



EMBRIOLOGIA GERAL ILUSTRADA

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INTRODUÇÃO

Este é um livro eletrônico simples e despretensioso, criado para auxiliar alunos ou profissionais da área biomédica a compreenderem o básico da Embriologia Humana Geral.

Consiste em um roteiro ilustrado cujas páginas são “quadros” de animações controladas pelo aluno, a medida que ele avança ou recua as páginas com as setas, determinando assim a velocidade da animação, tornando-a interativa.

Espero que este material seja suficientemente motivador para despertar o interesse do aluno pela Embriologia, estimulando-o a ir em busca de mais conhecimento através da pesquisa.

A autora

SUMÁRIO

- ✓ Introdução
- ✓ Primeira Semana do Desenvolvimento Humano
- ✓ Segunda Semana do Desenvolvimento Humano
- ✓ Terceira Semana do Desenvolvimento Humano
- ✓ Quarta a Oitava Semanas do Desenvolvimento Humano
- ✓ Bibliografia

1ª Semana do desenvolvimento Humano:

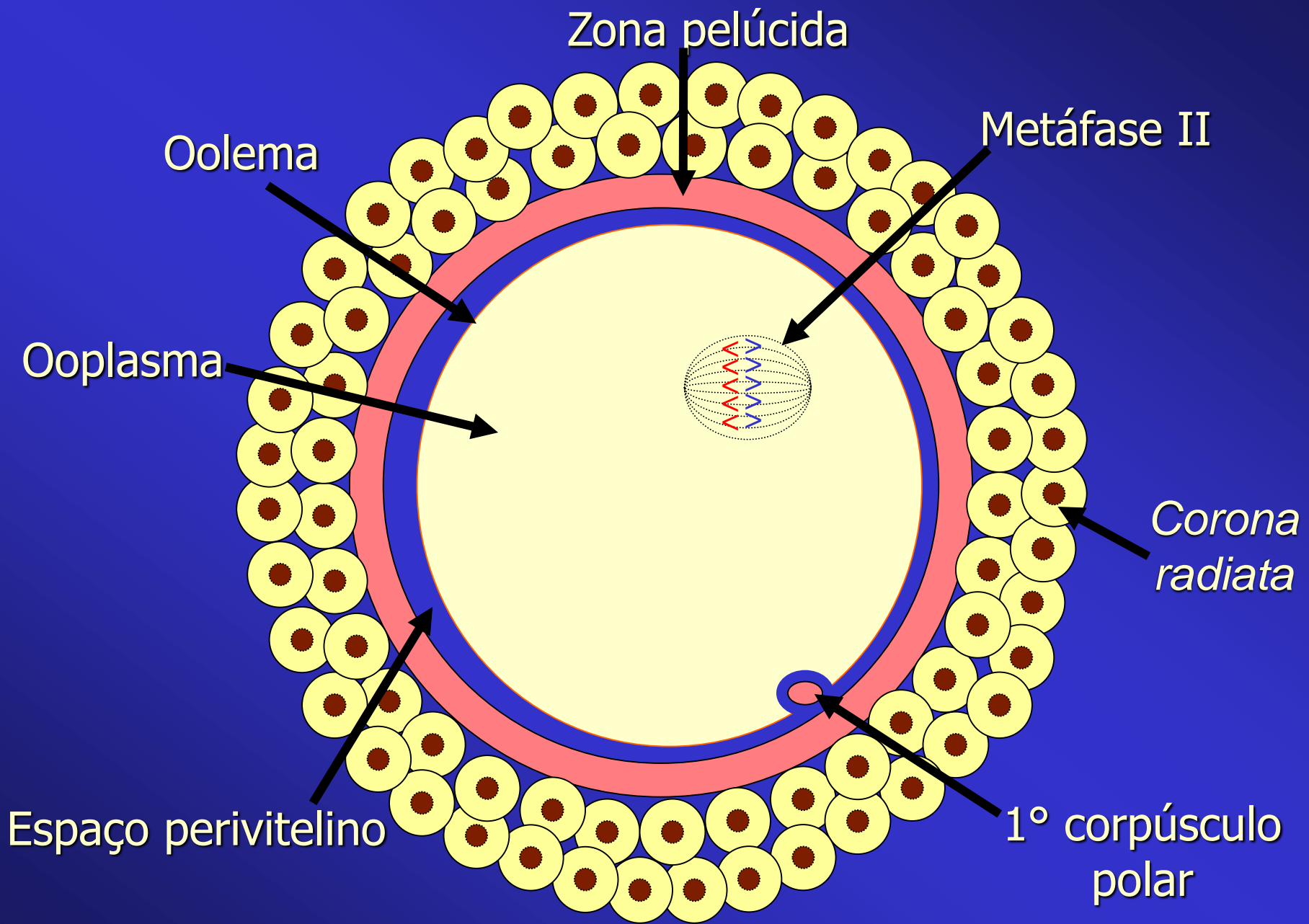
O desenvolvimento humano inicia com a FECUNDAÇÃO - fusão dos gametas masculino e feminino, que resulta na formação do zigoto, a 1ª célula do novo indivíduo.

RESULTADOS DA FECUNDAÇÃO:

- ✓ Conclusão da 2ª divisão meiótica do ovócito
- ✓ Restauração do n° diplóide de cromossomos
- ✓ Variação da espécie
- ✓ Determinação do sexo cromossômico do embrião
- ✓ Ativação metabólica do ovócito / início da segmentação

OS GAMETAS

- Feminino: Ovócito secundário (óvulo)
- Masculino: Espermatozóide



Zona pelúcida

Metáfase II

Oolema

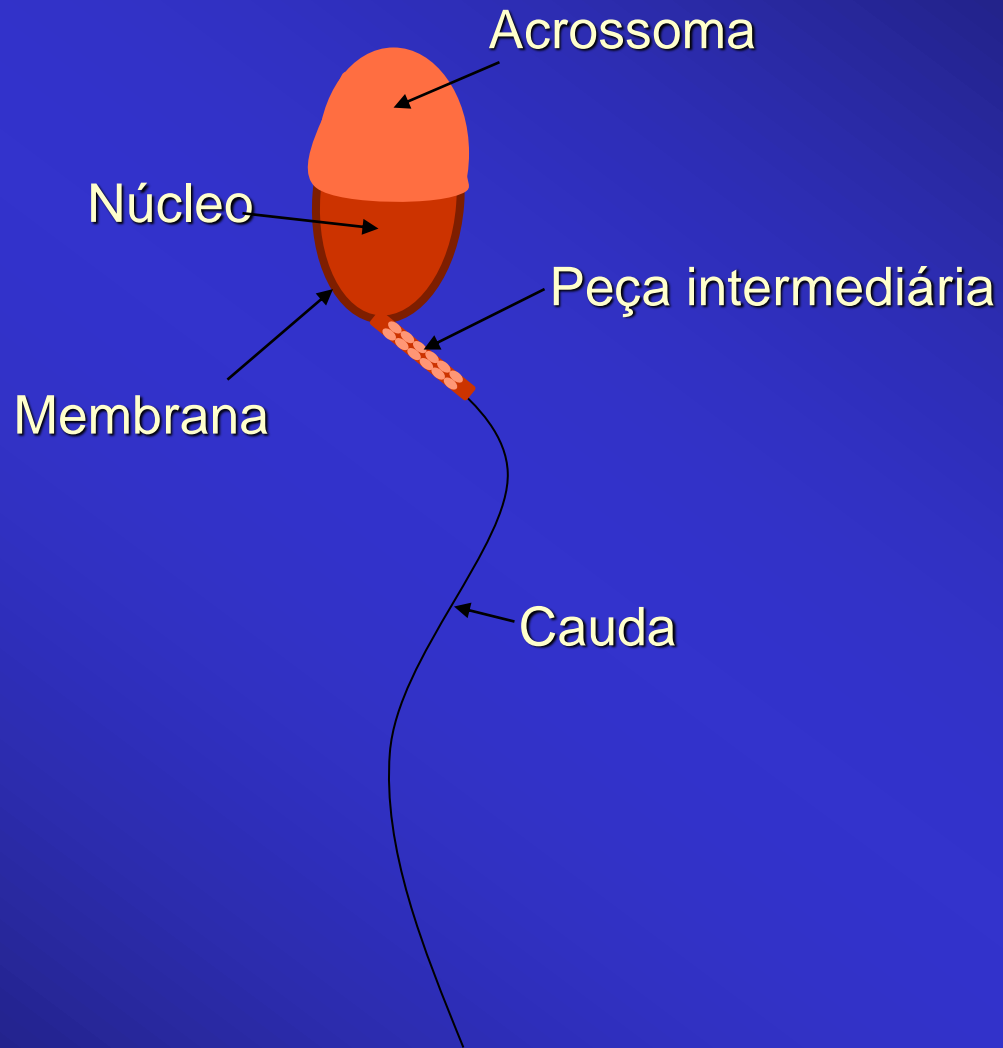
Ooplasma

Corona radiata

Espaço perivitelino

1º corpúsculo polar

Ovócito secundário



Espermatozóide

CAPACITAÇÃO ESPERMÁTICA

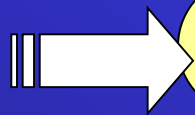
- Processo através do qual os espermatozóides adquirem capacidade para fecundar o ovócito secundário (óvulo).
- Consiste na remoção de glicoproteínas e proteínas seminais da superfície do acrossoma do espermatozóide.
- Ocorre durante a passagem dos espermatozóides através do trato genital feminino.

FECUNDAÇÃO

- ☑ A fecundação e o desenvolvimento embrionário inicial ocorrem no oviduto (trompa).
- ☑ O embrião entra na cavidade uterina por volta do 3º dia após a fecundação, no estágio de mórula.

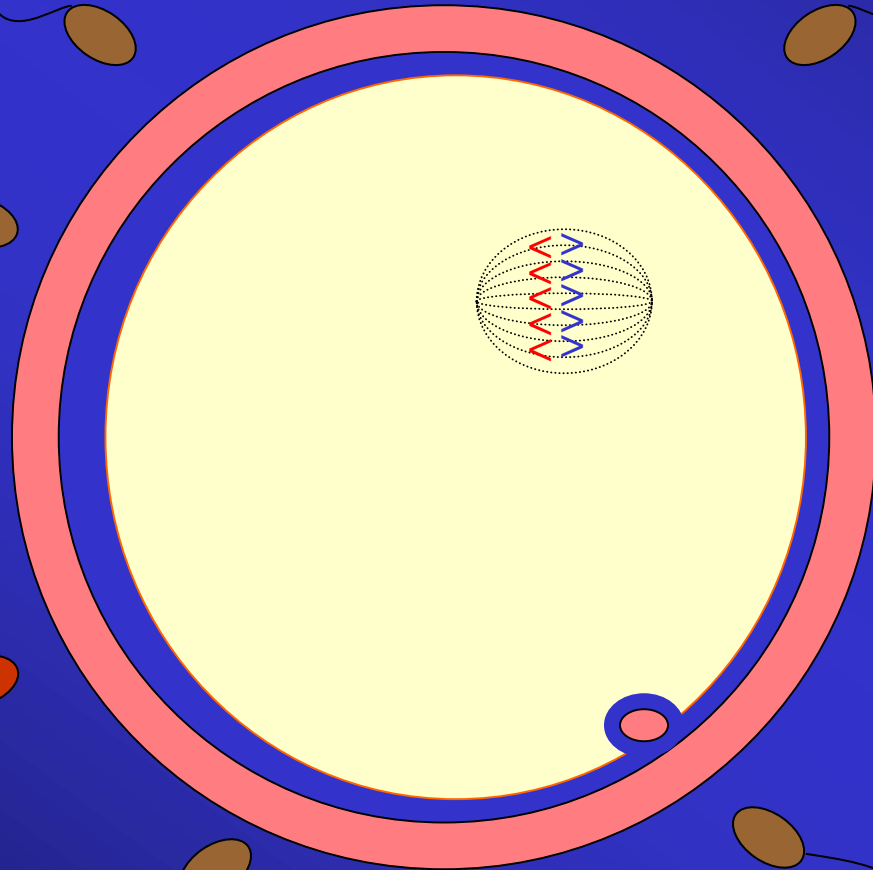
Quando se aproxima do ovócito, o espermatozóide sofre a chamada “reação do acrossoma”, processo em que surgem perfurações no acrossoma, com a liberação das enzimas que vão possibilitar a penetração do ovócito.

Corona radiata

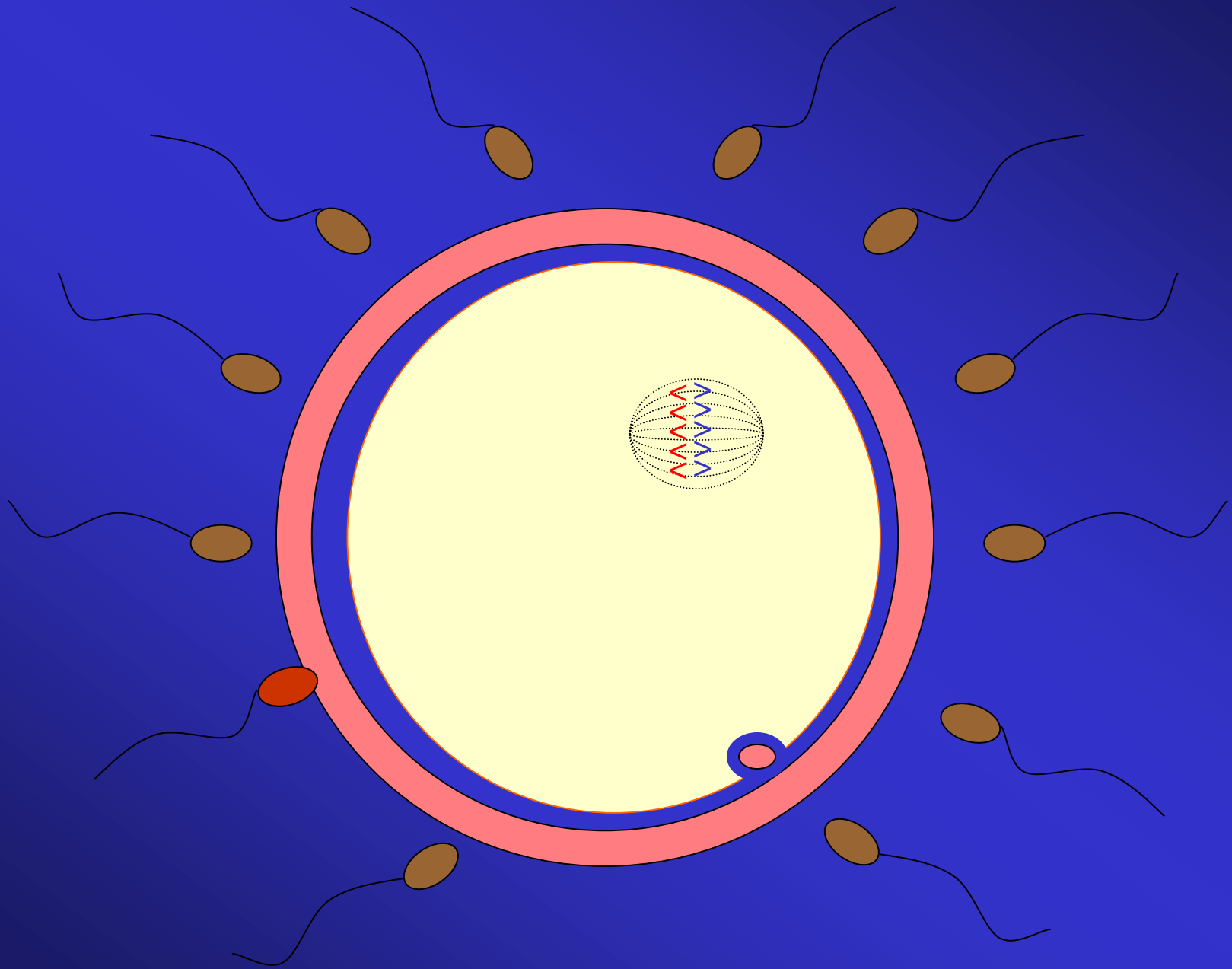


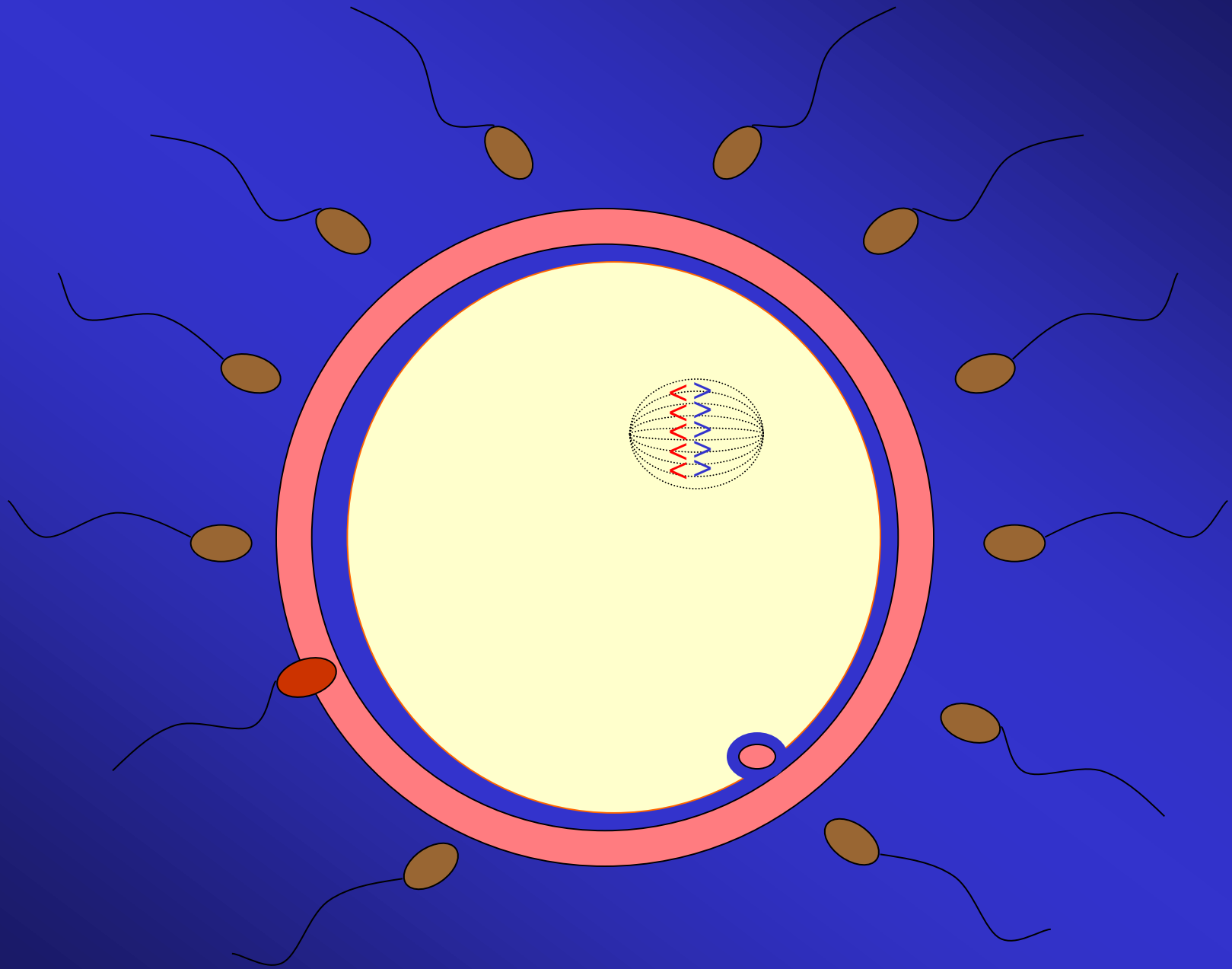
As principais enzimas liberadas são a hialuronidase, que permite a passagem entre as células da *Corona radiata*, e a acrosina, que permite a passagem através da zona pelúcida.

