

Placenta and Fetal Membranes

Amnion - Epiblast / Extraembryonic Mesoderm

Yolk Sac - Hypoblast / Extraembryonic Mesoderm

Allantois - Embryonic Hindgut

Chorion - Trophoblasts / Extraembryonic Mesoderm

Placenta - Chorion / Maternal Decidua

Amnion

Amnionic membrane is two cell layers

- 1) epiblast derived extraembryonic ectodermal layer
- 2) thin non-vascular extraembryonic mesoderm

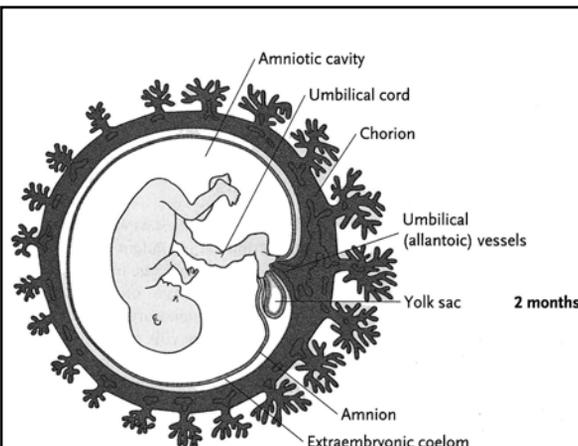
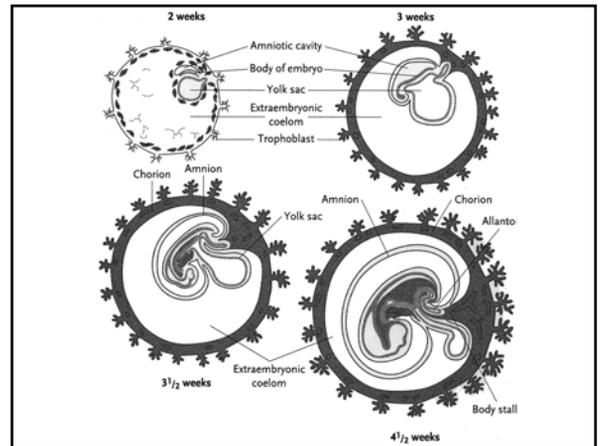
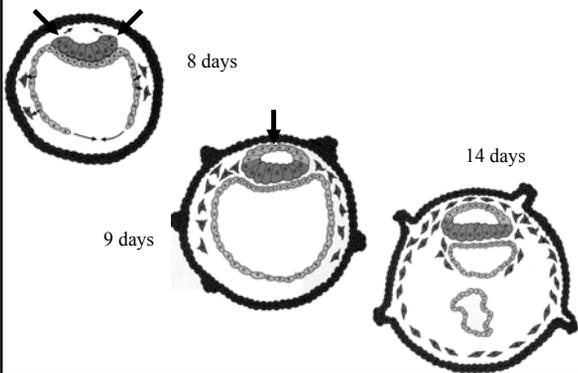
As the amnion enlarges it encompasses the embryo on the ventral side, merging around the umbilical cord.

Amnion forms the epithelial layer of the umbilical cord

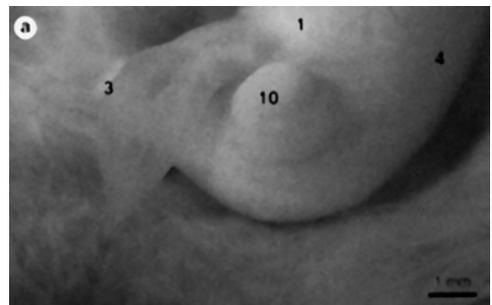
With embryo growth the amnion obliterates the chorionic cavity

Amnionic sac is fluid filled called amniotic fluid: the embryo is bathed in the fluid

