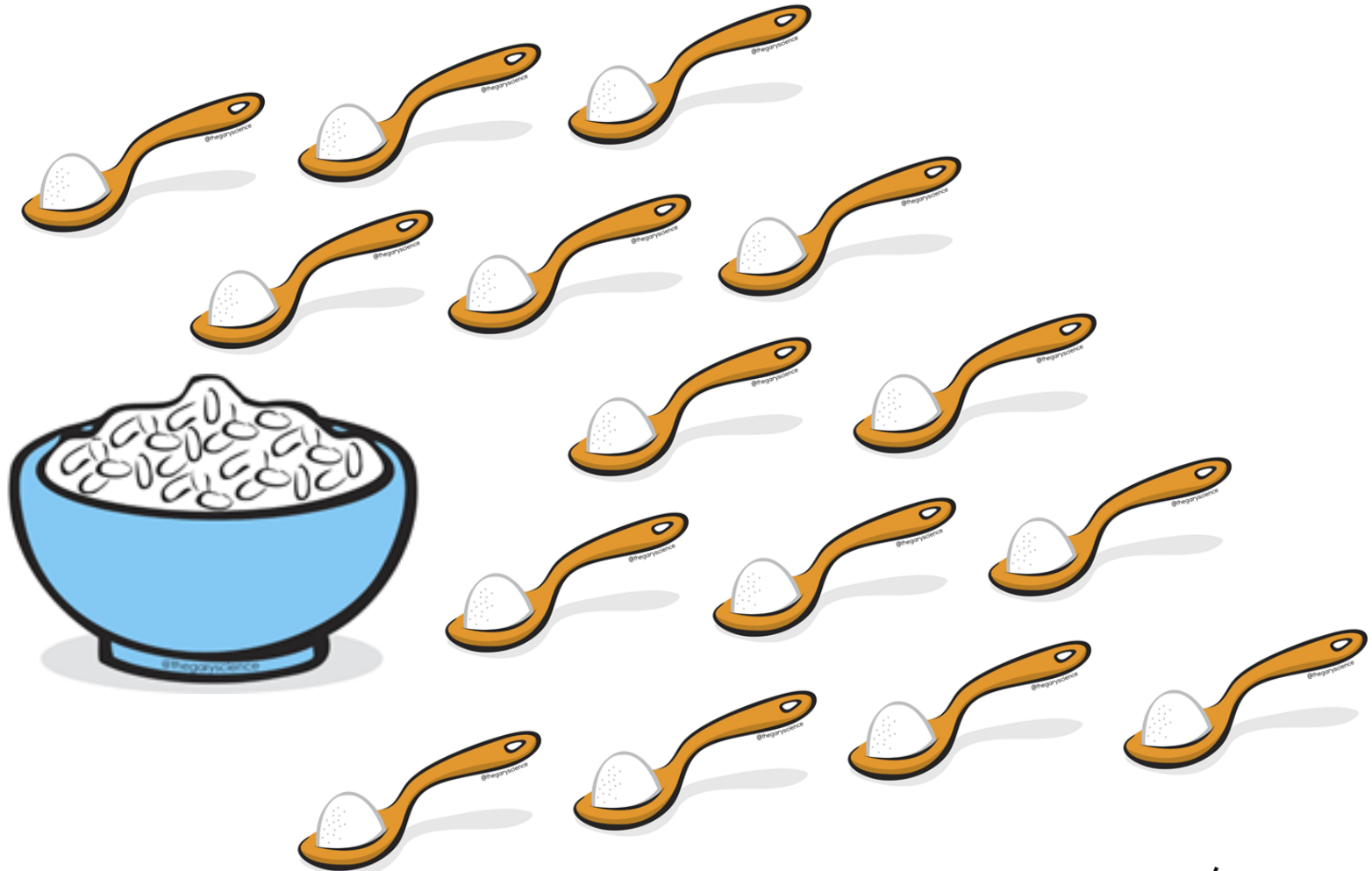
~~NO~~FRUCTOSE

Pasta



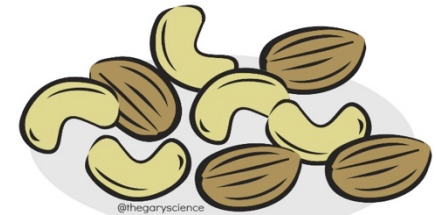
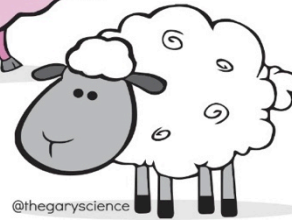
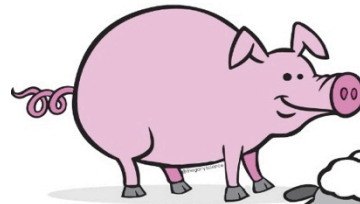
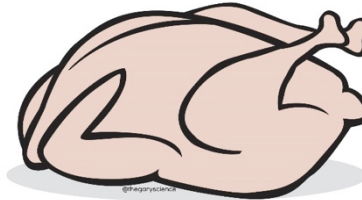
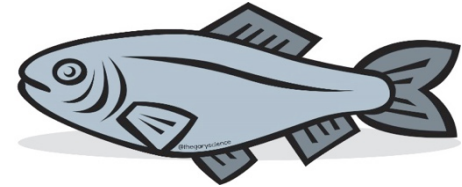
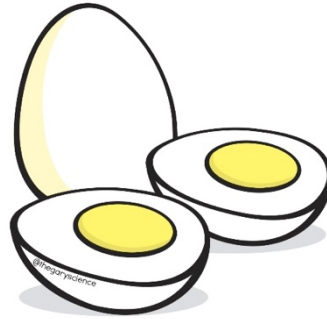
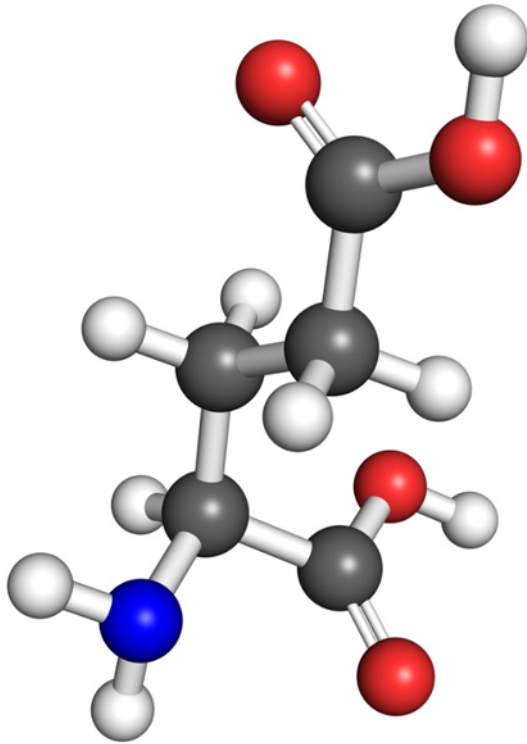
~~NO~~FRUCTOSE

Rice



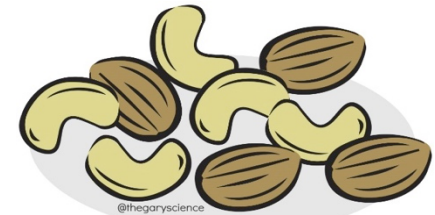
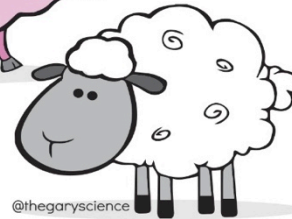
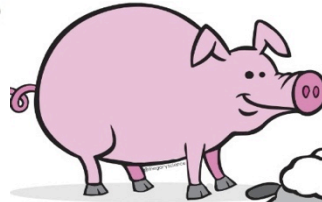
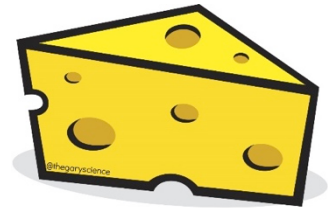
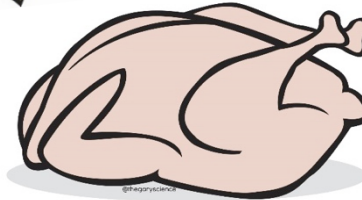
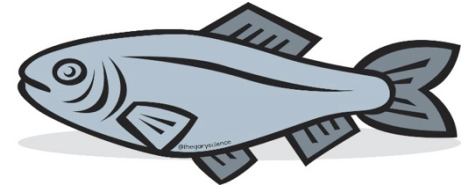
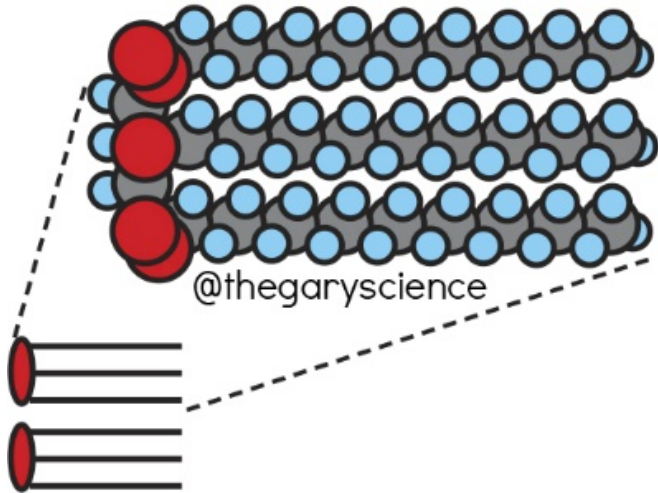
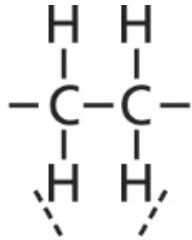
~~NO~~FRUCTOSE

Protein



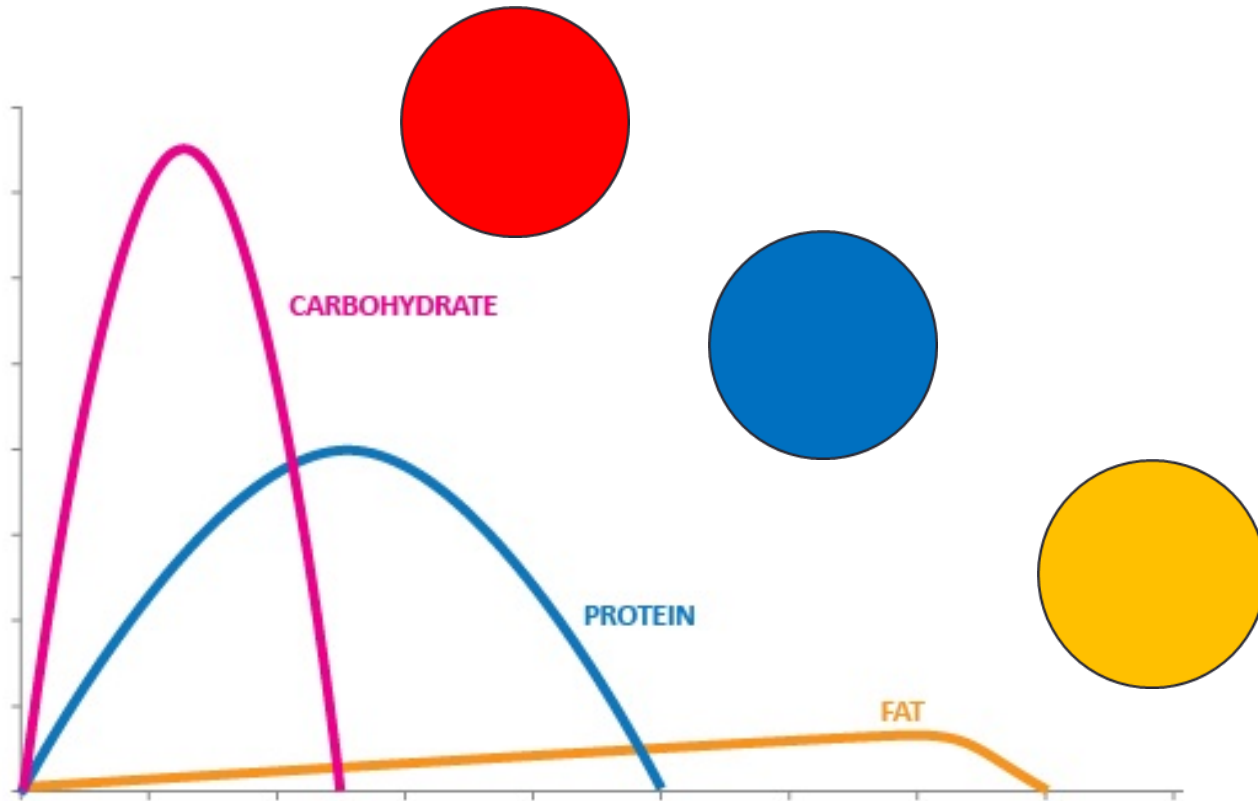
NO / **FRUCTOSE**

Healthy Fat



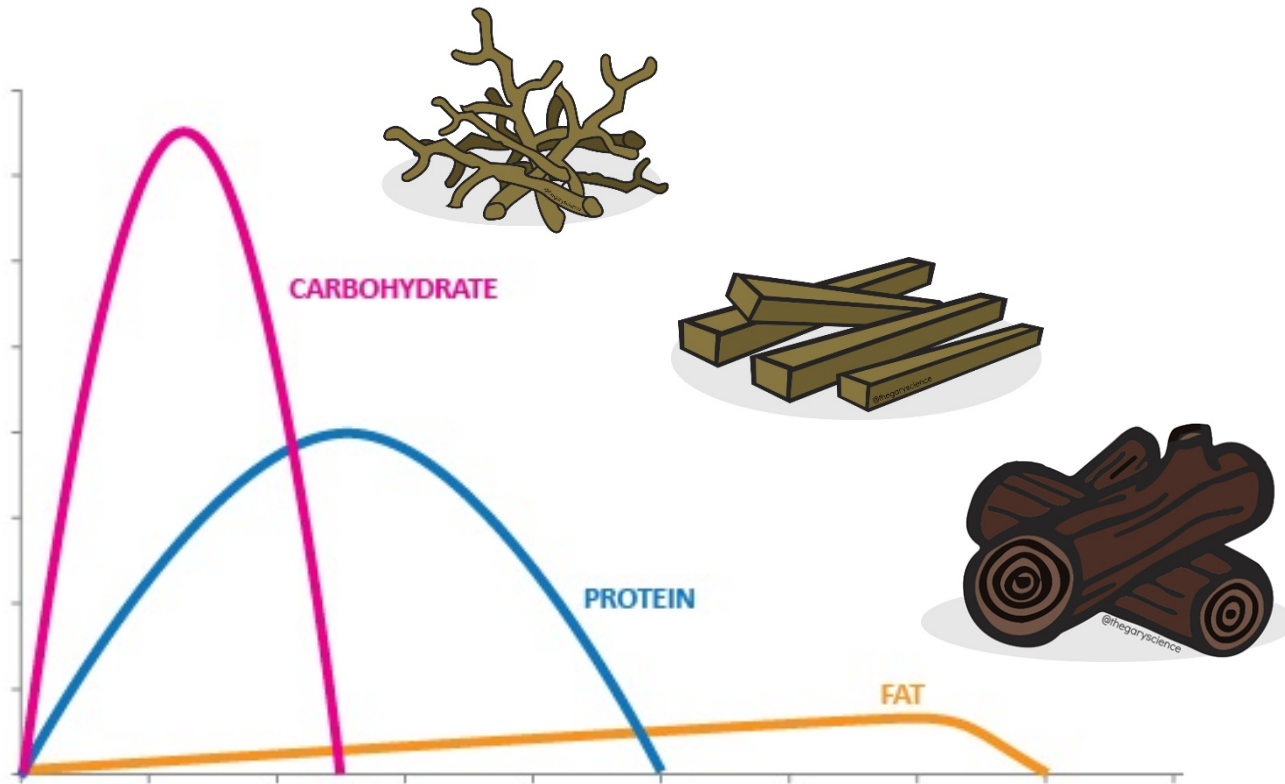
~~NO~~FRUCTOSE

Blood Glucose / Insulin



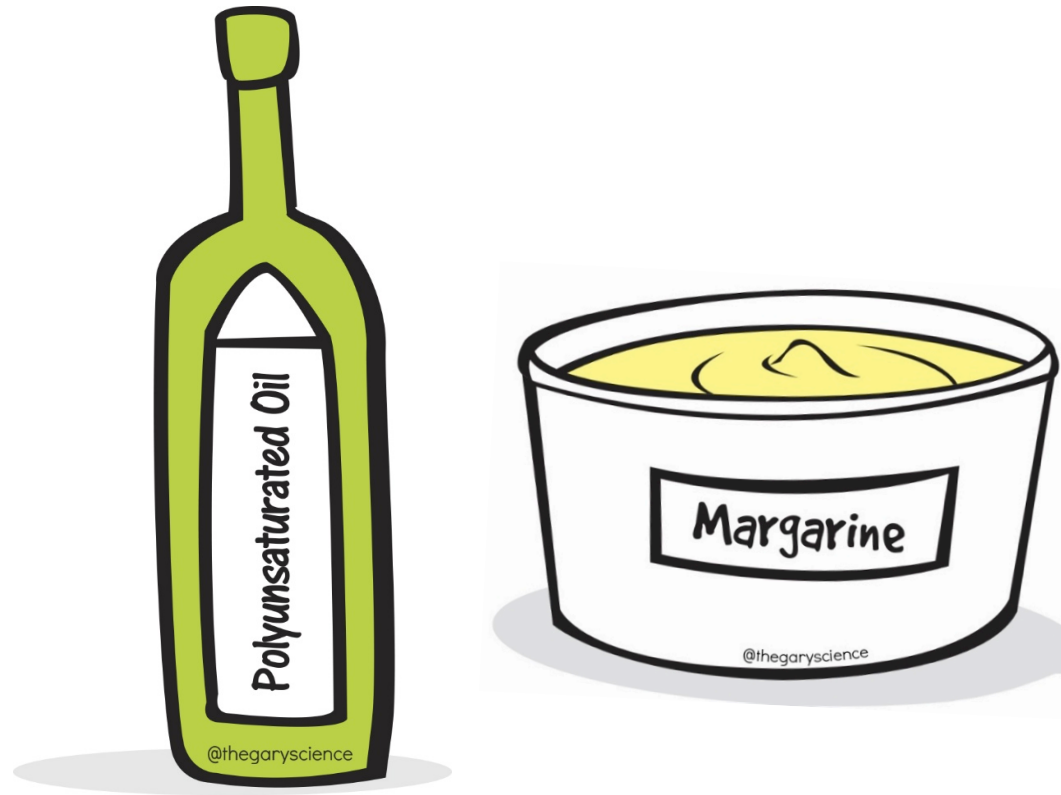
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Blood Glucose



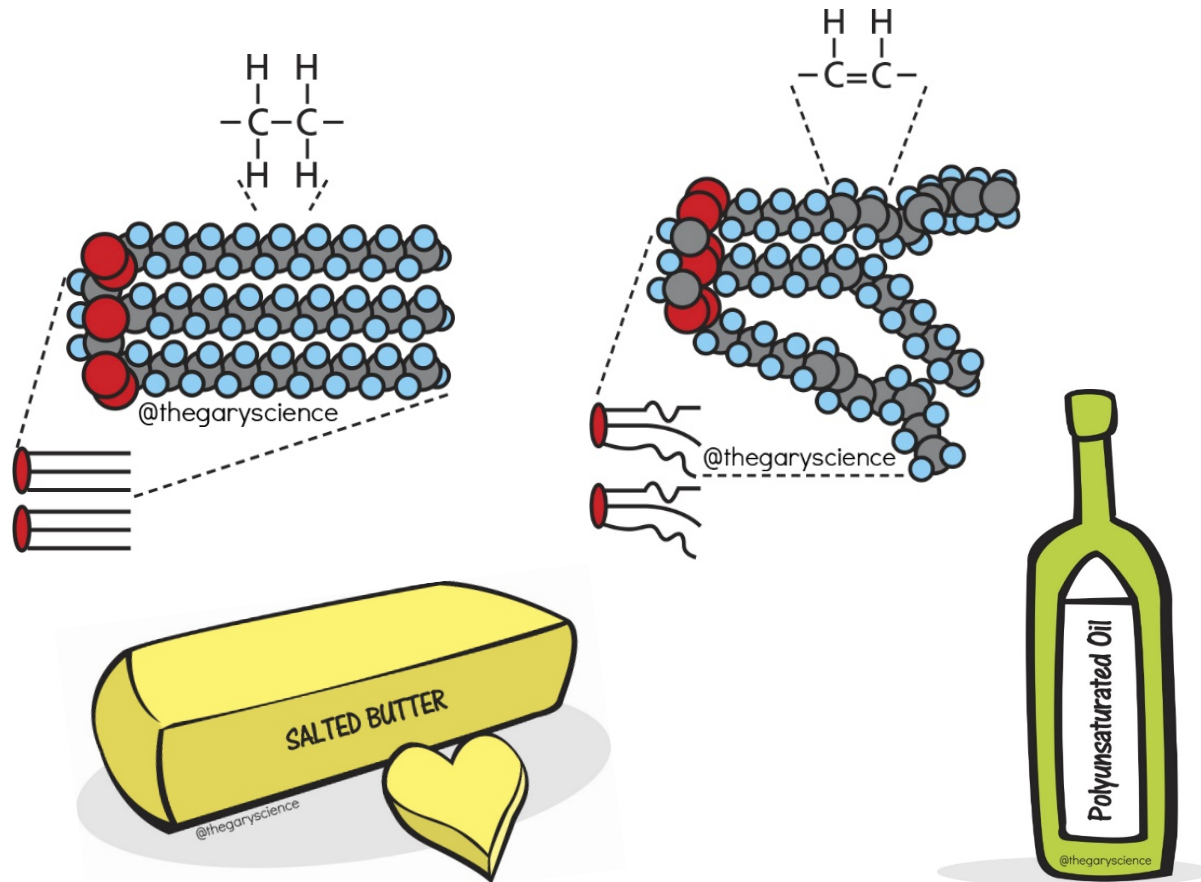
~~NO~~FRUCTOSE

Polyunsaturated Oils - PUF's



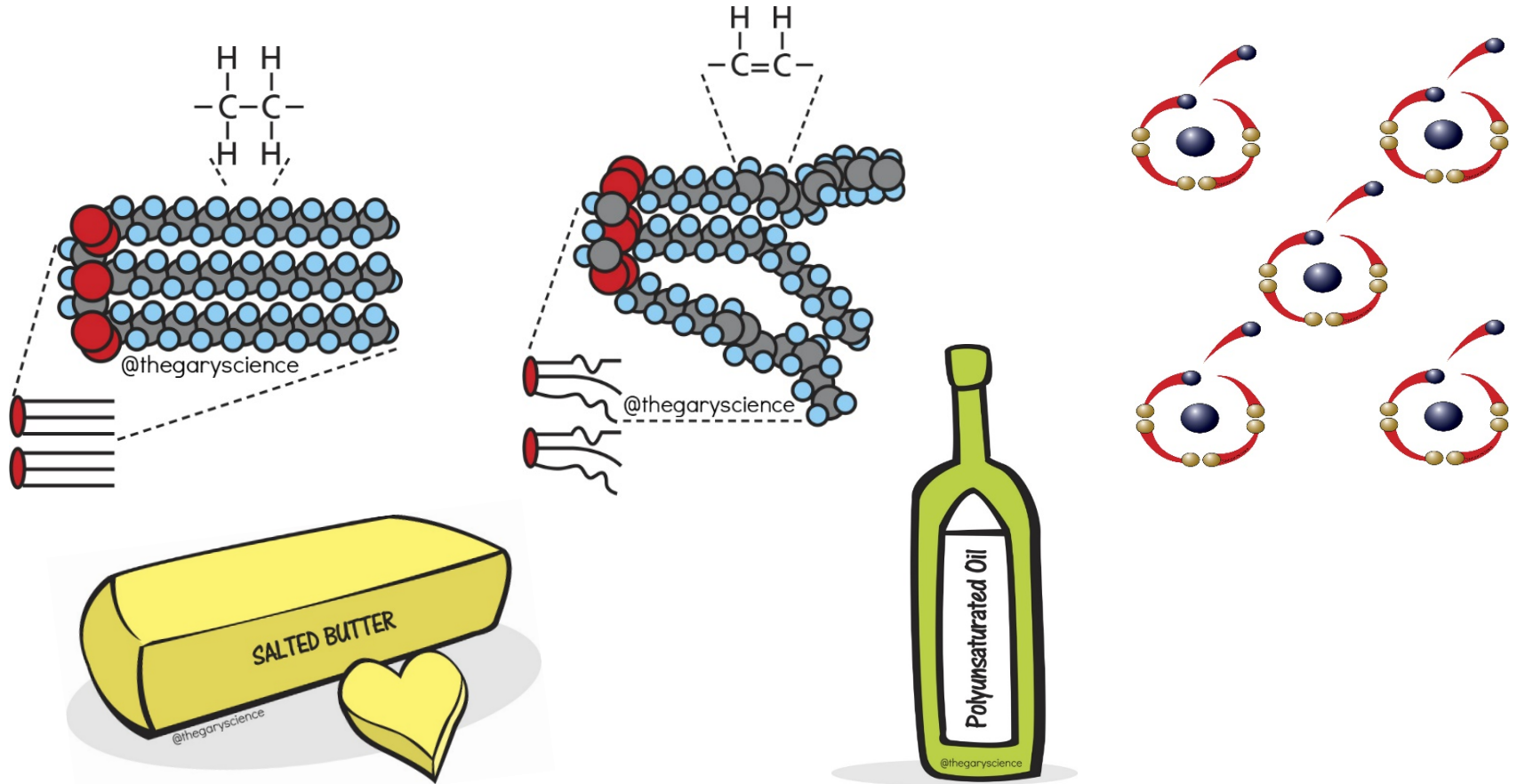
~~NO~~FRUCTOSE

'Fat' or 'Oil'



NO / **FRUCTOSE**

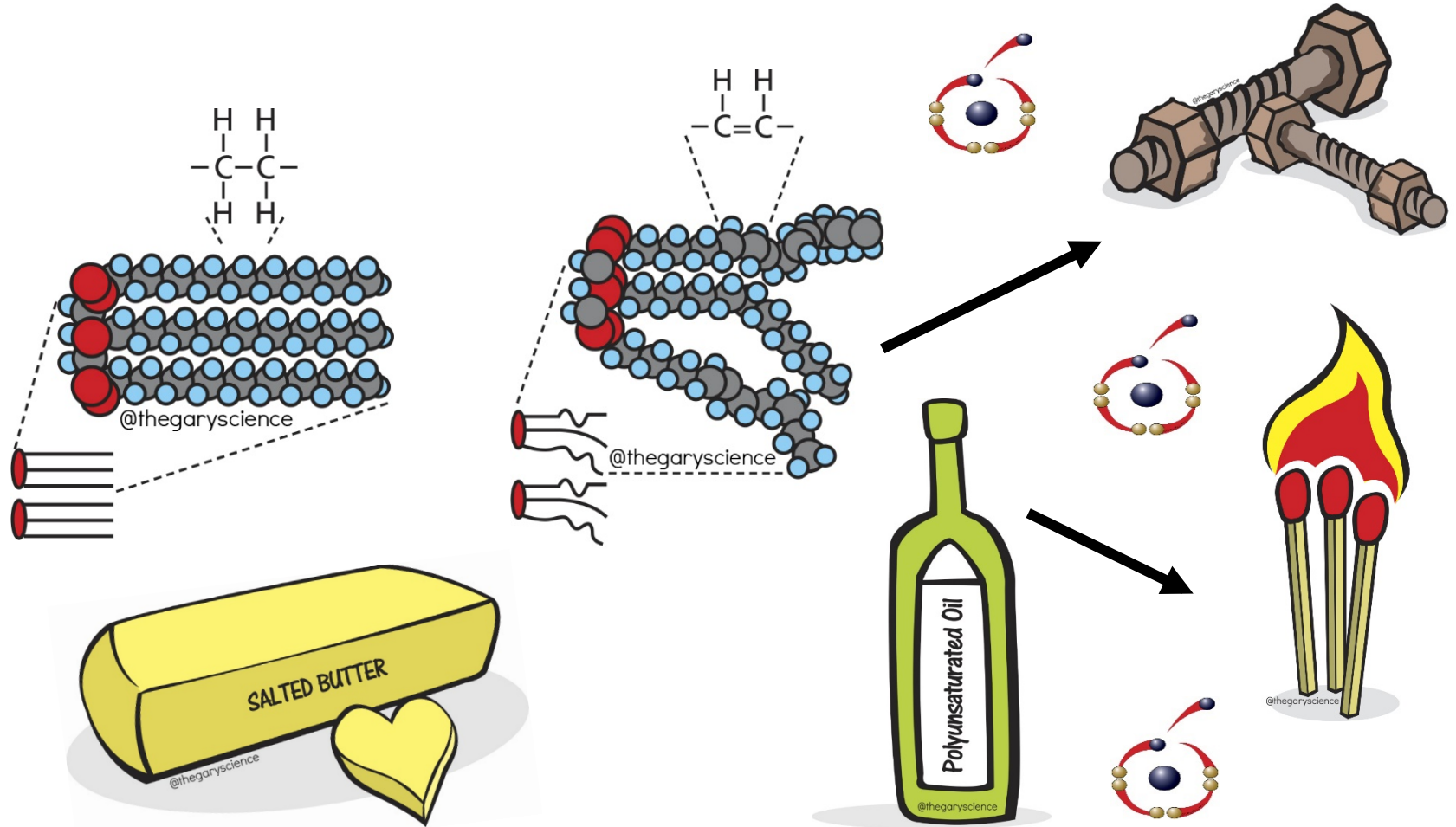
'Fat' or 'Oil'



Lawrence GD, Dietary fats and health: dietary recommendations in the context of scientific evidence. *Adv Nutrition*. 2013 May 1;4(3):294-302.

