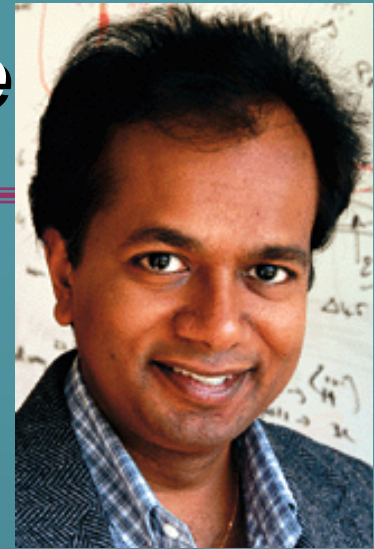


Life Is Sweet

Biological Engineer Ram Sasisekharan:
Tackling Complex Carbohydrates

Ram Sasisekharan Deciphers the Code



Biological engineer Sasisekharan wants to unlock the healing power of sugars.

Biological sugars (carbohydrates)

- Help heal scrapes
- Hold cells together
- Communicate messages throughout the body

Question:

Where do we find carbohydrates?

Answer: In most life forms

Carbohydrates = Main energy source for the body

Simple carbohydrates

- Sweetened breakfast cereal
- Orange juice
- Candy



Complex carbohydrates

- Starch in potatoes
- Pasta
- Fiber in apple skins and vegetables


Carbs Made Simple

Types of carbohydrates:


- Monosaccharide—one simple sugar molecule
- Disaccharide—two simple sugar molecules linked together
- Polysaccharide—long, interconnected complexes of monosaccharide or disaccharide units that repeat a pattern



Name a common monosaccharide.

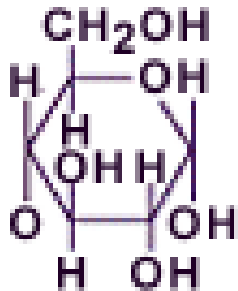


Name a disaccharide that is a staple in most households.



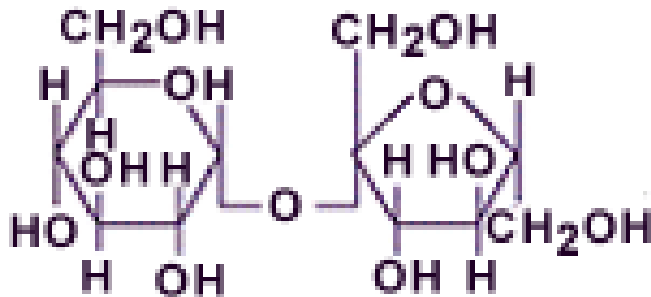
Do these molecules have a positive or negative charge?

Common Sugar Molecules



Glucose

Monosaccharide



Sucrose

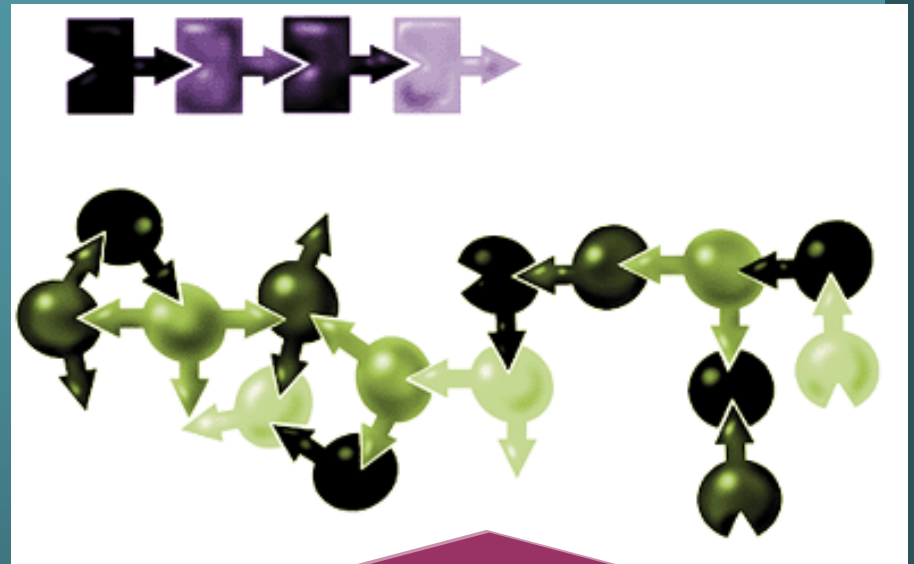
Disaccharide consisting of glucose and fructose chemically linked together

Complex Carbohydrates – Zillions of Flavors

Amino acids



- Building blocks of proteins
- Link together in a linear fashion



Complex carbohydrates



- Simple sugars connected in various combinations
- Often have branched structure

Proteoglycans Have Many Roles

Characteristics

- Bundle of molecules consisting of polysaccharides nestled together with proteins
- Located everywhere in the body
- Can twist and bend