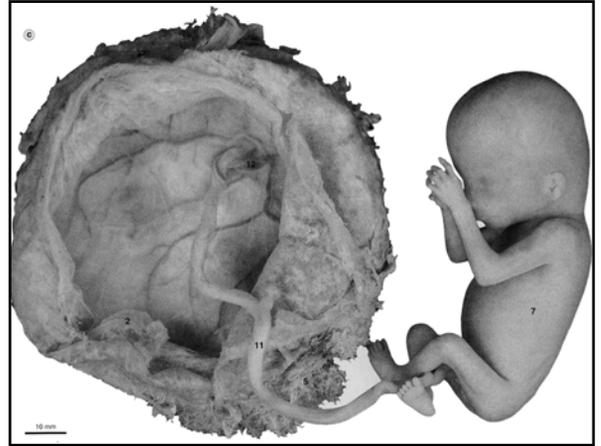
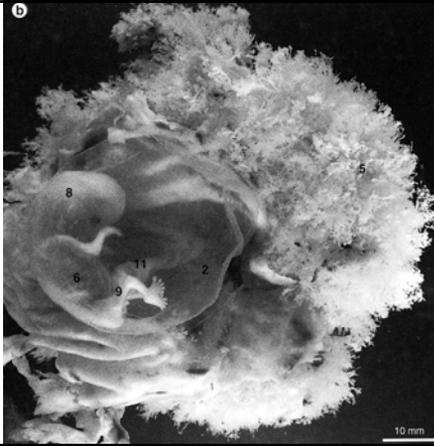
Extraembryonic Tissues



Amnion



Amnion



Amniotic Fluid

Up to week 20 - fluid is similar to fetal serum (keratinization)

After 20 weeks – Contribution from urine, maternal serum filtered thru endothelium of nearby vessels, filtration from fetal vessels in cord

Near birth - can contain fetal feces called meconium

Near birth – amniotic fluid (500-1000 ml) exchanges every 3 hrs
1) across the amnion – exchange with maternal fluids.
2) fetal swallowing (20 ml/hour) – to gut – adsorption by fetus – out the umbilical cord to placenta.

Hydraminos – Excess fluid (>2000 ml), esophageal atresia

Oligohydramnios – Insufficient fluid (<500 ml), renal agenesis

Amnion Function

Mechanical protection: hydrostatic pressure

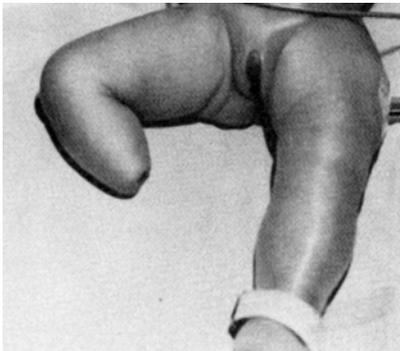
Allows free movement - which aids in neuromuscular development

Antibacterial

Allow for fetal growth

Protection from adhesions

Amnion Band Syndrome (ABS)



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Yolk Sac

Hypoblast - the primary yolk sac or Heuser's membrane.

Day 12 - Second wave of cell migration - forms definitive yolk sac

Composed of extraembryonic endoderm

Early nutrition (2-3 weeks) for the embryo - later shrinking - nonfunctional – Meckels diverticulum (outpocketing of small intestine)

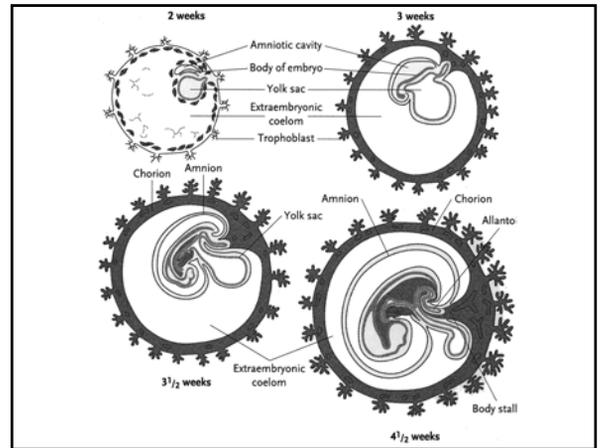
Connects to midgut via the yolk sac stalk

Derivatives:

Early blood cells forms from blood islands

Primordial germ cells

The early gut, epithelium of the respiratory and digestive tracts



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Allantois

Endodermal origin – caudal outpocketing of the yolk sac

Invades the connecting stalk (extraembryonic mesoderm) that suspends the embryo in the chorionic cavity

Involved in early hematopoiesis (up to 2 months)

The allantois blood vessels - artery and vein - becomes the umbilical vessels

Remnants of Allantois becomes the urachus ligament that connects the belly button to the bladder