NO / **FRUCTOSE**

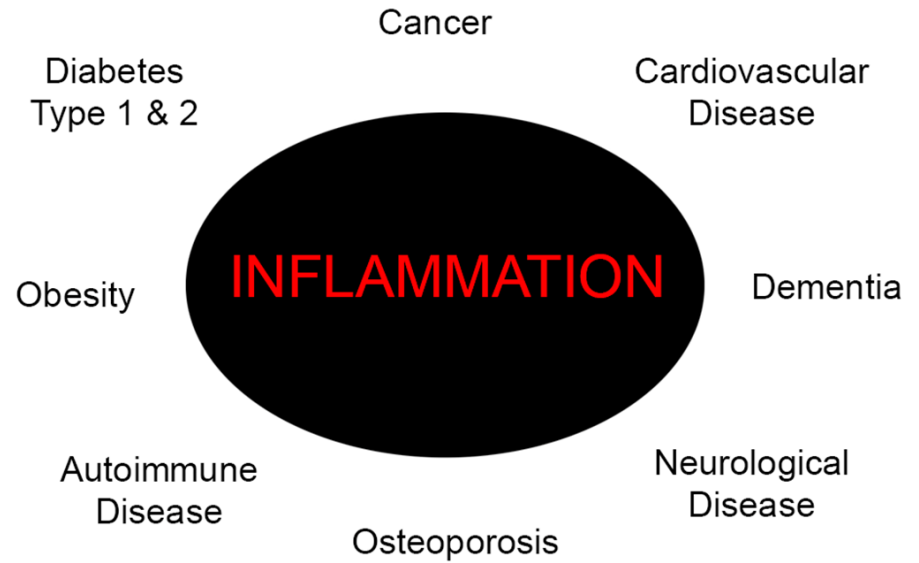
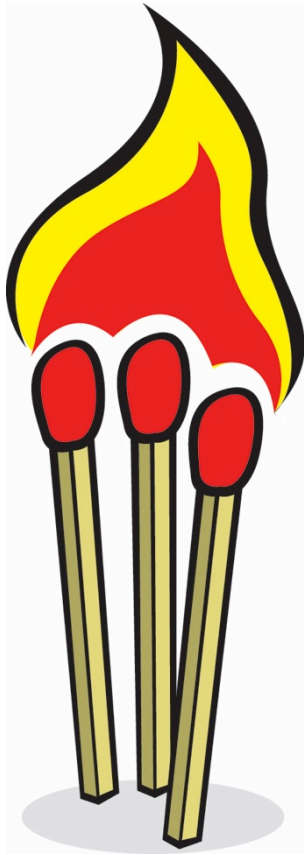
Saturated or Polyunsaturated



Lawrence GD, Dietary fats and health: dietary recommendations in the context of scientific evidence. *Adv Nutrition*. 2013 May 1;4(3):294-302.

~~NO~~FRUCTOSE

Mechanism



~~NO~~FRUCTOSE

Model of 'Modern' Disease

- Observation ✓
- Hypothesis ✓
- Mechanism ✓
- Pathophysiology
- Association evidence
- Intervention evidence

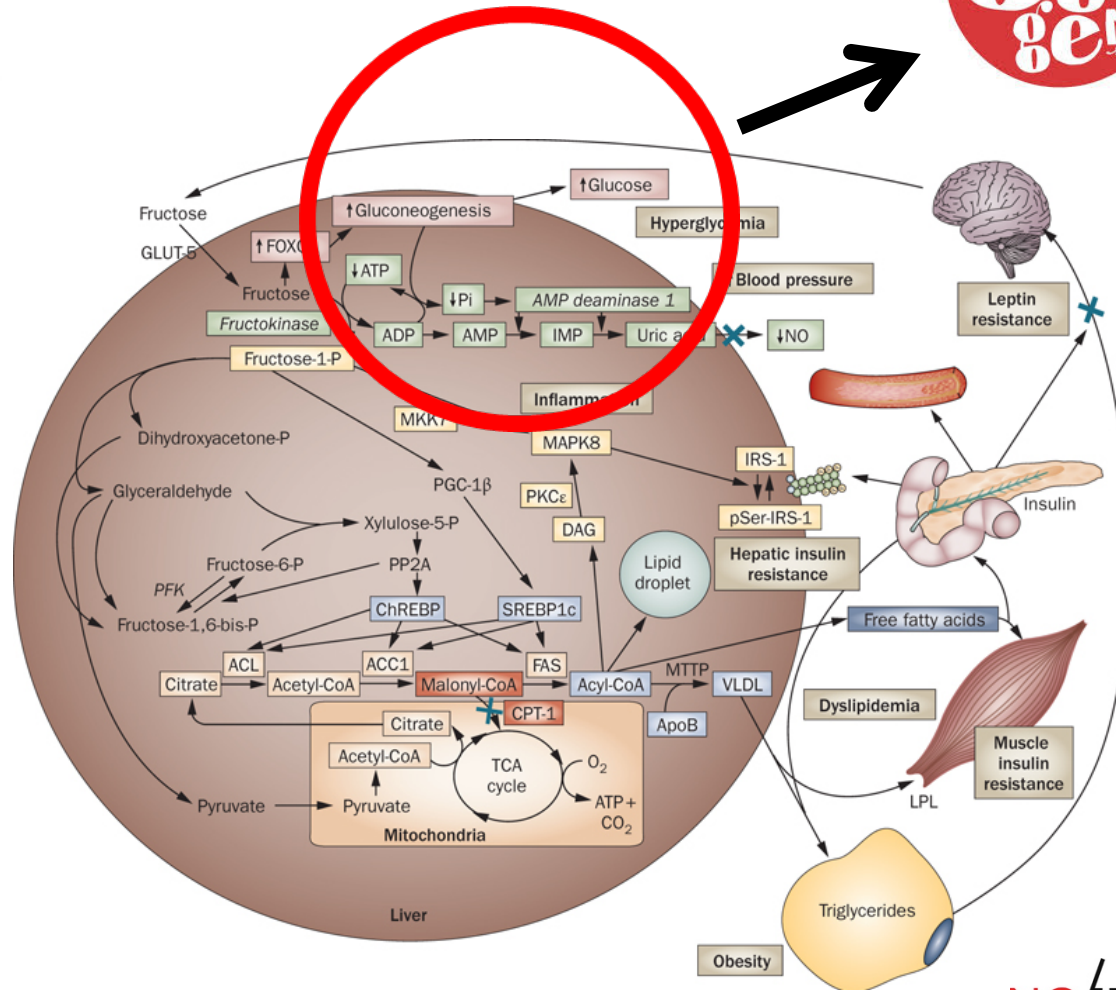
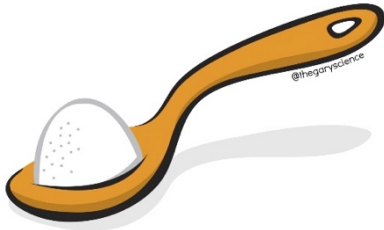


Pathophysiology



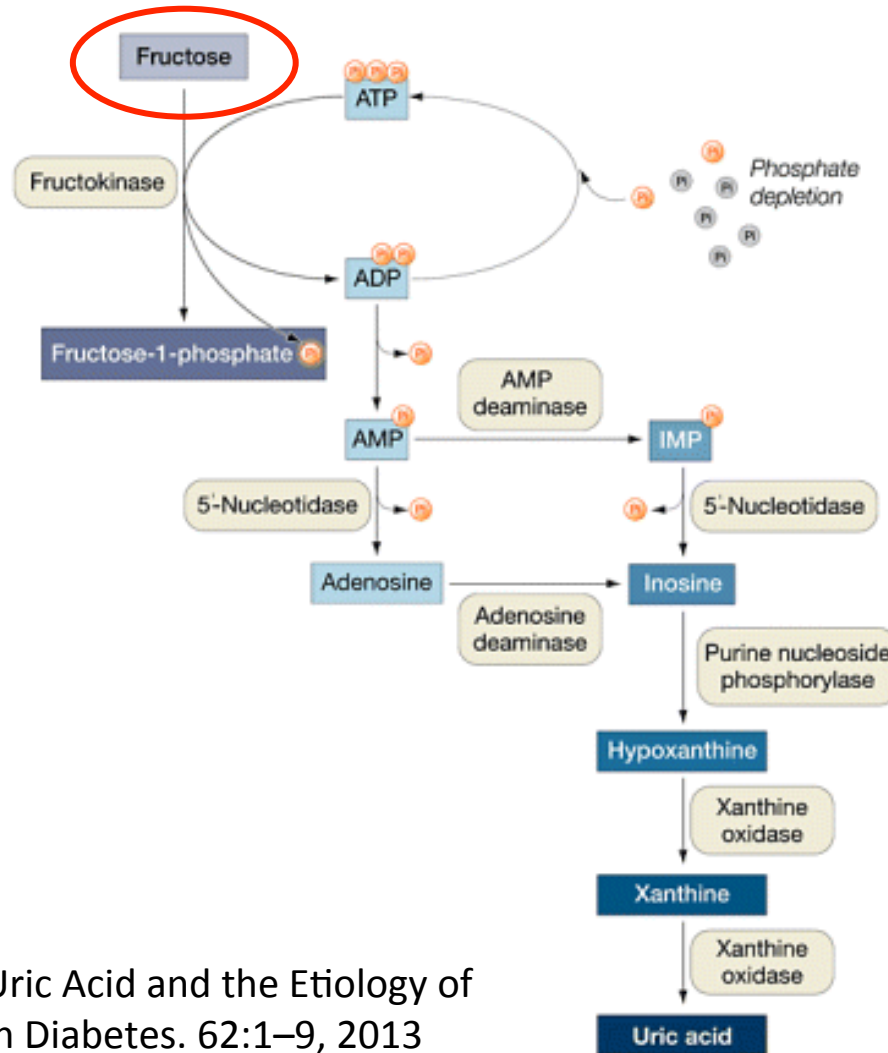
NO/FRUCTOSE

Fructose to Glycogen



NO FRUCTOSE

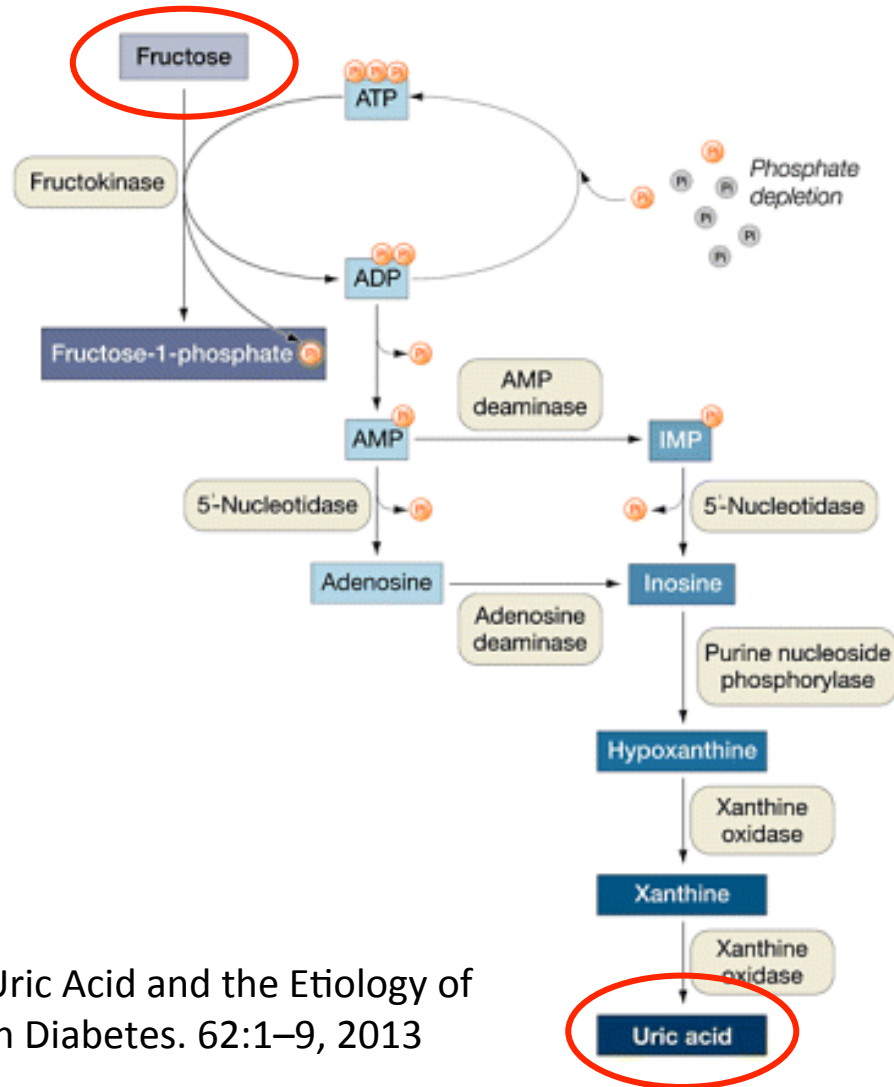
Fructose – Uric Acid



Johnson,R et al. Sugar, Uric Acid and the Etiology of Diabetes. Perspectives in Diabetes. 62:1–9, 2013

NOFRUCTOSE

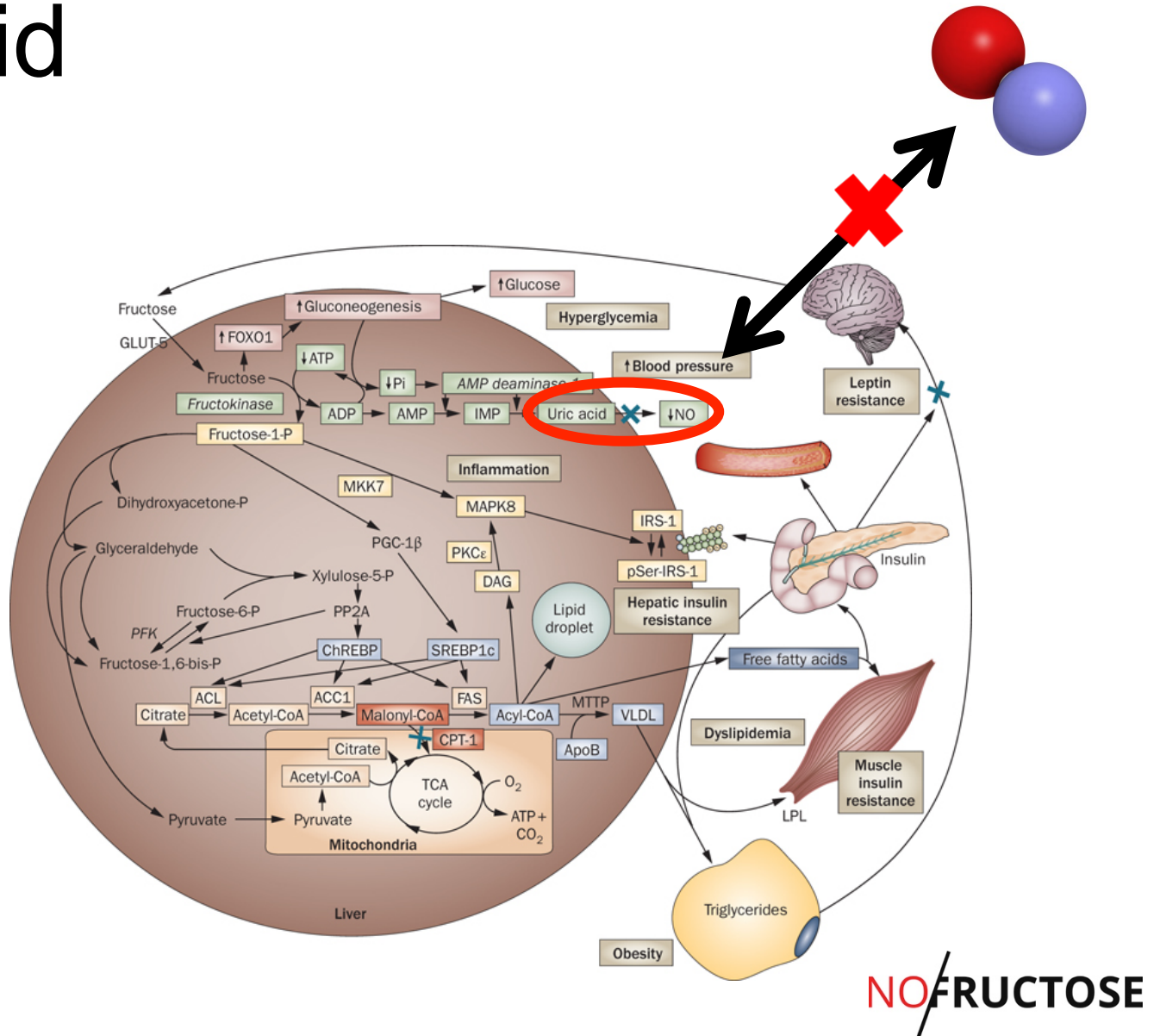
Fructose – Uric Acid



Johnson, R et al. Sugar, Uric Acid and the Etiology of Diabetes. Perspectives in Diabetes. 62:1–9, 2013

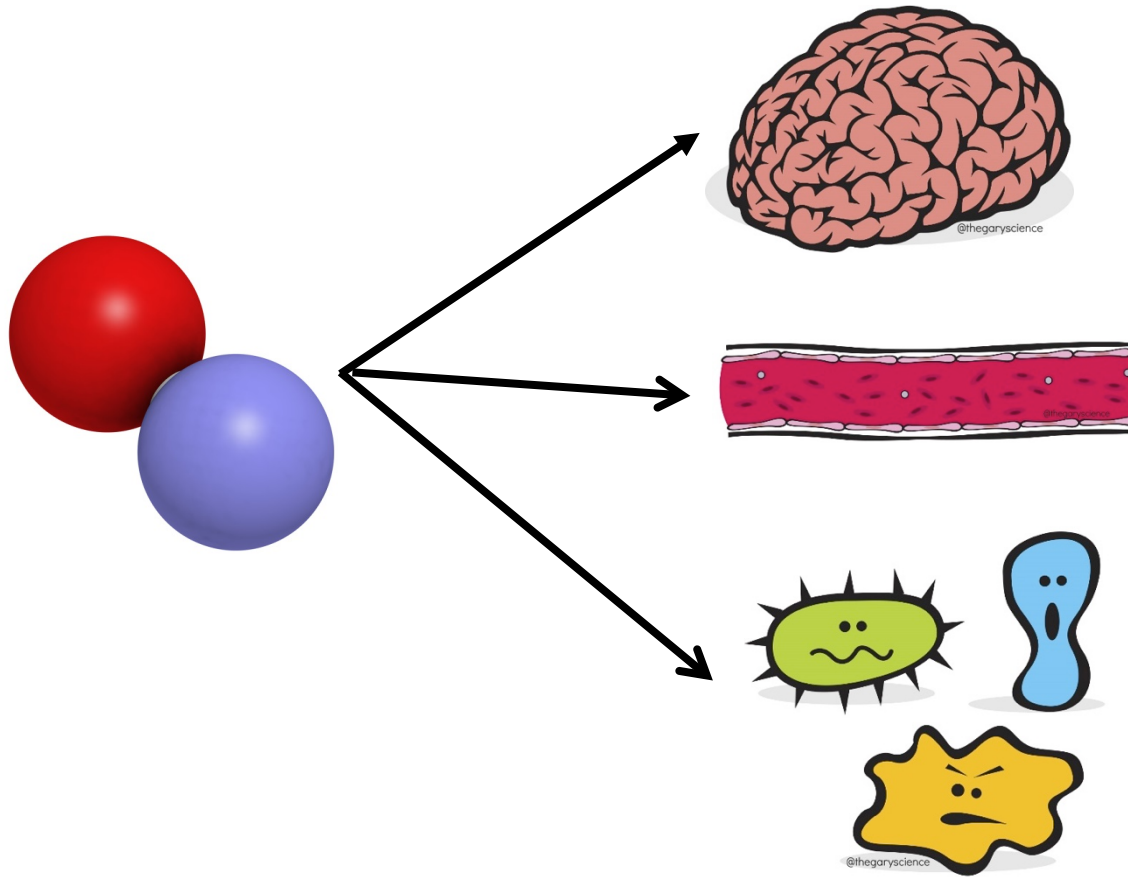
~~NO~~FRUCTOSE

Uric Acid



NOFRUCTOSE

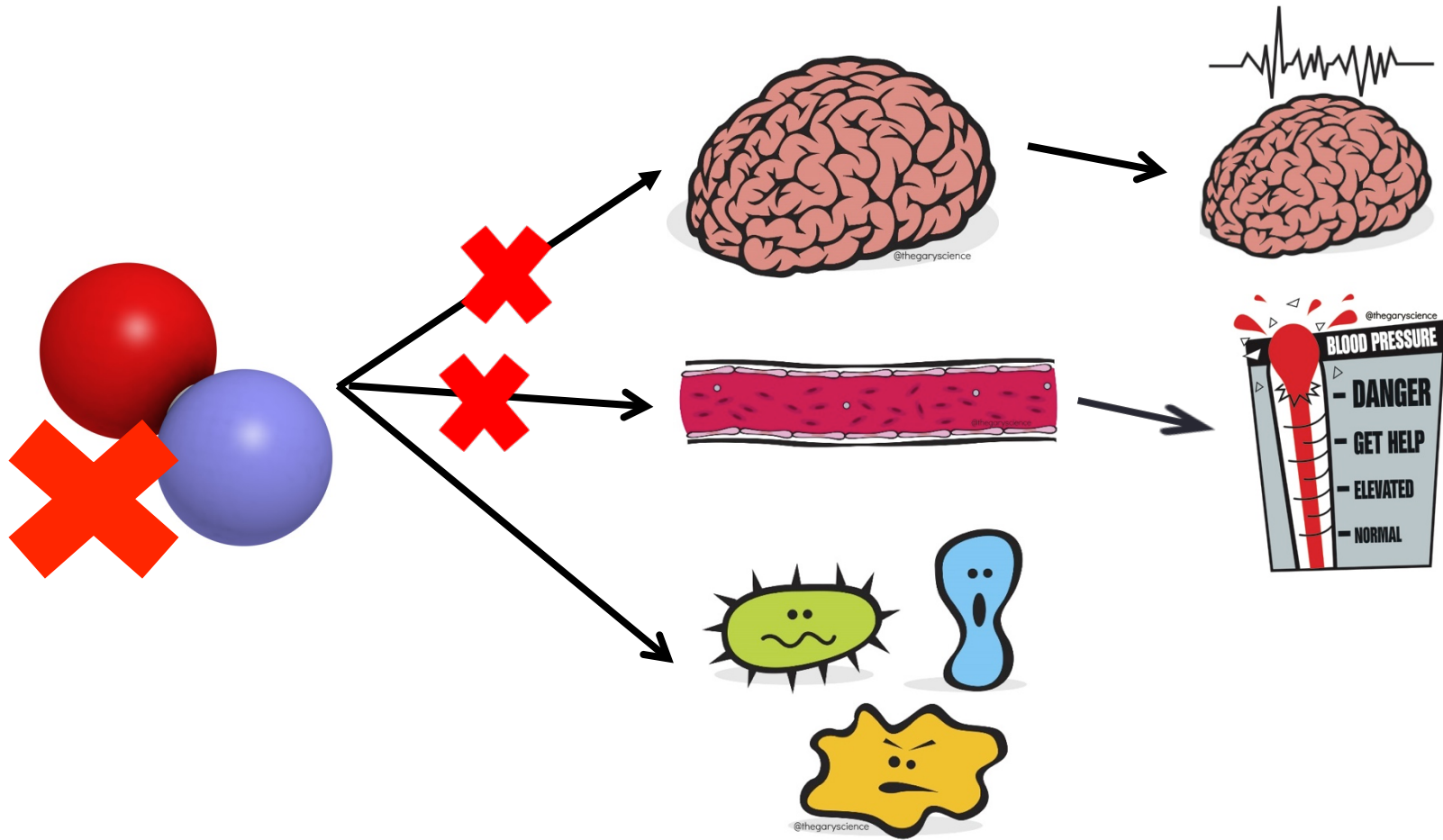
Nitric Oxide



Wenwen Cai et al. Acute metabolic and endocrine responses induced by glucose and fructose in healthy young subjects: A double-blinded, randomized, crossover trial. *Clinical Nutrition* S0261-5614(17)30047 Feb 2017

