COACERVATES THEORY

Coacervates are a collection of proteins and carbohydrates surround by water molecules.

Coacervate is derived from the Latin word *coacervare*, meaning “to assemble together or cluster”.

Coacervates form when various combinations of proteins and carbohydrates are added to water. The proteins form a boundary layer of water around them that is distinctly separate from the water they are suspended in. These proteins and the water layer are called coacervates.

Composition combinations include: protein—carbohydrate, protein—protein, protein—nucleic acids

Coacervates have been studied by Oparin, and he was found that under certain conditions coacervates can be stabilized in water for weeks if they were given a metabolism, a system for producing energy.

To accomplish this, Oparin added enzymes and glucose (sugar) to the water. The coacervate took in the enzymes and glucose, and then the enzymes caused the coacervate to combine the glucose with the carbohydrate in the coacervate. This caused the coacervate to grow in size. Waste products from the reaction of the glucose were expelled out of the coacervate.

Once the coacervate became large enough, it began to spontaneously break up into smaller coacervates. If the daughter coacervates received the enzymes or were able to create their own enzymes, they would be able to continue growing and budding.
LIPOSOMES THEORY

Liposomes are spheres of lipid bilayers found in water.

Liposome is derived from two Greek words: lipo (“fat”) and soma (“body”); liposomes are primarily composed of phospholipids.

When phospholipids are mixed with water, they form a lipid bilayer. The lipid bilayer could then allow other organic molecules to enter the liposome and potentially carry out reactions that allow the liposome to grow and reproduce. These reactions would break down glucose (sugar) to accumulate mass in the liposome and release waste through the lipid bilayer. These reactions could be considered a type of metabolism that provides energy and food for the liposome.

Micelles, which are simpler structures with a single lipid layer could also go through similar processes.

Liposomes contain a lipid bilayer, which is one of the essential components of cells. Liposomes may be the beginnings of the first cells.
**PROTEINOID MICROSPHERES THEORY**

*Proteinoid microspheres are a collection of proteins that form spheres when they are heated.*

Proteinoid microspheres form when protein aggregates are heated in a solution of water at 130°C to 180°C. The proteins spontaneously aggregate into microspheres. These microspheres develop an outer boundary that resembles the double lipid layer of cell membranes (but no lipids are present).

Sidney Fox has studied proteinoid microspheres. He was interested in the way that proteinoids produce their energy (metabolism). He found that proteinoids maintained a continual supply of energy from the reactions that they carried out inside themselves. Proteinoids contained enzymes that maintained reactions, which incorporate glucose (sugar) into the proteinoid’s mass. Proteinoid microspheres also had osmotic properties, where substances could pass in and out by osmosis. This additional mass allows the proteinoid to grow. He also found that proteinoid microspheres bud in a manner very similar to bacteria.

Proteinoid microspheres seem to have the ability to incorporate food (glucose) into their mass and to reproduce. Proteinoid microspheres seem to have the characteristics of beginning cells.