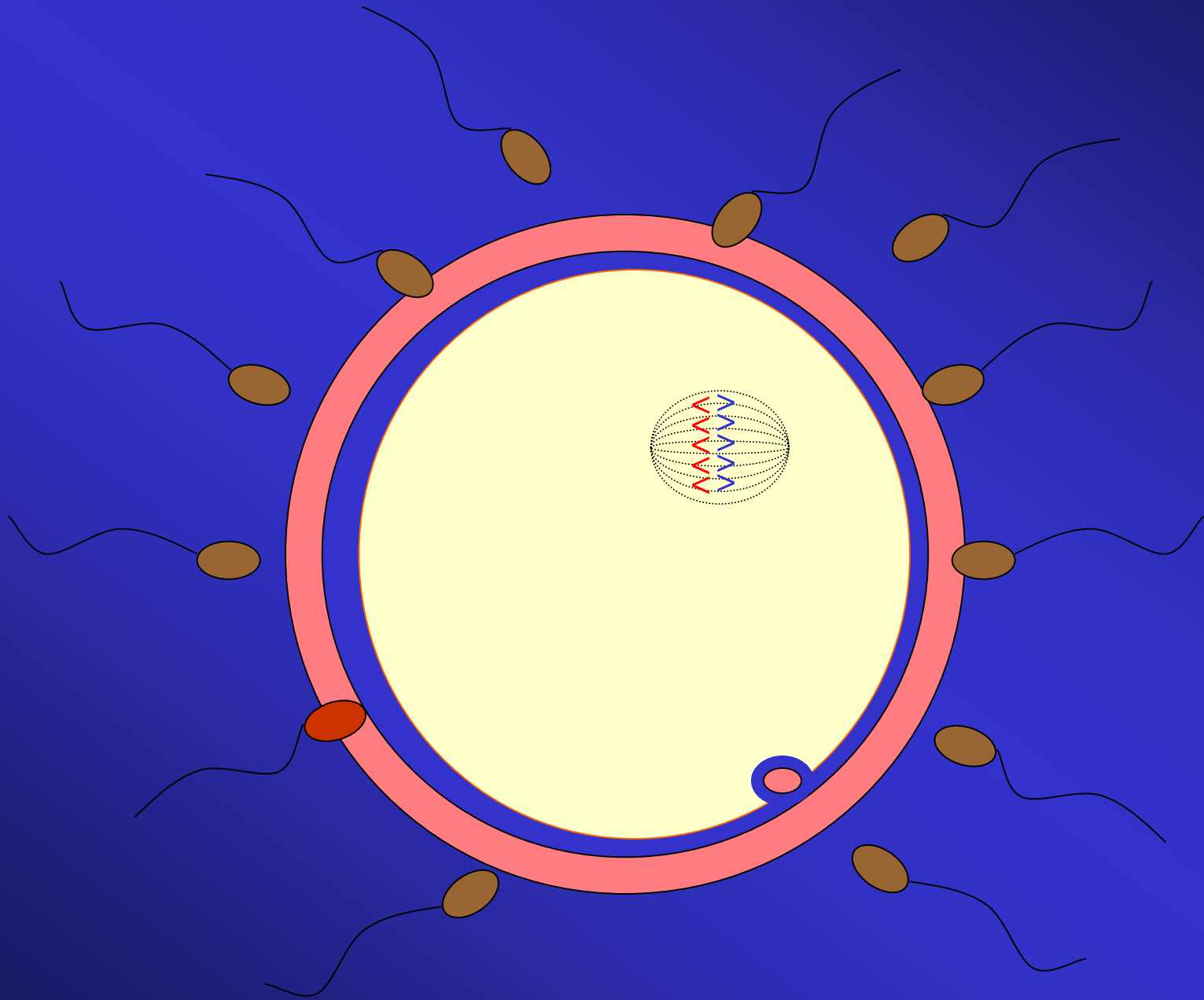
**Espermatozóide
fecundante**

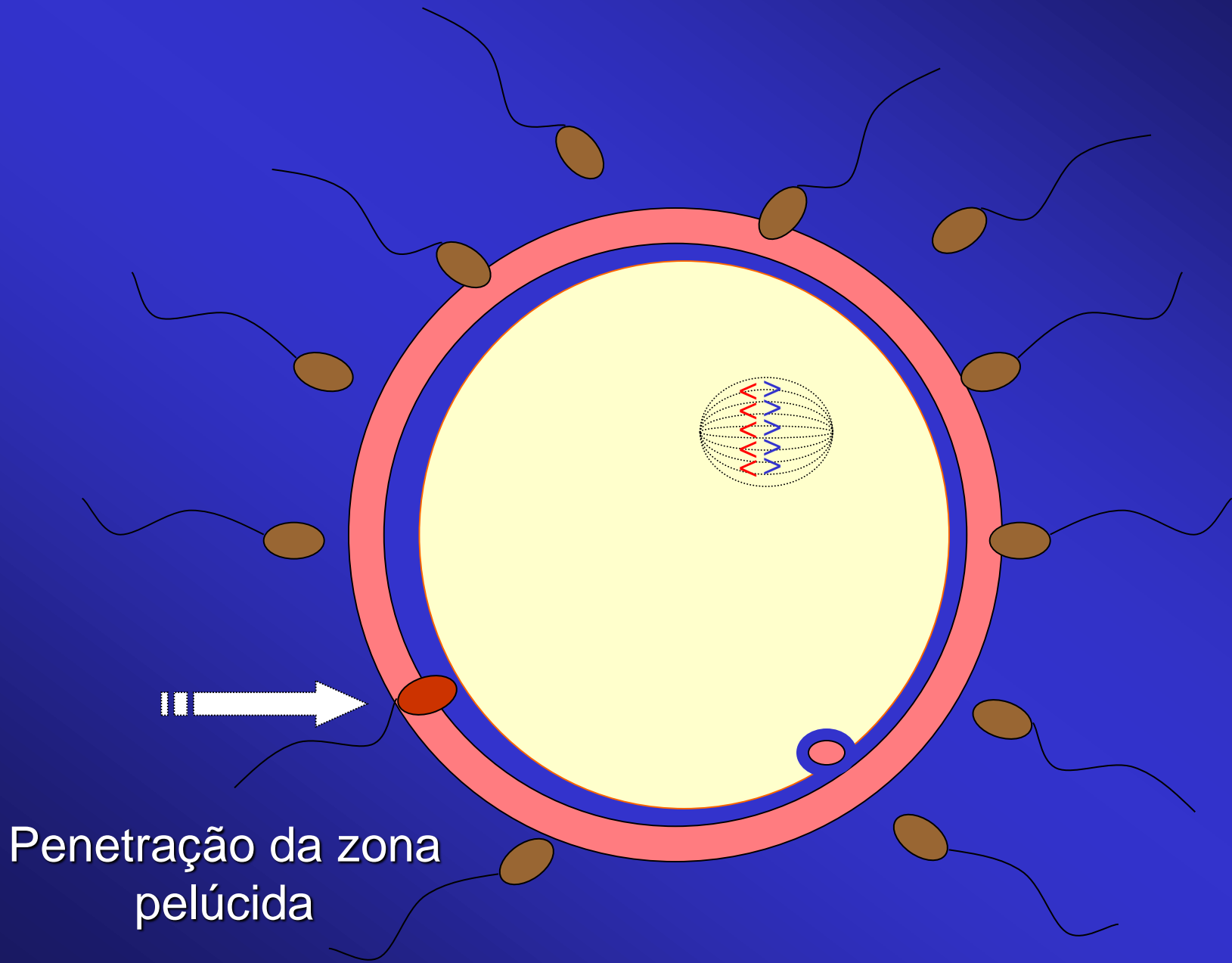


Início da fecundação...