NO/FRUCTOSE

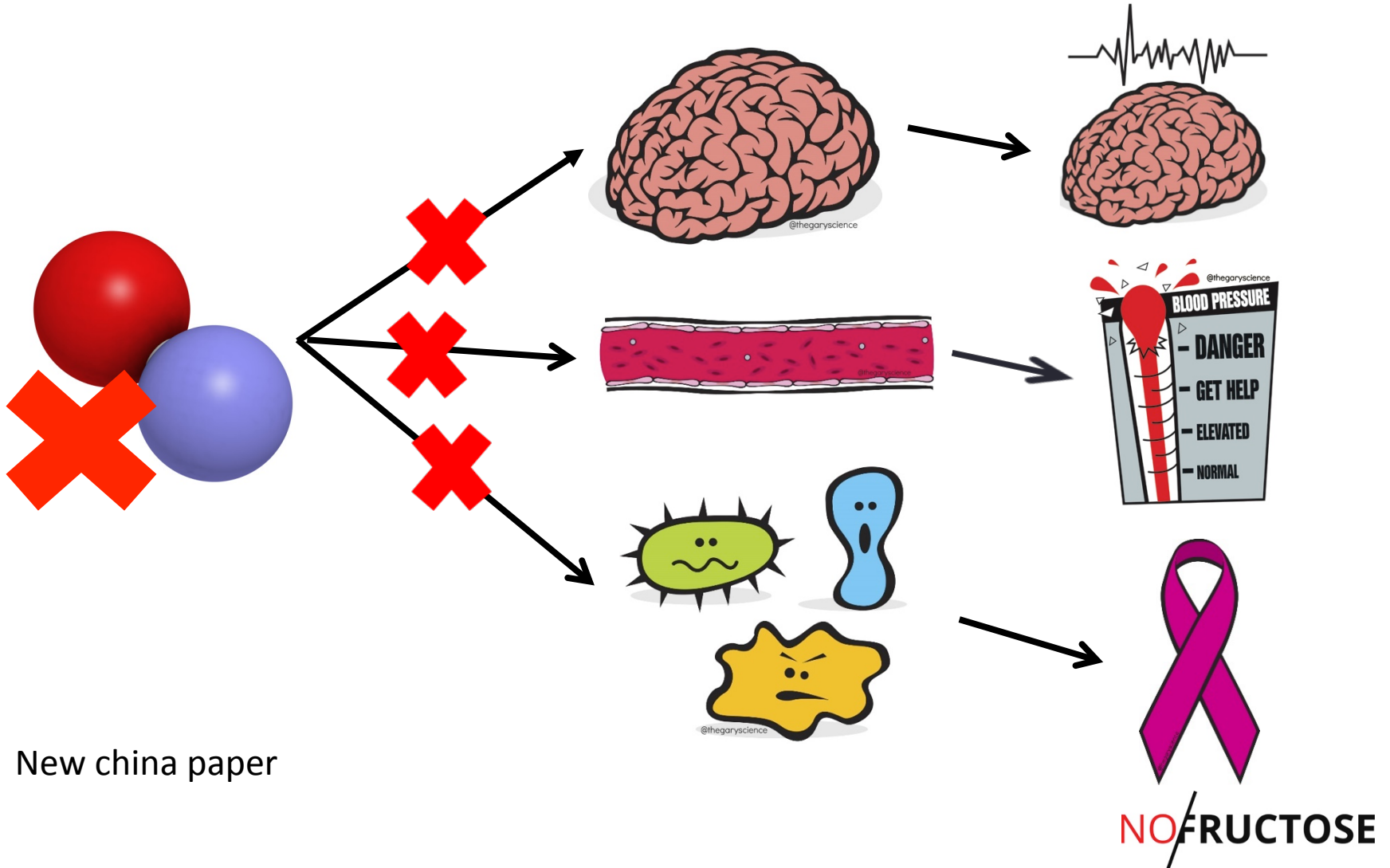
Nitric Oxide Inhibits Nitric Oxide



Wenwen Cai et al. Acute metabolic and endocrine responses induced by glucose and fructose in healthy young subjects: A double-blinded, randomized, crossover trial. *Clinical Nutrition* S0261-5614(17)30047 Feb 2017

NO/FRUCTOSE

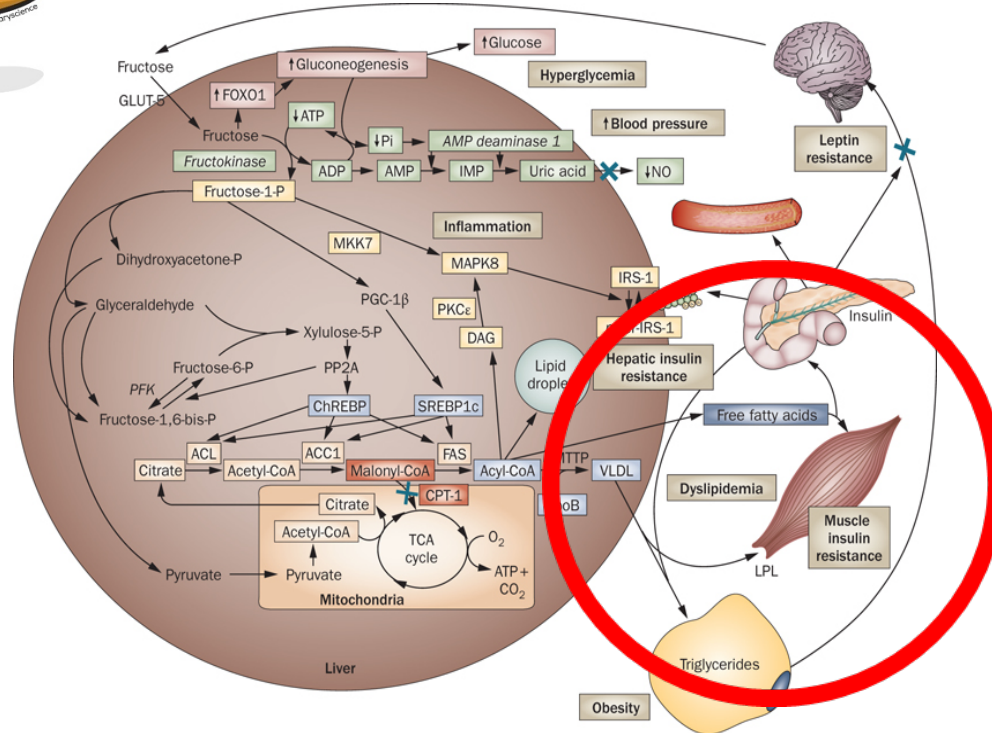
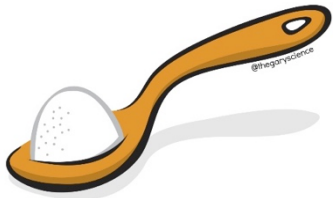
Nitric Oxide Inhibits Nitric Oxide



New china paper

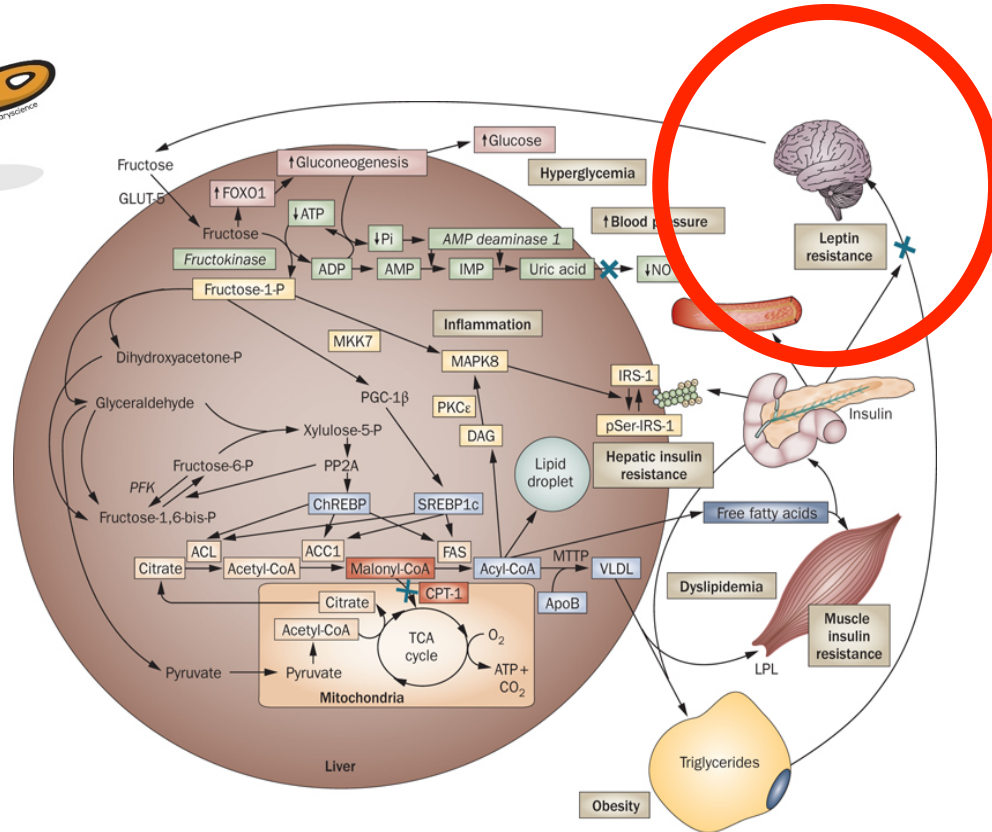
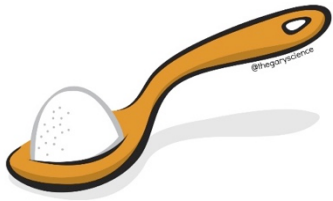
~~NO~~/FRUCTOSE

Insulin Resistance



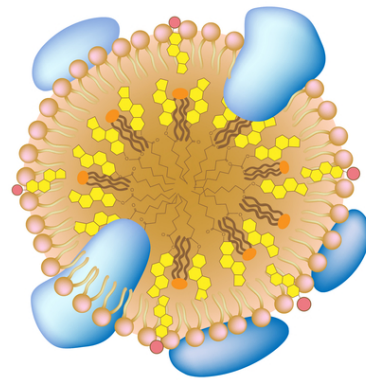
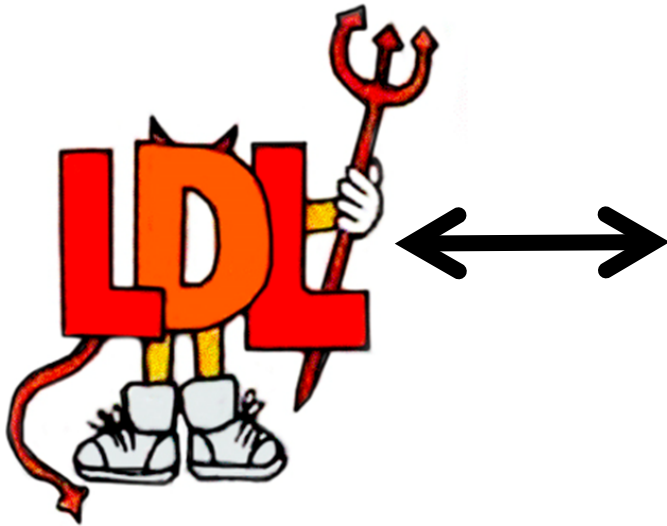
NO/~~FRUCTOSE~~

Leptin Inhibitor

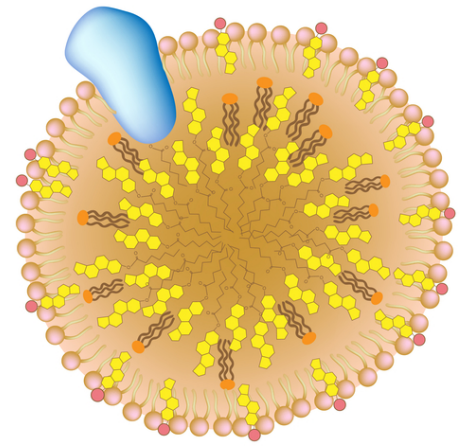


~~NO~~FRUCTOSE

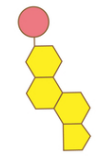
LDL's Filled with Fat



HDL



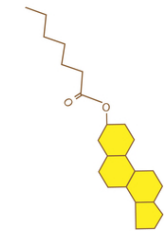
LDL



Cholesterol



Triglyceride



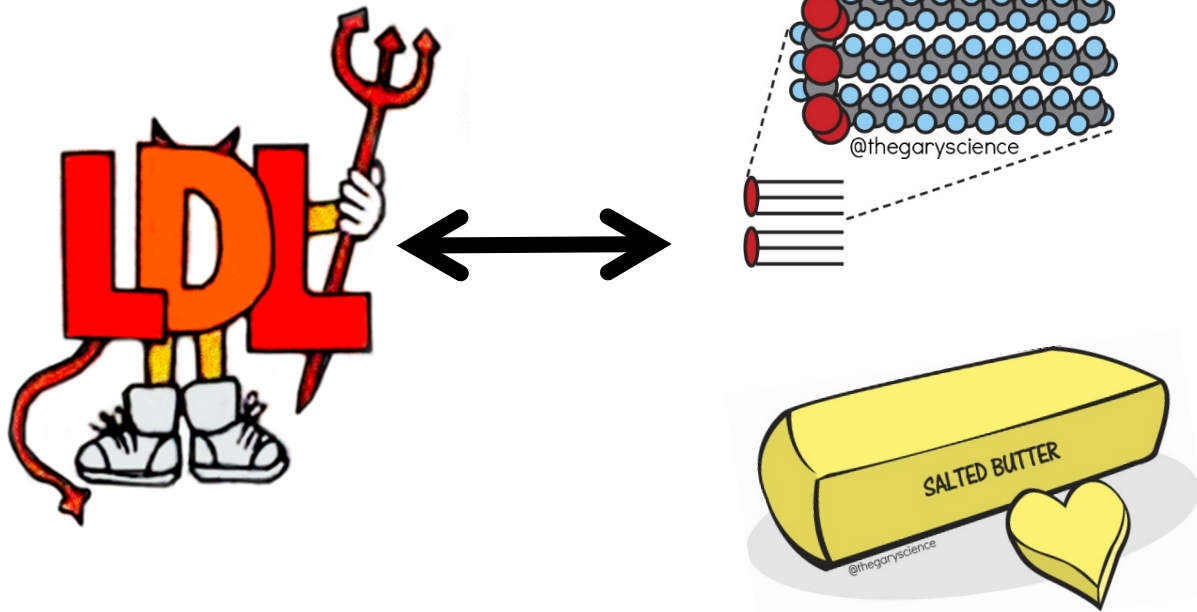
Cholesterol ester



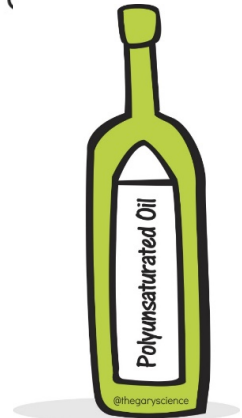
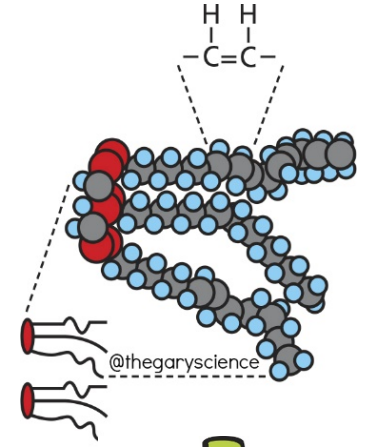
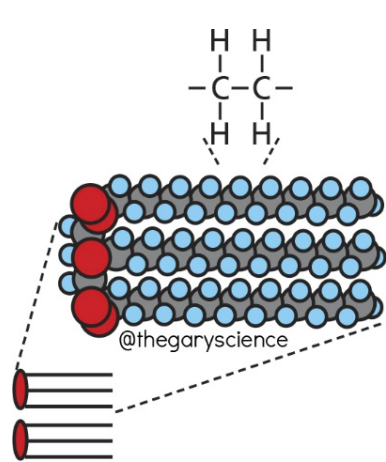
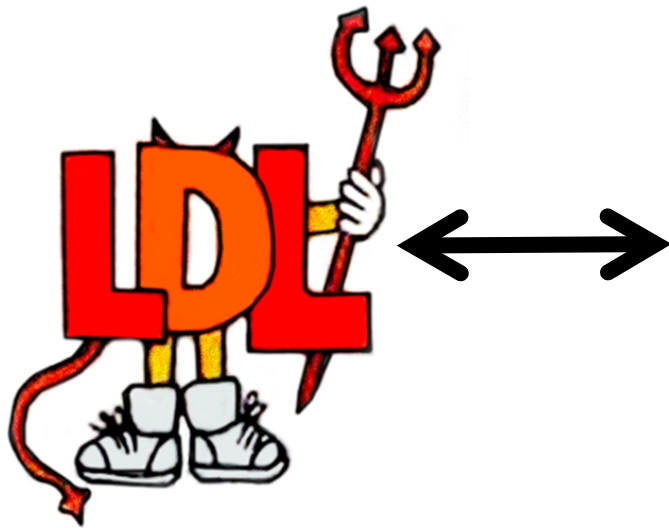
Apoprotein

NO / **FRUCTOSE**

LDL's Filled with Fat

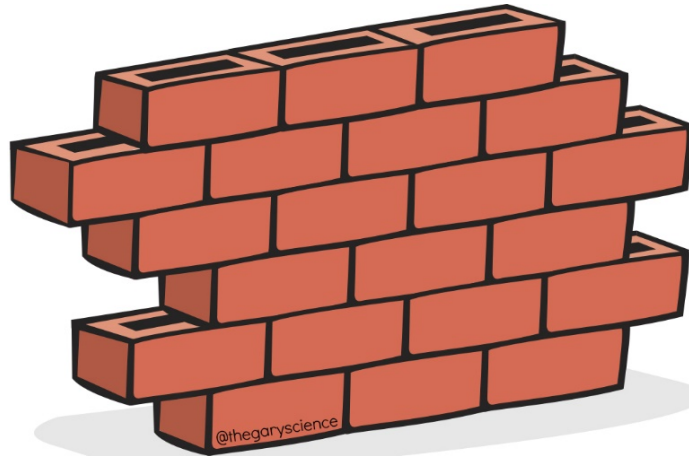
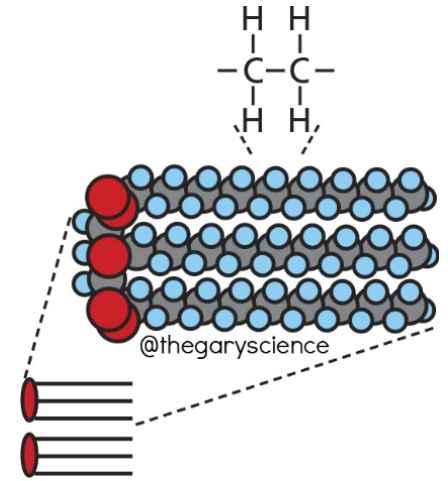


LDL's Filled with Fat



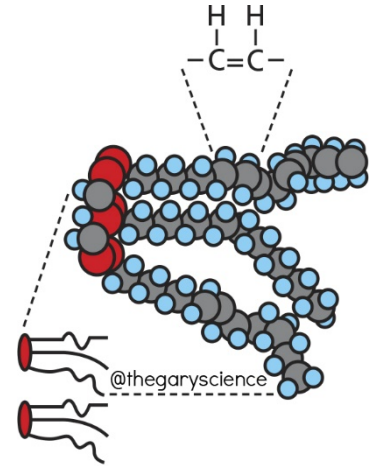
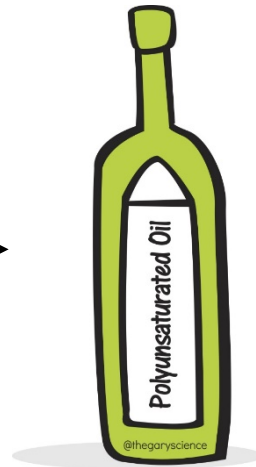
~~NO~~FRUCTOSE

LDL's filled with Saturated Fats



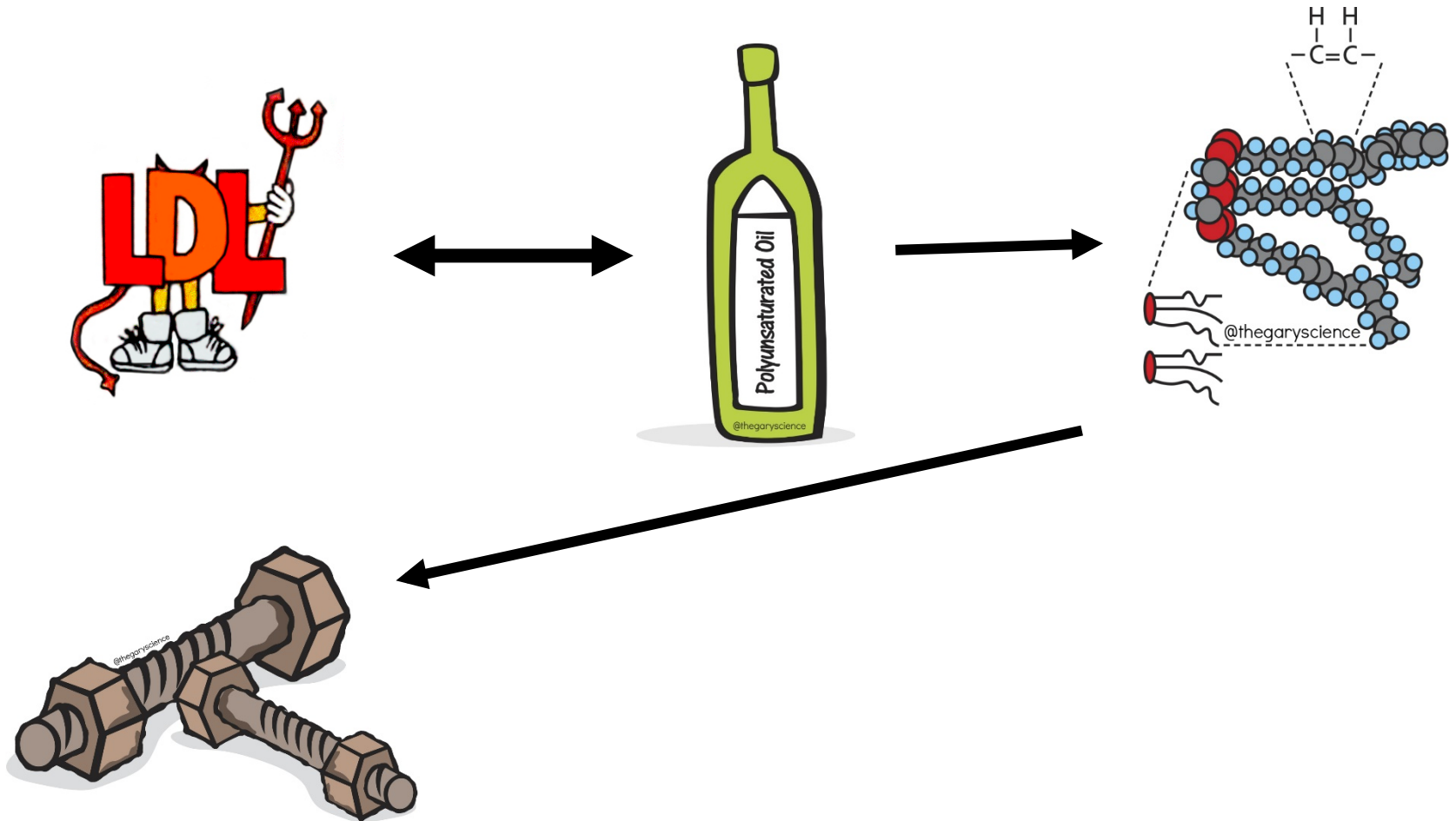
~~NO~~FRUCTOSE

LDL's filled with Polyunsaturated Fats



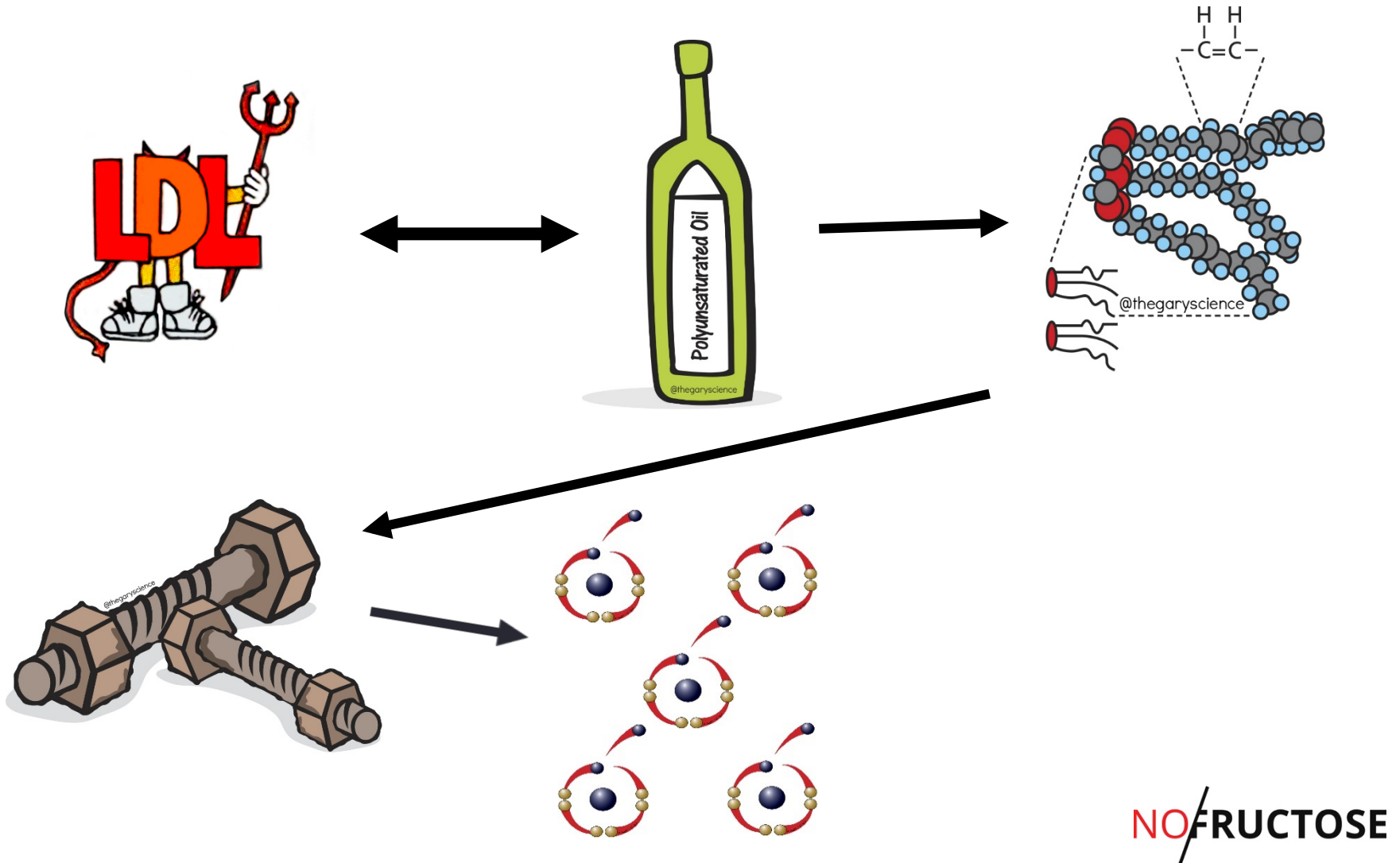
~~NO~~FRUCTOSE

LDL's filled with Polyunsaturated Fats

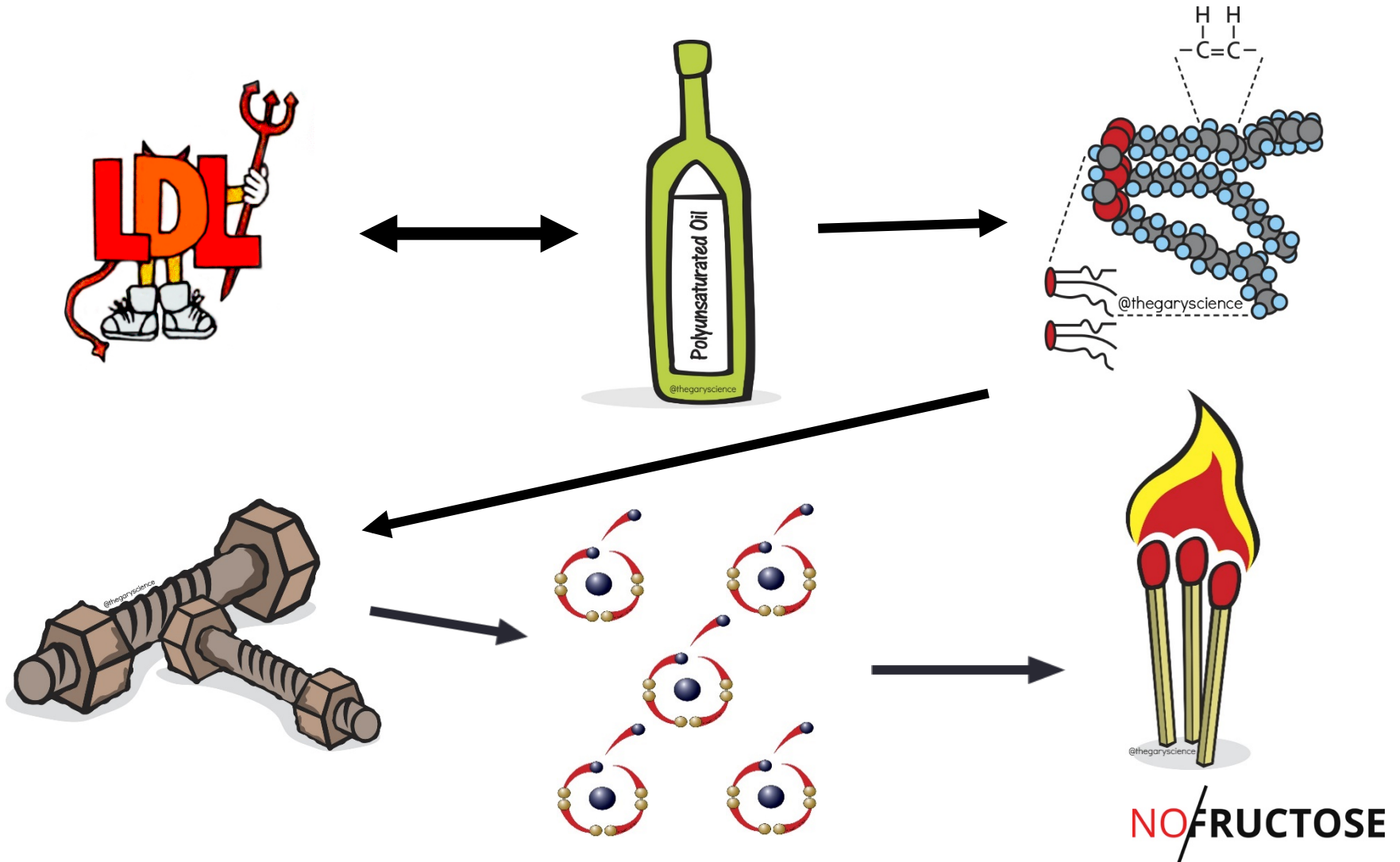


NO / **FRUCTOSE**

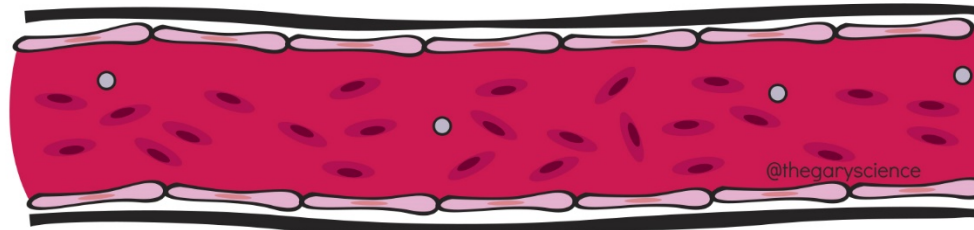
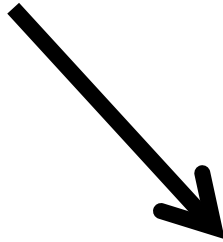
LDL's filled with Polyunsaturated Fats