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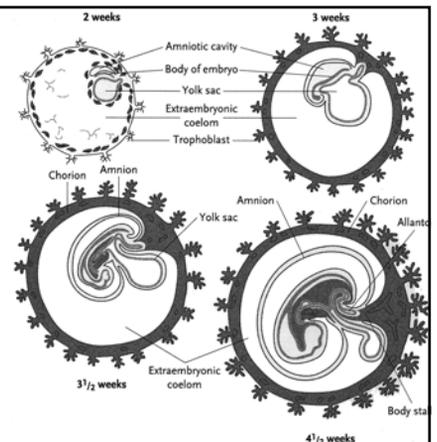
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Chorion



Chorion

Chorionic cavity (extraembryonic coelom)- lined with extraembryonic mesoderm

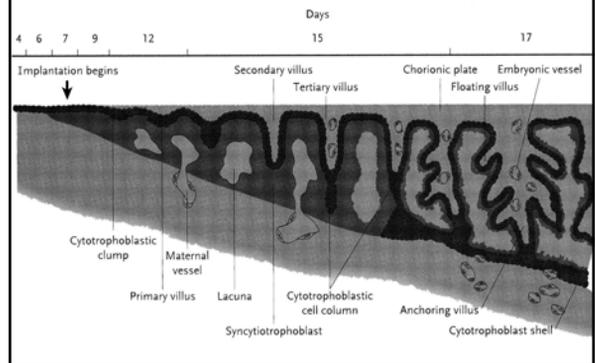
Chorionic cavity expands separating amnion from cytotrophoblast

Chorionic sac consist of:
 cytotrophoblastic layer
 syncytiotrophoblastic layer
 extraembryonic somatic mesoderm

The Chorion / maternal endometrium forms the placenta

Chorion forms stem villi

Stem Villi



Stem Villi

Chorionic Plate – Stem villi extends from this tissue

Primary stem villi (day 11-13) - finger-like protrusions into endometrium - contains syncytiotrophoblast, cytotrophoblast.

Secondary stem villi (day 16) - extraembryonic mesoderm invasion into villi core.

Tertiary stem villus (21 day) - extraembryonic vessels - chorionic arteries and veins derived from extraembryonic mesoderm.

Hemichorial type placenta – maternal blood baths villi

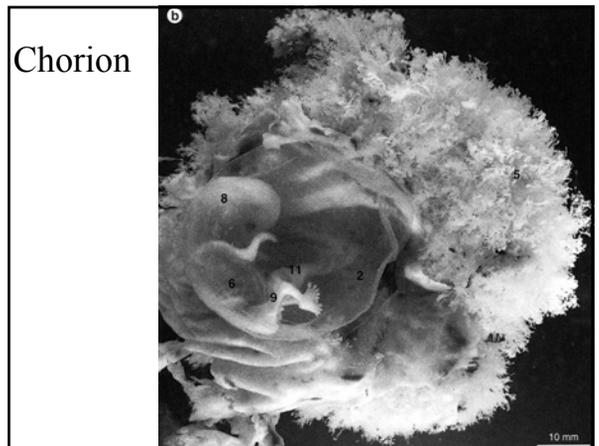
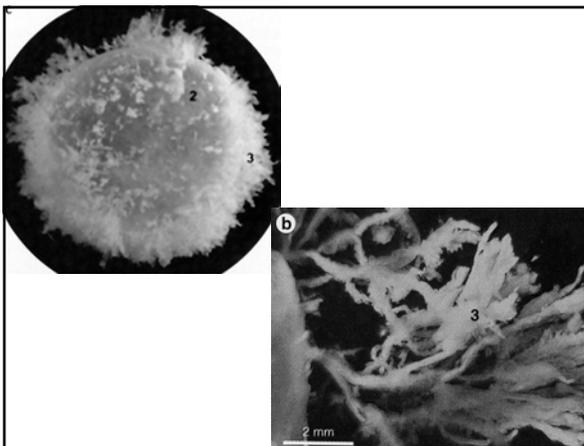
Stem Villi

Cytotrophoblastic cell column – terminal villi, solid mass of trophoblast

Cytotrophoblastic shell – surrounds embryo; direct contact with maternal decidual cells