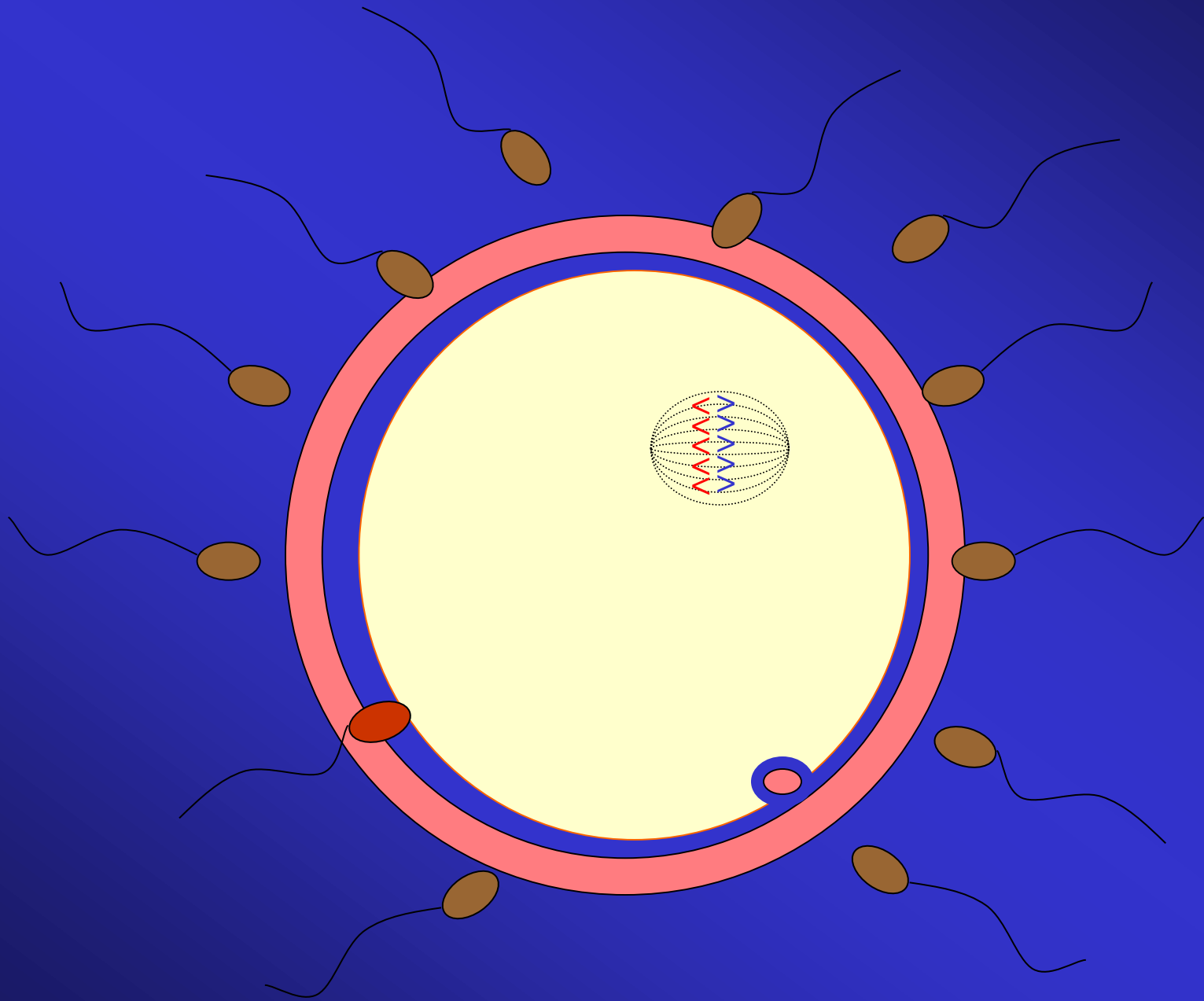


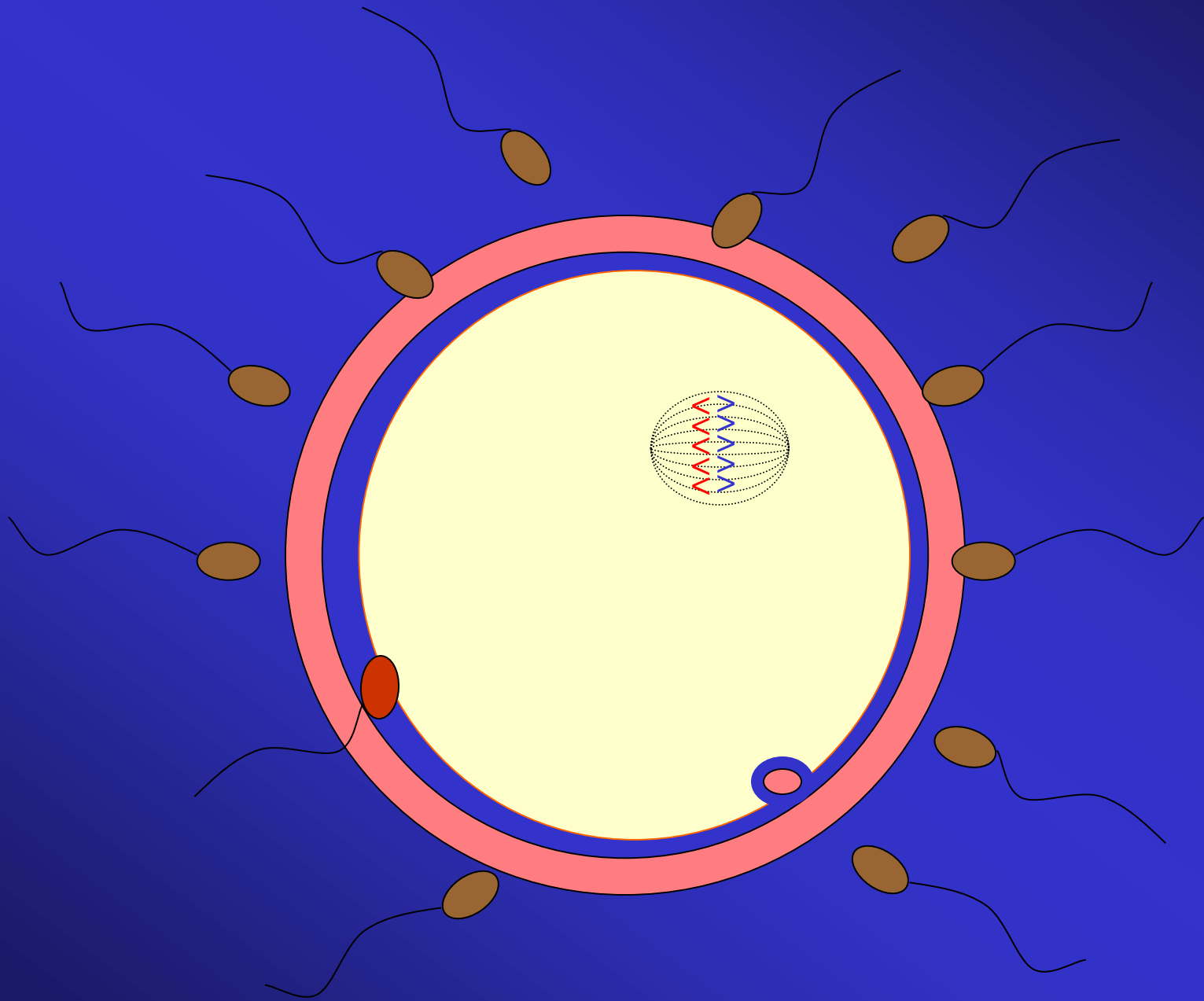


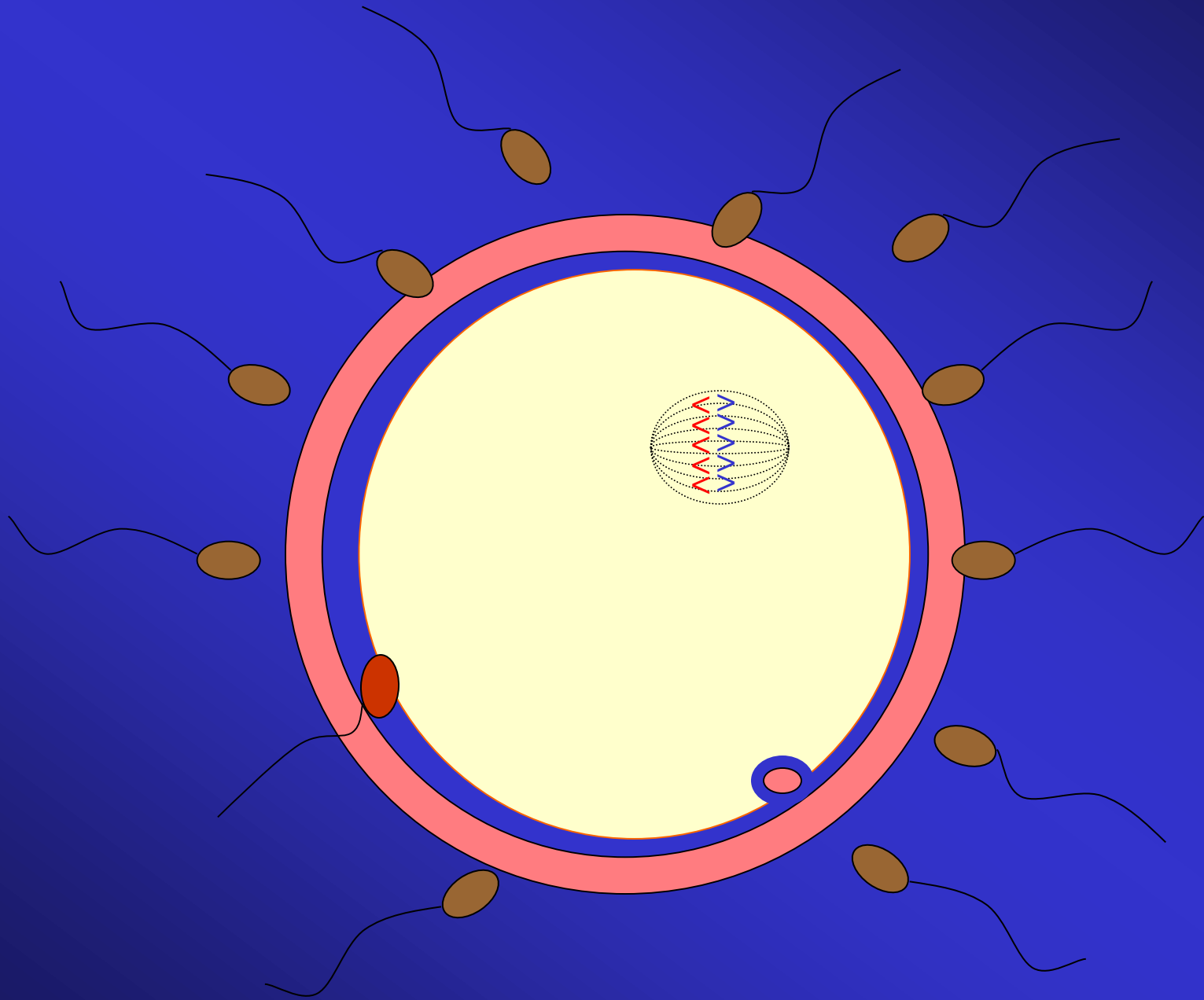


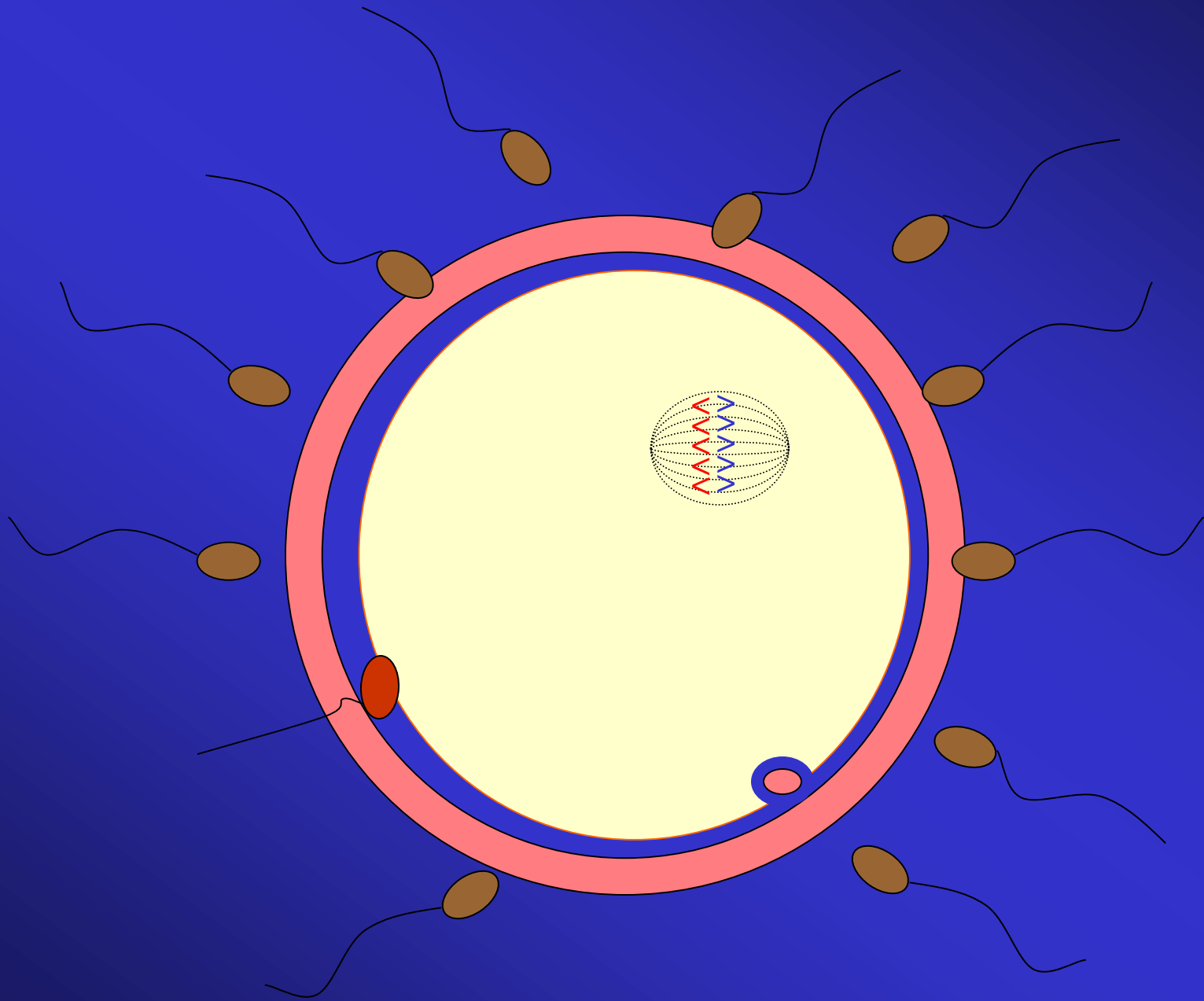


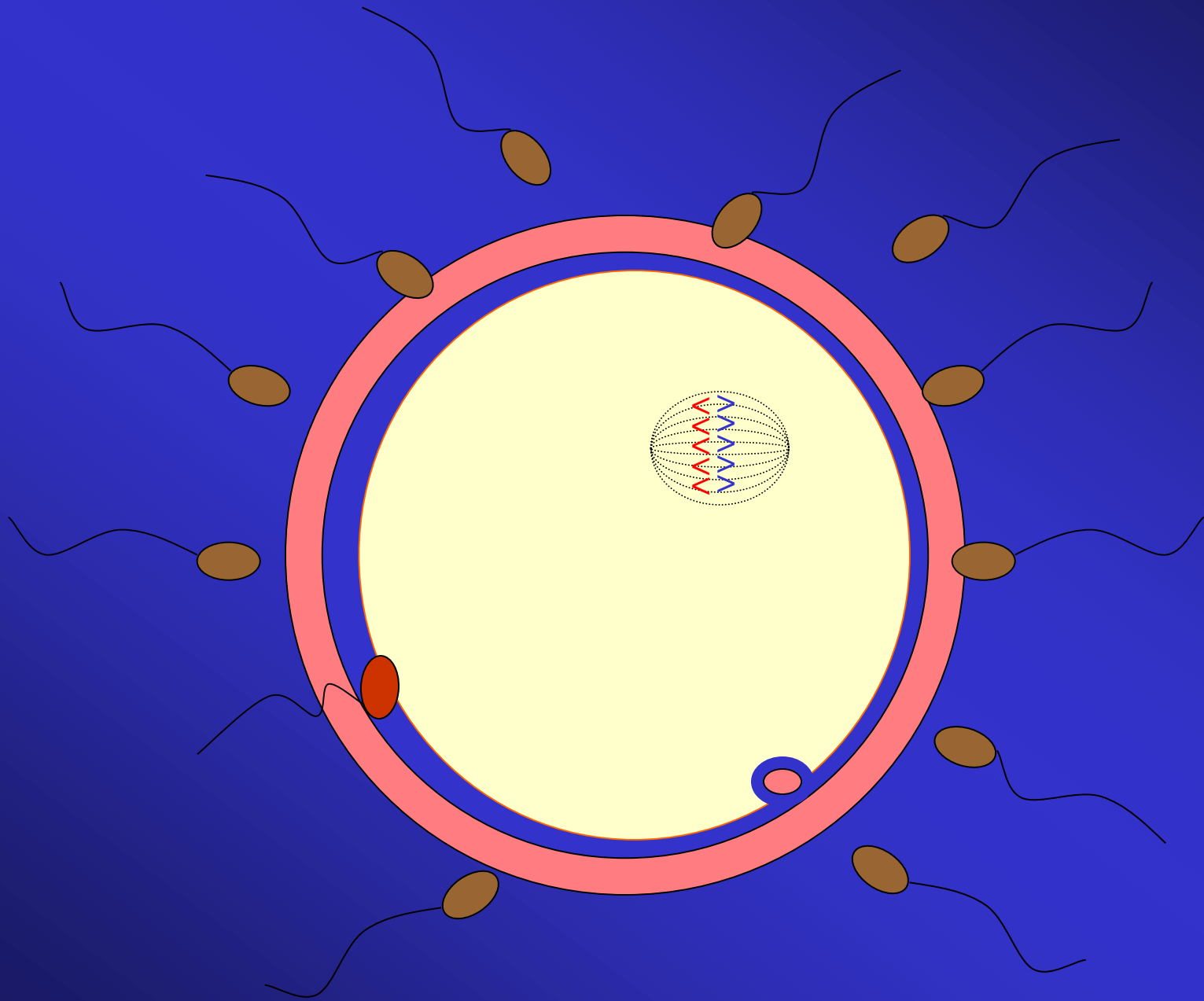
Penetração da zona
pelúcida

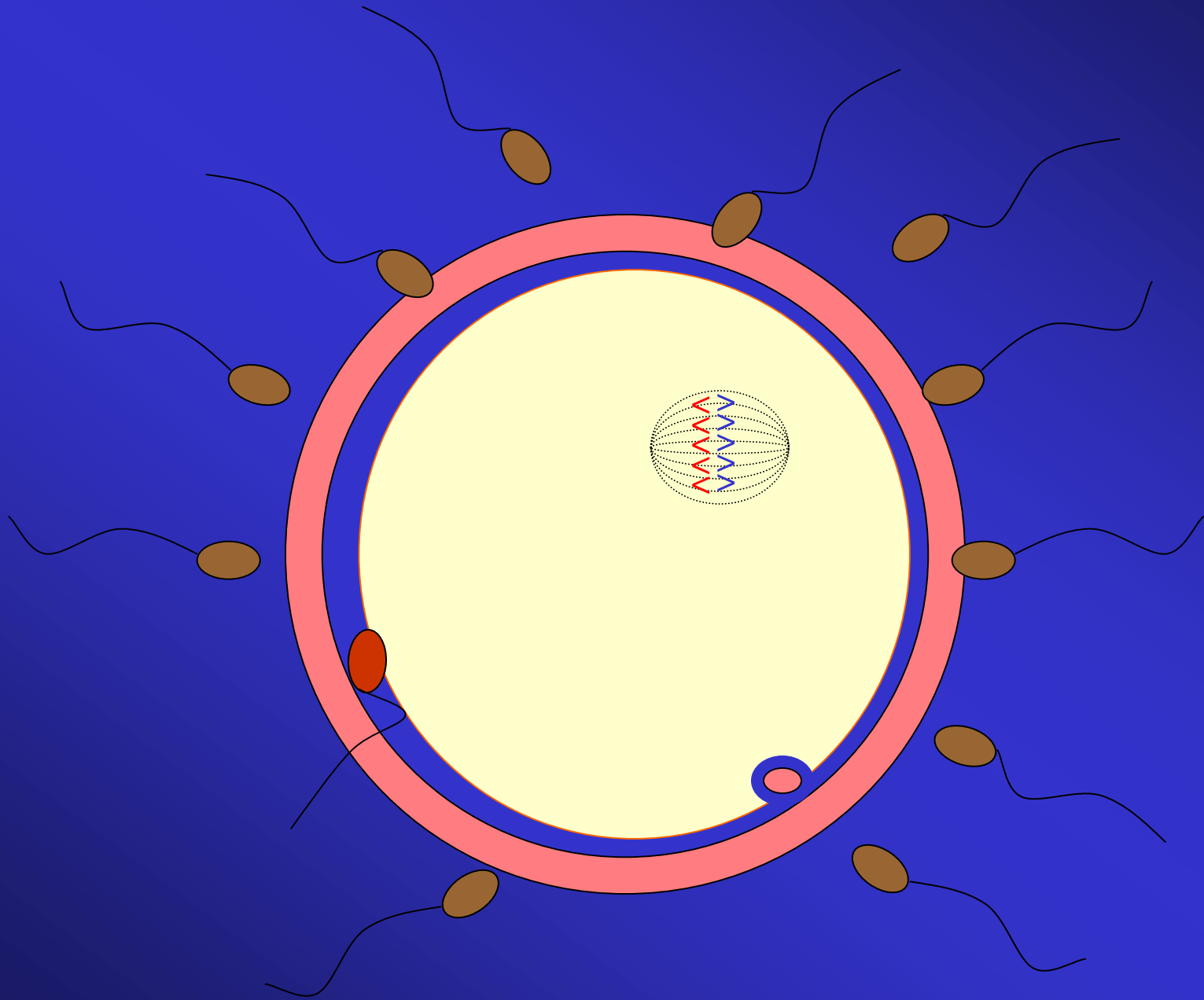


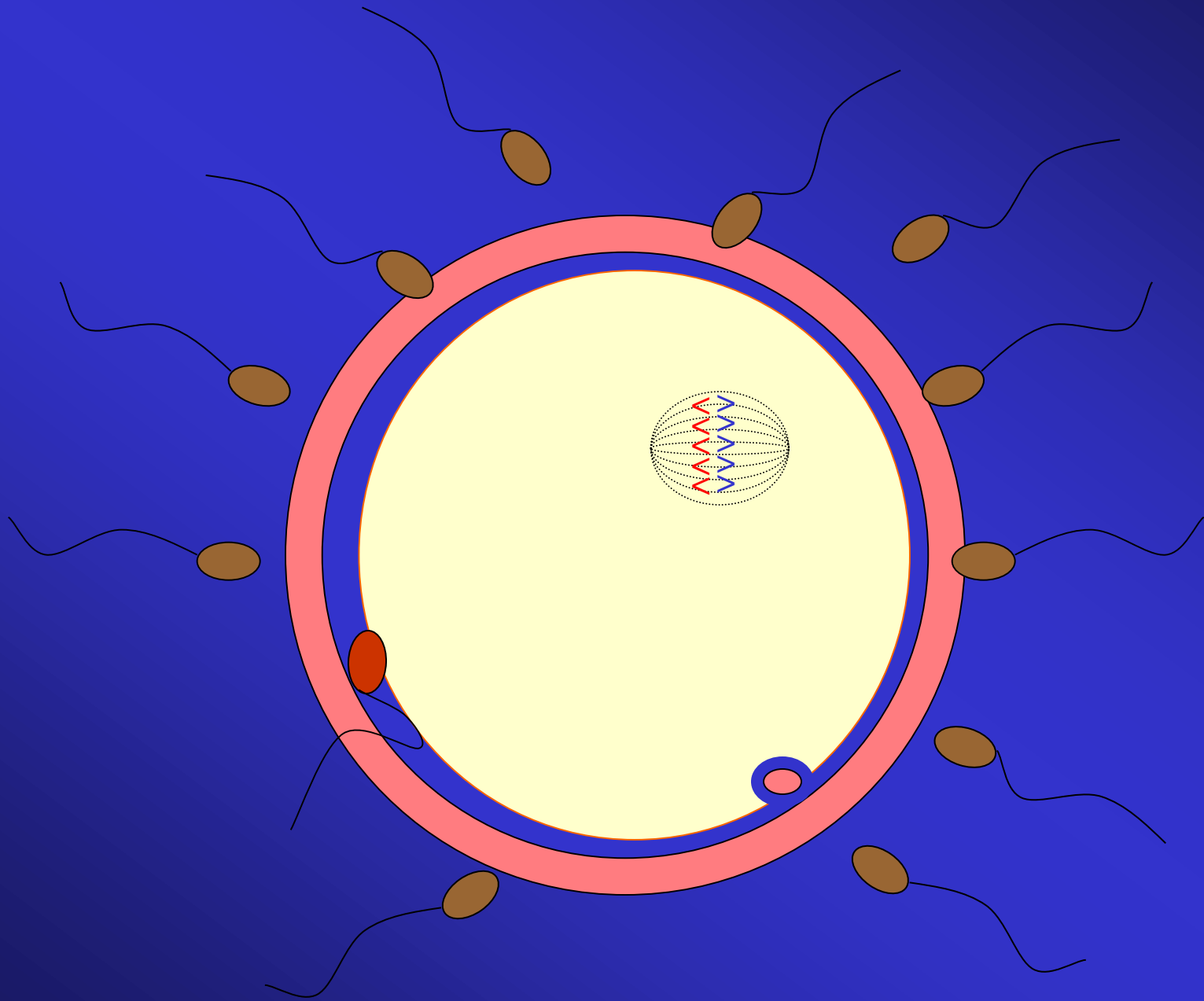


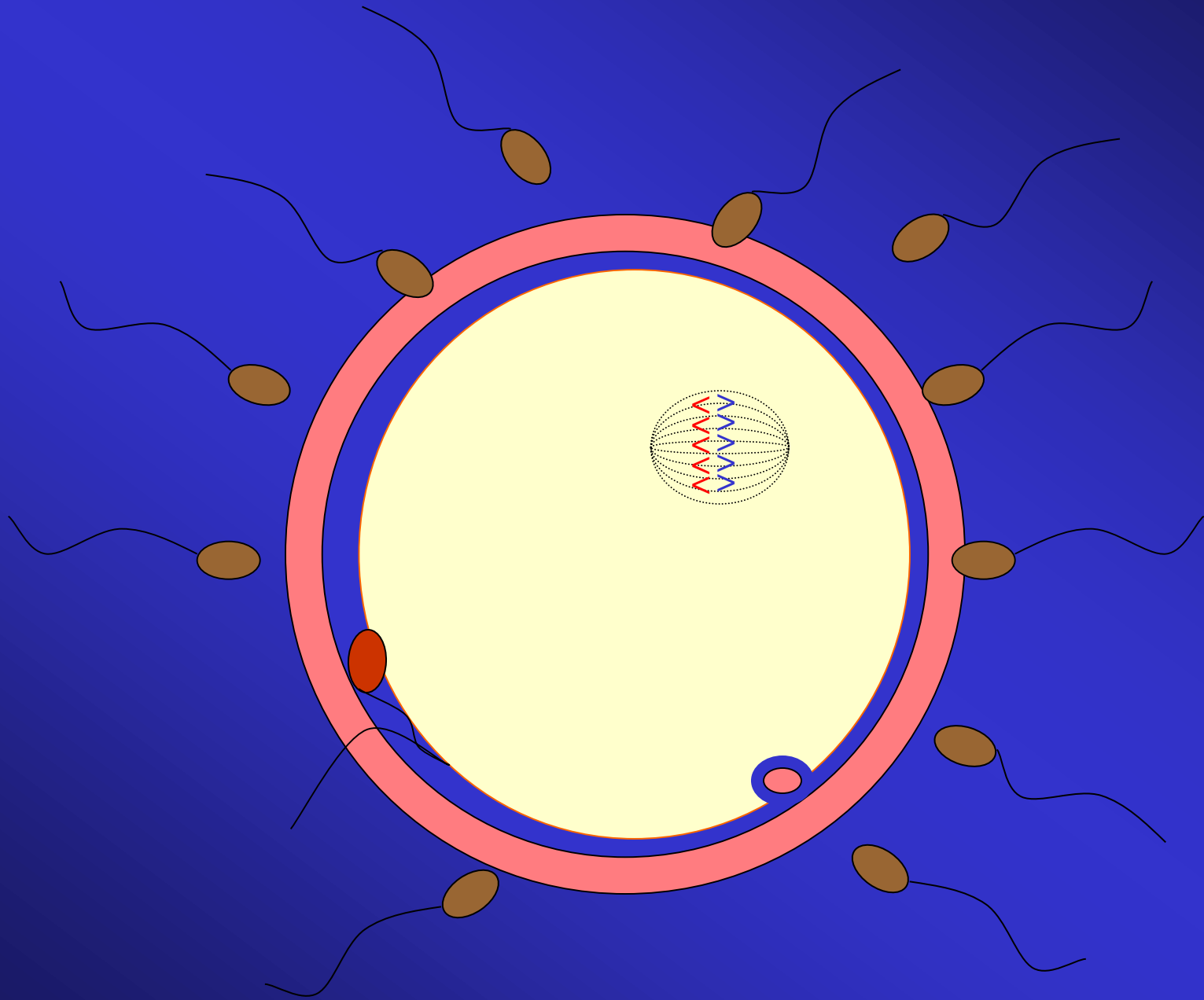


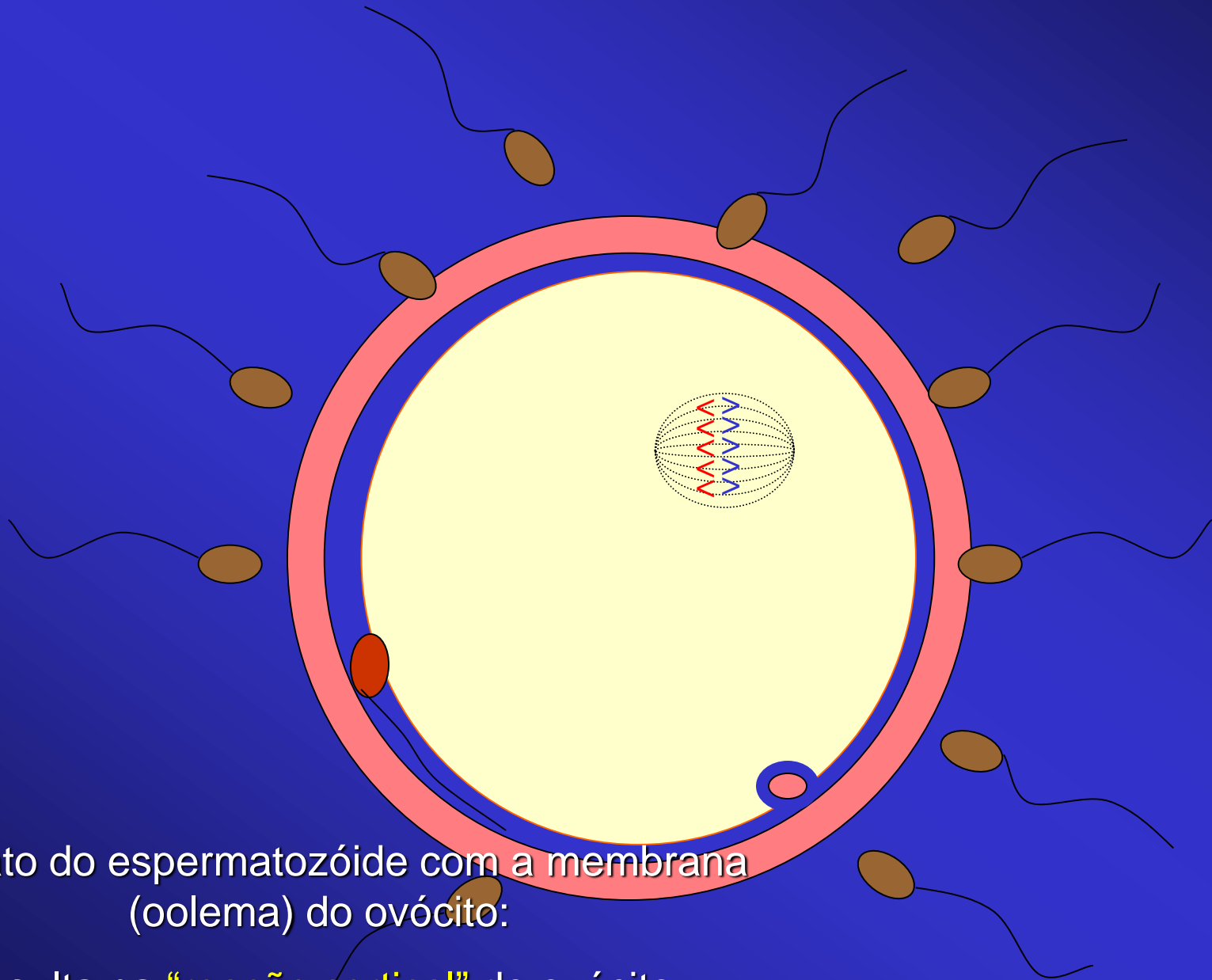








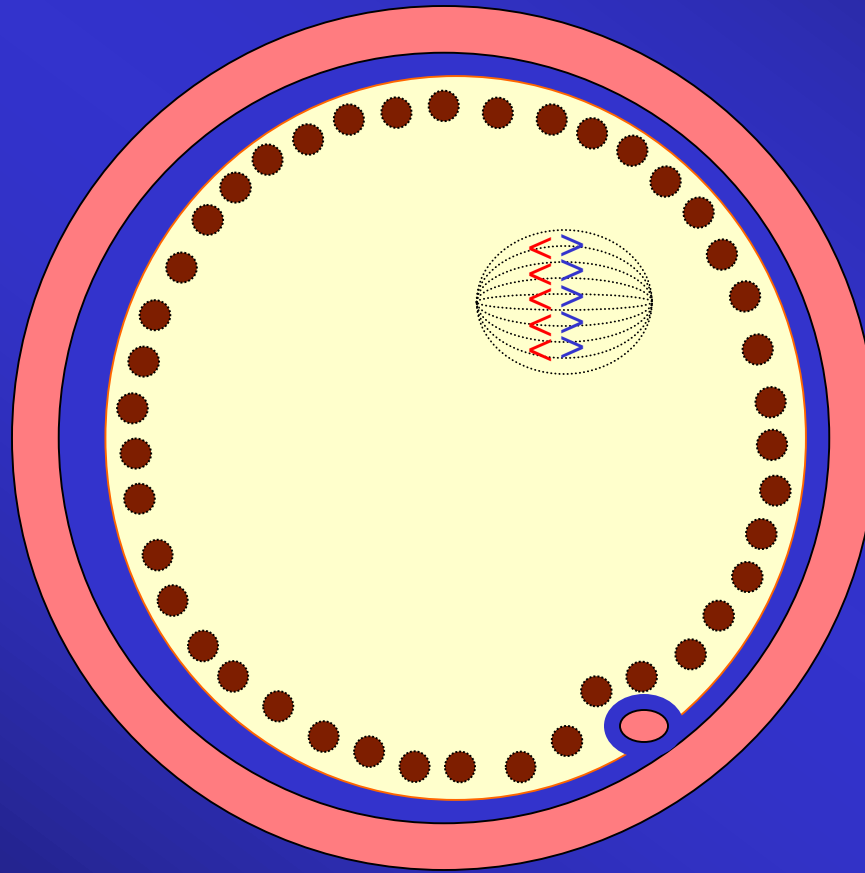




Contato do espermatozóide com a membrana (olema) do ovócito:

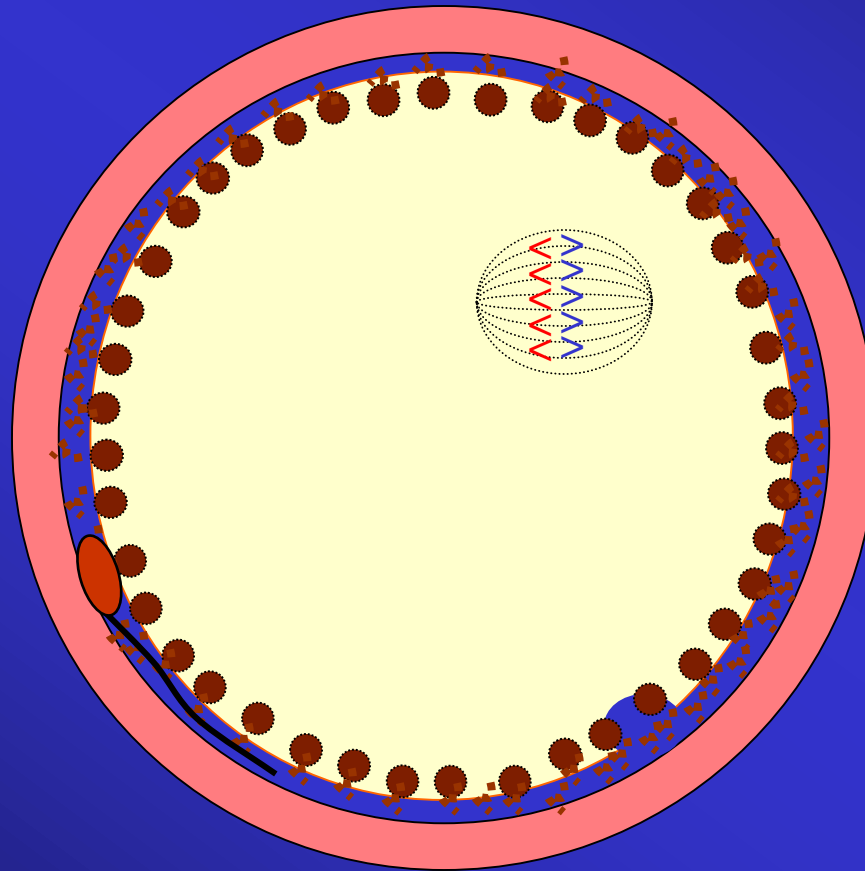
Resulta na “**reação cortical**” do ovócito, ocorrendo o bloqueio à polispermia.