LDL's filled with Polyunsaturated Fats

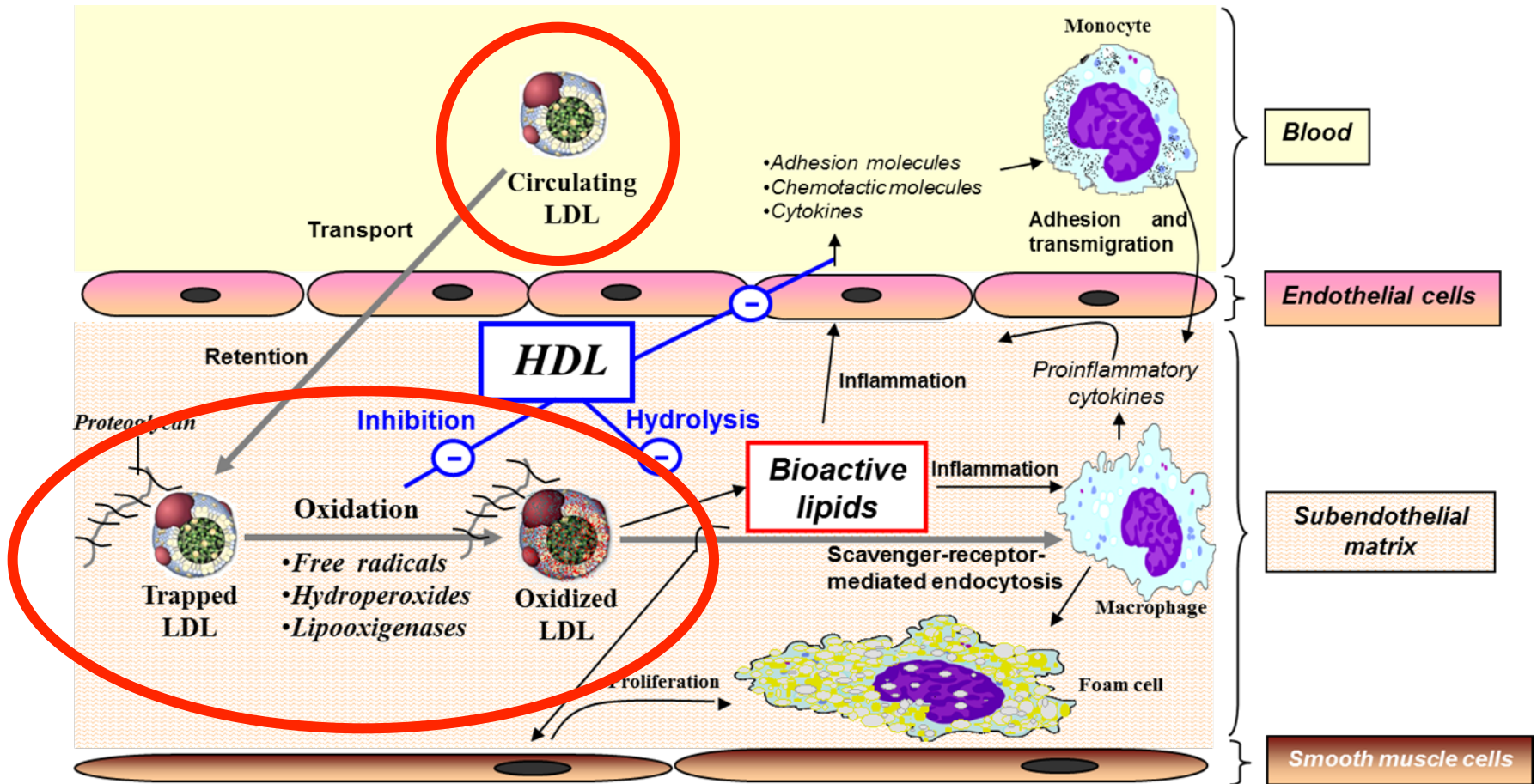


LDL's – Blood Vessel Walls

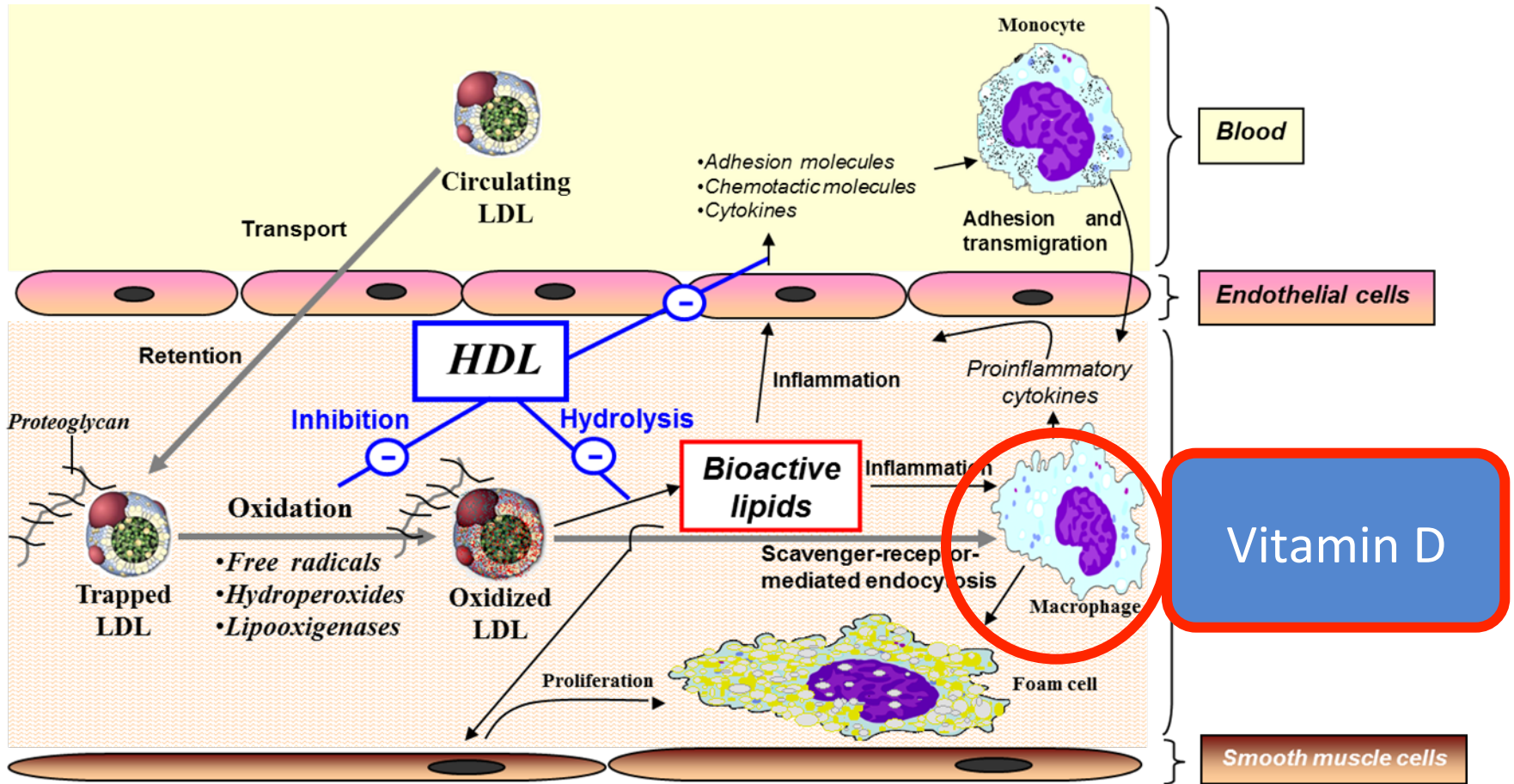


~~NO~~FRUCTOSE

LDL's - Goldilocks size



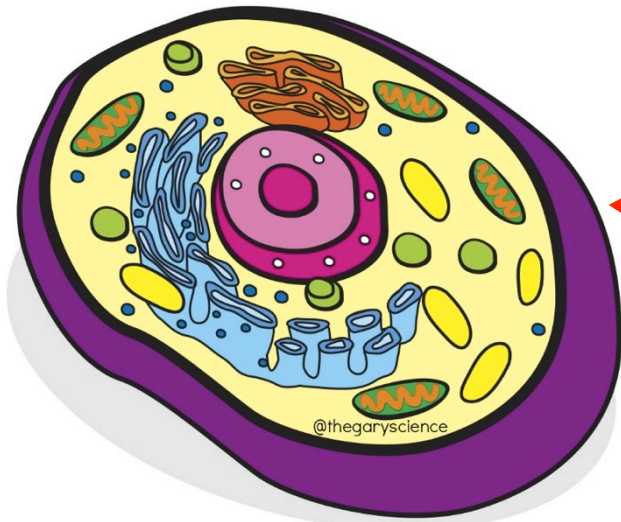
Lifestyle Related Disease



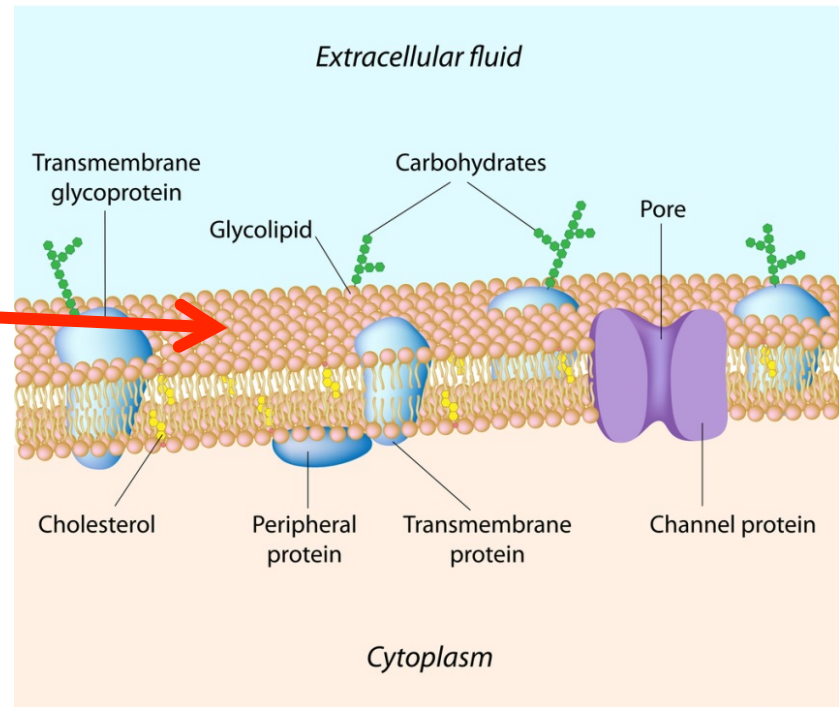
Dr Joan Gil, Barcelona, 2006 Origin of Atherosclerosis

NO / **FRUCTOSE**

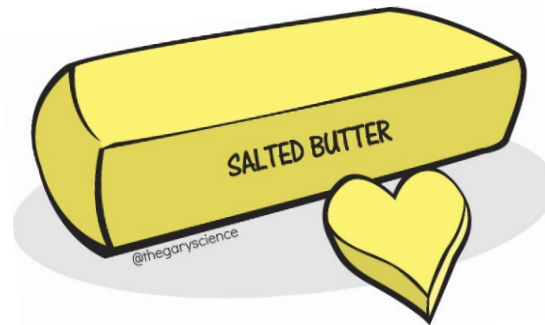
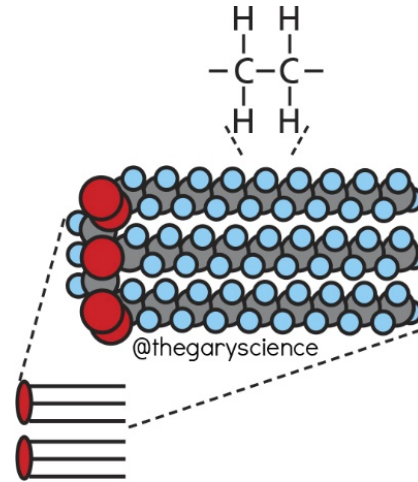
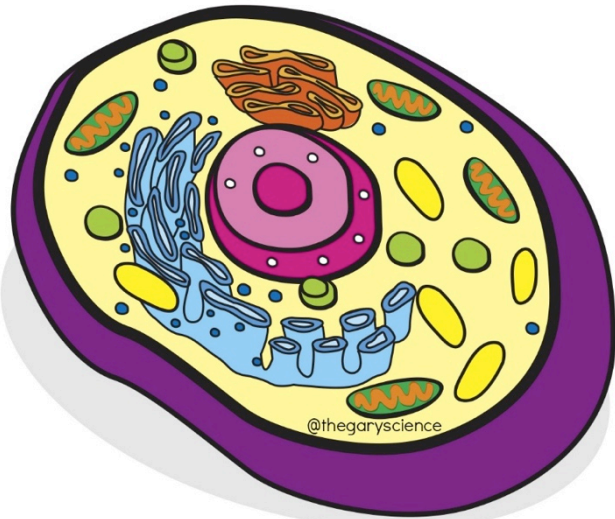
Cell Membrane Wall



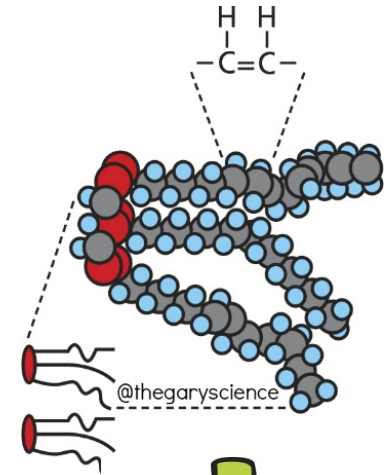
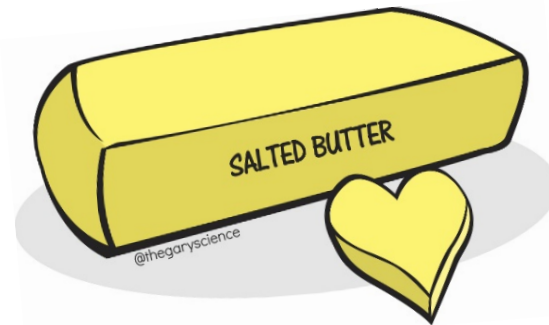
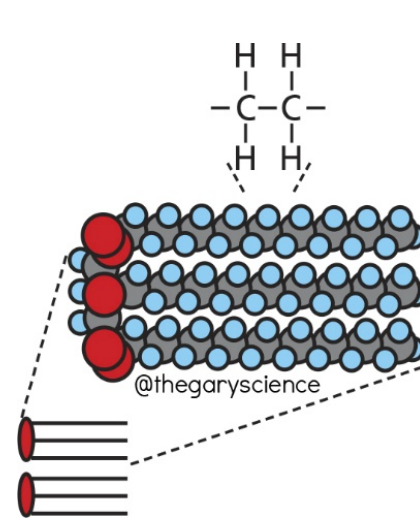
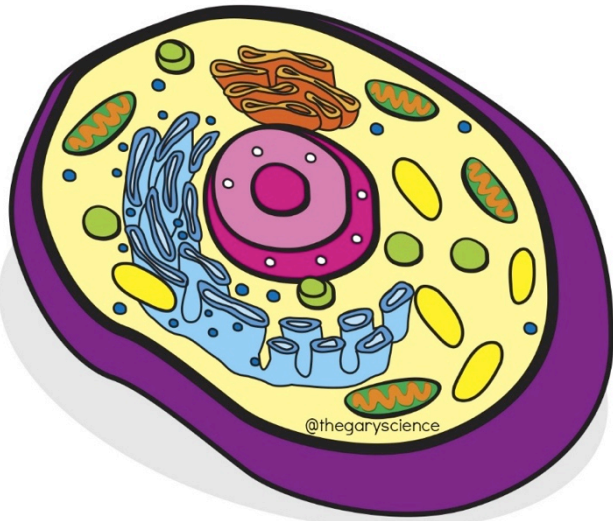
Plasma Membrane Structure



Cell Membrane Wall

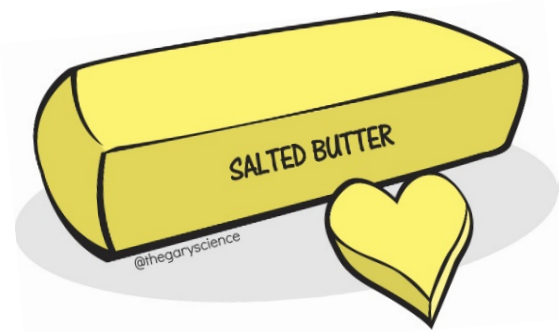
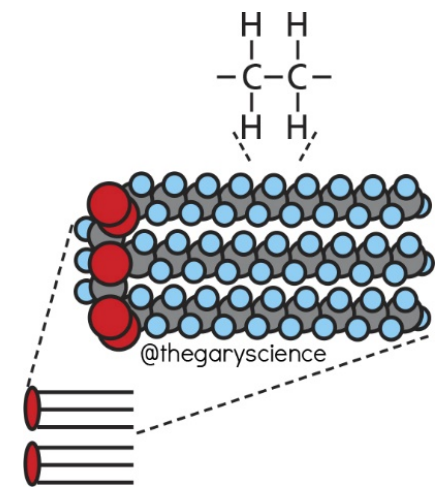
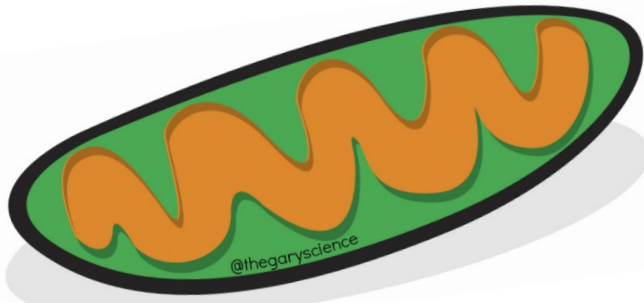


Cell Membrane Wall



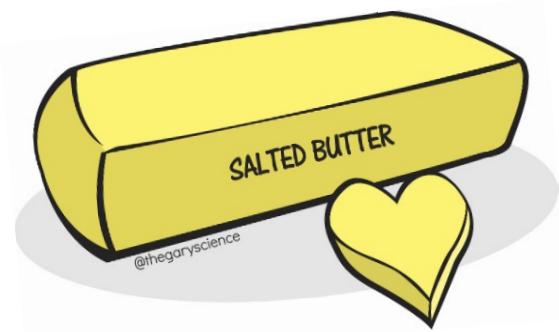
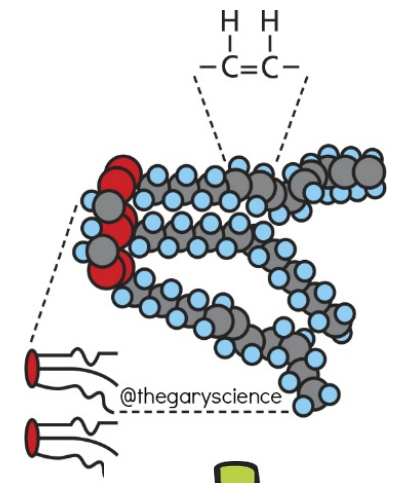
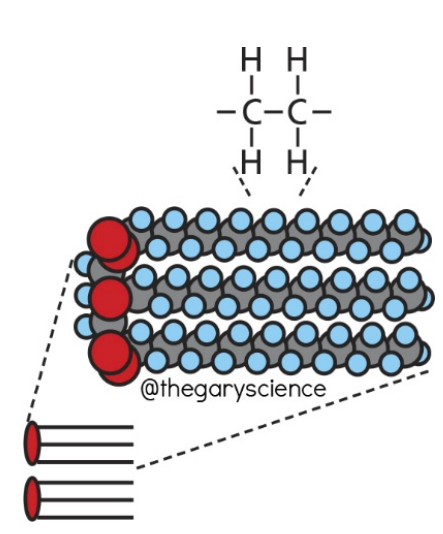
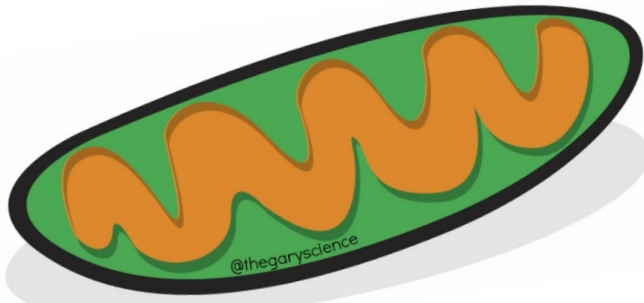
NO / **FRUCTOSE**