Anchoring Villi – give off cytotrophoblastic extensions - anchoring because they represent the real maternal-embryo link

Floating Villi – branches off anchoring villi – dangles freely in maternal blood



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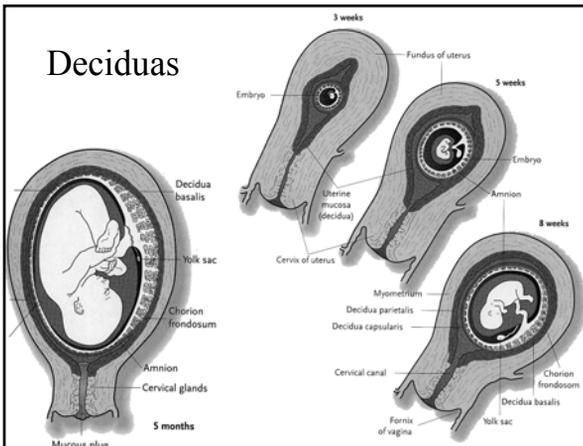
Decidua

Decidual Reaction – stromal cells – accumulate glycogen and lipid, called **Decidual Cells**

Decidua basalis - forms maternal component of the placenta; associates with the chorion frondosom

Decidua capsularis - superficial layer overlying the entire embryo - this layer eventually degenerates; associates with the chorion laeve

Decidua parietalis - all remaining parts of the endometrium - not associated with the embryo



Making the Placenta

By 8 weeks - chorionic stem villi over the entire surface of the chorionic sac

Those villi associated with the decidua basalis increase in size and more villi form.

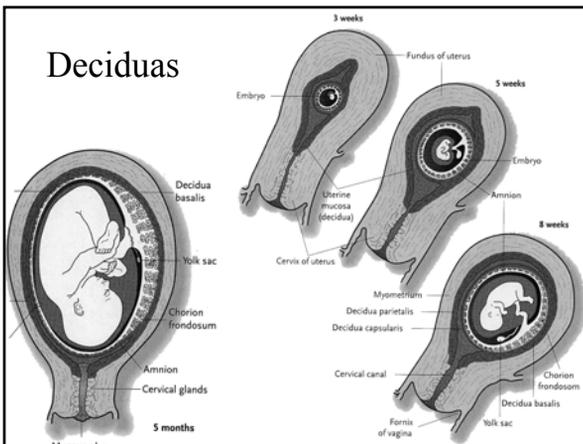
Enlargement includes further branching of the anchoring villus - chorion frondosum.

The villi continue to enlarge during most of gestation.

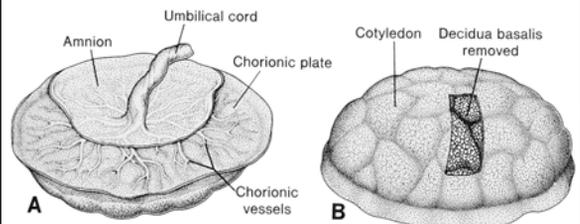
The villi project into a blood filled intervillous space resulting from the erosion of the decidua basalis.

Endometrial vessels - spiral arteries and endometrial veins

Villi associated with the decidua capsularis degenerate - this region is called the chorion laeve



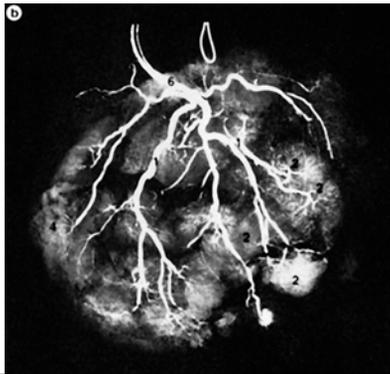
Placenta



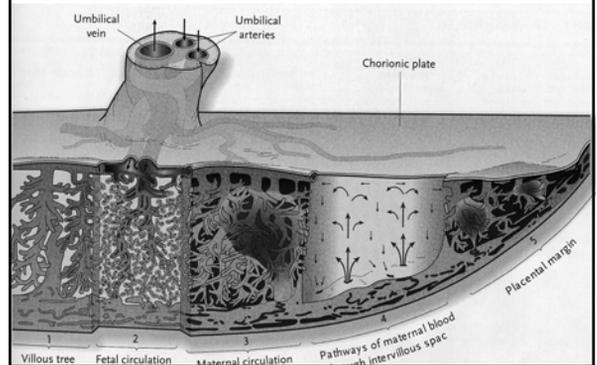
The erosion of the decidua basalis is incomplete - uneroded regions called decidual septa.