A reação cortical:

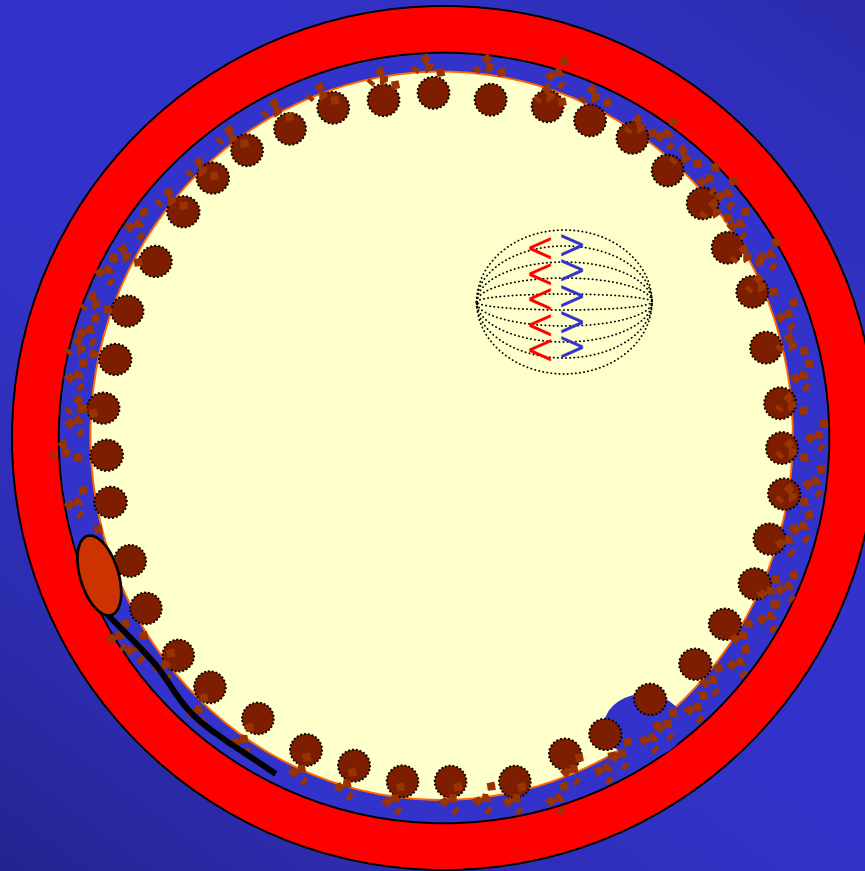


Grânulos corticais:
Formados durante a maturação
citoplasmática do ovócito

A liberação do seu conteúdo no espaço perivitelino, por exocitose, após o contato do espermatozóide com o oolema, resulta na modificação estrutural da zona pelúcida...

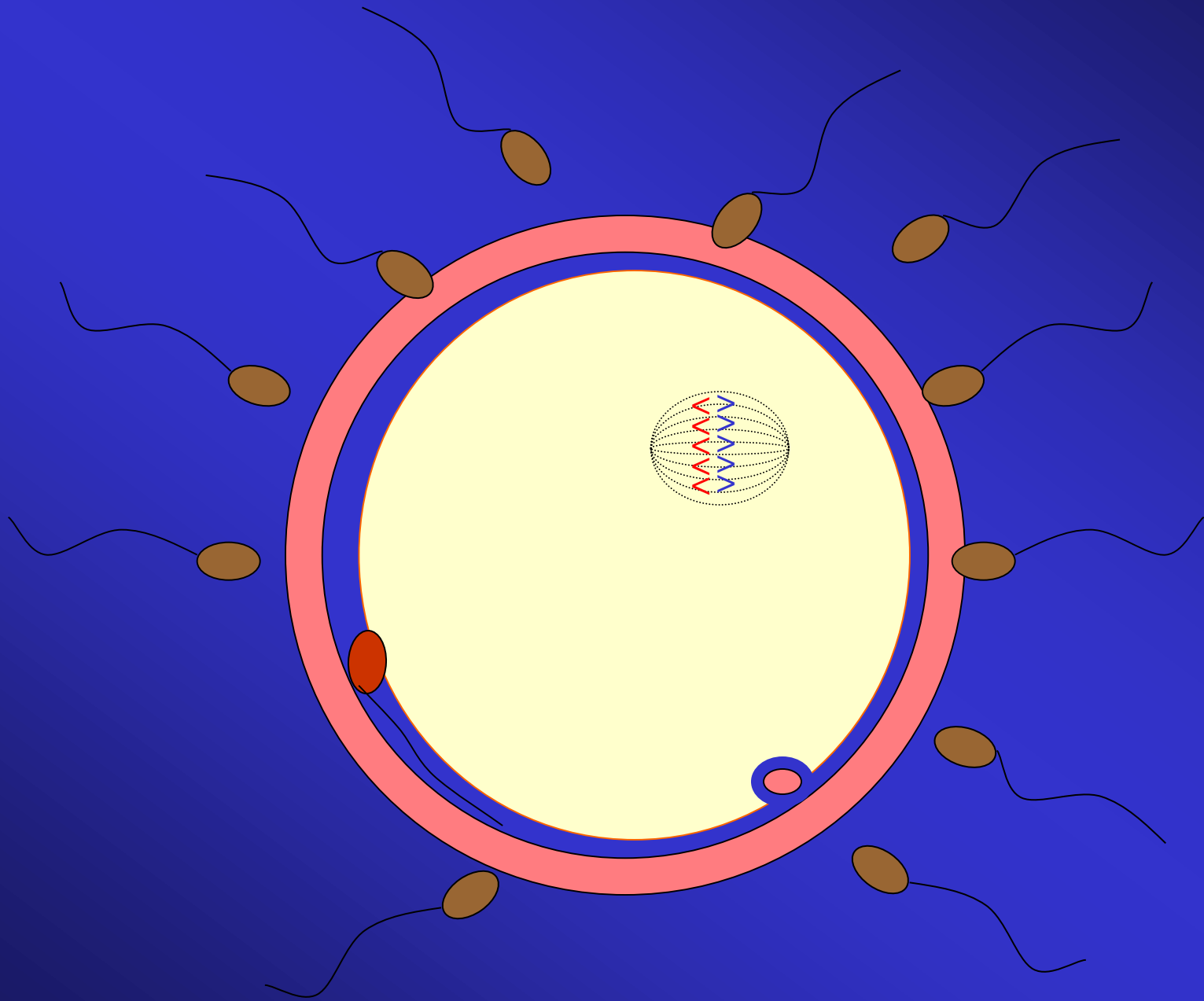


...que se torna impermeável à entrada de outros espermatozóides.

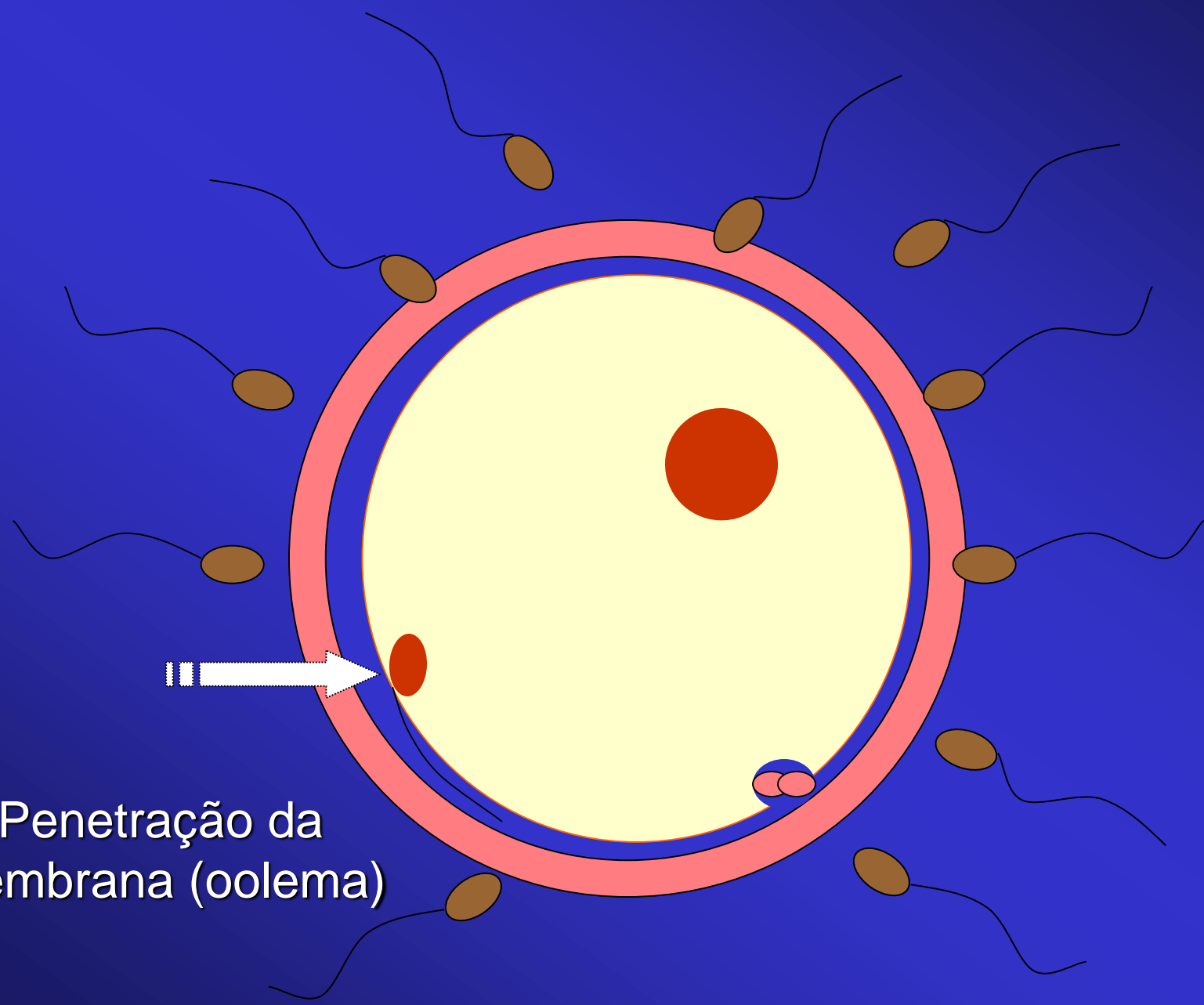


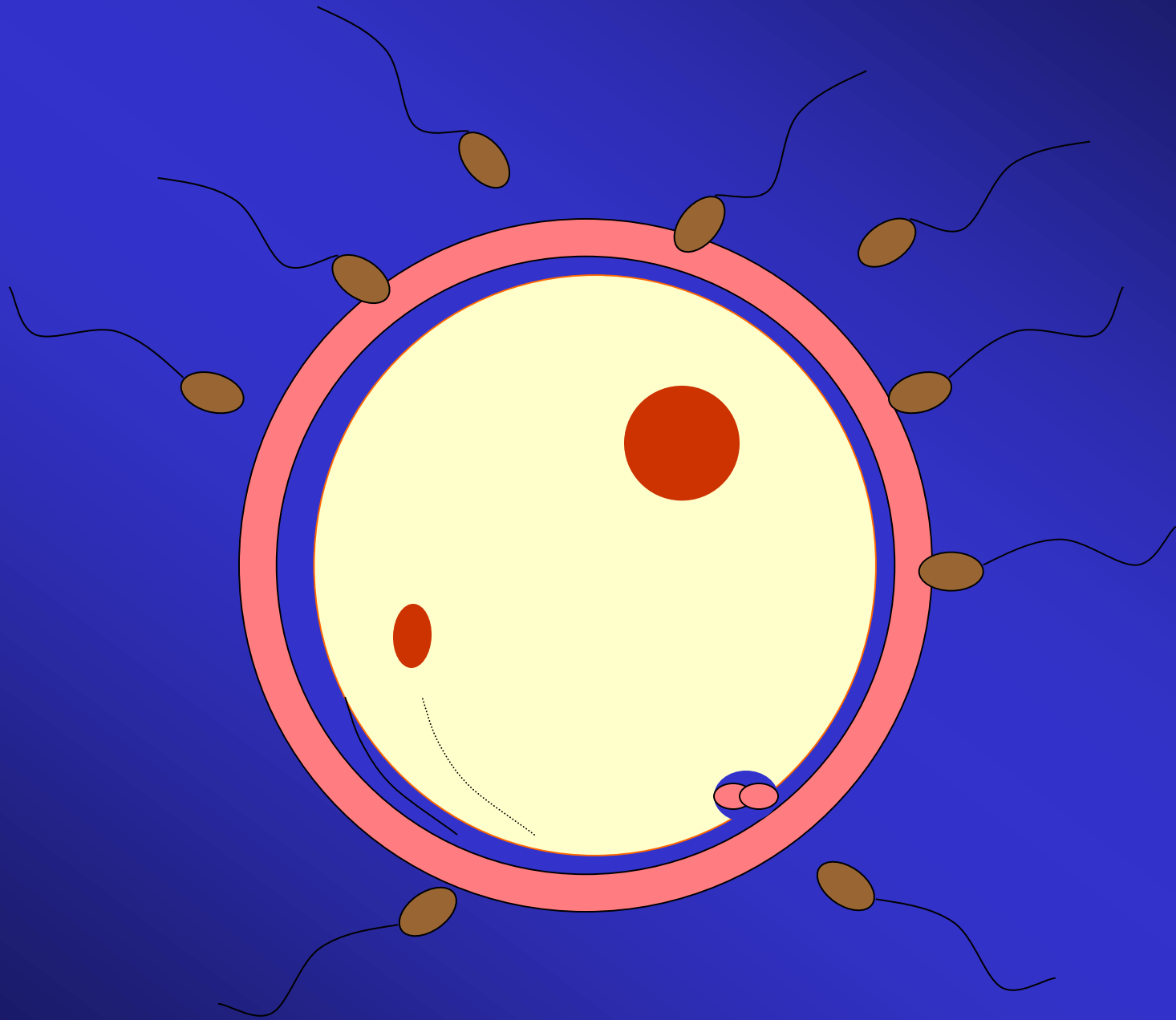
É o chamado bloqueio à polispermia.

Continuação do processo de fecundação...



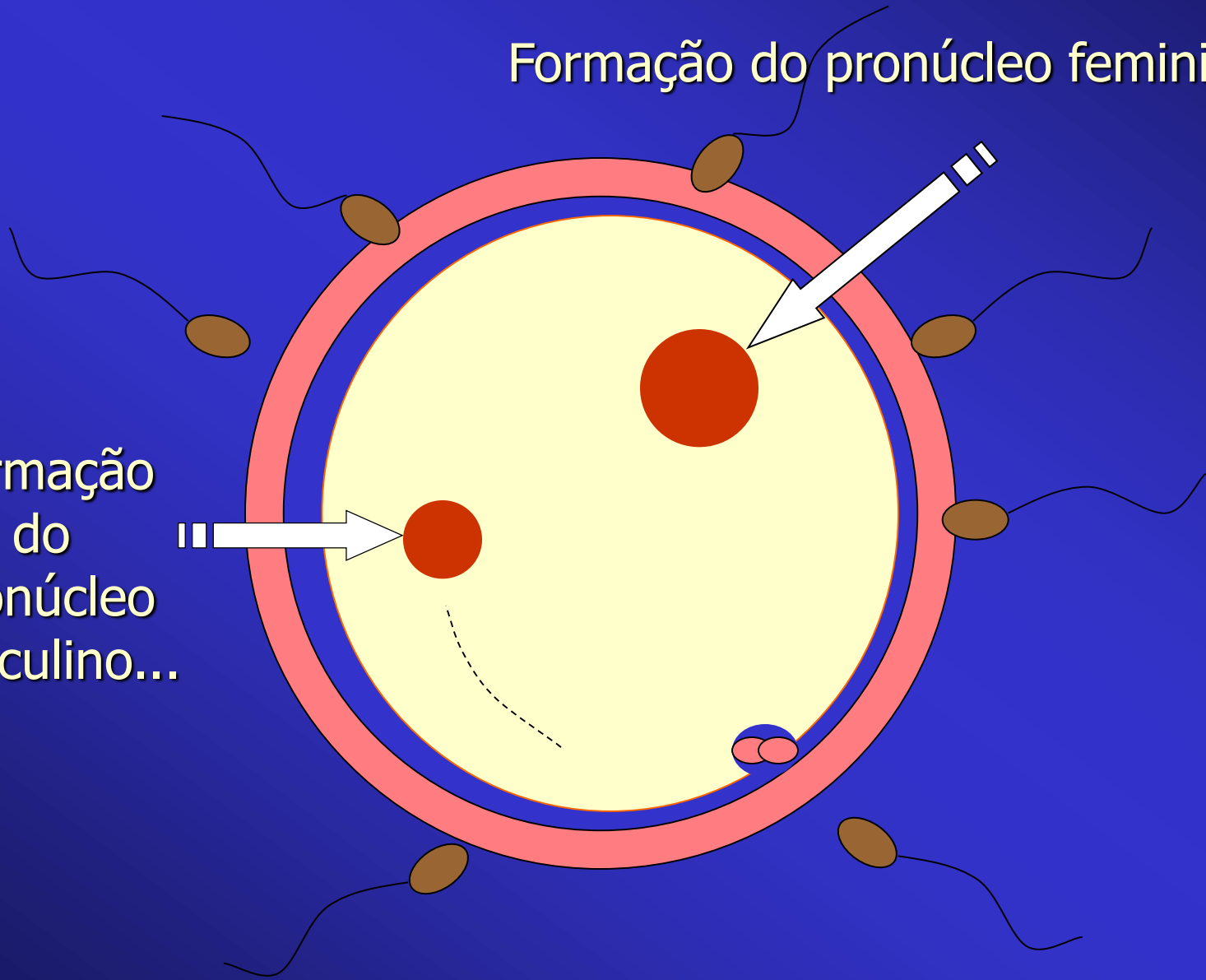
Penetração da
membrana (olema)