Mitochondrial Membrane Wall



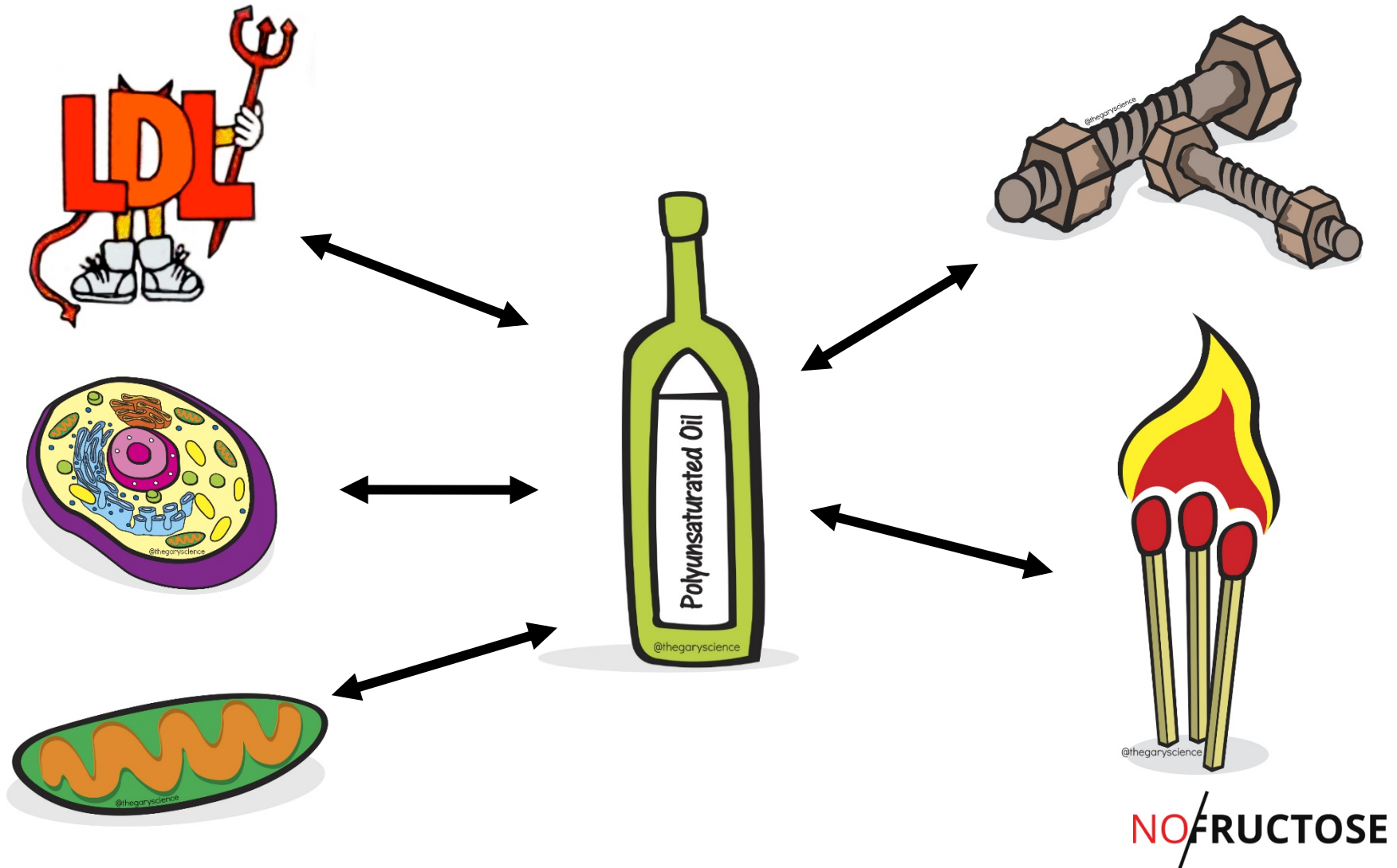
NO/**FRUCTOSE**

Mitochondrial Membrane Wall

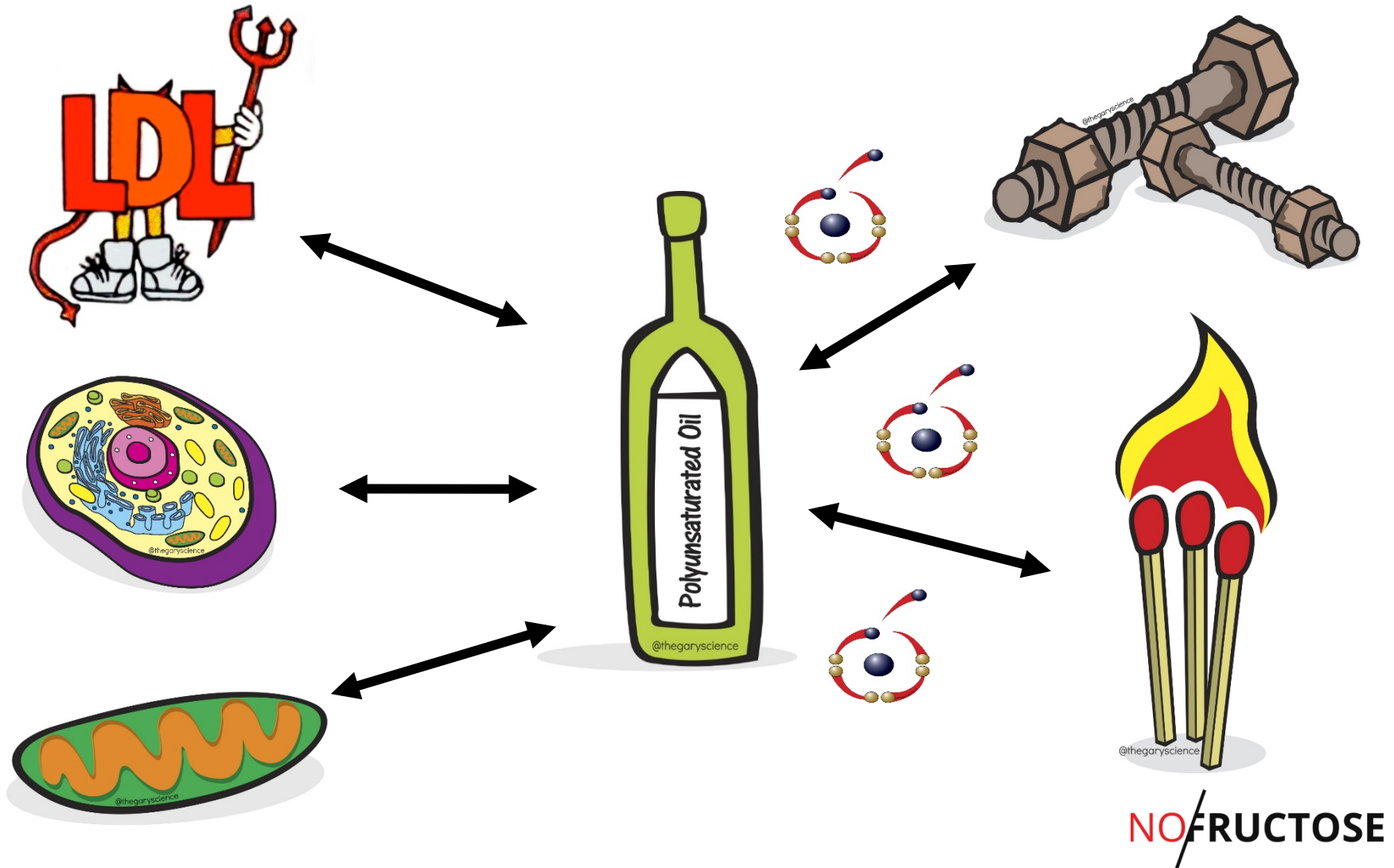


NO / **FRUCTOSE**

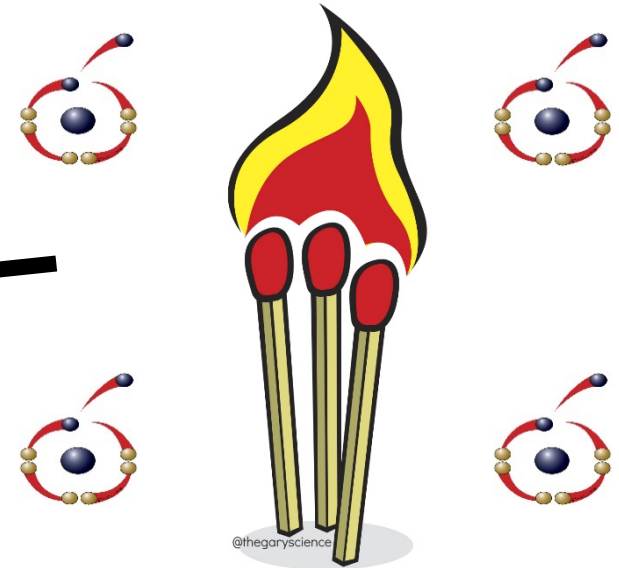
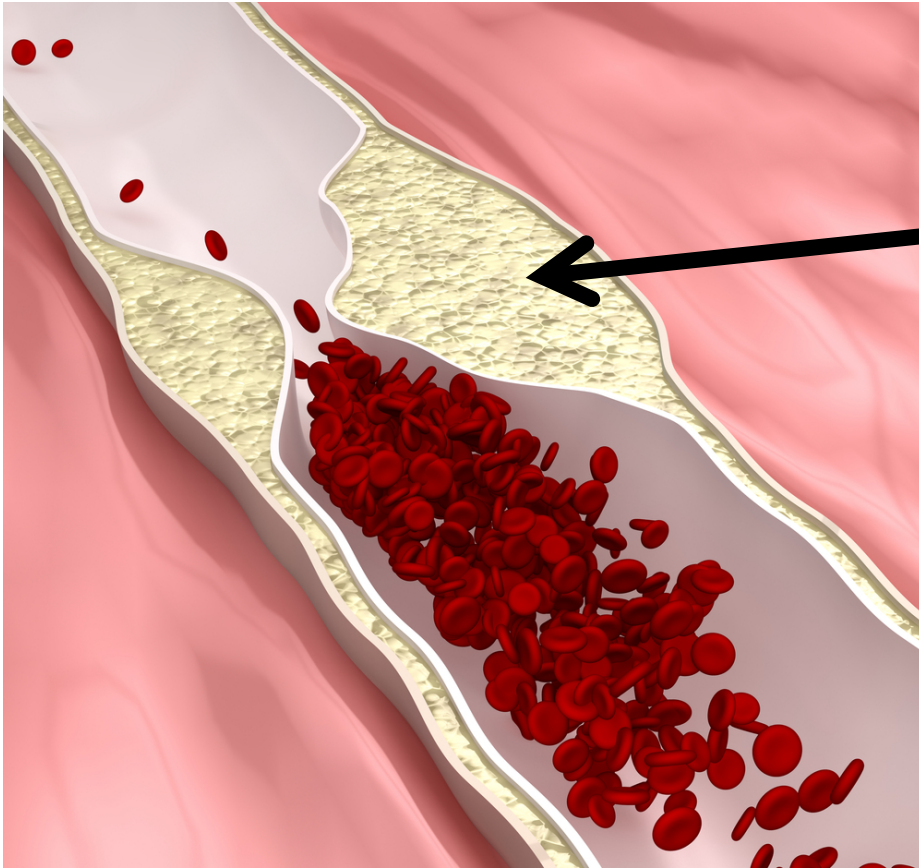
LDL's and Membranes filled with PUF's



LDL's and Membranes filled with PUF's

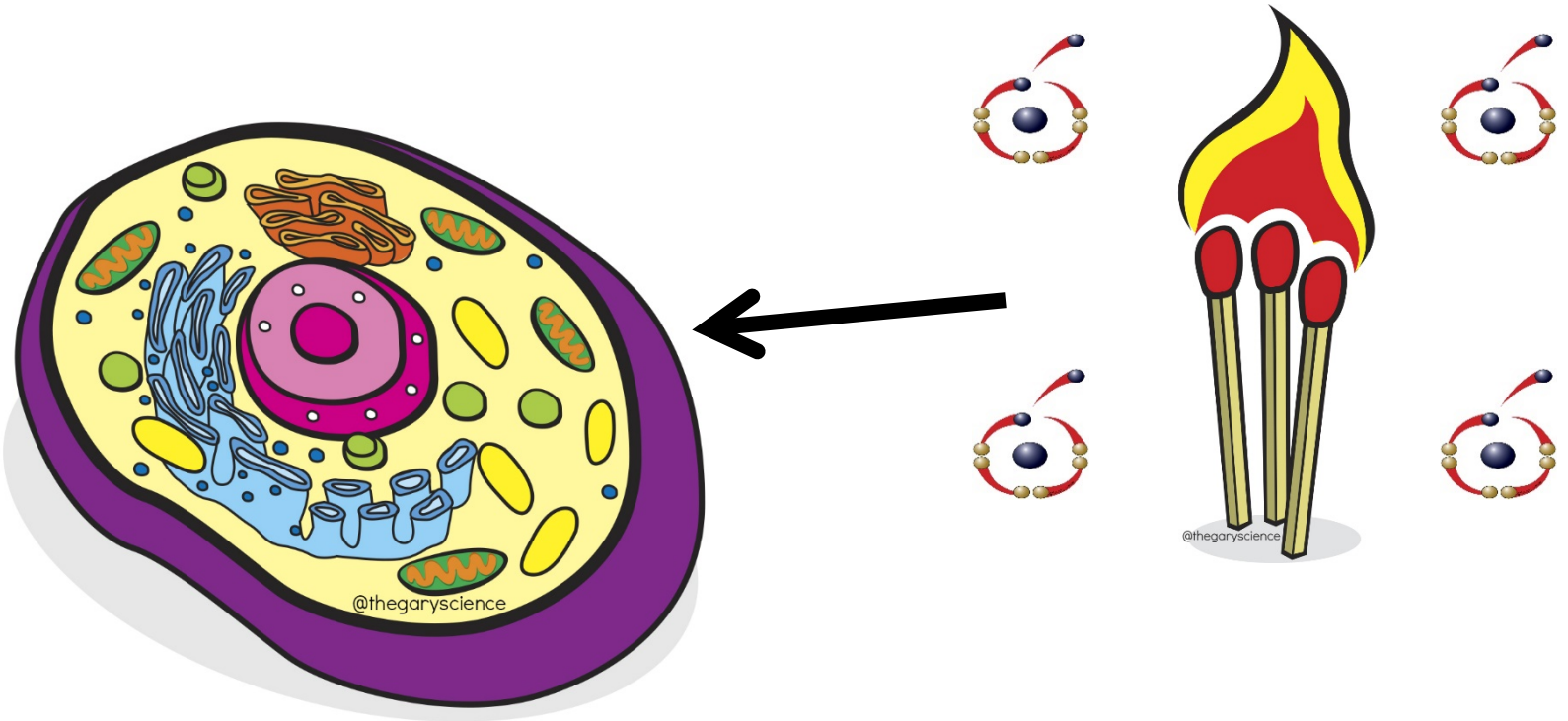


Arterial Wall Inflammation



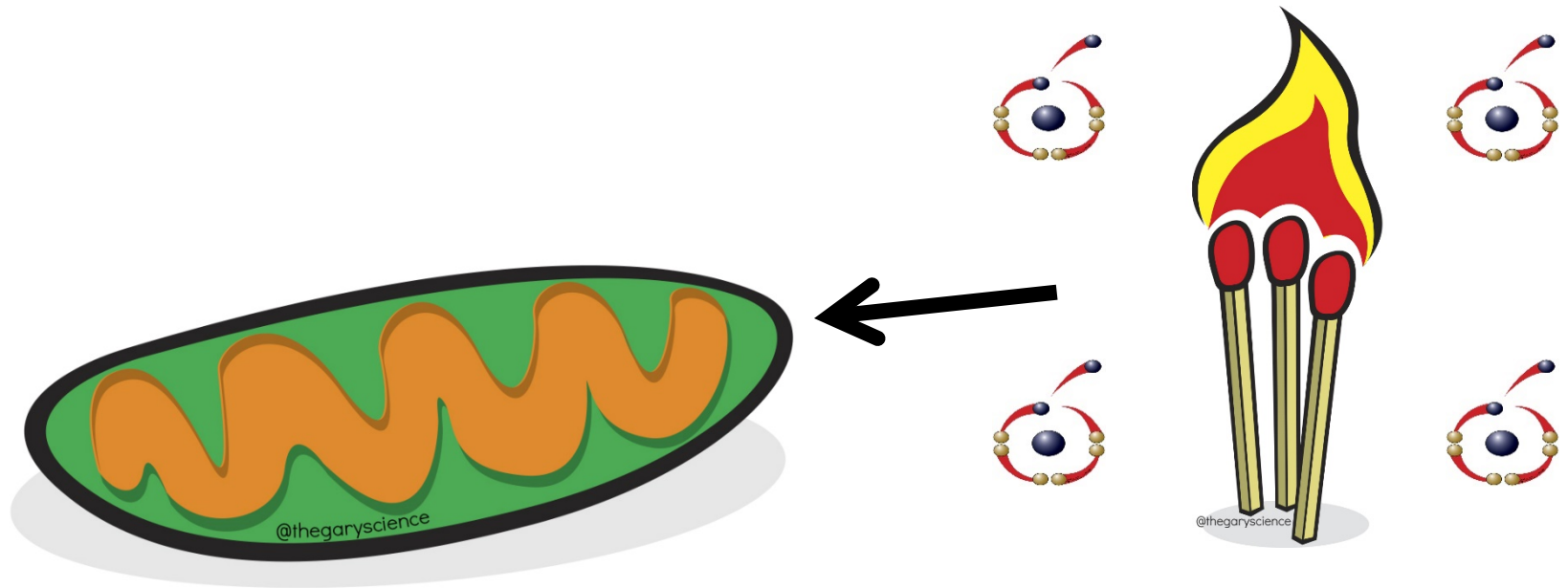
~~NO~~FRUCTOSE

Cell Membrane Inflammation



~~NO~~FRUCTOSE

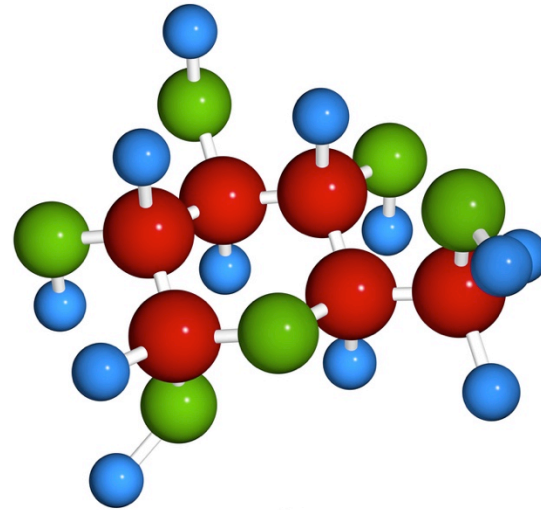
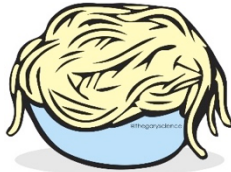
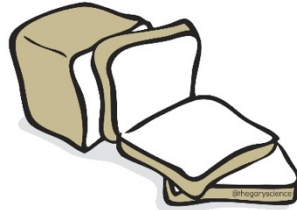
Mitochondrial Membrane Inflammation



~~NO~~FRUCTOSE

Carbohydrate

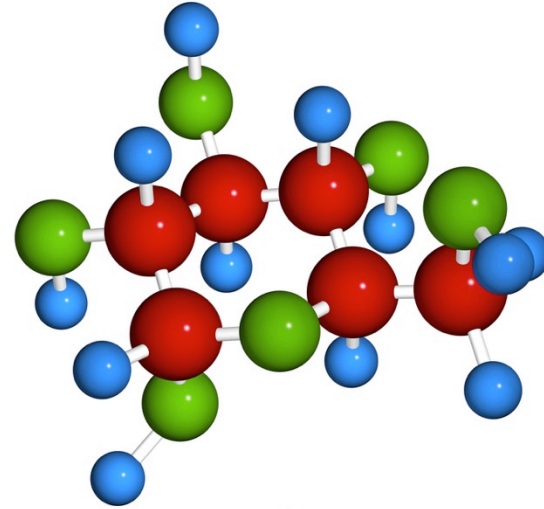
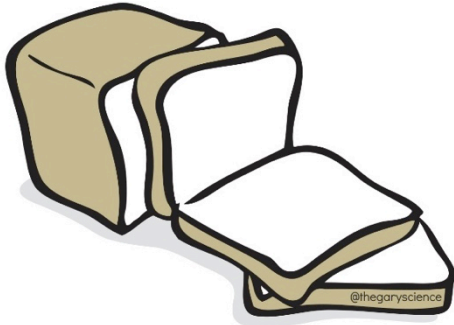
- Glucose
- Starches
 - Bread
 - Rice
 - Pasta
 - Cereal
 - Potato
- Maltose
- Lactose
- Dextrose
- "Fructose"



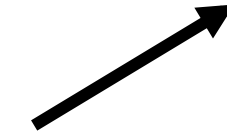
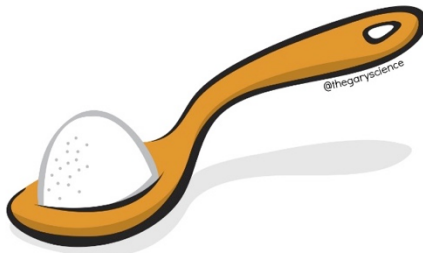
Glucose

~~NO~~FRUCTOSE

Carbohydrate



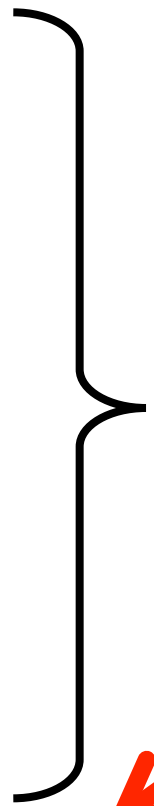
Glucose



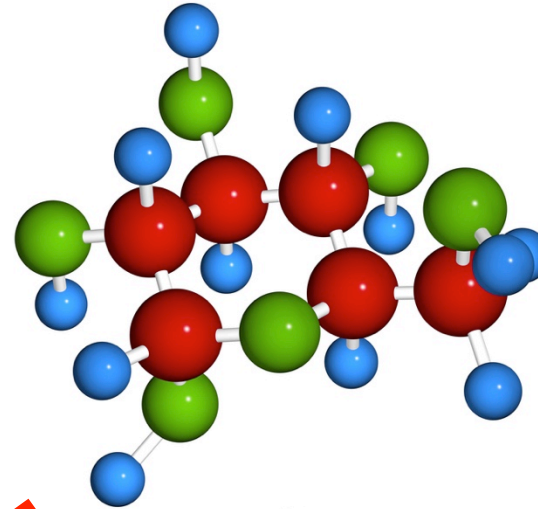
~~NO~~FRUCTOSE

Carbohydrate

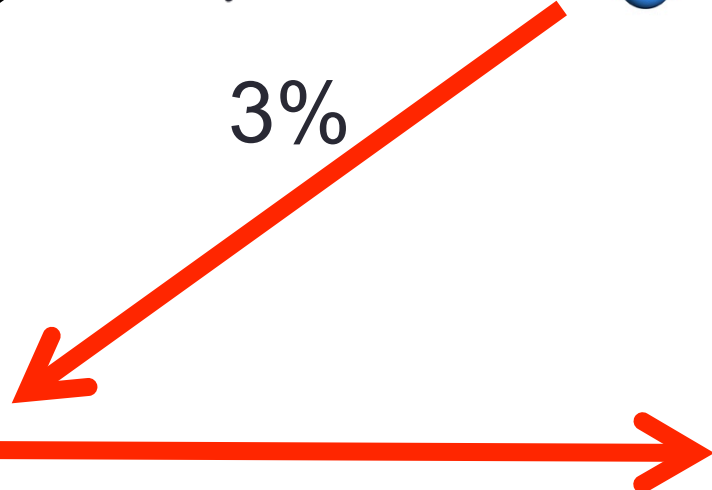
- Glucose
- Starches
 - Bread
 - Rice
 - Pasta
 - Cereal
 - Potato
- Maltose
- Lactose
- Dextrose
- “Fructose”



3%



Glucose



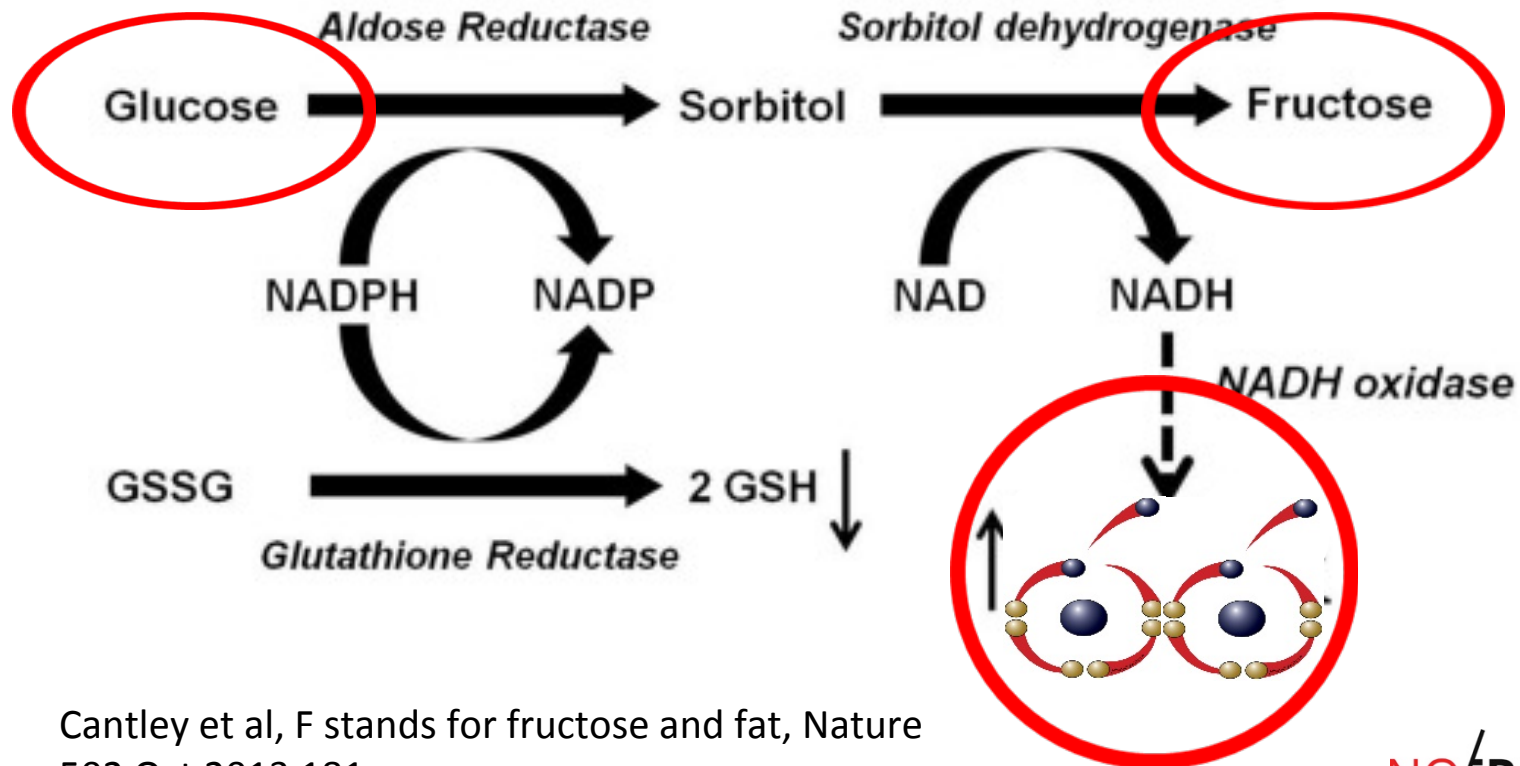
‘Polyol Conversion’



~~NO~~FRUCTOSE

Endogenous Production Fructose

- Polyol Pathway
- Normal 3% conversion



Cantley et al, F stands for fructose and fat, Nature
502 Oct 2013 181

~~NO~~FRUCTOSE

Endogenous Production Fructose

- Insulin resistance
- Hyperglycaemia
- 10 fold increase
- 30%+ Glucose to Fructose

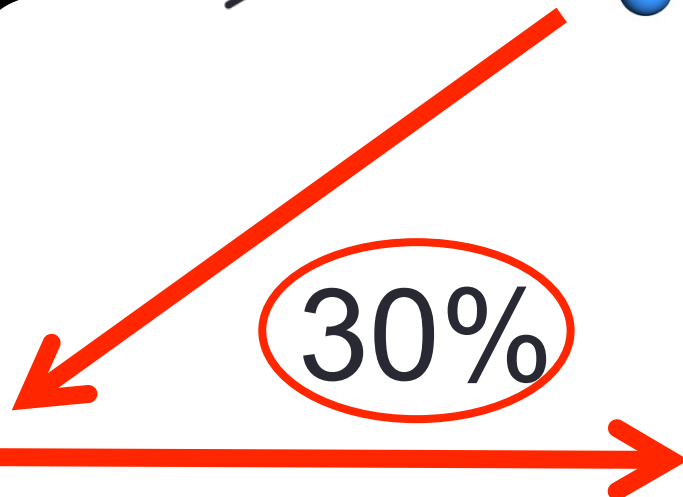
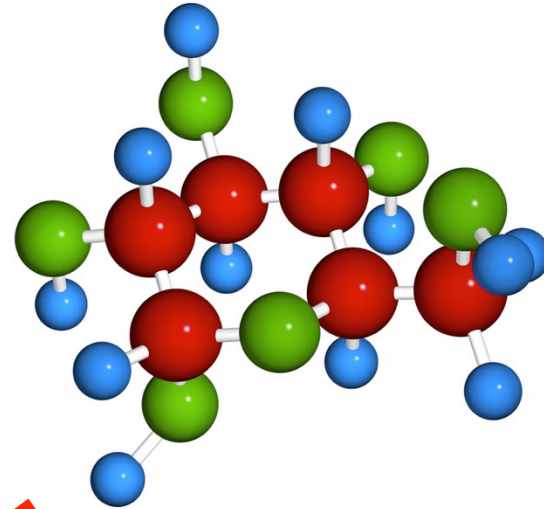
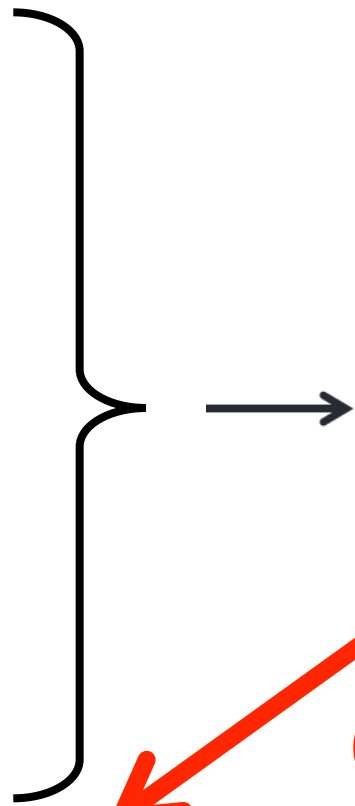


Direct measurement of polyol pathway activity in the ocular lens.
Gonzalez, R.G. et al (1984). *Diabetes* 33, 196–199.