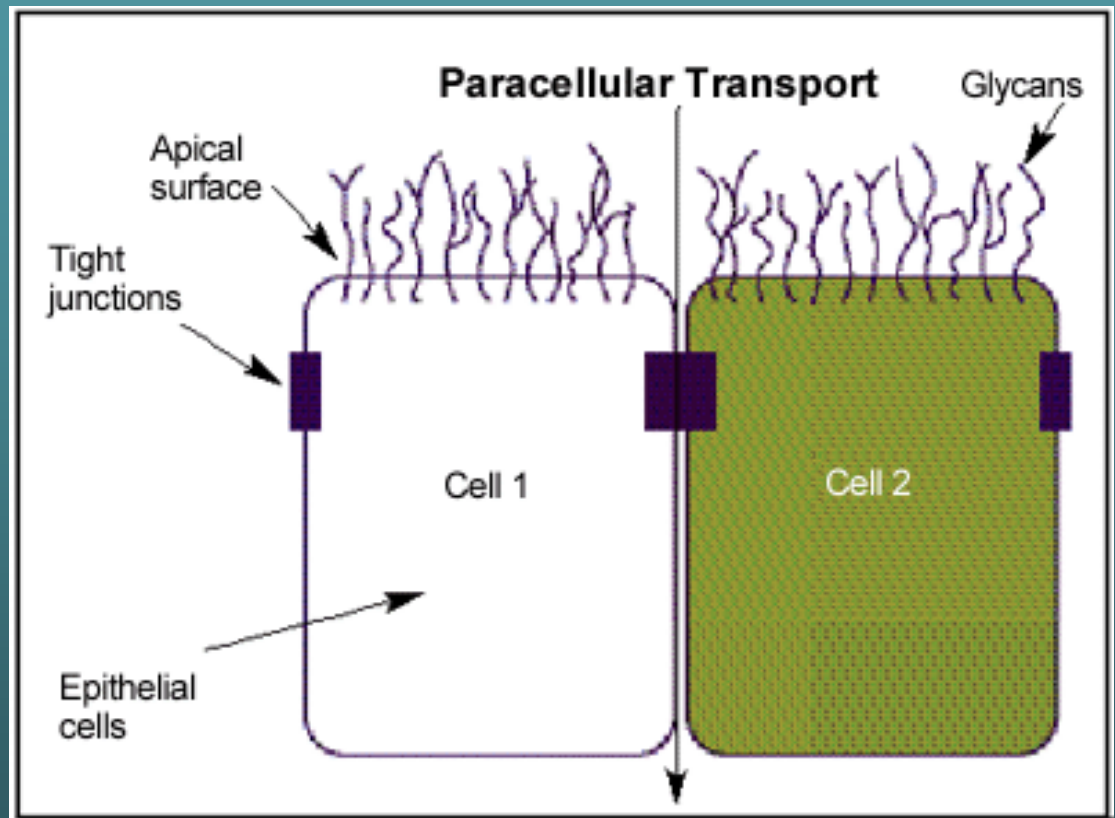
Biological roles

- Help thicken fluid in joints
- Key component in cartilage and connective tissue
- Dot cell surfaces
- Help cells roam around the body

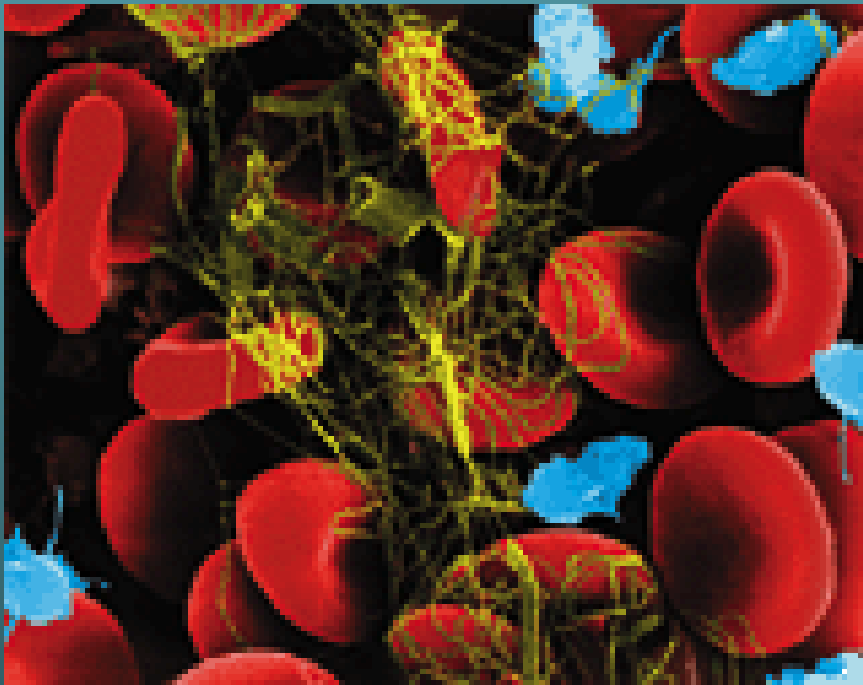
Open, Sesame

Paracellular transport, in which molecules pass between epithelial cells, appears to be gated by a “sugar code.”

The code is specified by glycan molecules that coat the top, or apical, surface of these cells.



Heparin: Sugar-based Anticoagulant



- Heparin and low-molecular weight heparin are drugs widely used to prevent blood clots that can lead to heart attacks and strokes
- Commercial preparations of heparin can produce excessive bleeding in some patients

Sweet Treatments

Commercial heparin	“Designer” heparins
Usually made from pig intestinal lining	May be safer than current preparations
Contains widely varying mixtures of different sizes of glycan molecules	Contain sugar molecules that work predictably
Difficult to know ahead of time how well a particular batch will work in patients	Design of the molecules enables them to be neutralized to prevent bleeding

Research Applications

How might knowledge about sugar molecules gained by Sasisekharan help in the fight against cancer?