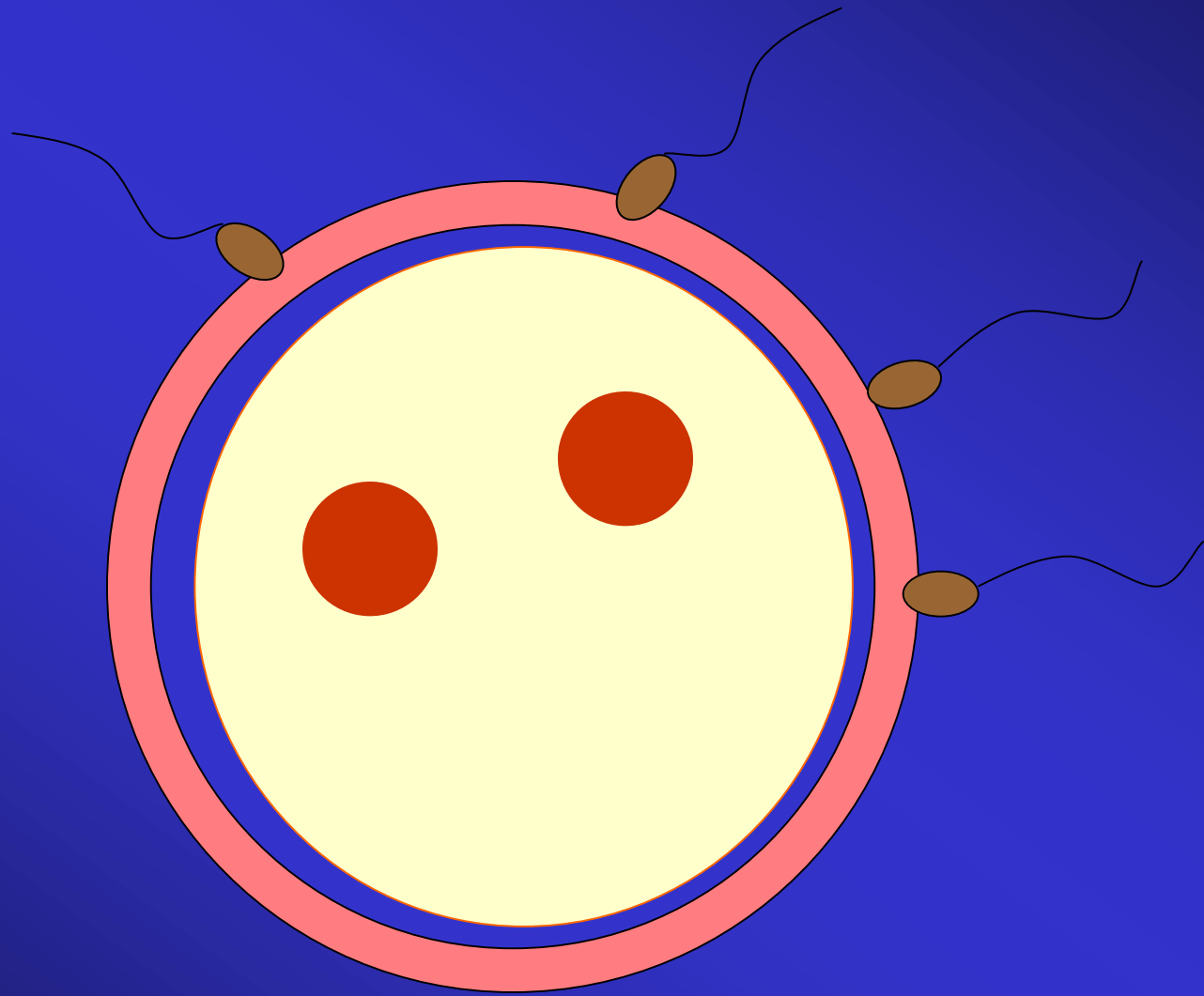


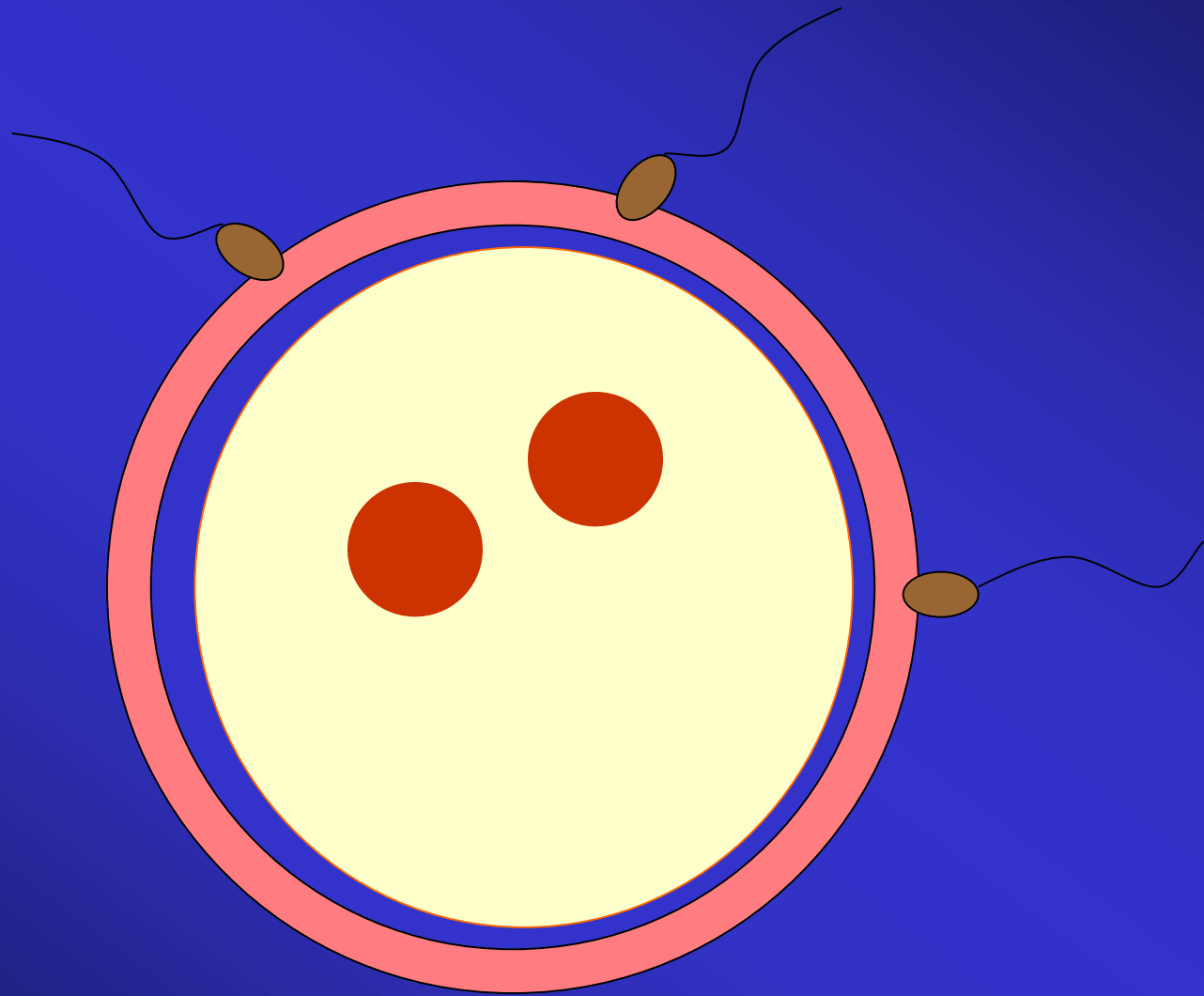


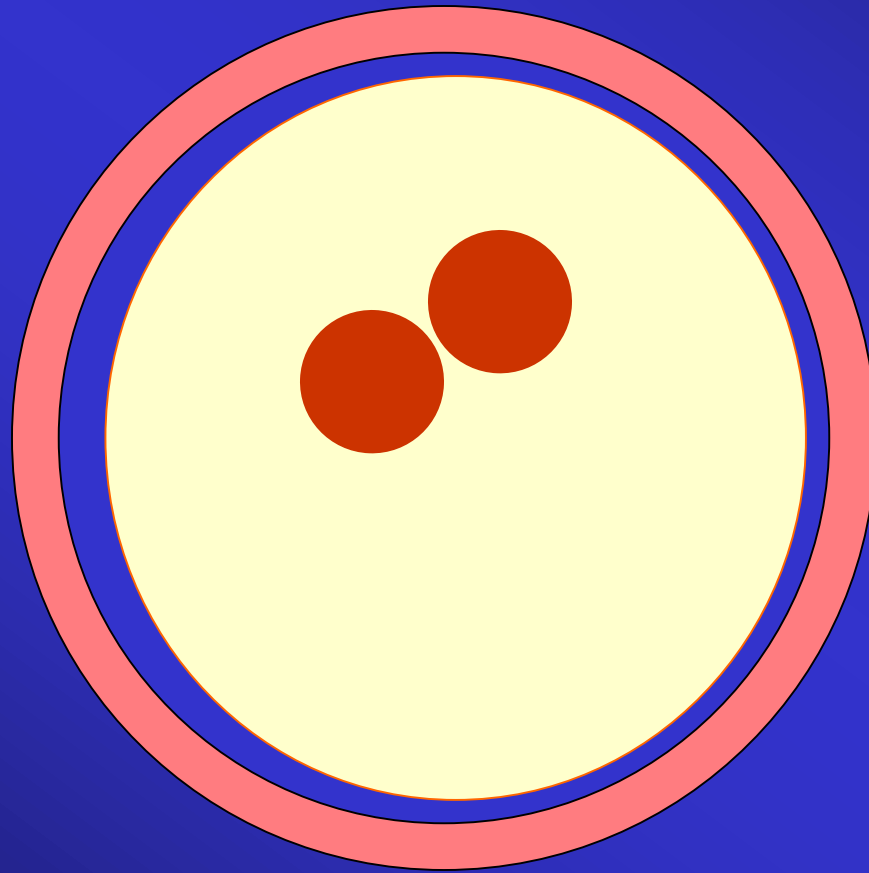
Formação do pronúcleo feminino...

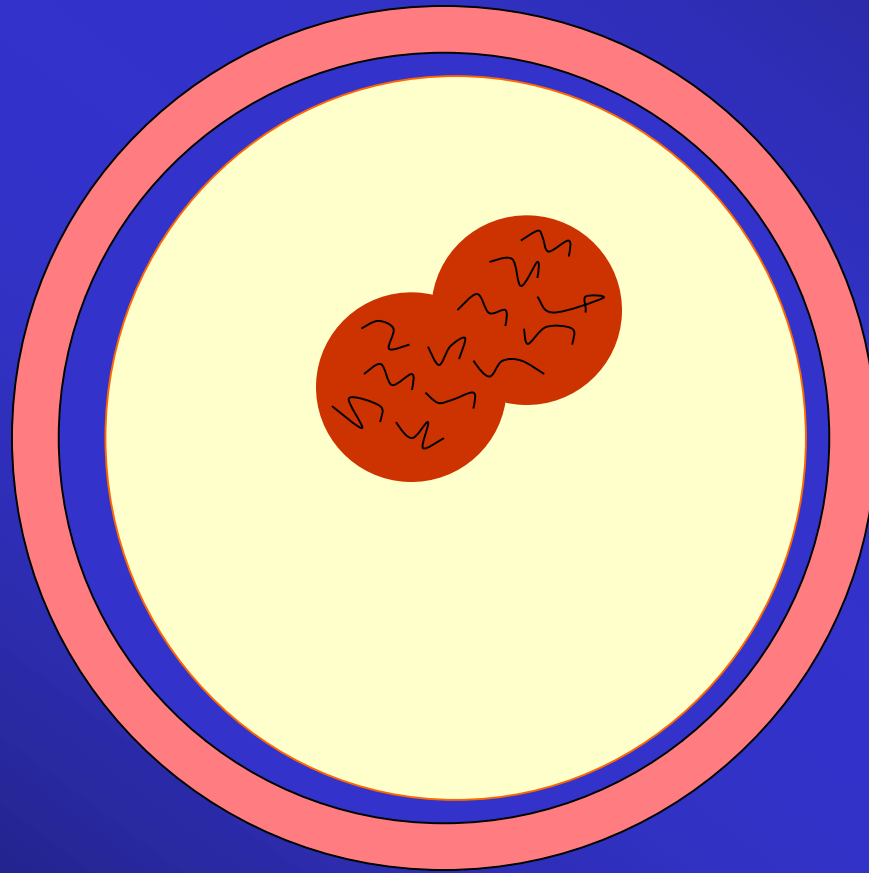
Formação
do
pronúcleo
masculino...



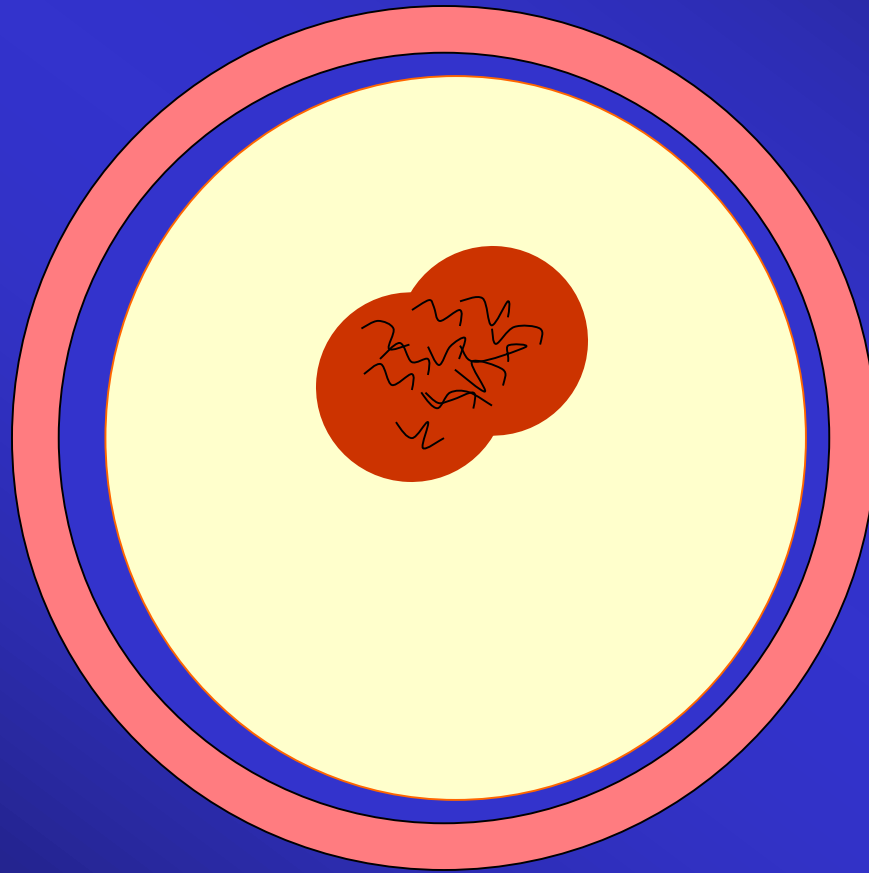




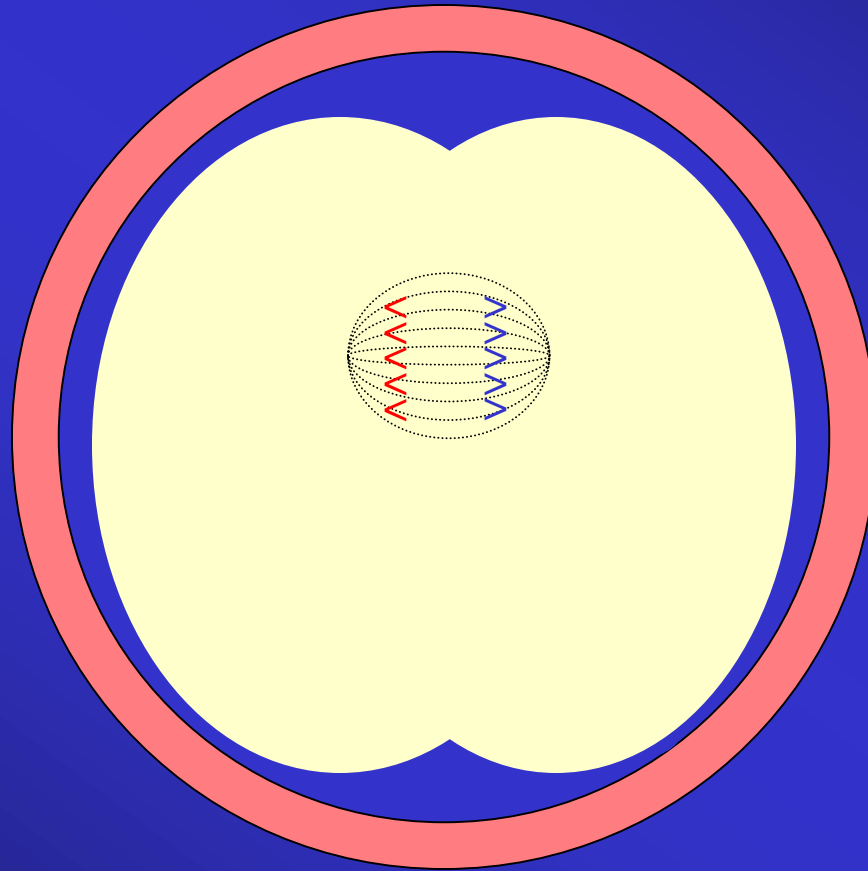




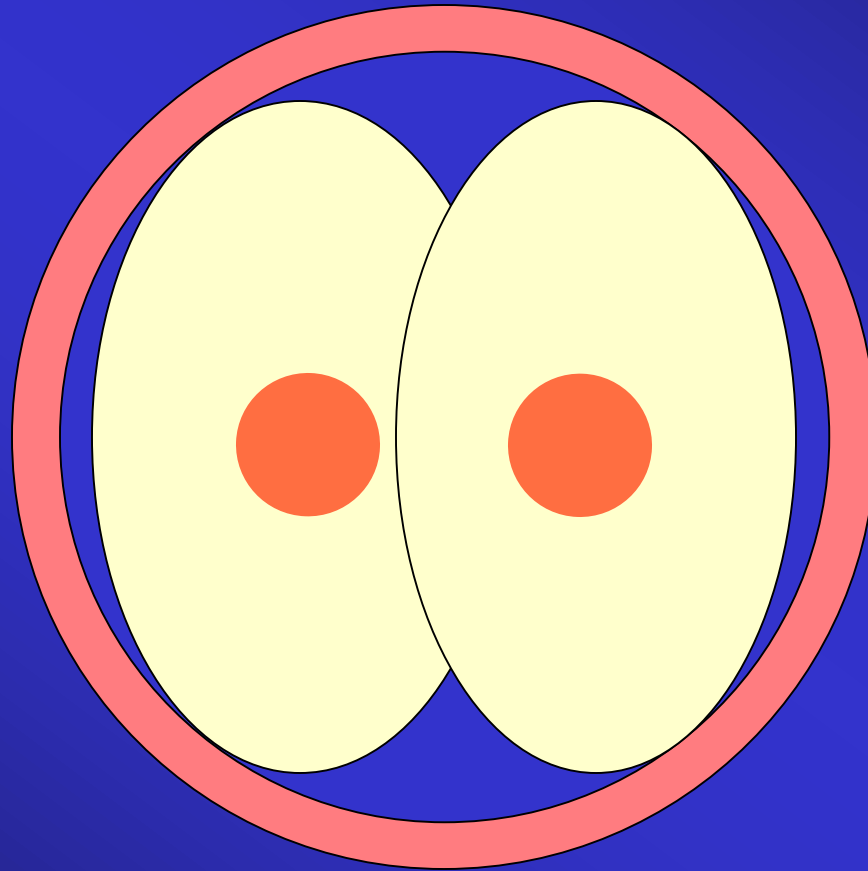
Singamia – fusão dos pronúcleos



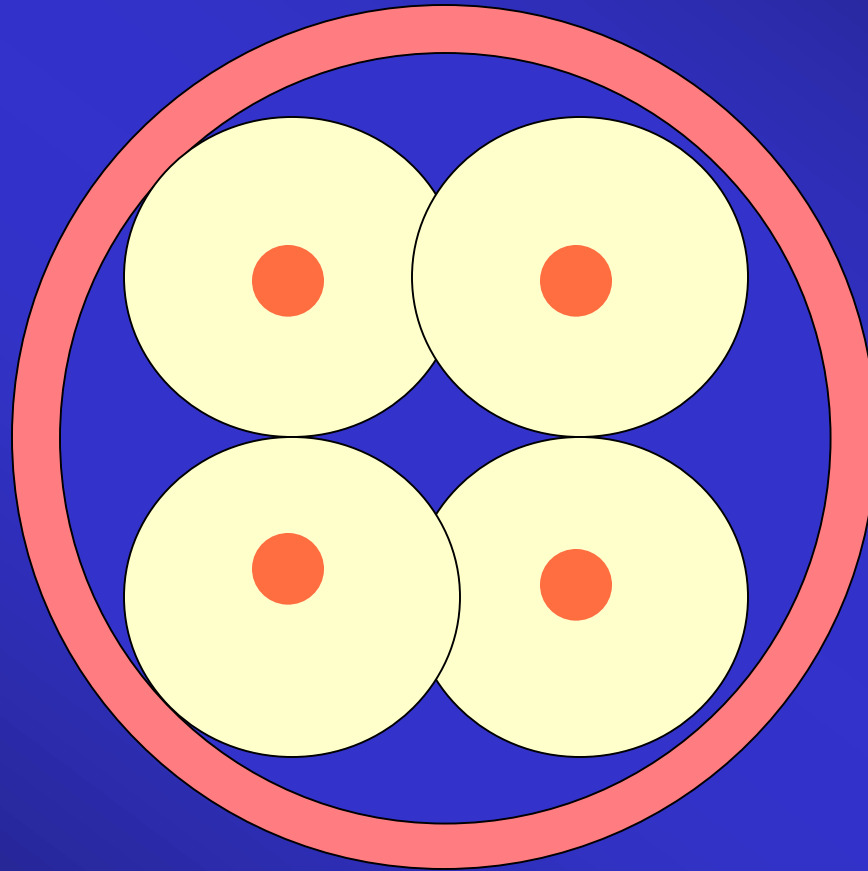
...mistura dos cromossomos maternos e paternos...



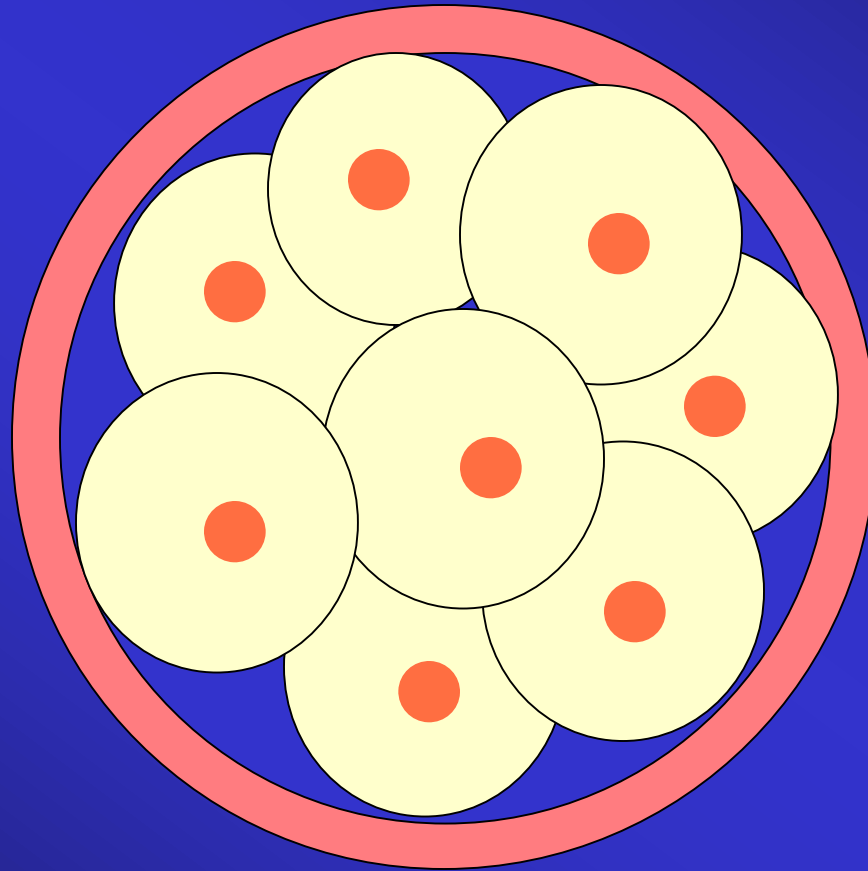
Formação do zigoto e início da 1ª clivagem
(divisão mitótica)