~~NO~~FRUCTOSE

Carbohydrate

- Glucose
- Starches
 - Bread
 - Rice
 - Pasta
 - Cereal
 - Potato
- Maltose
- Lactose
- Dextrose
- "Fructose"



'Polyol Conversion'

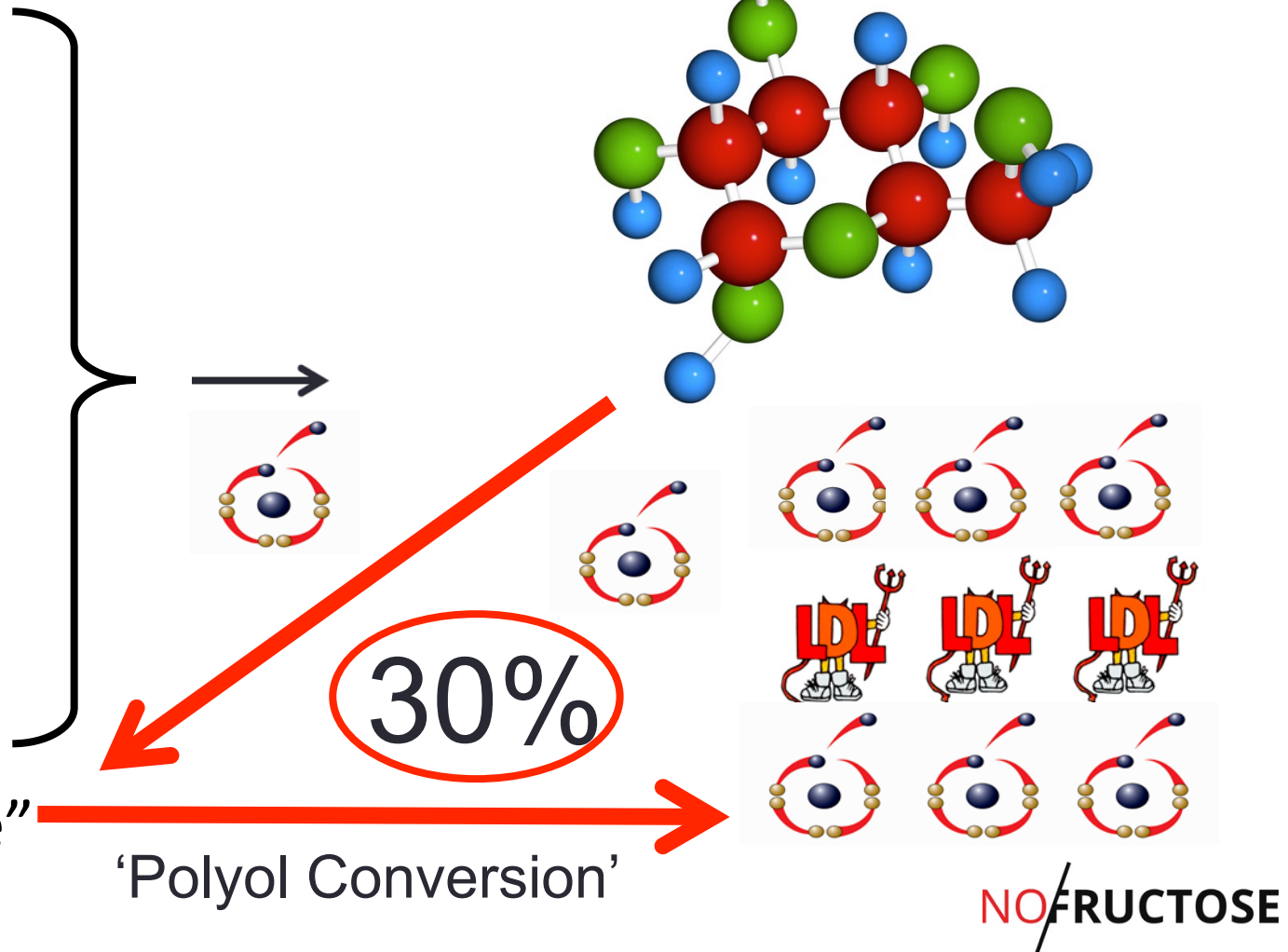
30%



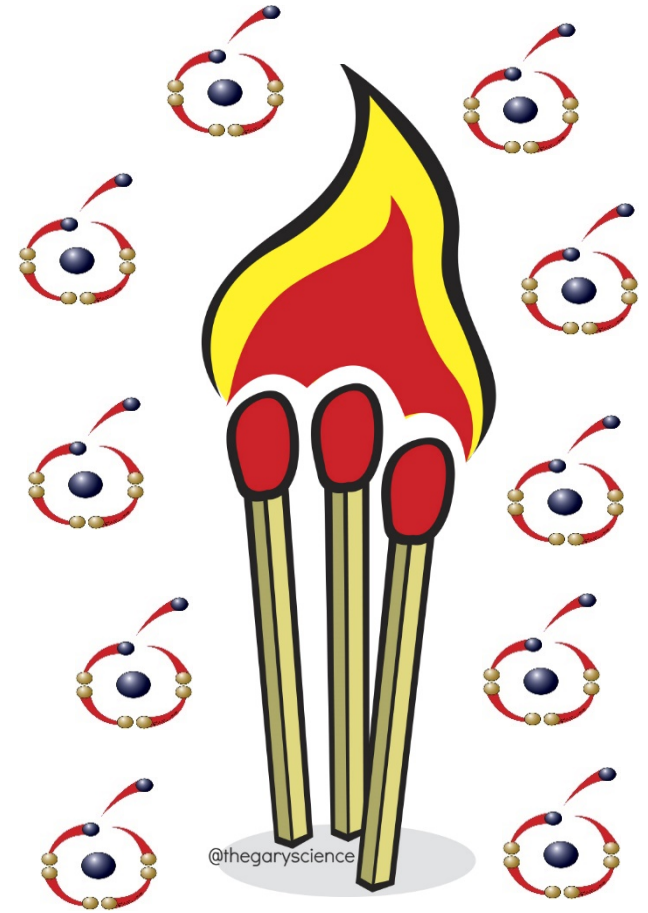
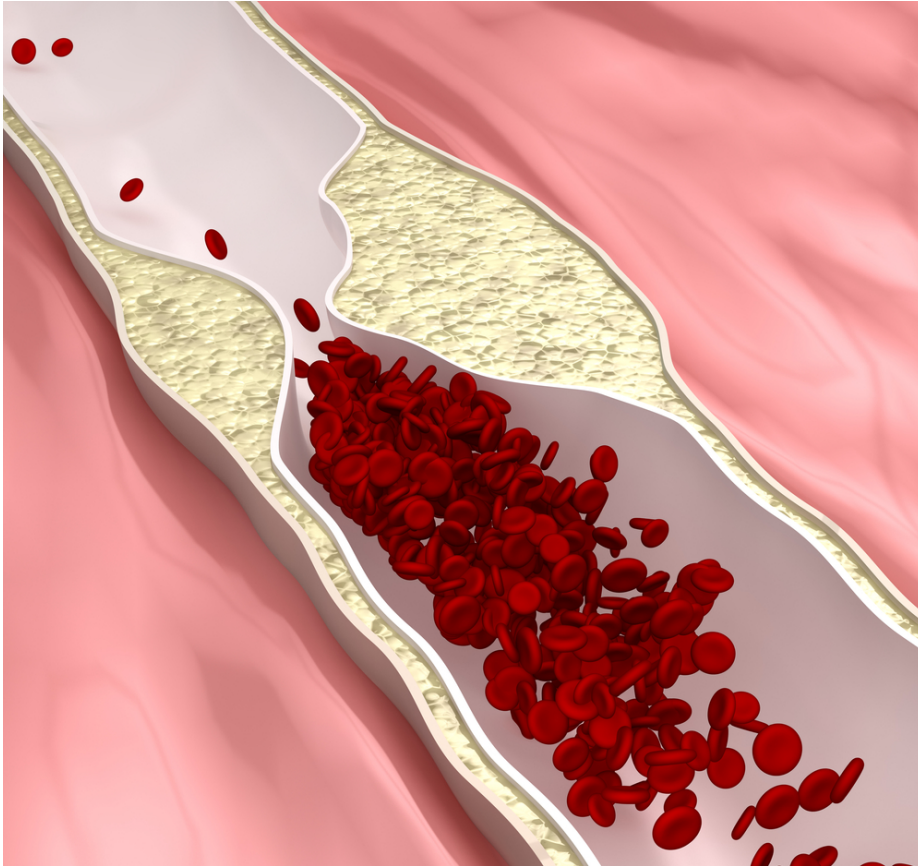
~~NO~~FRUCTOSE

Carbohydrate

- Glucose
- Starches
 - Bread
 - Rice
 - Pasta
 - Cereal
 - Potato
- Maltose
- Lactose
- Dextrose
- “Fructose”



Arterial Wall Inflammation



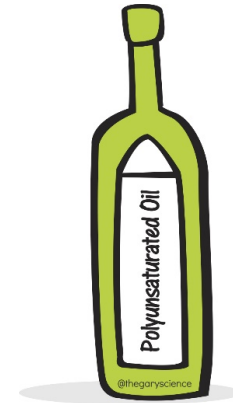
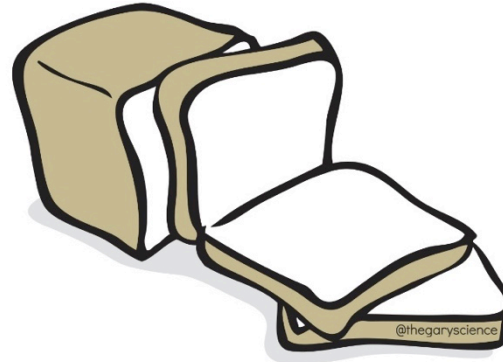
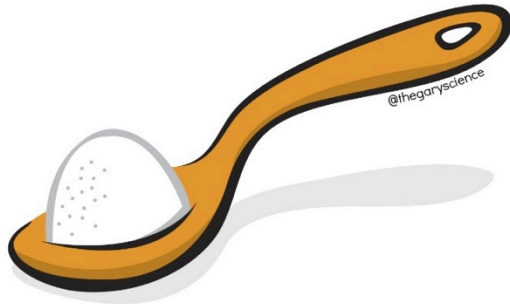
~~NO~~FRUCTOSE

Model of 'Modern' Disease

- Observation ✓
- Hypothesis ✓
- Mechanism ✓
- Pathophysiology ✓
- Association evidence
- Intervention evidence



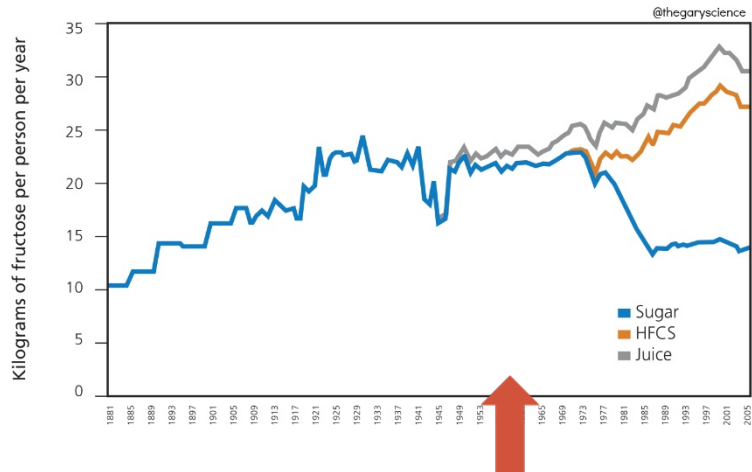
'Nutritional' Model of Modern Disease



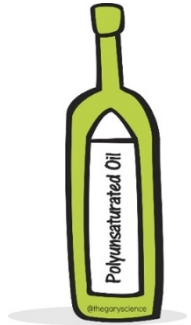
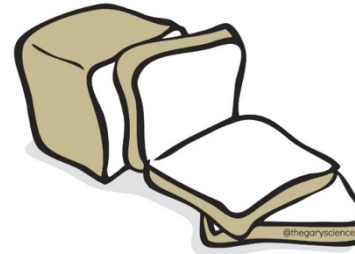
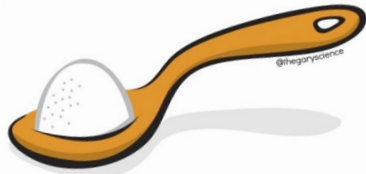
NO / **FRUCTOSE**

Fructose Consumption 1970's

Total Fructose Consumption
per person per year (kgs) 1881 - 2005



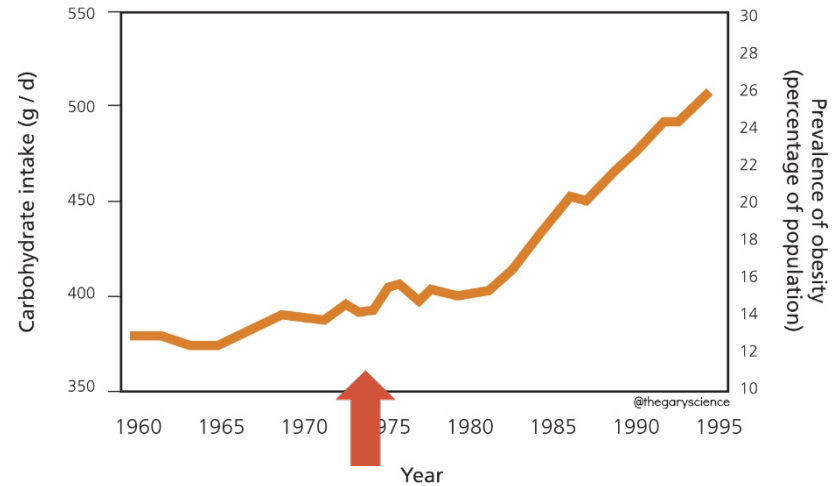
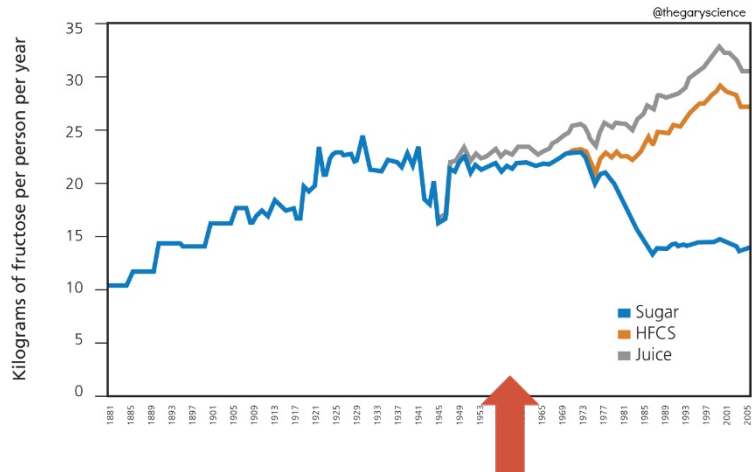
'Nutritional' Model of Modern Disease



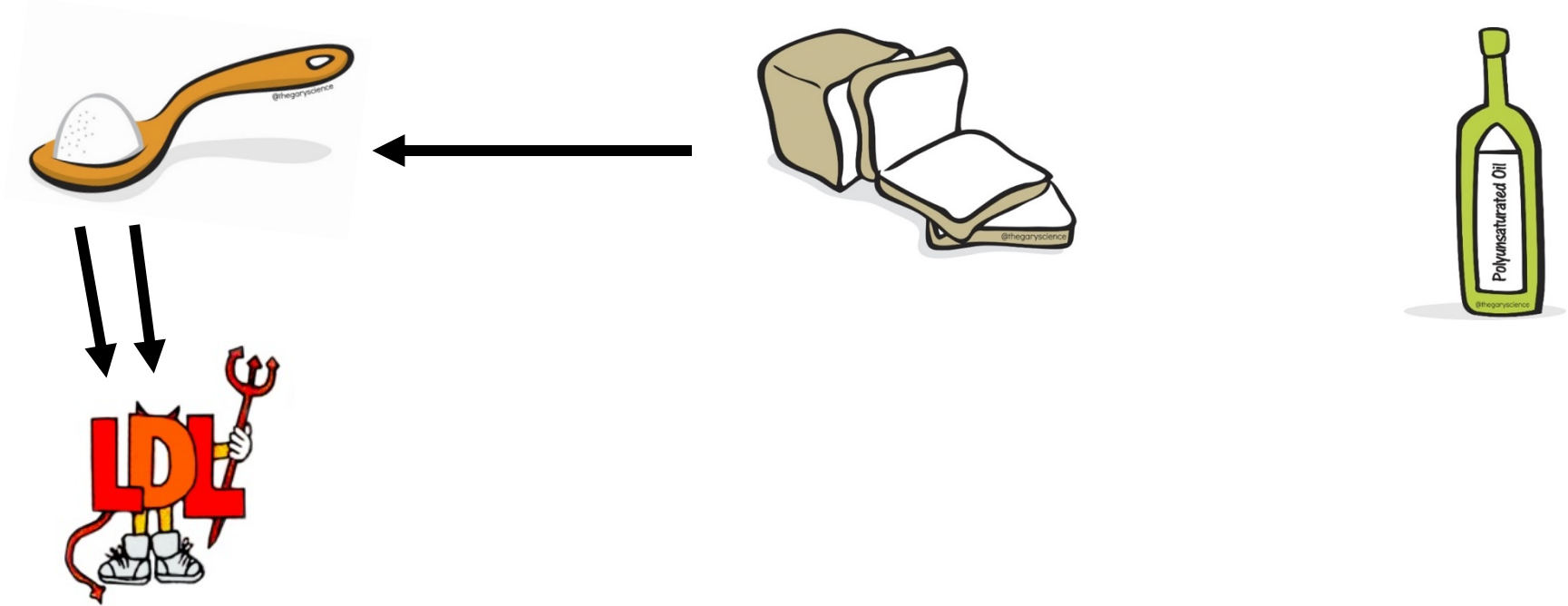
~~NO~~FRUCTOSE

Carbohydrate Consumption 1970's

Total Fructose Consumption
per person per year (kgs) 1881 - 2005



'Nutritional' Model of Modern Disease

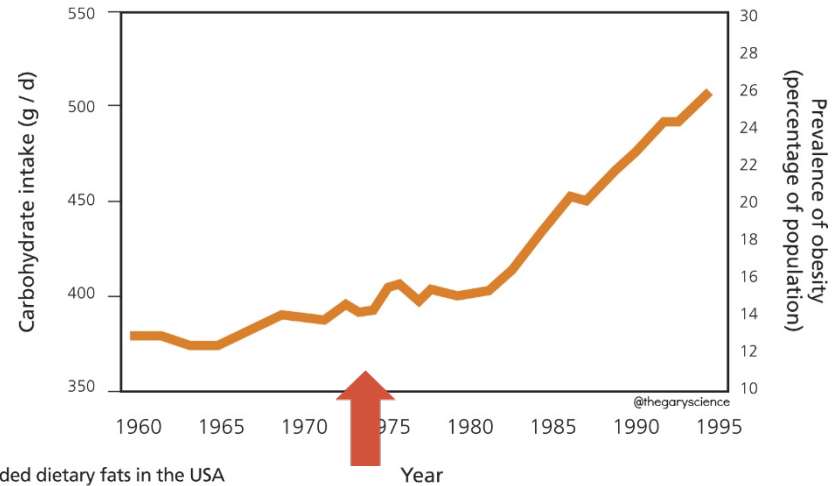
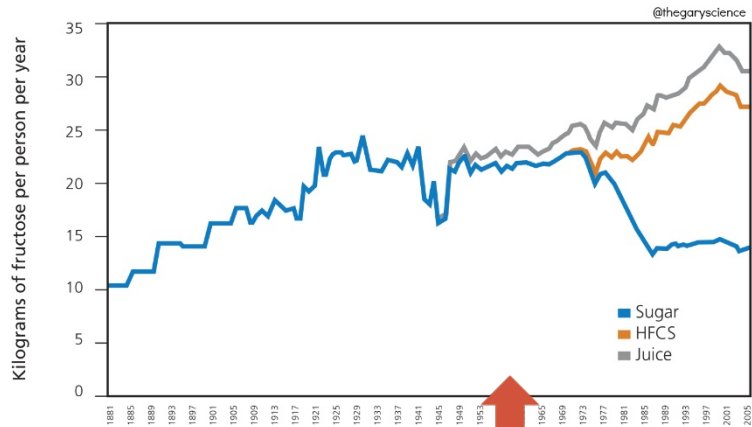


~~NO~~FRUCTOSE

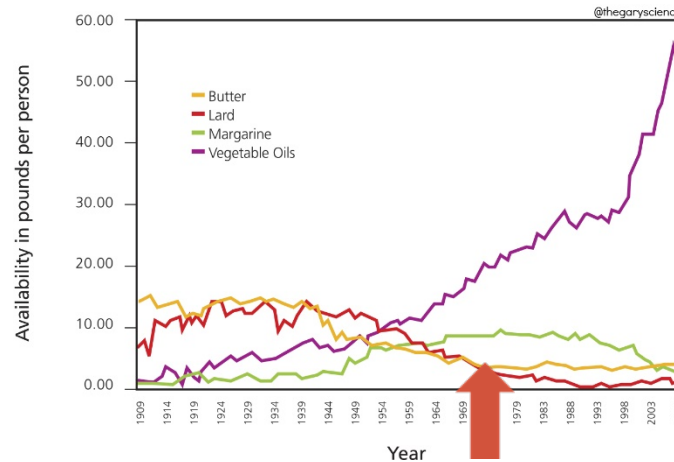
Polyunsaturated Oils 1970's



Total Fructose Consumption
per person per year (kgs) 1881 - 2005

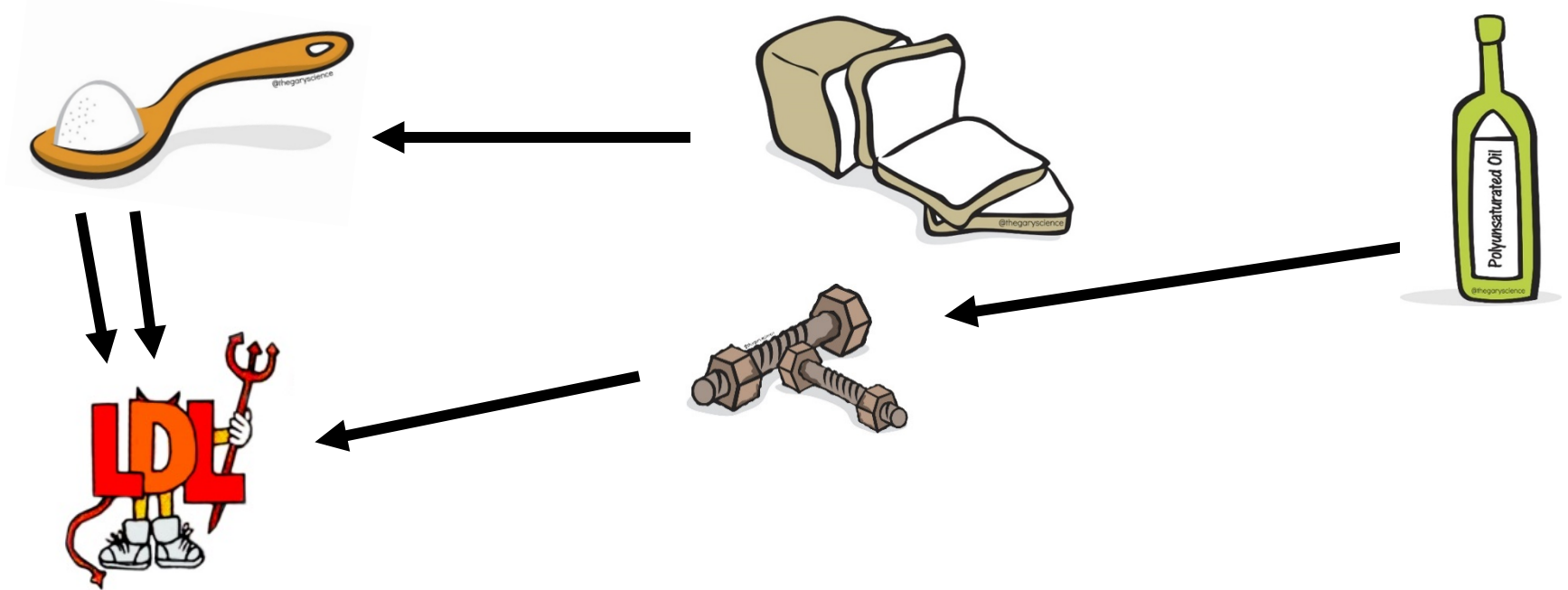


Availability of added dietary fats in the USA



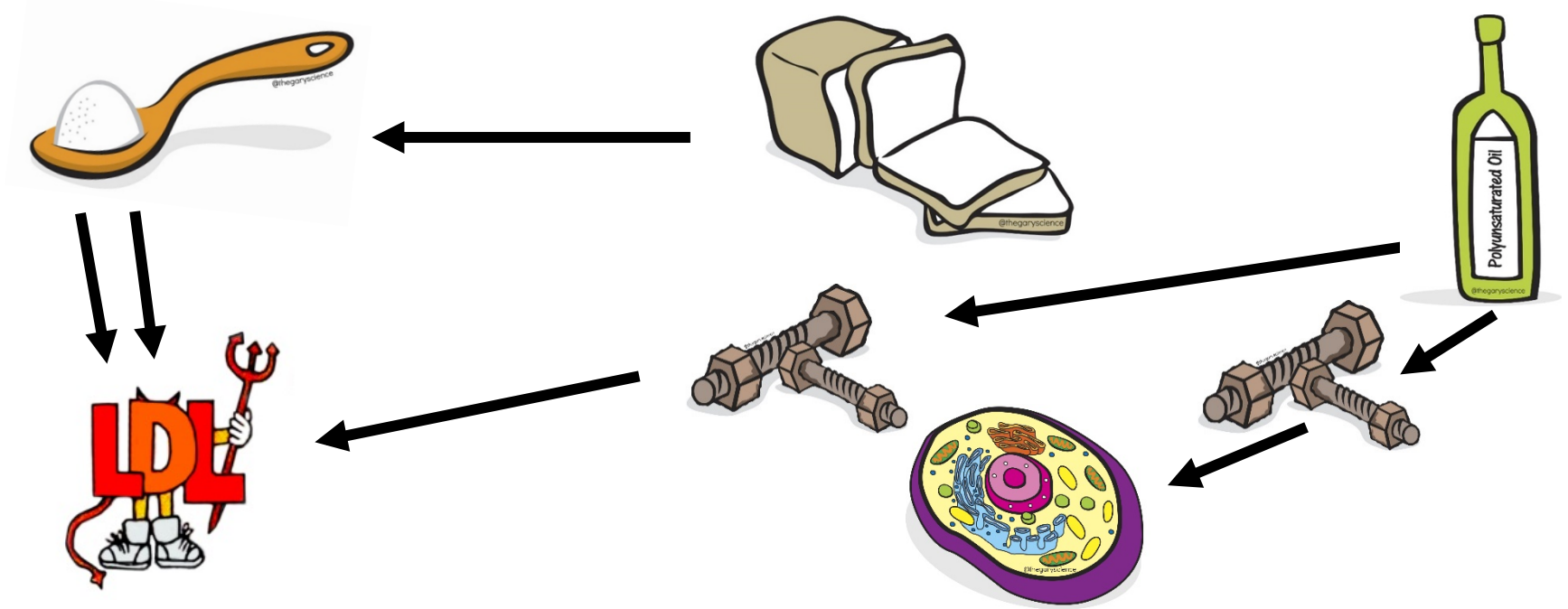
~~NO~~FRUCTOSE

'Nutritional' Model of Modern Disease



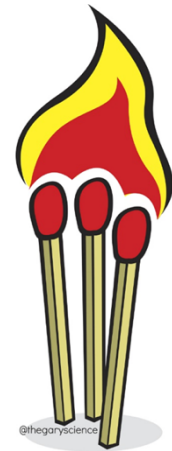
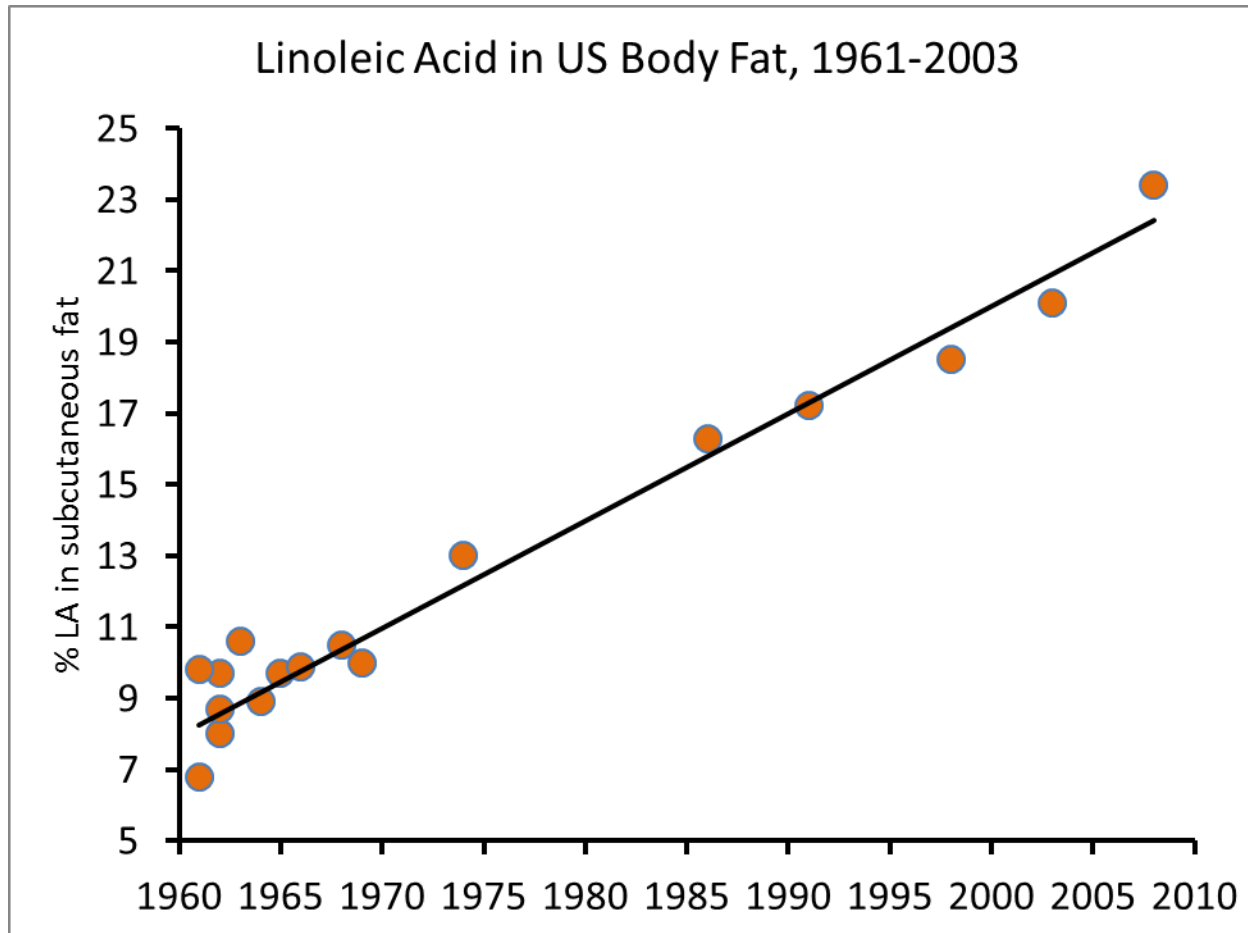
NO / **FRUCTOSE**