The decidual septa define regions of the placenta called cotyledon.

Placental Blood Flow



Placental Anatomy



Umbilical Cord

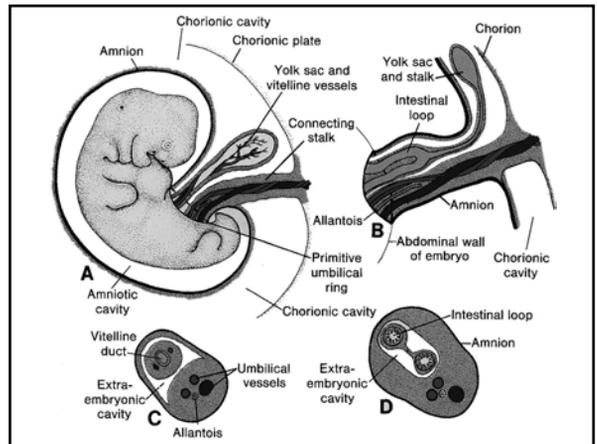
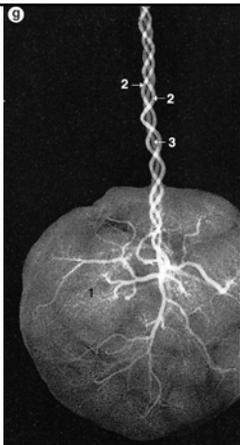
One umbilical vein, two umbilical arteries

Wharton's jelly – mucoid connective tissue surrounding vessels

Allantois

Yolk Stalk (vitelline duct) and vitelline vessels (early)

Intestinal loop – umbilical hernia (late)



Placental Circulation

Fetal – Contained within vessels

Umbilical Arteries – chorionic plate – branches to stem villi – capillaries in terminal villi – return via umbilical vein

Maternal – Free-flowing lake

Spiral arteries open into intervillous space and bath the villi

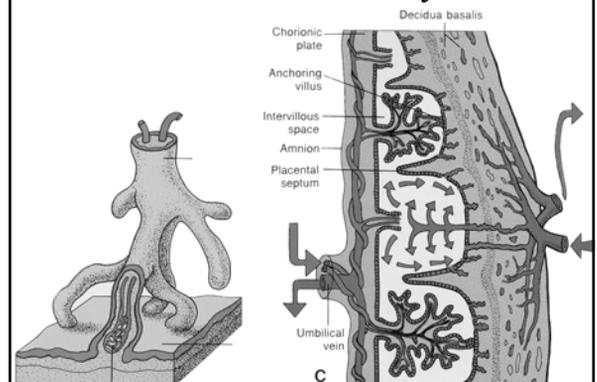
150 ml of maternal blood

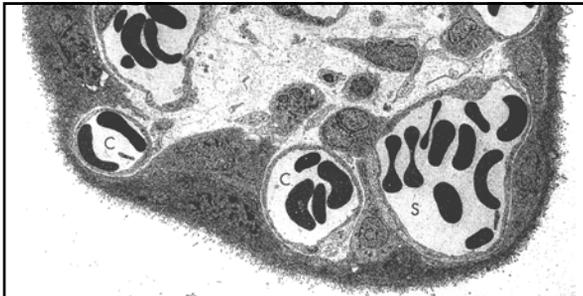
Exchanged - 3-4 times/minute

Reduced blood pressure in intervillous space

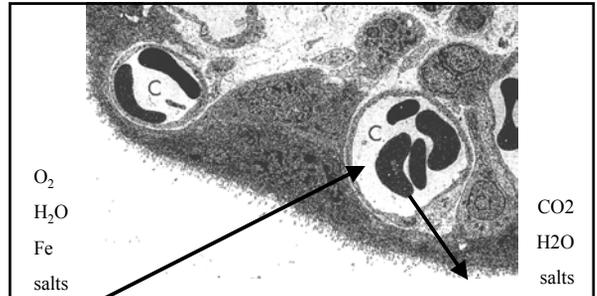
Oxygenated blood to the chorionic plate, return bathes the villi