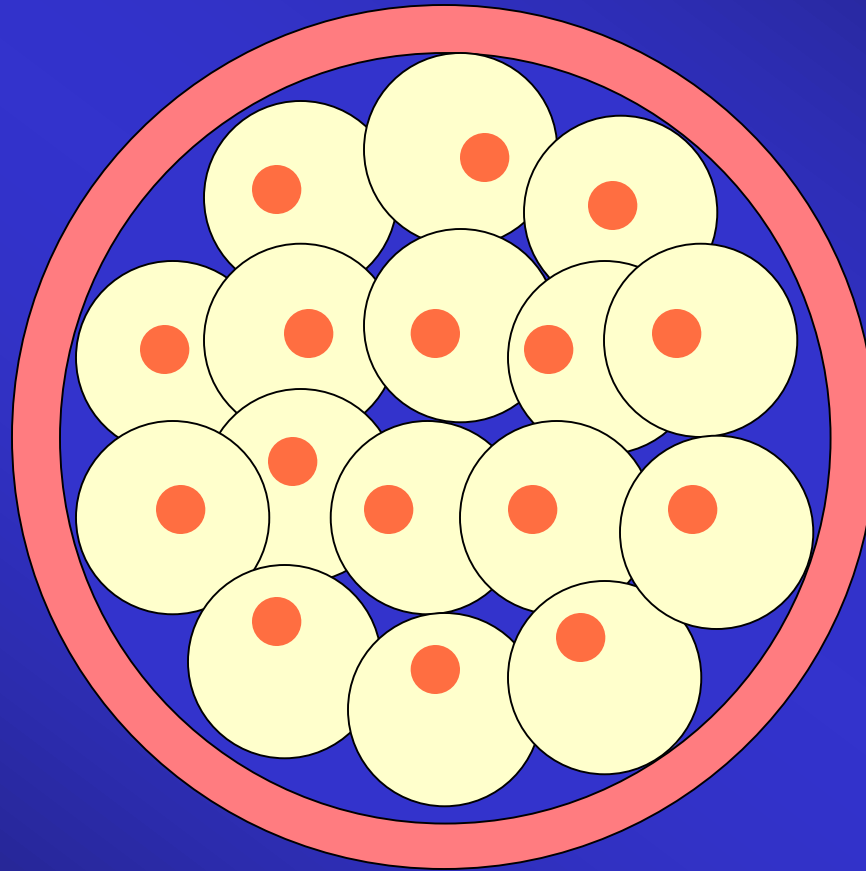
Embrião de 2-células



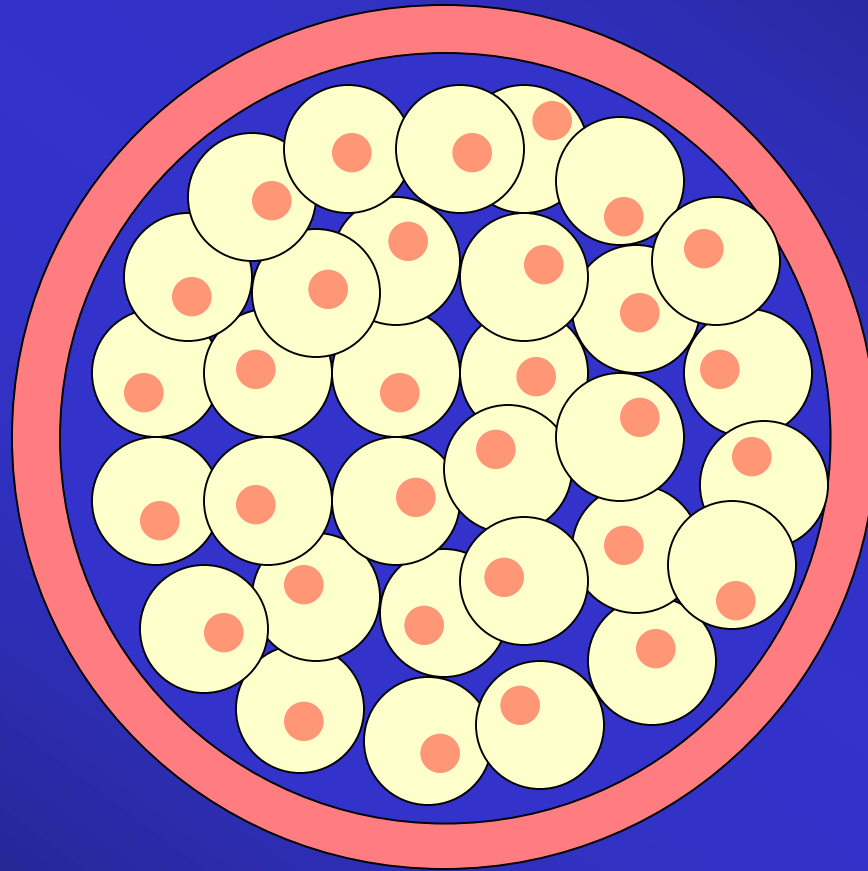
Embrião de 4-células



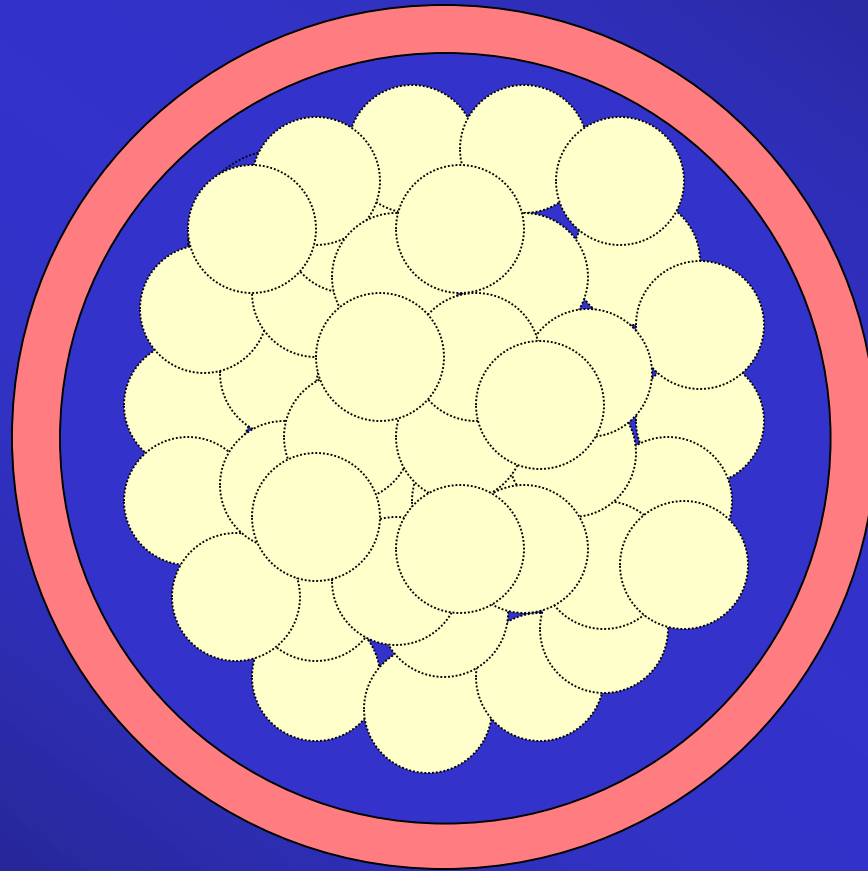
Embrião de 8-células



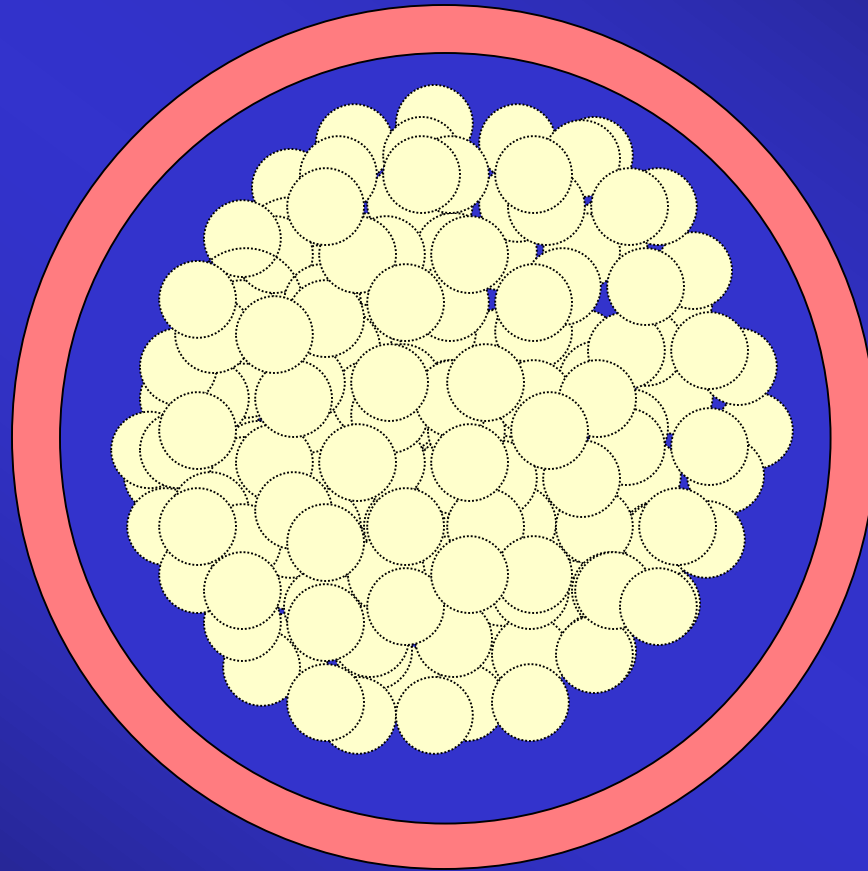
Embrião de 16-células

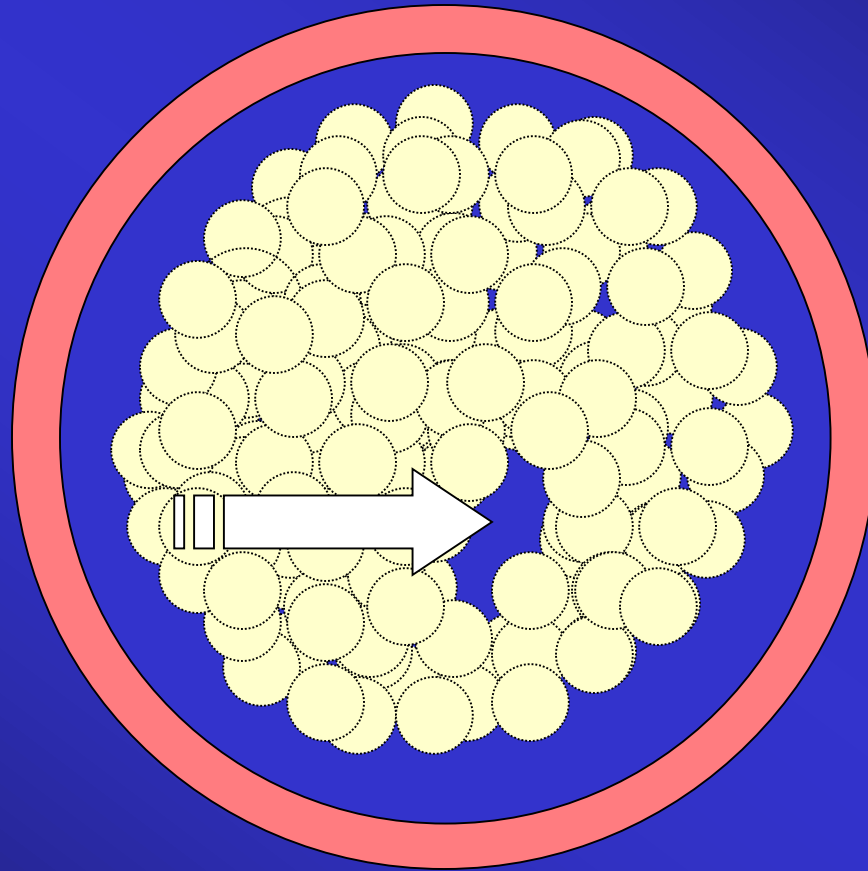


Mórula

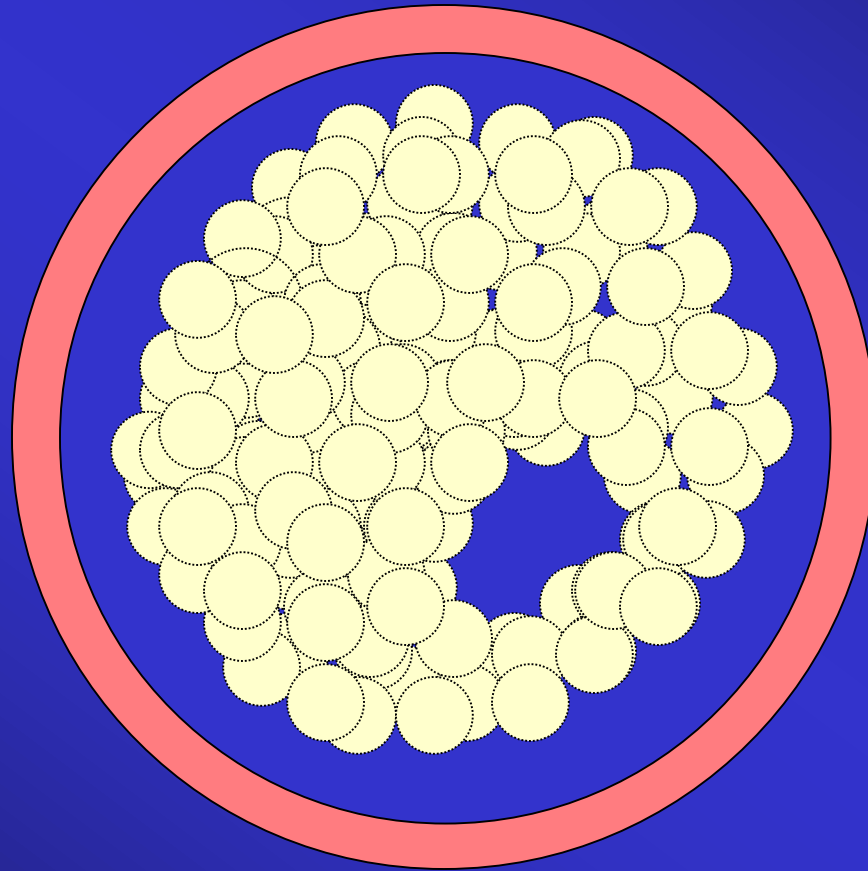


Compactação...

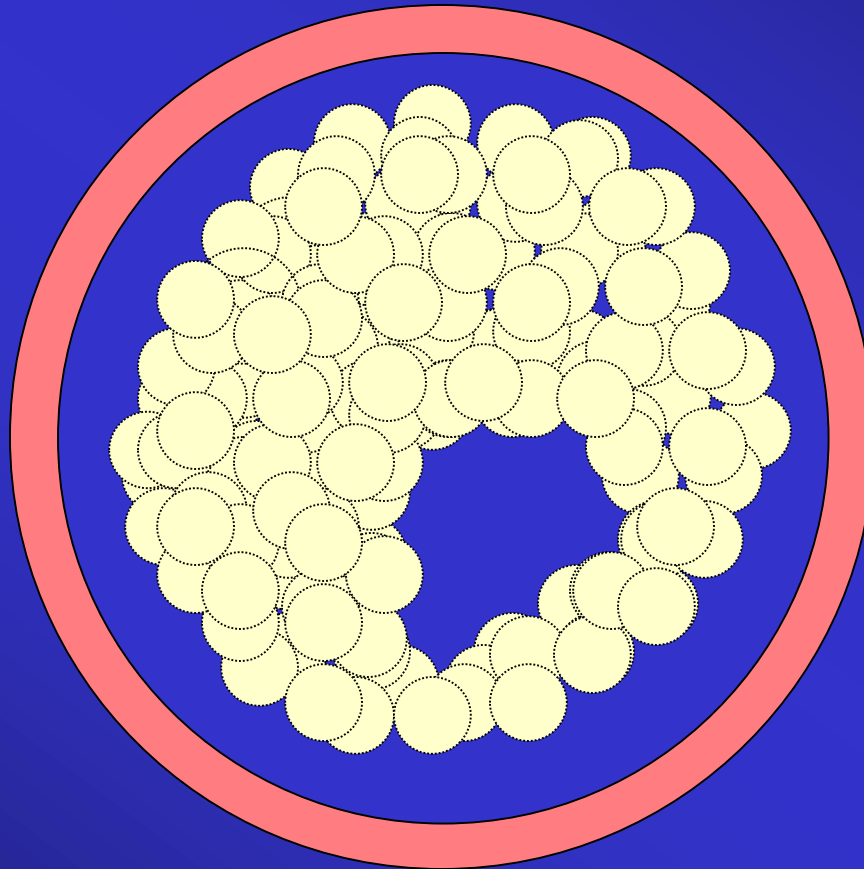


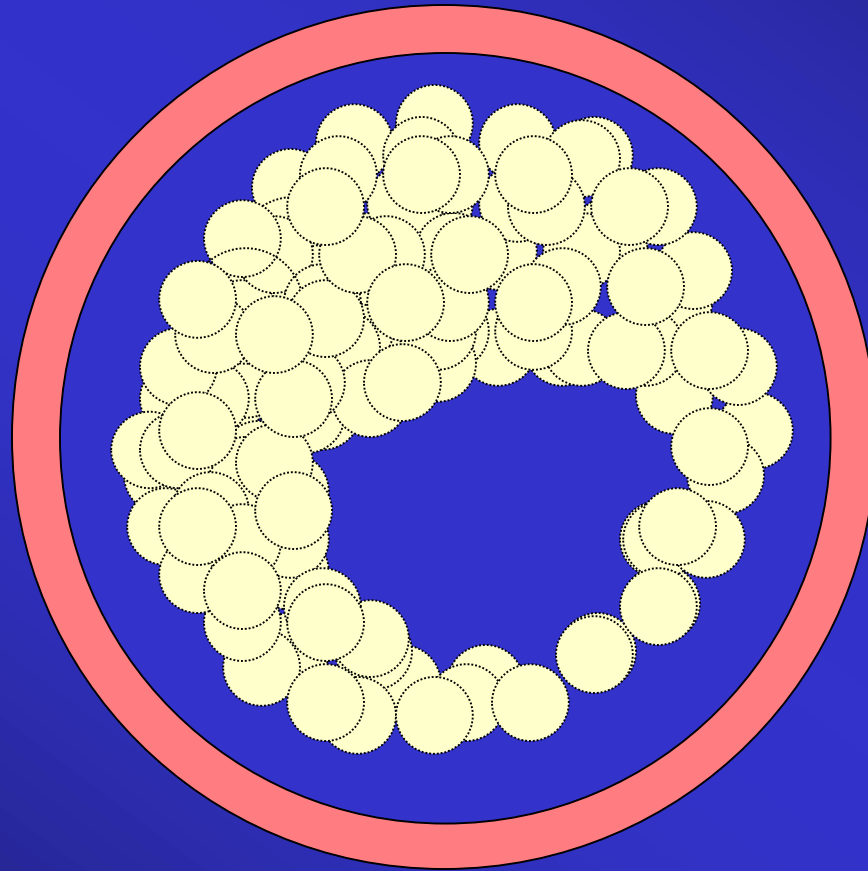


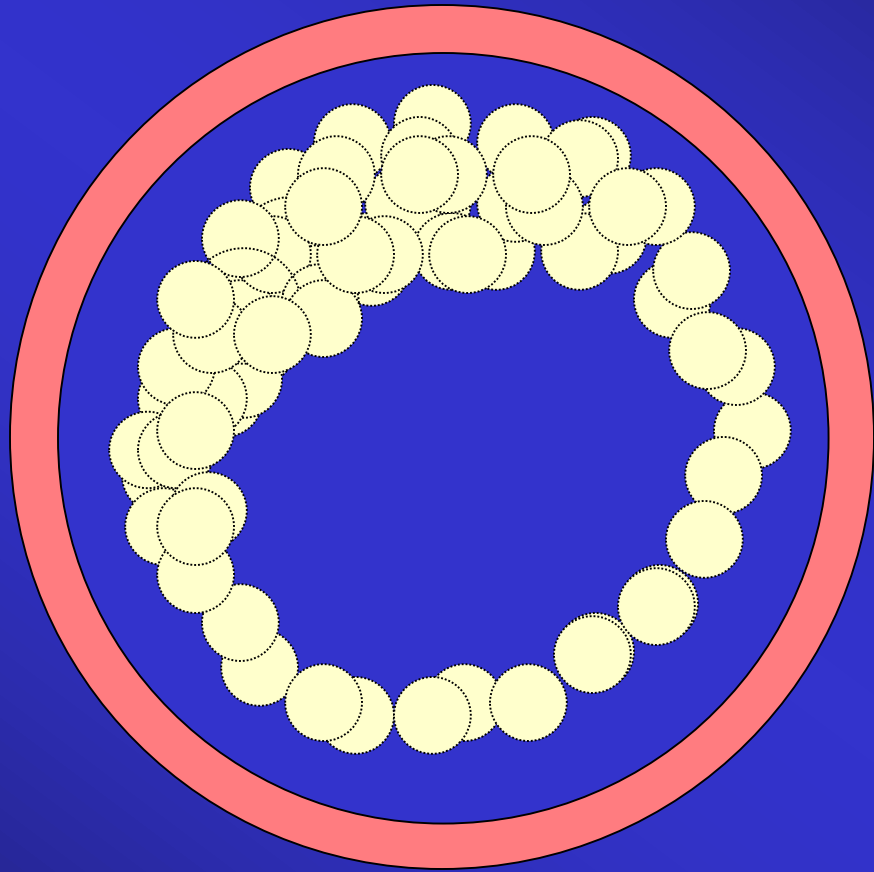
Formação da blastocele...