'Nutritional' Model of Modern Disease



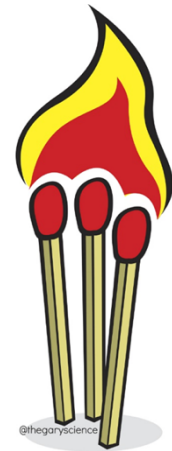
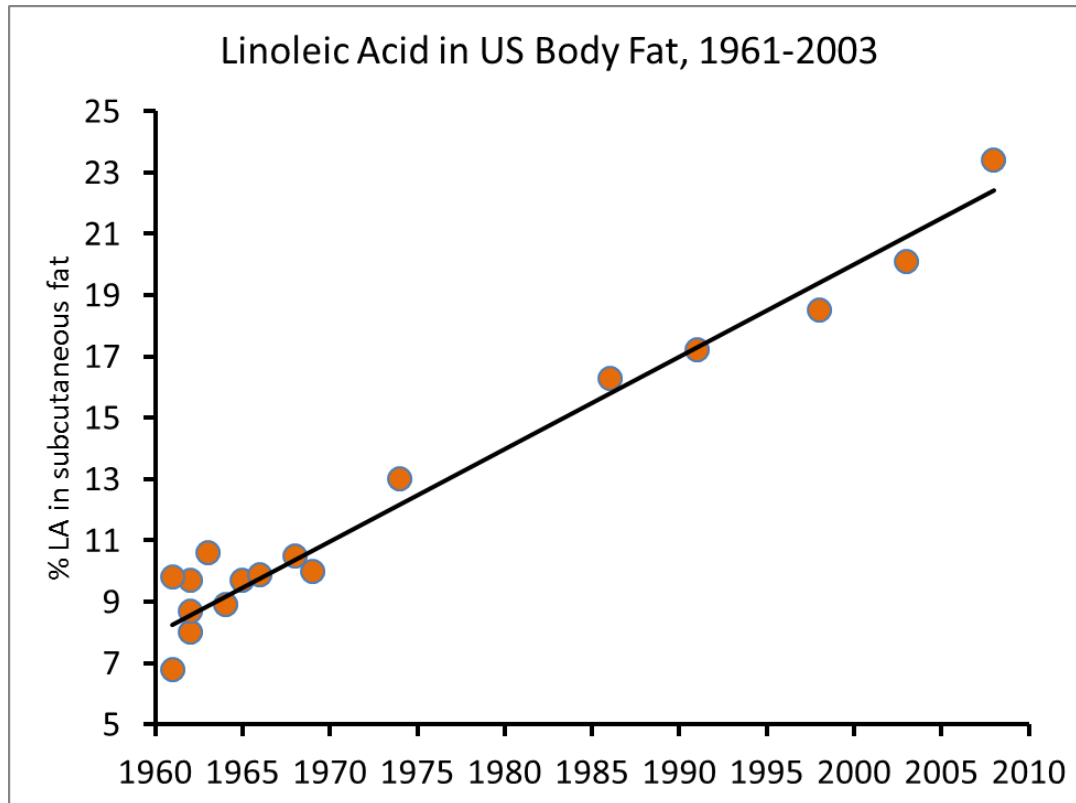
~~NO~~FRUCTOSE

Stephan Guyenet – Omega 6 Fat



~~NO~~FRUCTOSE

Stephan Guyenet – Omega 6 Fat



Blog post

NO/**FRUCTOSE**

Breast Milk

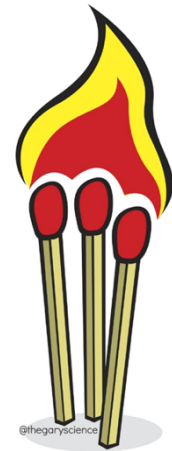
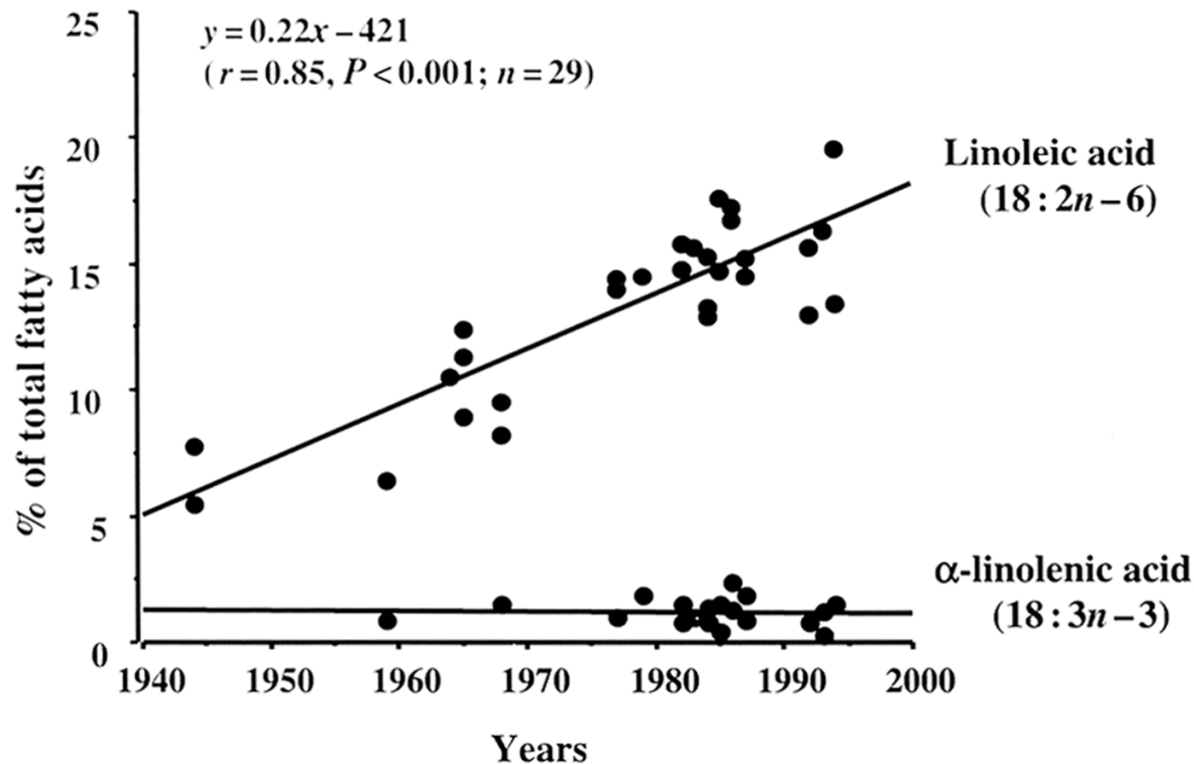
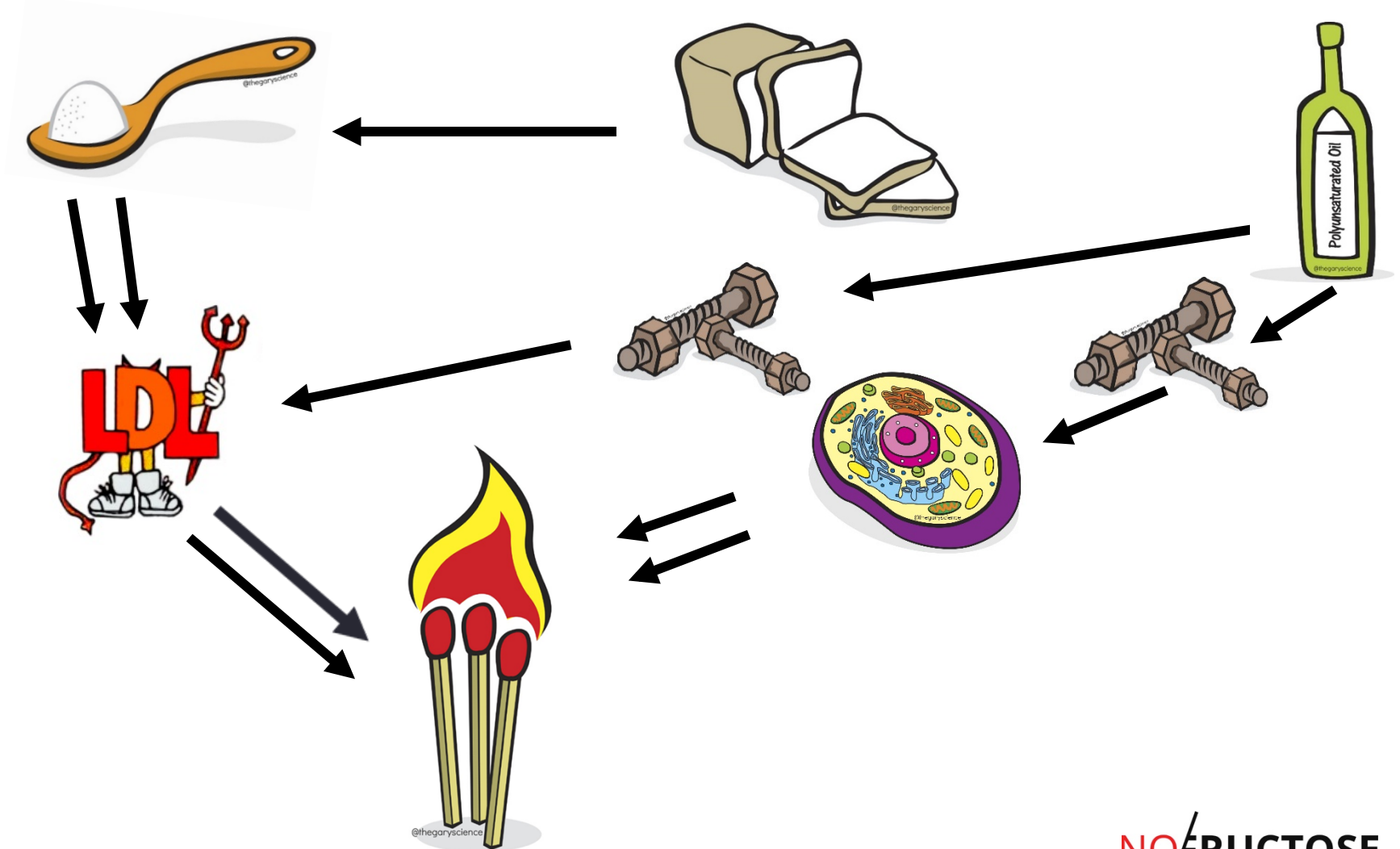


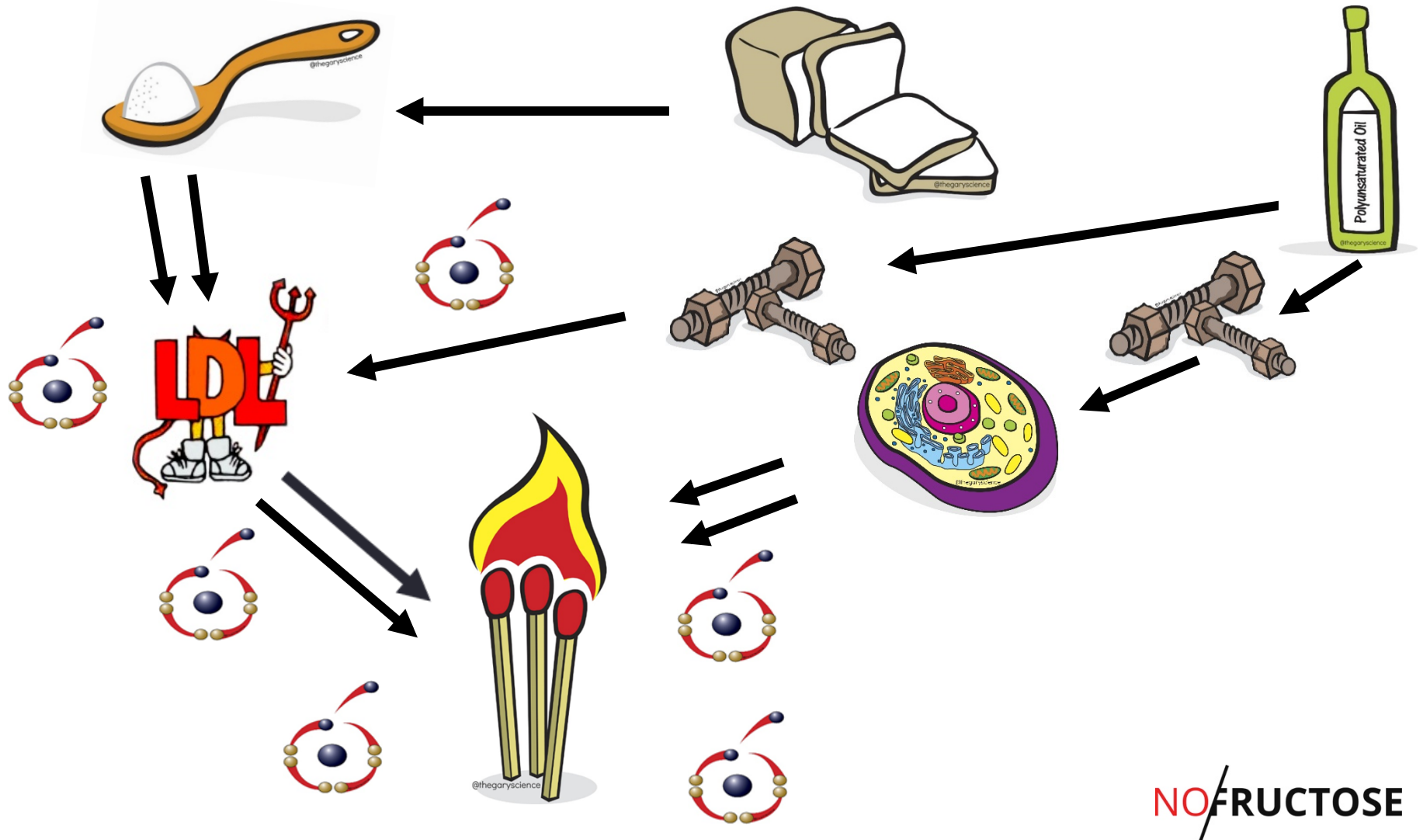
Figure 2 Linoleic and α -linolenic acid content in mature breast milk of US women from 1945 to 1995 (adapted from references 37–42).

'Nutritional' Model of Modern Disease

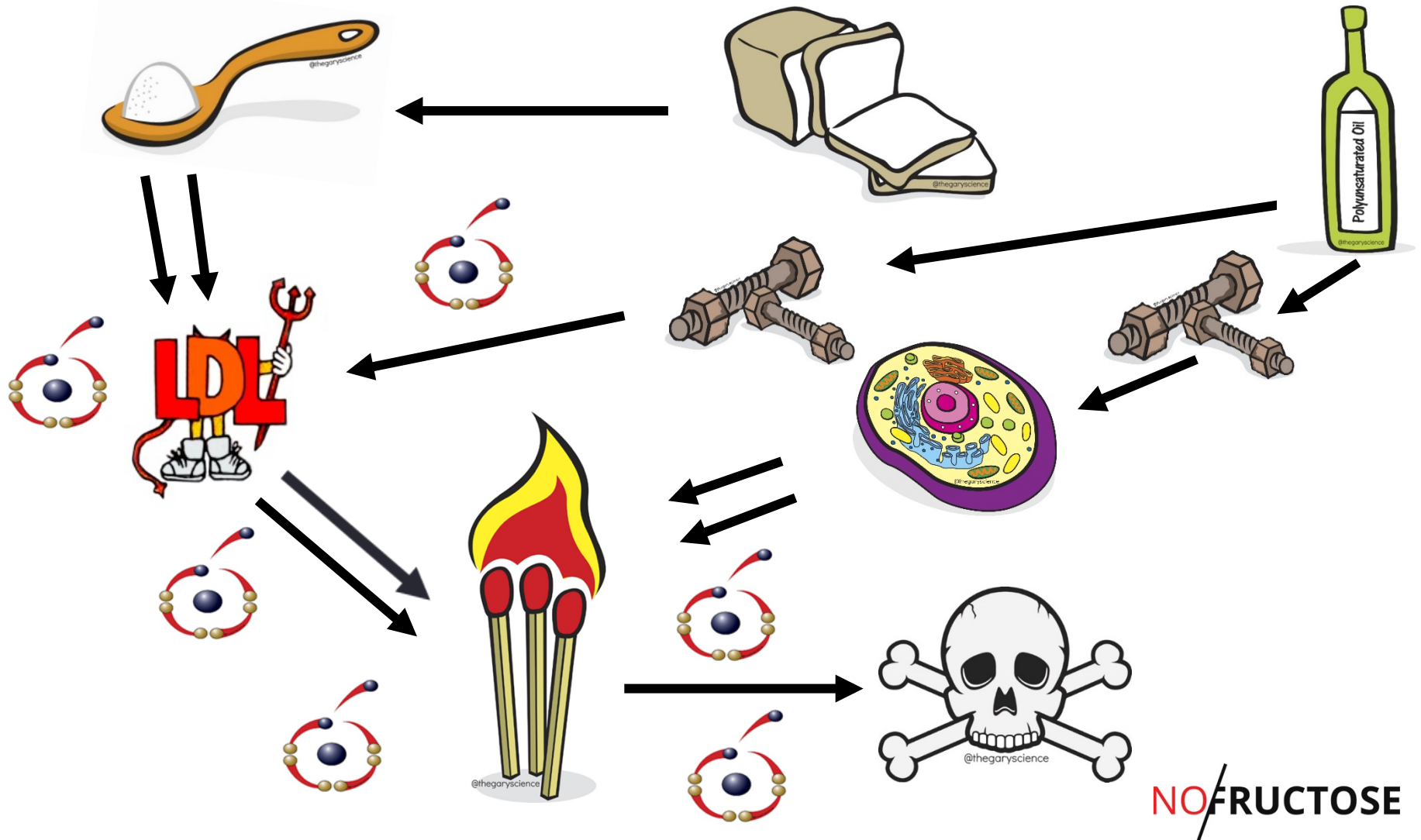


NO / **FRUCTOSE**

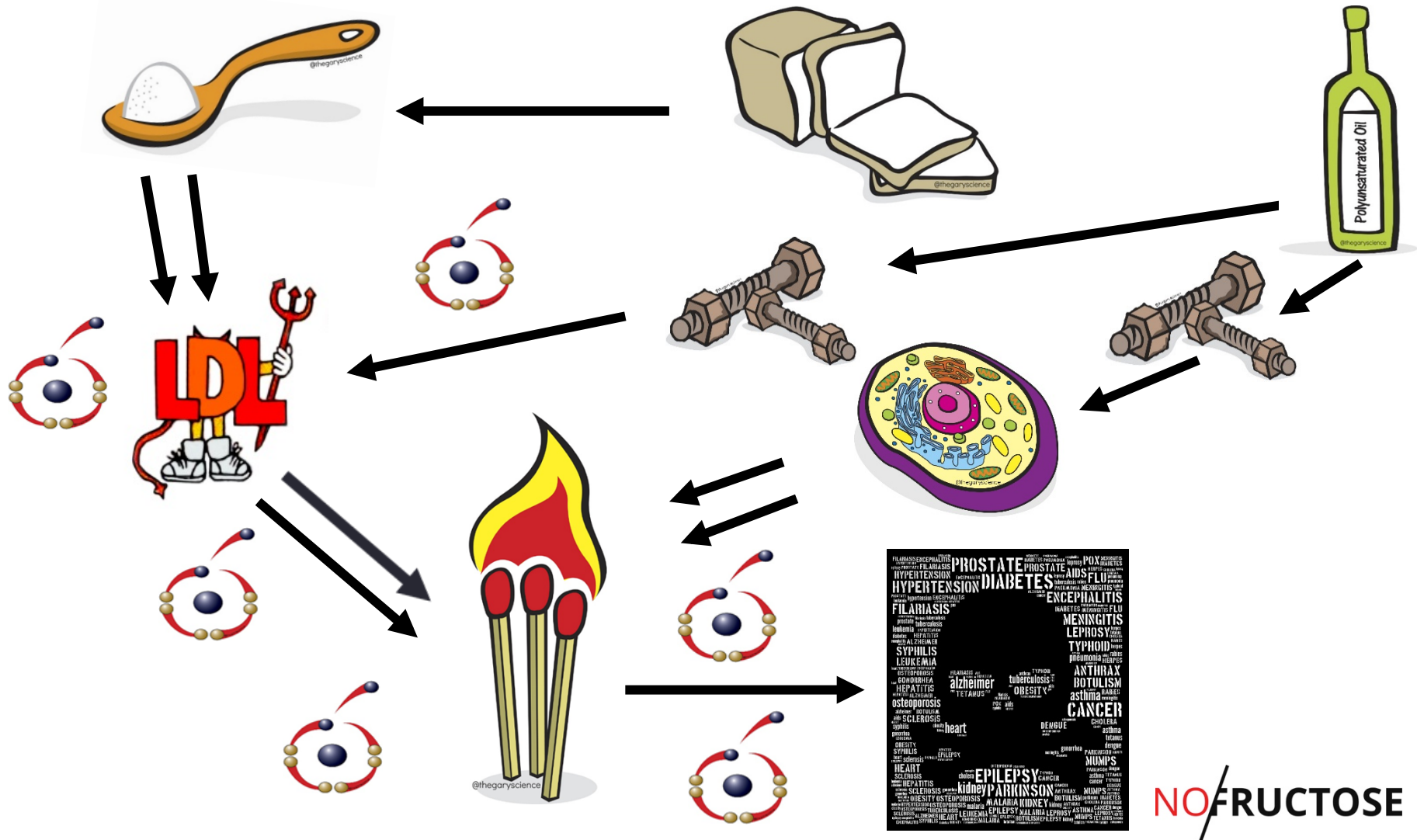
'Nutritional' Model of Modern Disease



'Nutritional' Model of Modern Disease



'Nutritional' Model of Modern Disease



NO FRUCTOSE

Model of 'Modern' Disease

- Observation ✓
- Hypothesis ✓
- Mechanism ✓
- Pathophysiology ✓
- Association evidence ✓
- Intervention evidence



Intervention Evidence

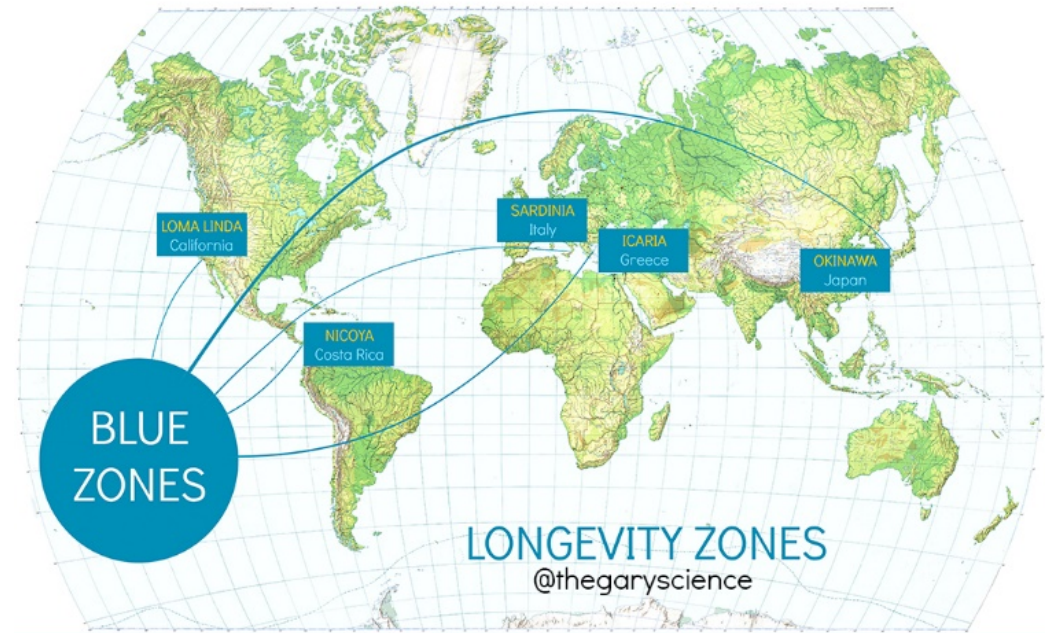
- Low Carb Healthy Fat Diets

Intervention Evidence

- Low Carb Healthy Fat Diets
- Ketogenic Diets

Intervention Evidence

- Low Carb Healthy Fat Diets
- Ketogenic Diets
- Longevity Cultures



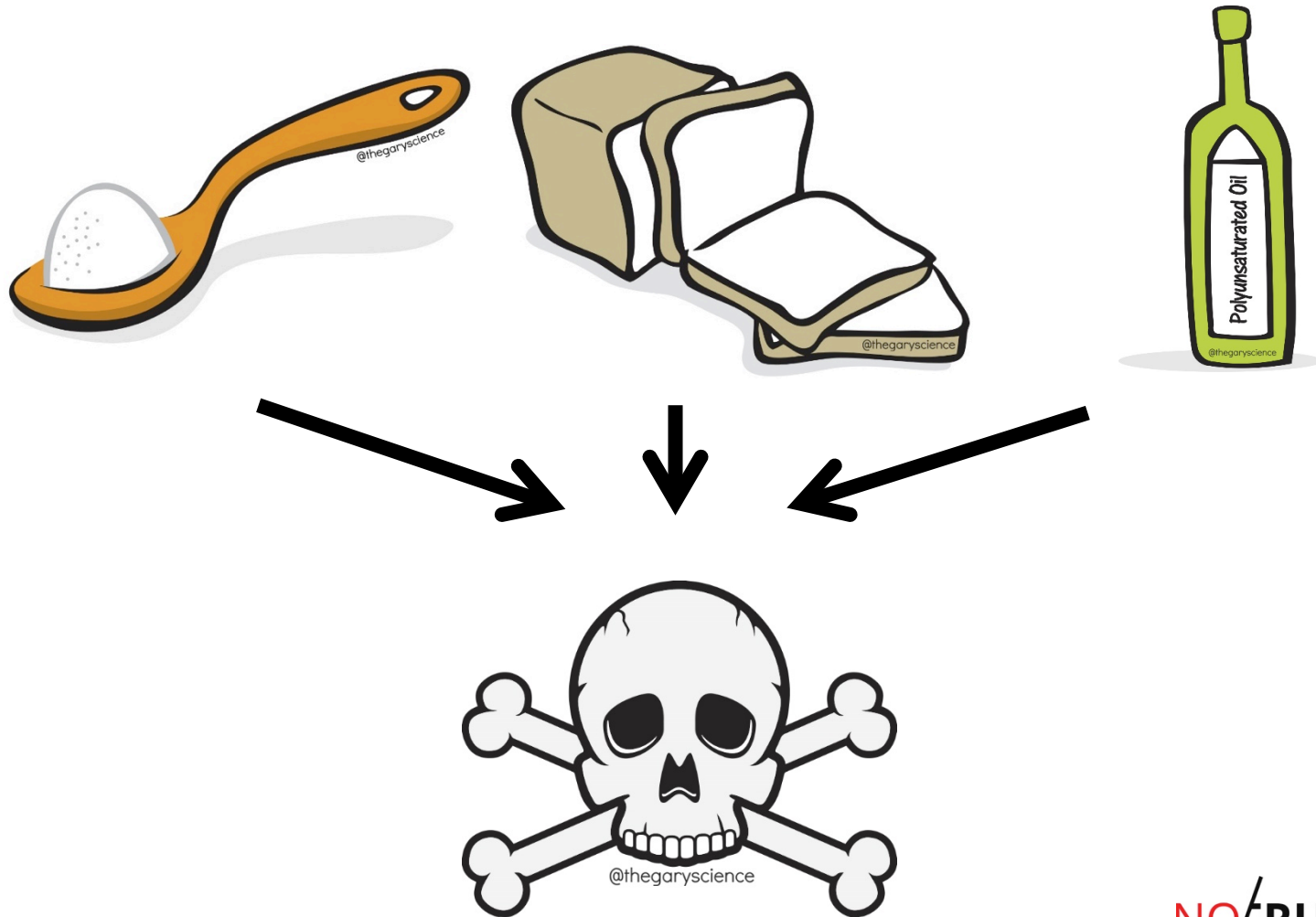
- Buettner, D. 2009. Blue Zones. www.bluezones.com