Placental Anatomy





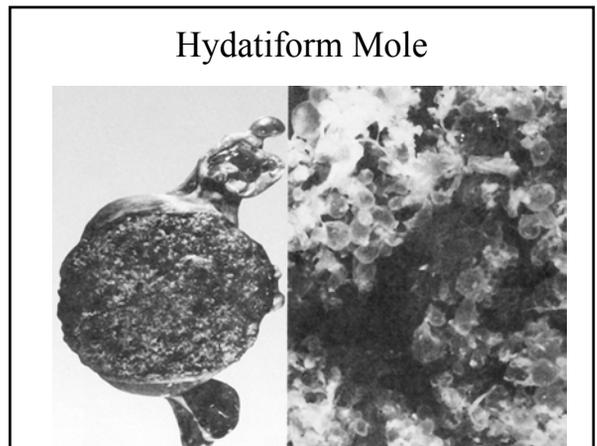
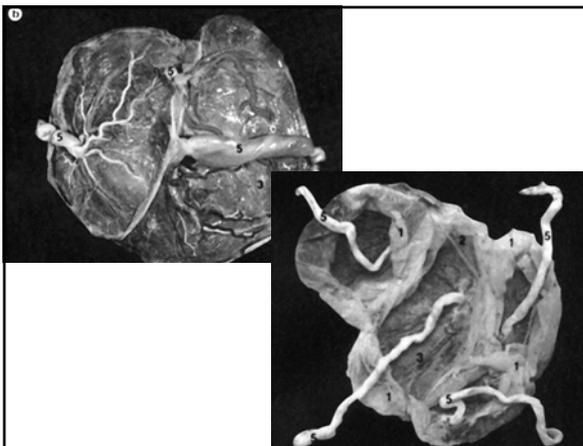
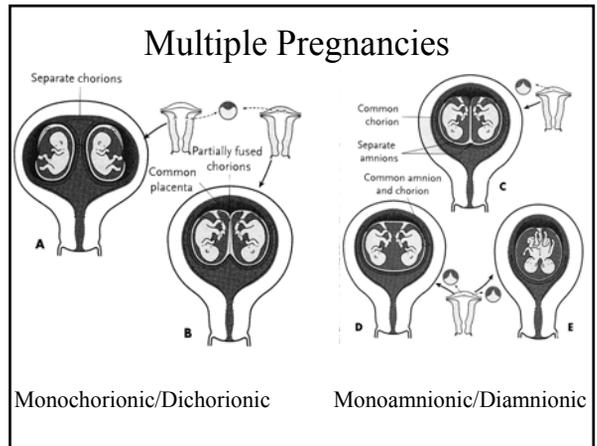
Placental barrier decreases with gestation
 Placental Barrier – syncytiotrophoblast + basal lamina, basal lamin + fetal capillary endothelium
 Syncytiotrophoblasts – many microvilli, no major histocompatibility antigens



O ₂	CO ₂
H ₂ O	H ₂ O
Fe salts	salts
carbohydrates, amino acids, lipids	urea, uric acid
vitamins, hormones, antibodies	creatinine
drugs, alcohol	bilirubin, hormones,
viruses (rubella, varicella-zoster, HIV)	RBC antigens

Placenta as an Endocrine Organ

Human Chorionic Gonadotropin – Corpus Luteum (declines after 8 weeks)
 Progesterone – High levels by the end of first trimester
 Estrogen – Synthesis involves enzymatic activity of fetal adrenal gland and liver
 Chorionic Somatomammotropin – Human Placental Lactogen – similar to GH (growth, lactation, lipid and carbohydrate metabolism)
 Placental Growth Hormone – similar to GH – Replaces maternal GH by 15 wks – enhances blood glucose levels
 Chorionic Thyrotropin, Chorionic Corticotropin



Erythroblastosis fetalis

Fetus / newborn - hemolytic disease (anemia)

Rh factor is a RBC surface antigen

Rh- mother with Rh+ 1st baby – Maternal antibodies
are induced after birth

At risk is second Rh+ baby

Maternal Rh antibodies cross placenta

Hemolysis of fetal Rh+ RBC