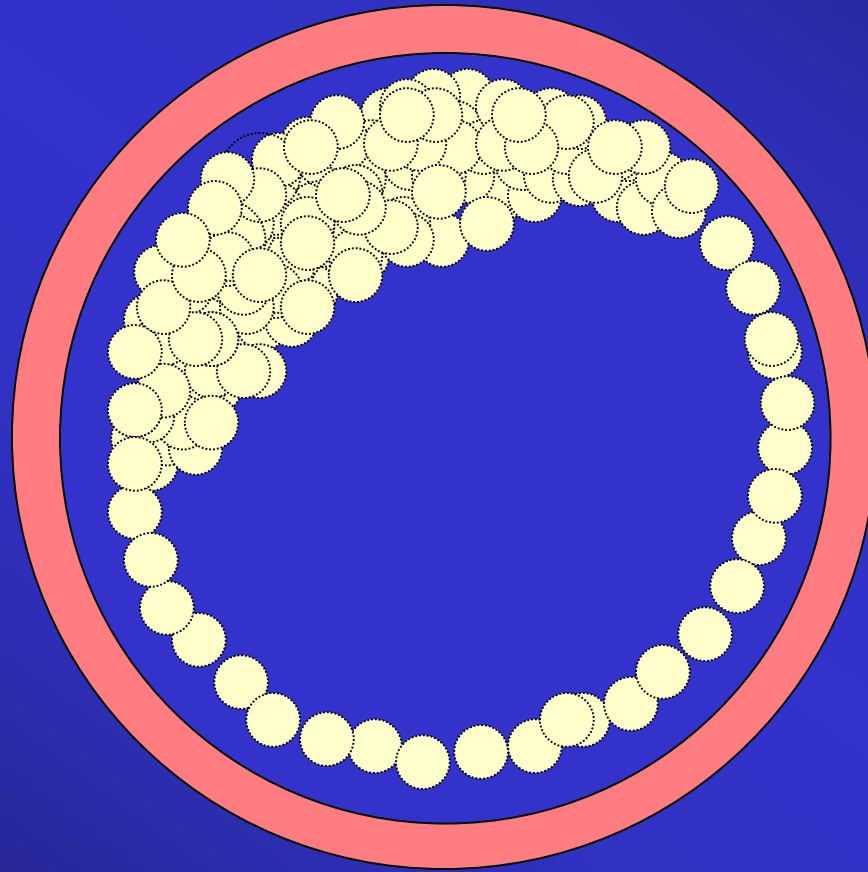


Blastocisto inicial



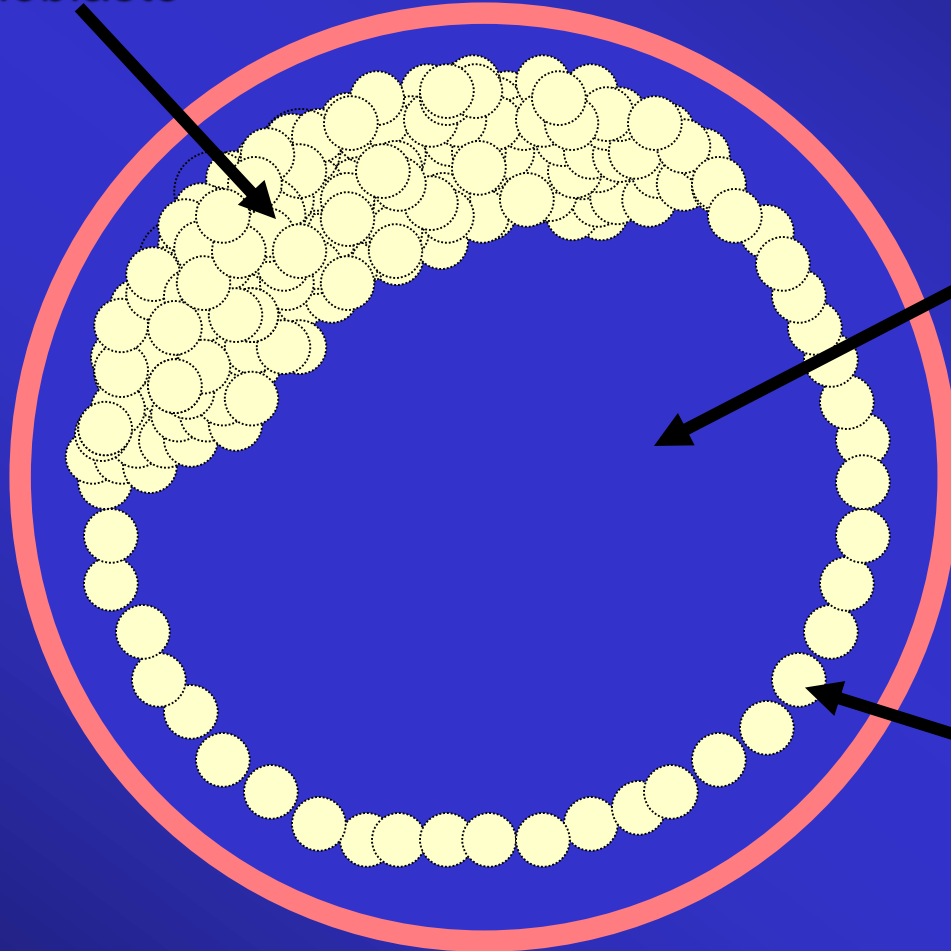






Blastocisto

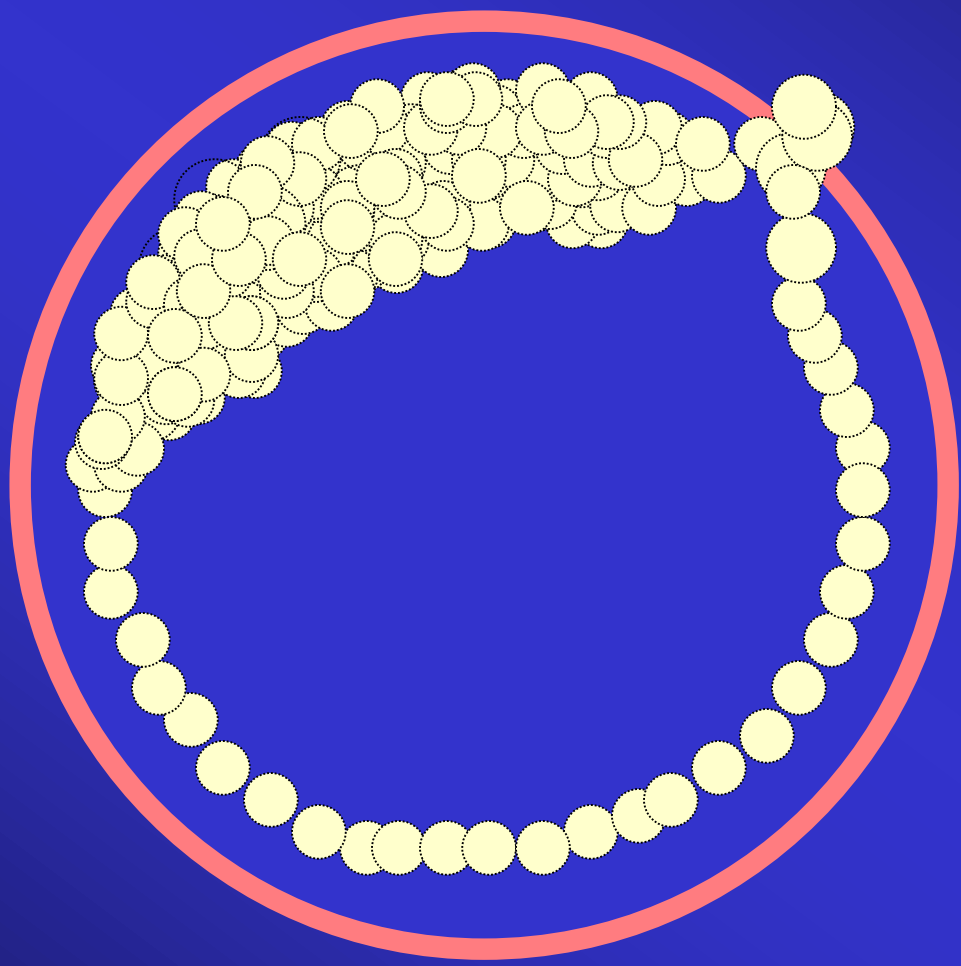
Embrioblasto



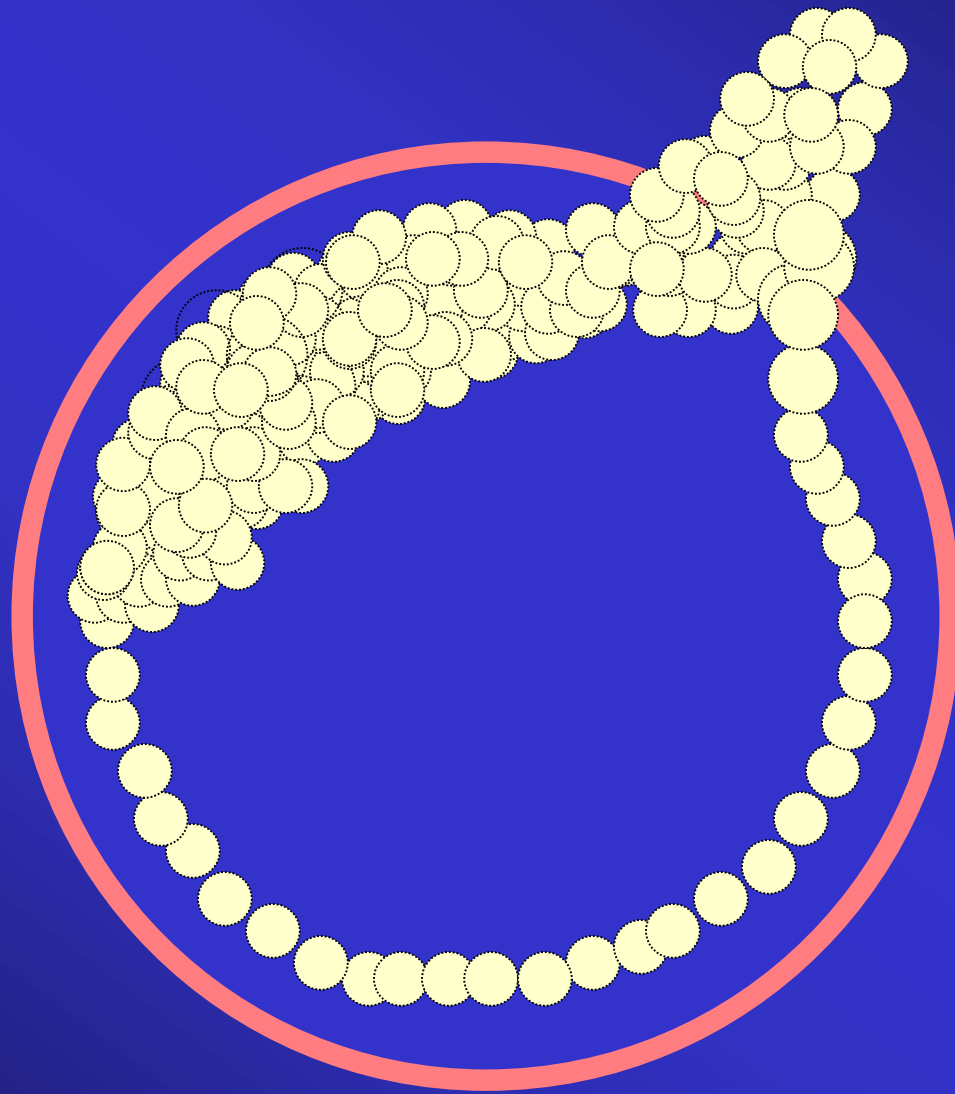
Blastocele

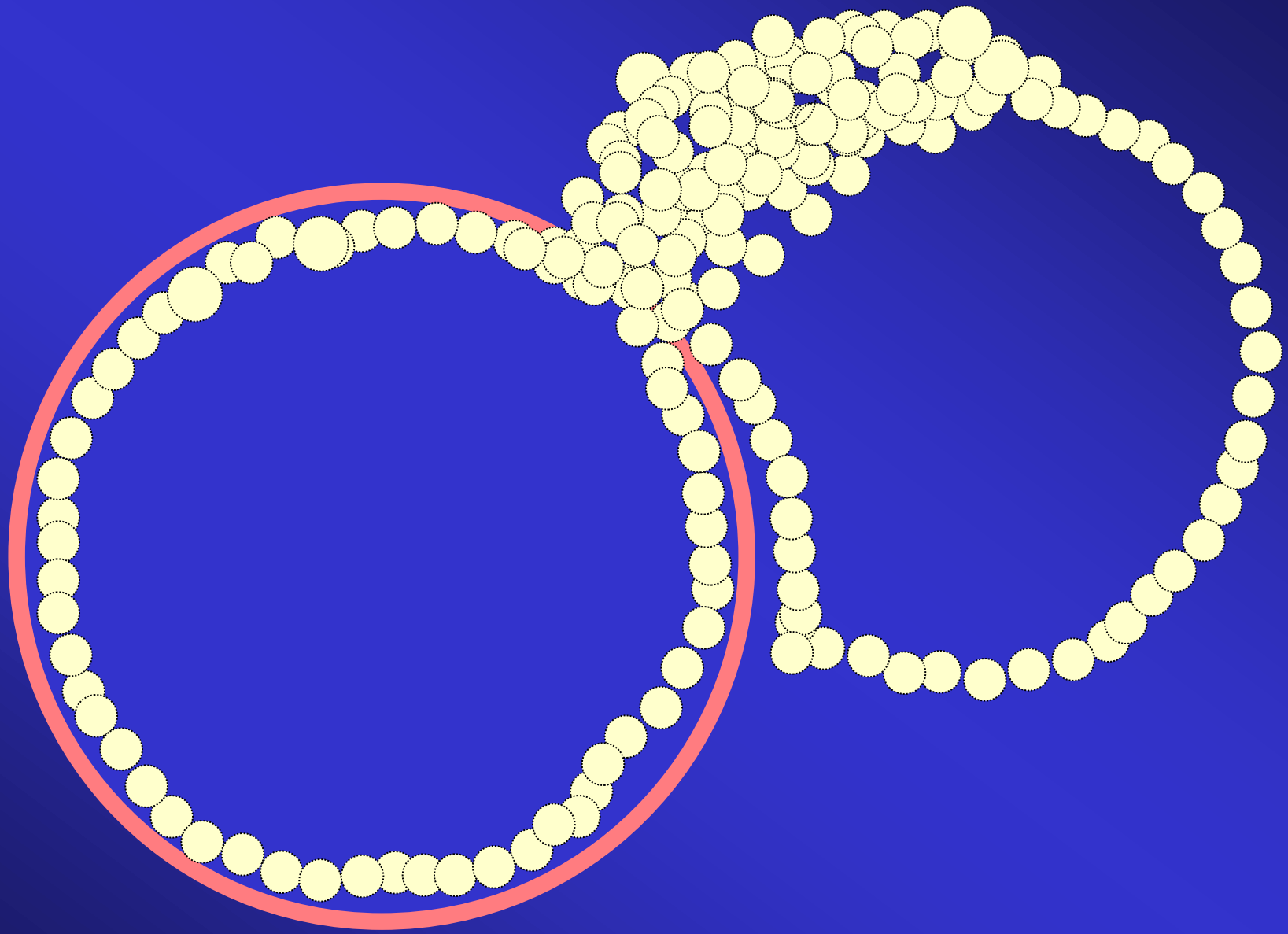
Trofoblasto

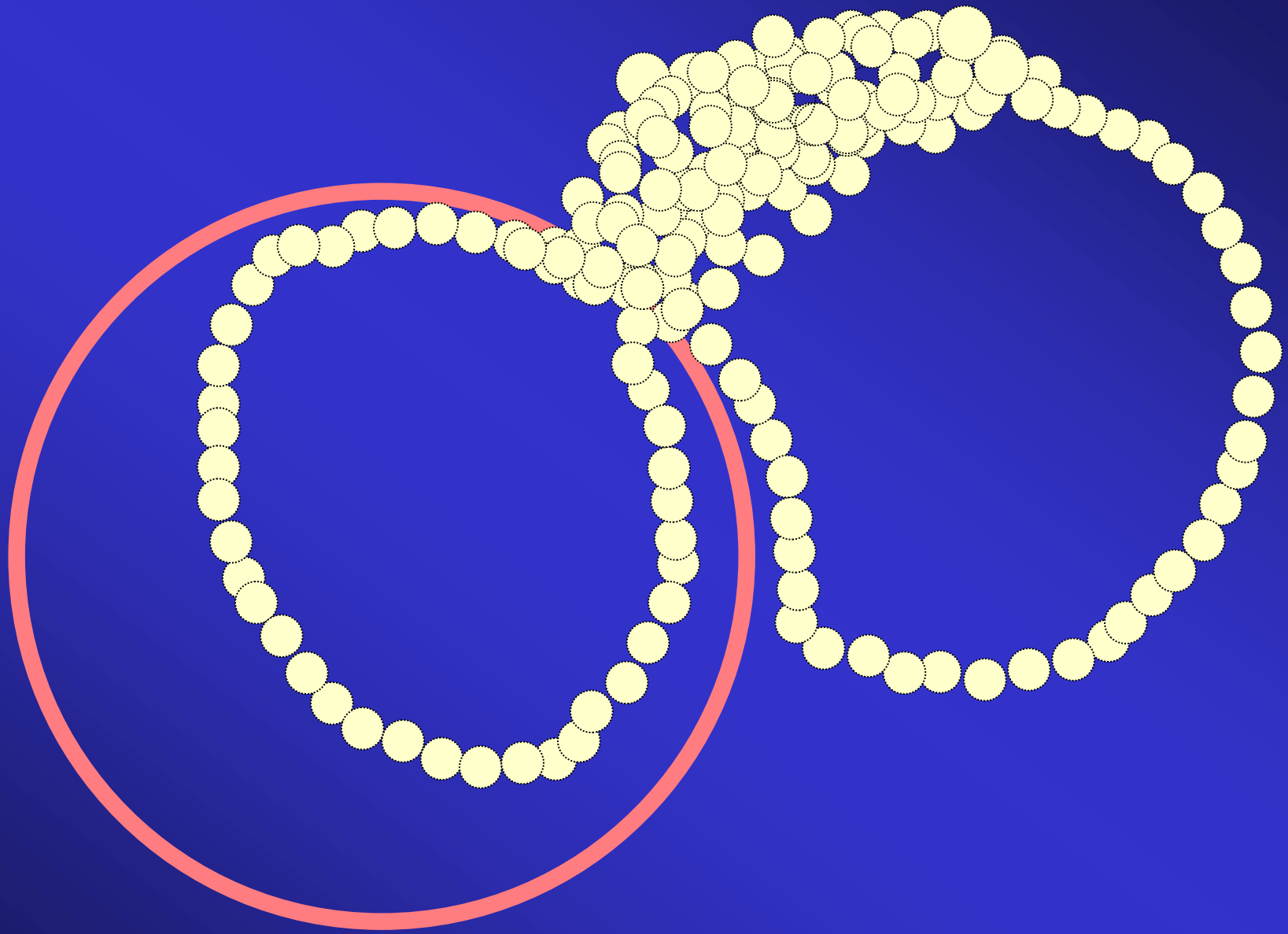
Blastocisto expandido

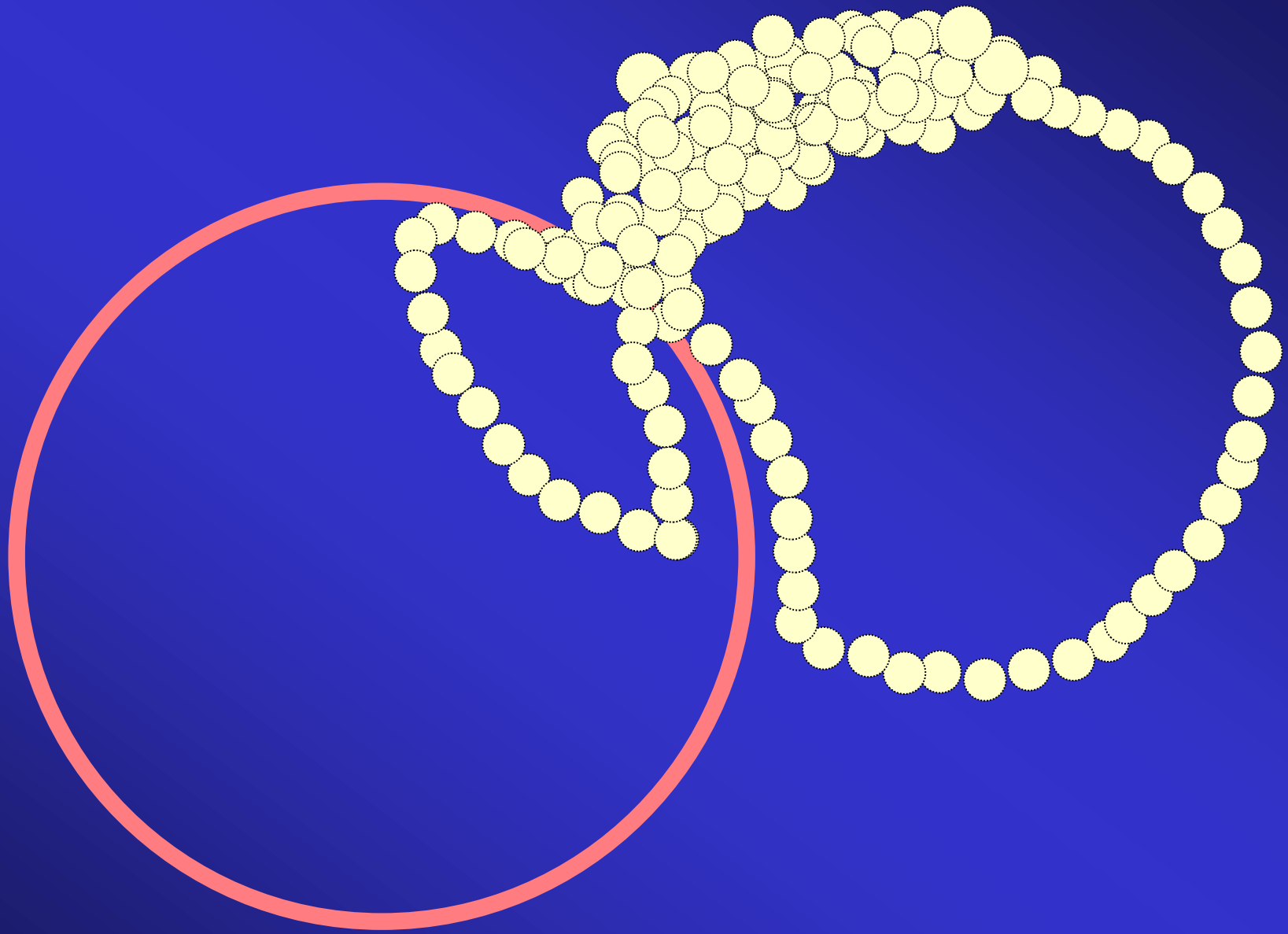