Model of 'Modern' Disease

- Observation ✓
- Hypothesis ✓
- Mechanism ✓
- Pathophysiology ✓
- Association evidence ✓
- Intervention evidence ✓

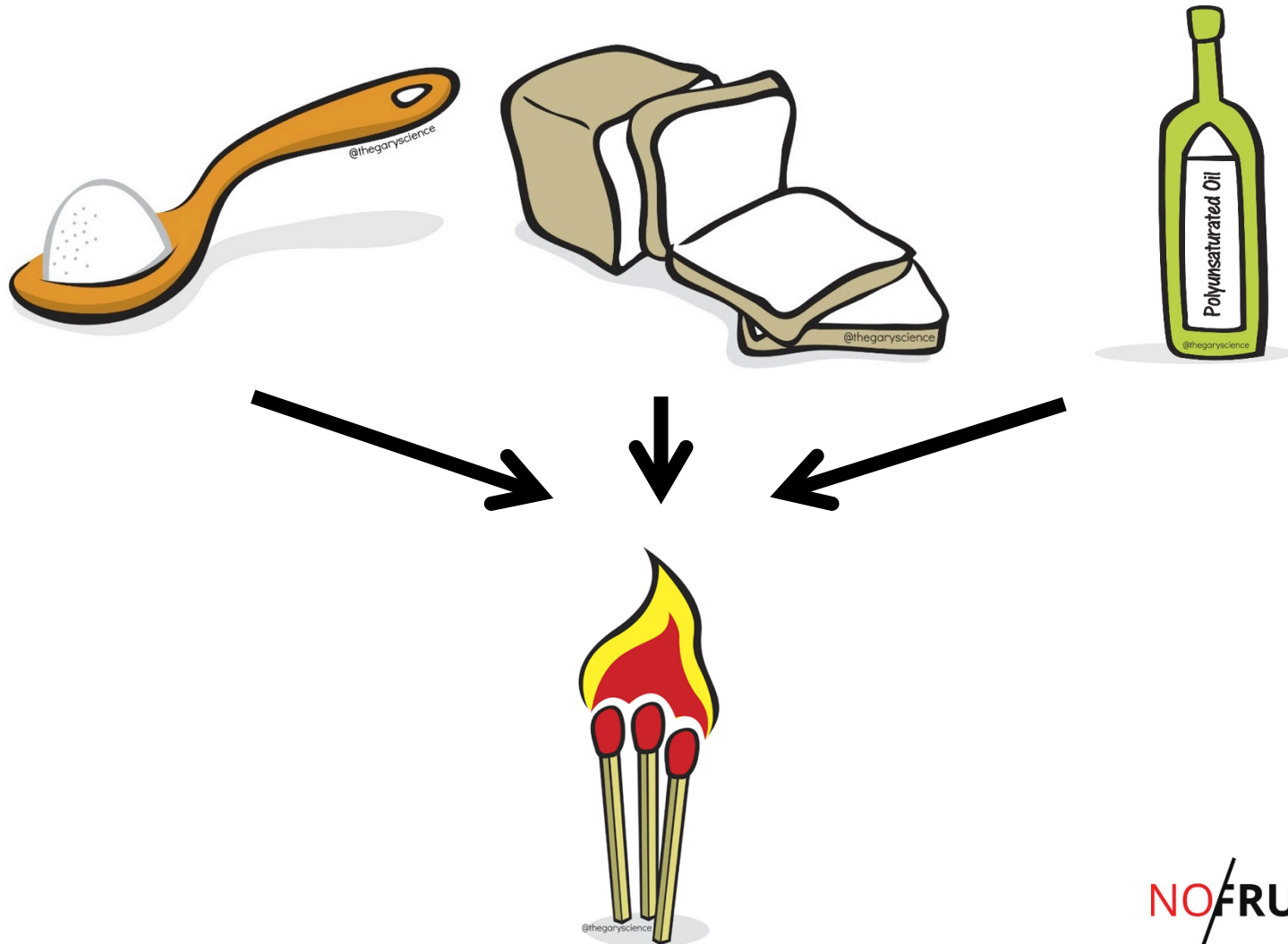


'Nutritional' Model of Modern Disease



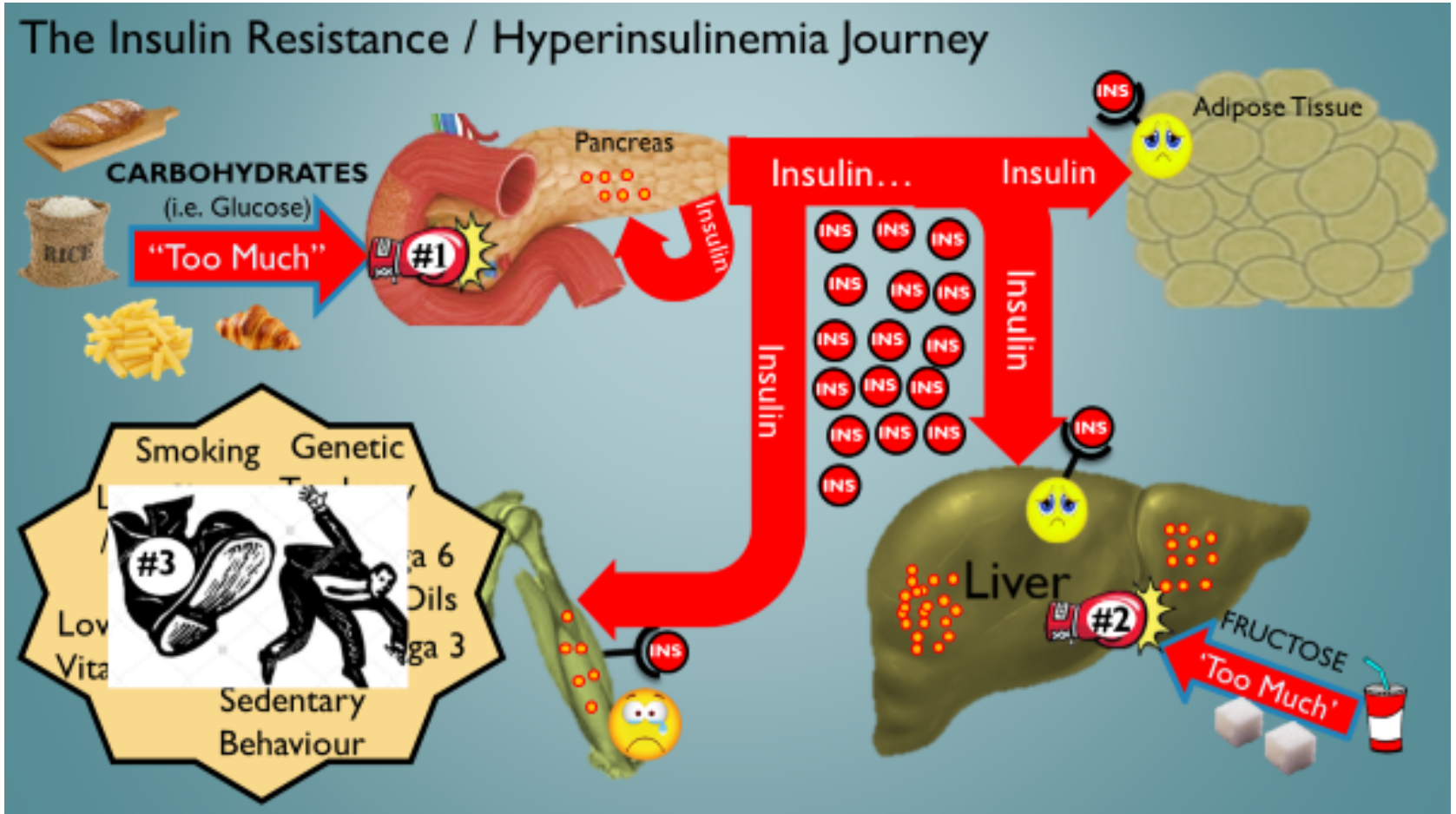
NOFRUCTOSE

'Nutritional' Model of Modern Disease



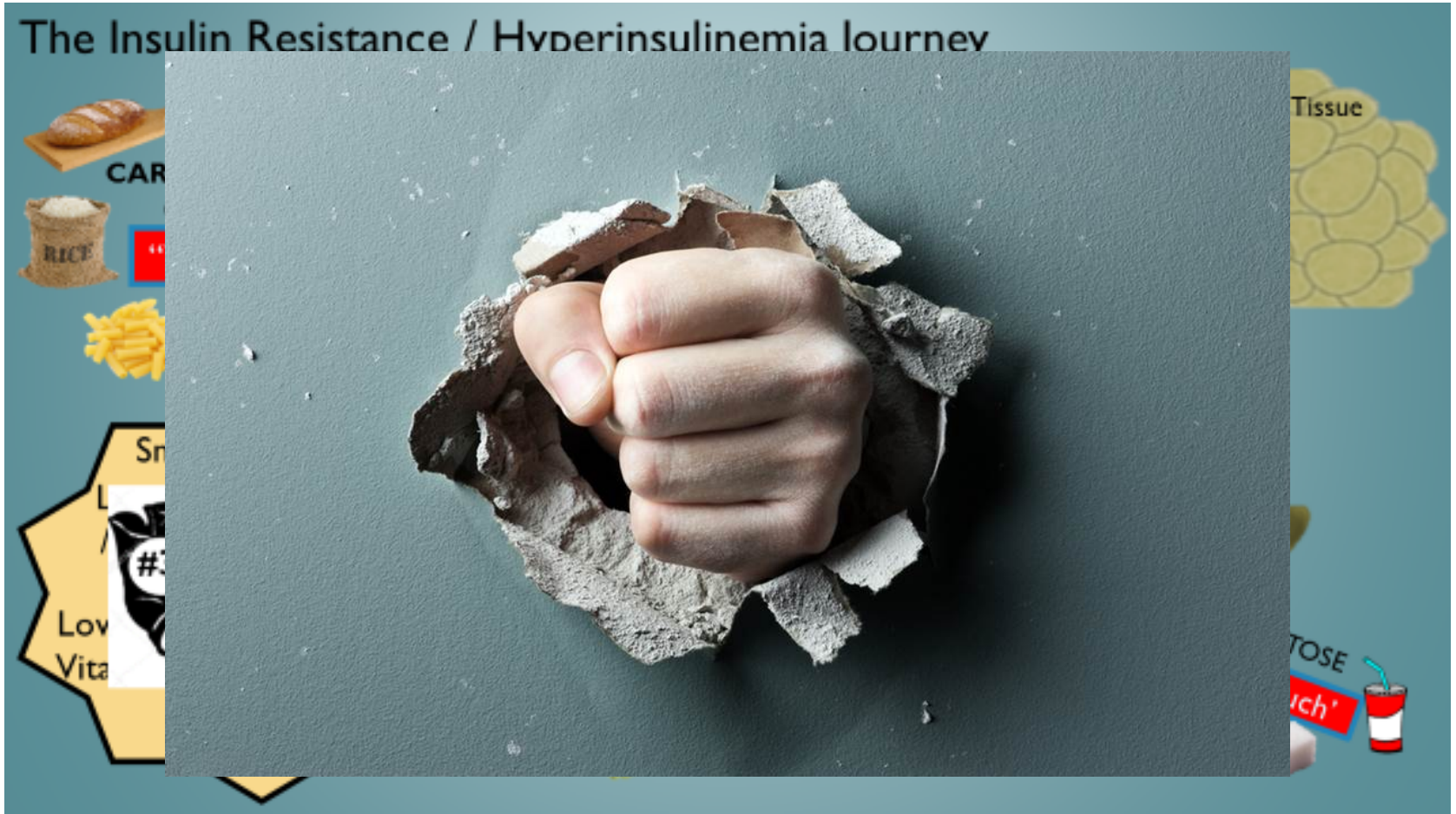
NO / **FRUCTOSE**

Ivor Cummins



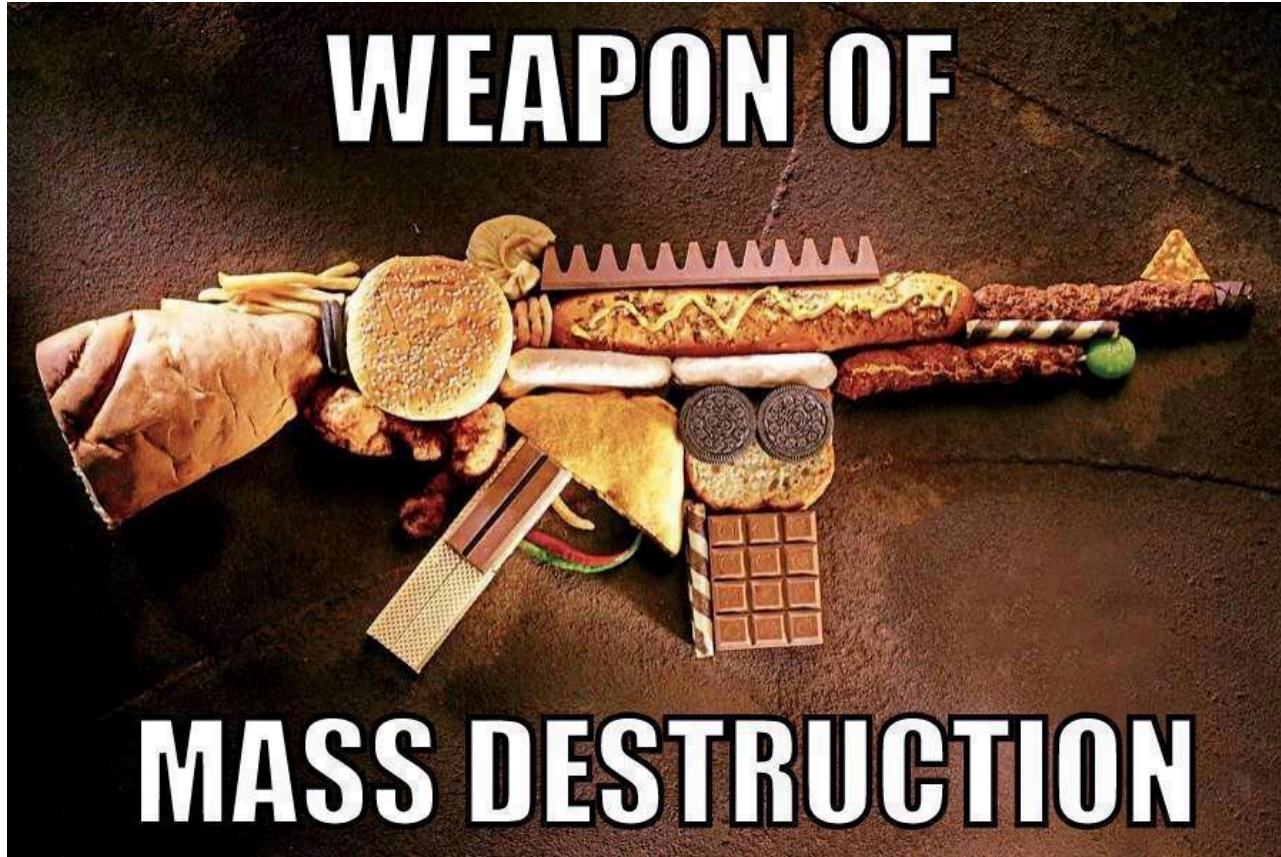
~~NO~~FRUCTOSE

Ivor Cummins

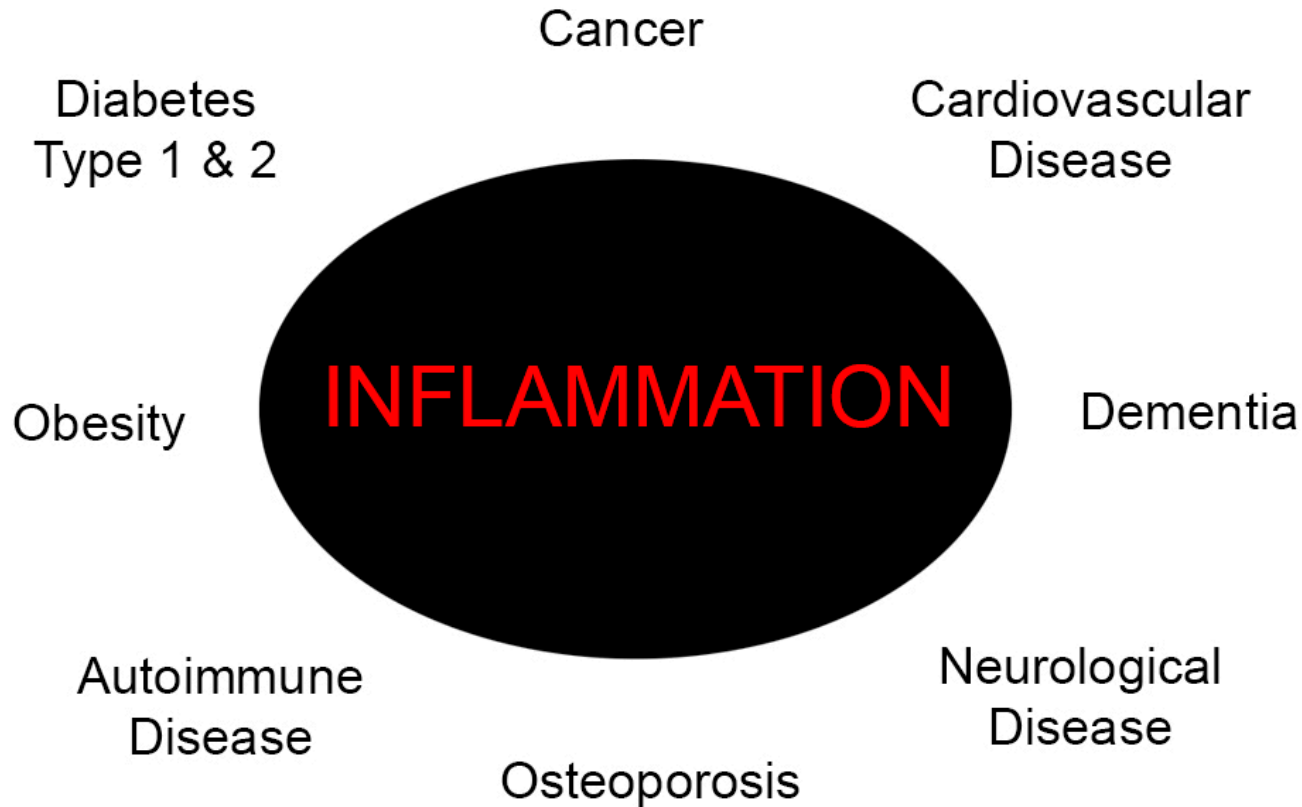


~~NO~~FRUCTOSE

'Nutritional' Model of Modern Disease

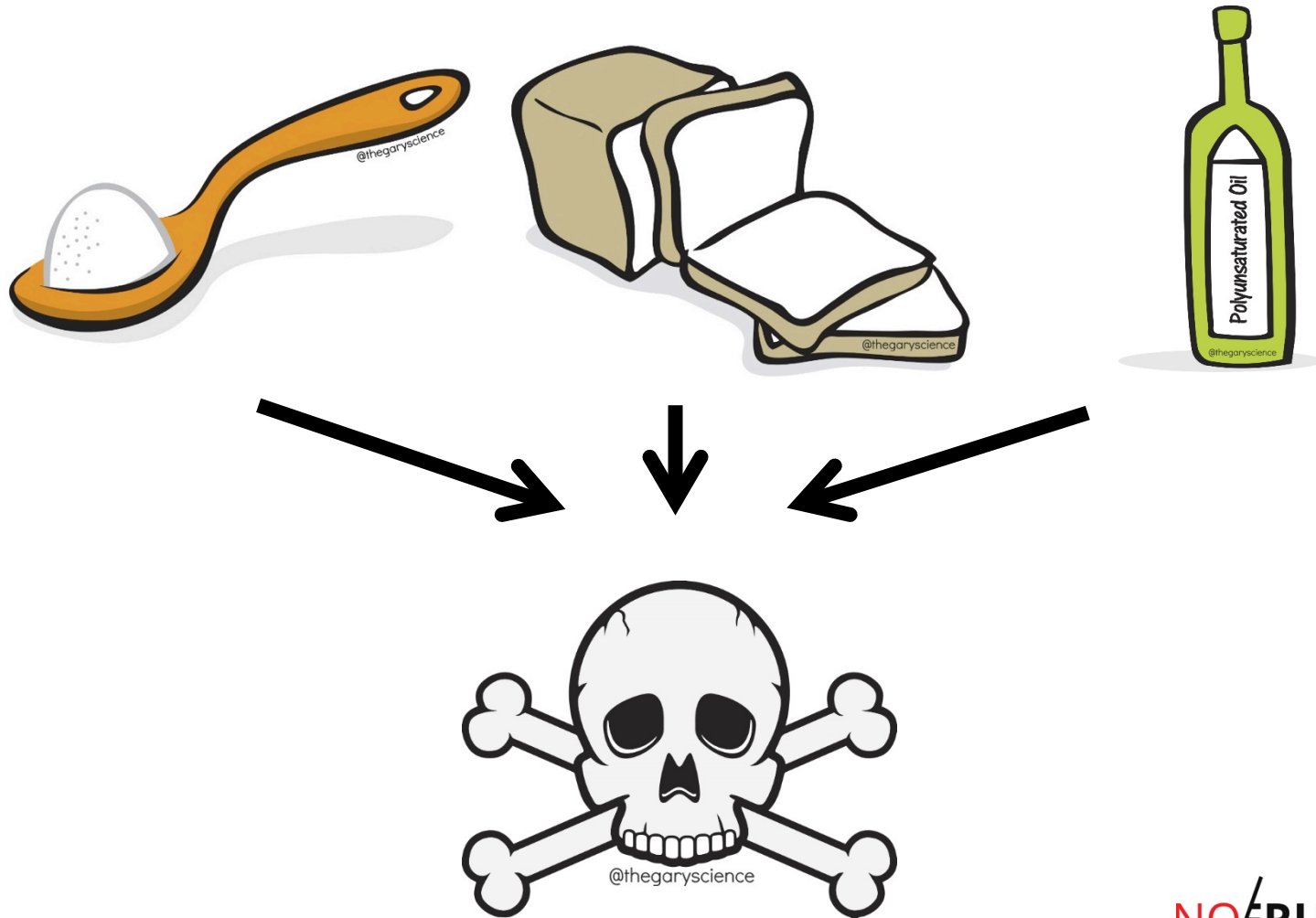


Modern Disease



NO/**FRUCTOSE**

'Nutritional' Model of Inflammation



NO / **FRUCTOSE**

Fireworks



NO / **FRUCTOSE**

Put Out the Inflammation



~~NO~~FRUCTOSE

Future Eating

- Local
- Seasonal
- Natural



~~NO~~FRUCTOSE

Future Eating

- Local
- Seasonal
- Natural

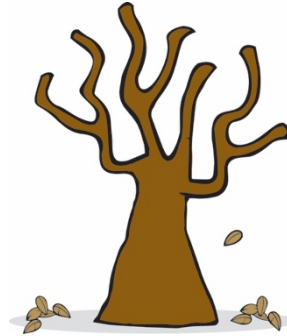
- 'MINDFUL'



~~NO~~FRUCTOSE

Future Eating

- REAL FOOD!



~~NO~~FRUCTOSE

Future Eating

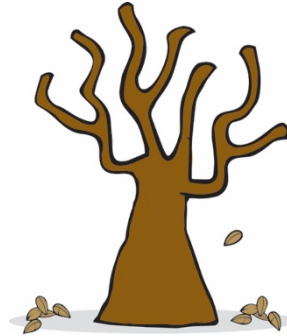
- REAL FOOD!
- LOW CARBOHYDRATE



~~NO~~FRUCTOSE

Future Eating

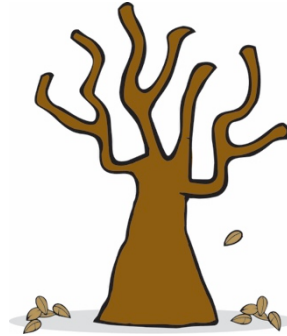
- REAL FOOD!
- LOW CARBOHYDRATE
- HEALTHY FAT



NO/~~FRUCTOSE~~

Future Eating

- REAL FOOD!
- LOW CARBOHYDRATE
- HEALTHY FAT
- Normal Protein



NO/~~FRUCTOSE~~

Future Eating

- REAL FOOD!
- LOW CARBOHYDRATE
- HEALTHY FAT
- Normal Protein

- MINIMAL POLYUNSATURATED OILS



SUGAR MAKES YOU
HUNGRY

CARBOHYDRATE MAKES YOU
FAT

@thegaryscience

POLYUNSATURATED OILS MAKE YOU
INFLAMED & SICK

NO/**FRUCTOSE**

#wecantwait

NO/~~FRUCTOSE~~

Thank you

- Belinda Fettke
- Serena Heyward
- David Gillespie
- Professor Robert Lustig
- Professor Richard Johnson
- Dr Rod Tayler
- Professor Ken Sikaris
- Dr Simon Thornley
- Dr Stephan Guyenet
- Professor Tim Noakes
- Professor Grant Schofield
- Dr Benjamin Seeds
- Dr Kieron Rooney
- Dr Troy Stapleton
- Professor Glen Lawrence
- Professor Thomas Seyfried
- Those that have gone before
- LGH Library Staff
- Medline search engine

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