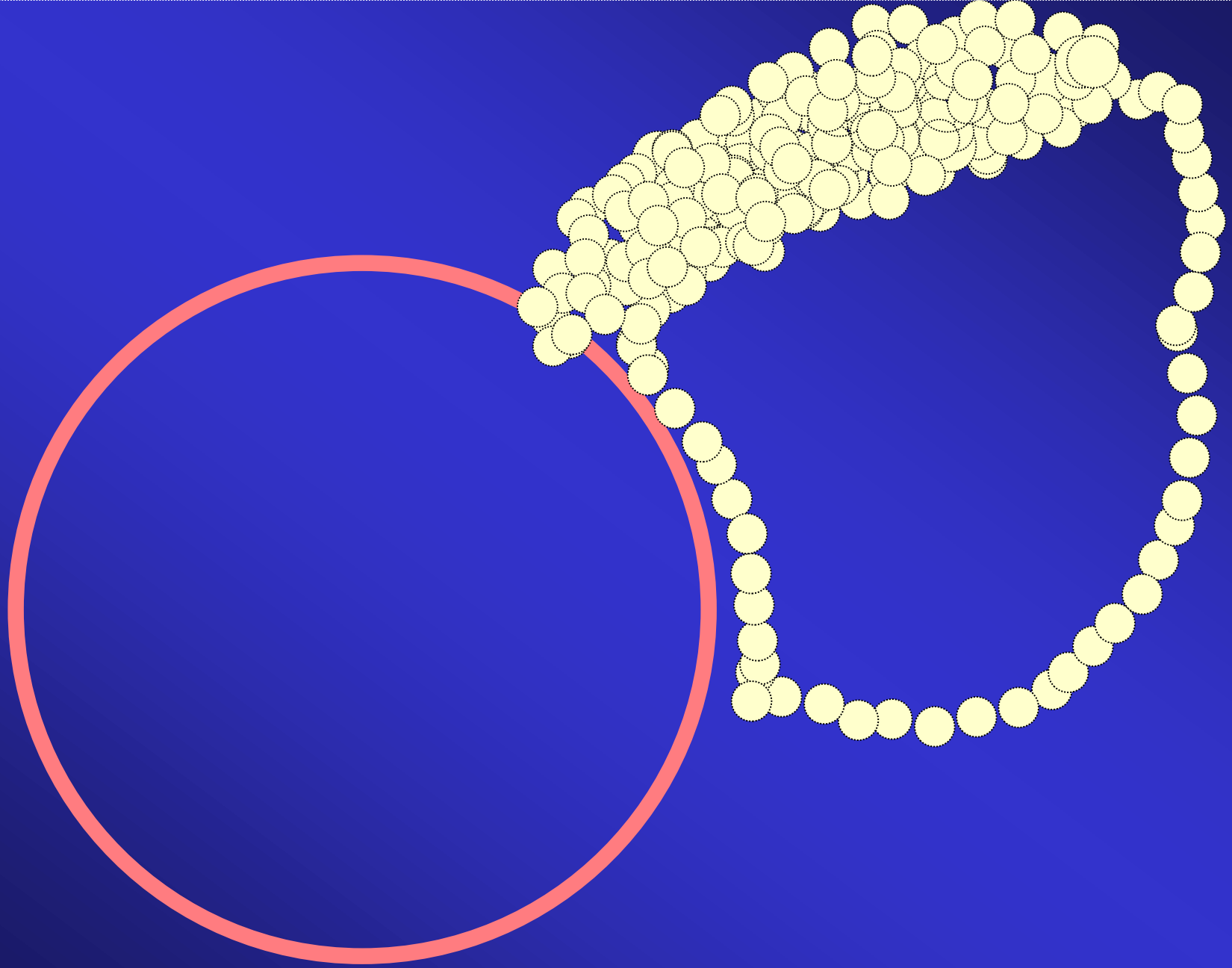
Início da eclosão

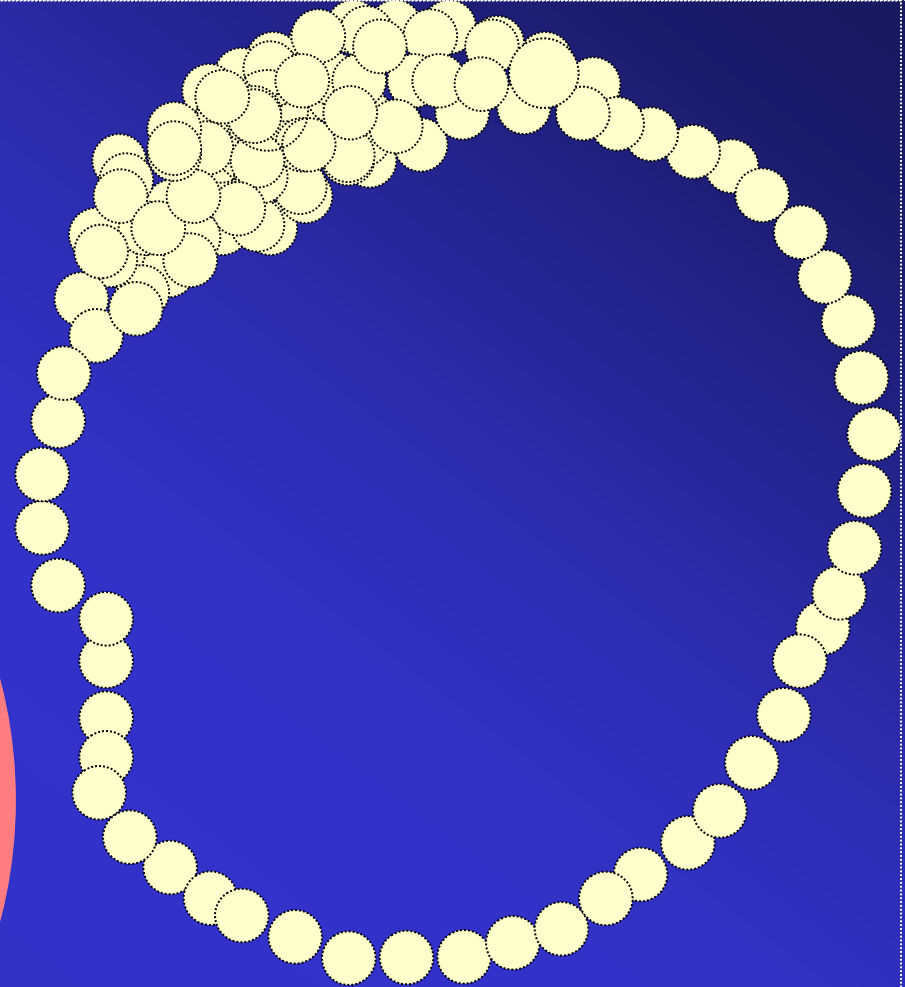




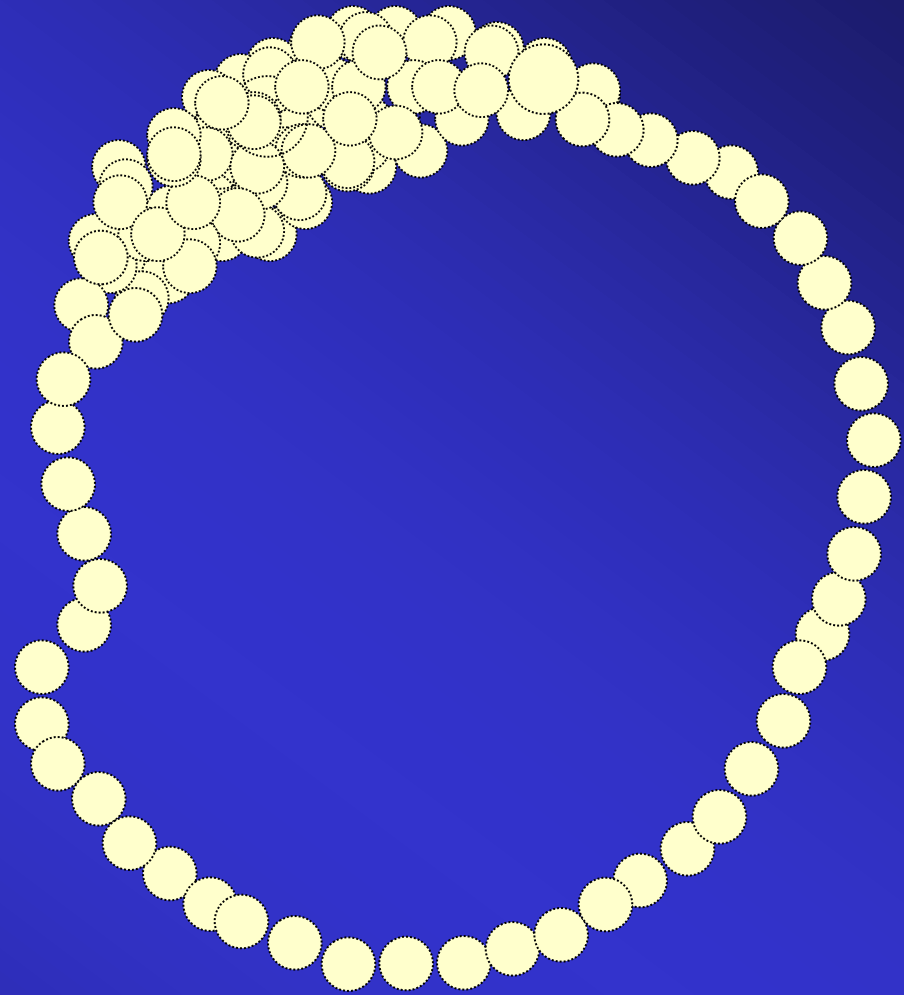


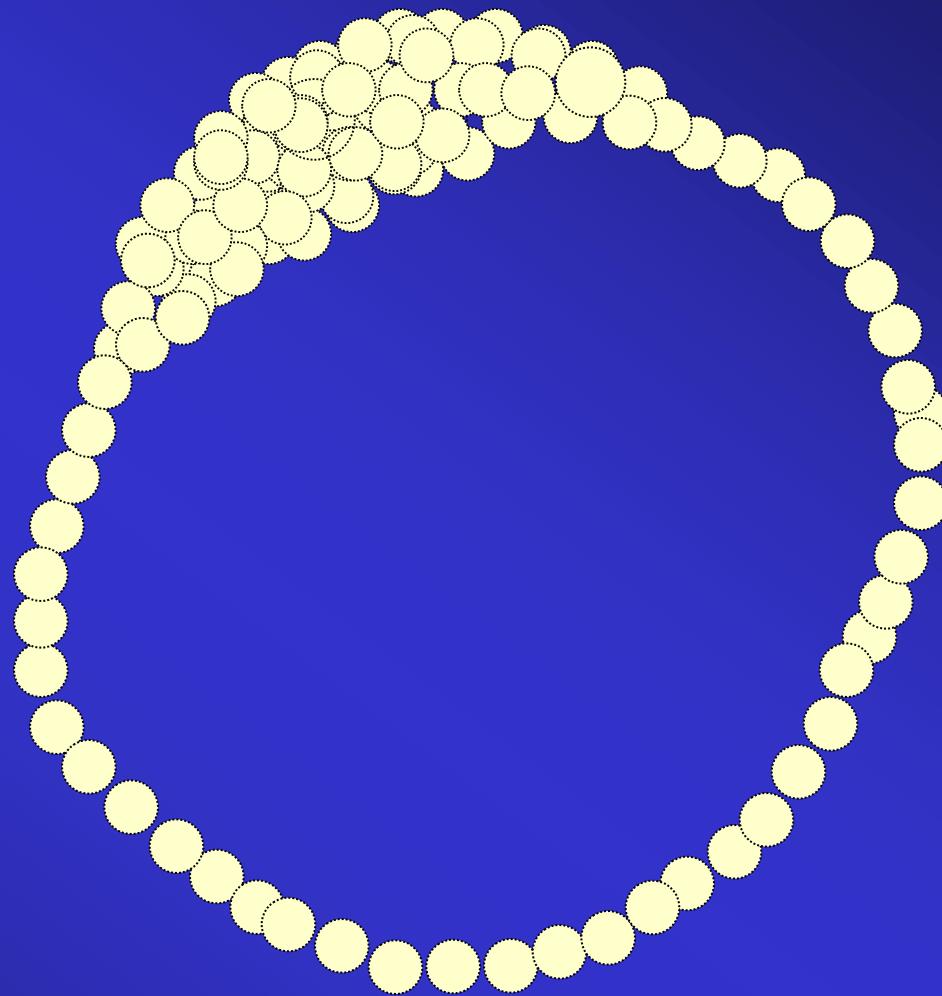


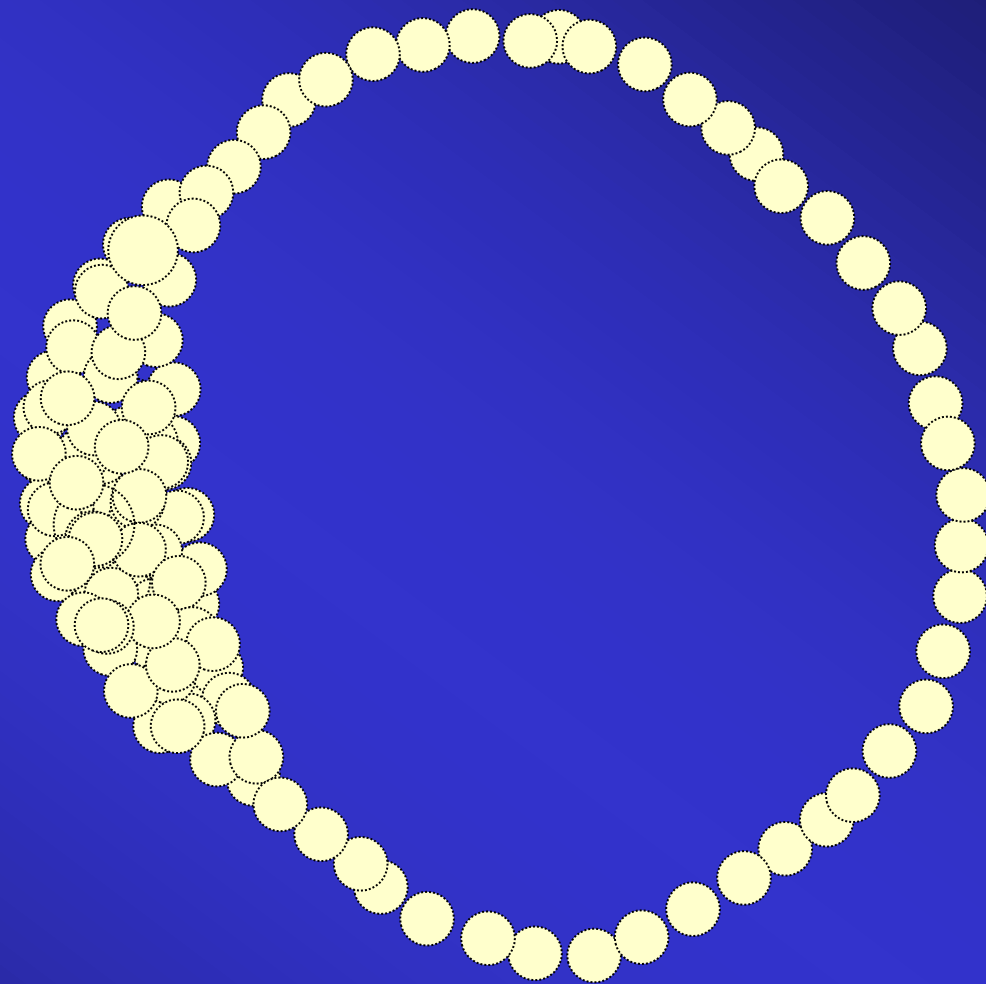


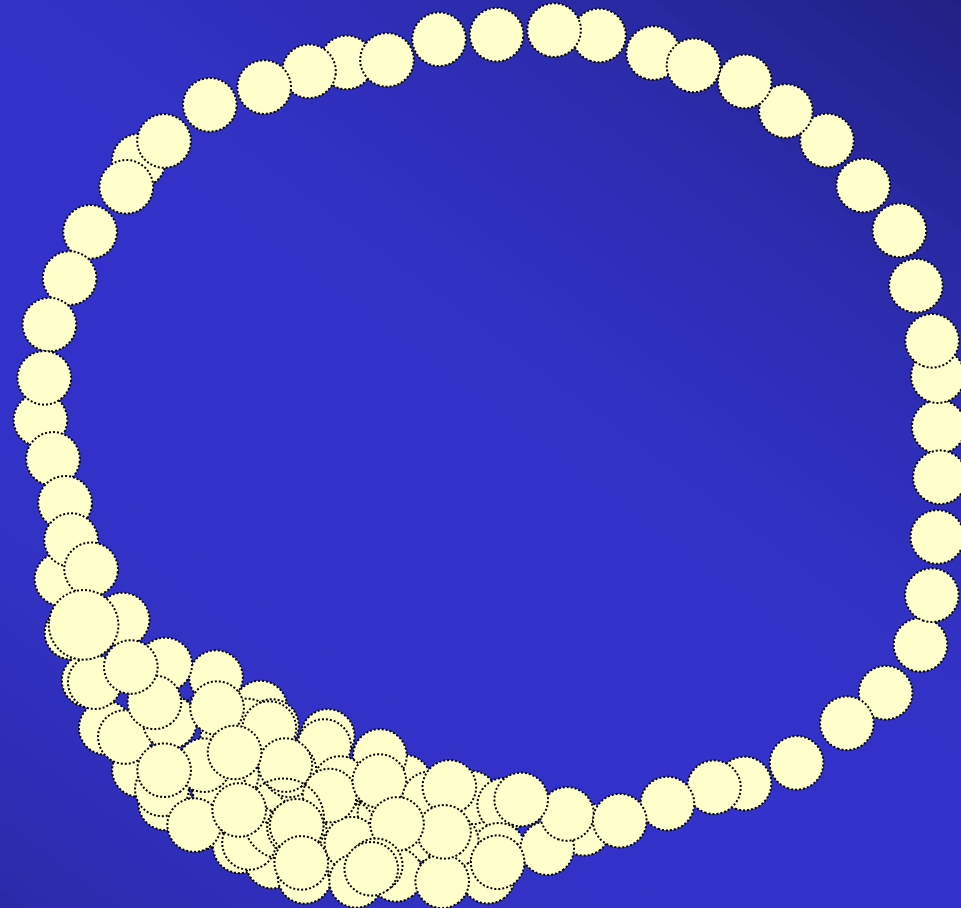


Blastocisto eclodido

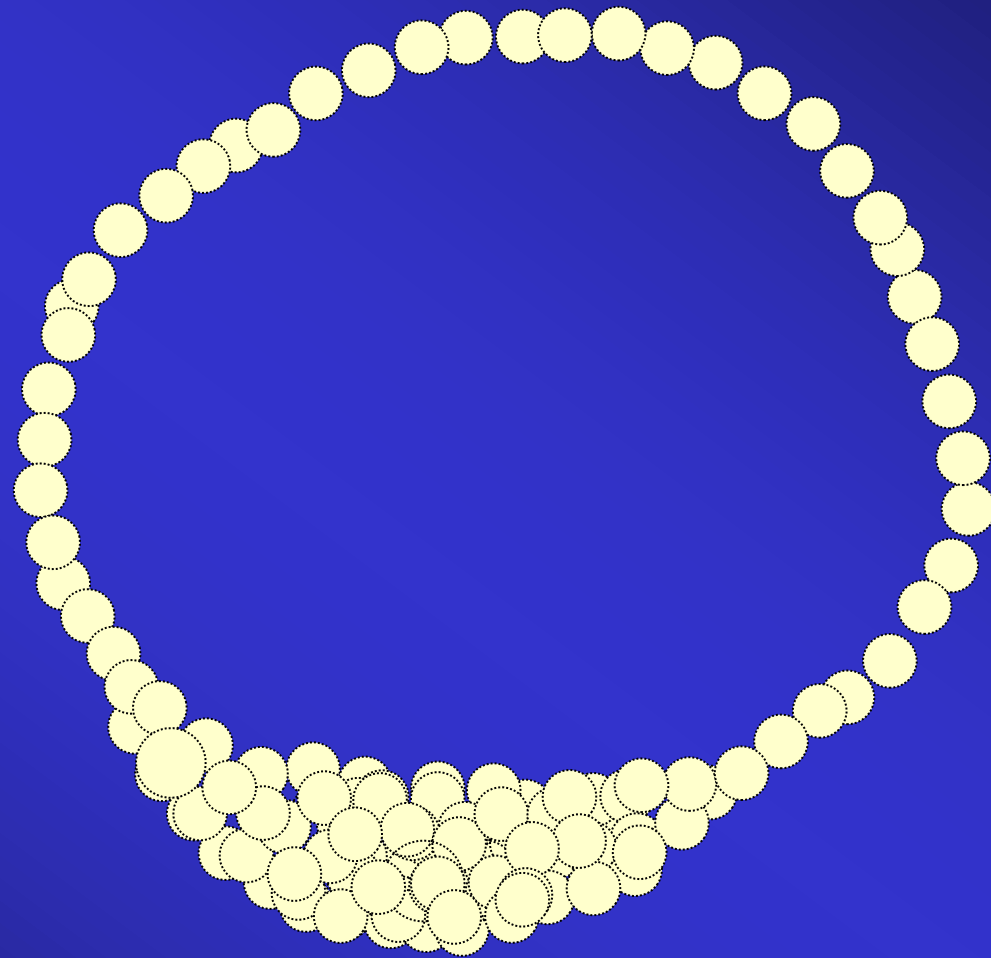


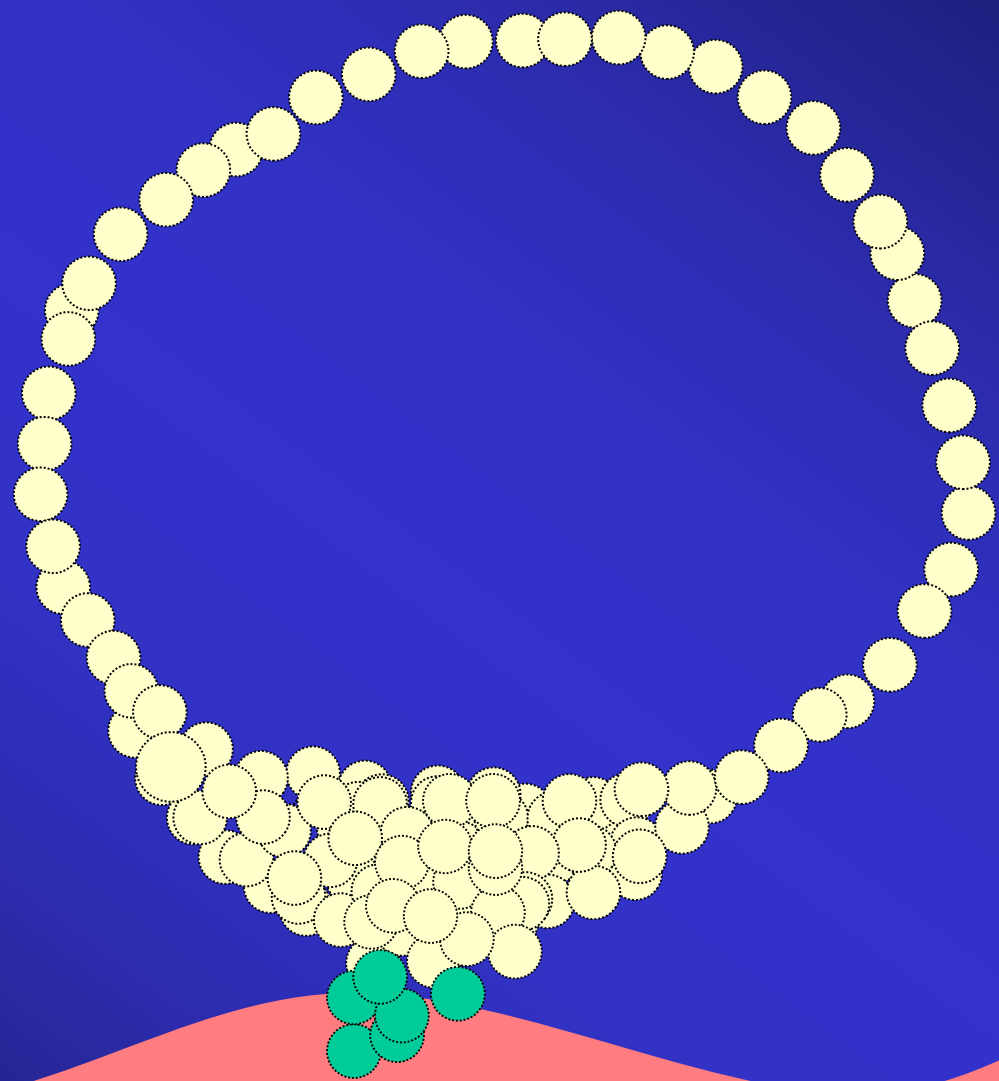






ENDOMÉTRIO



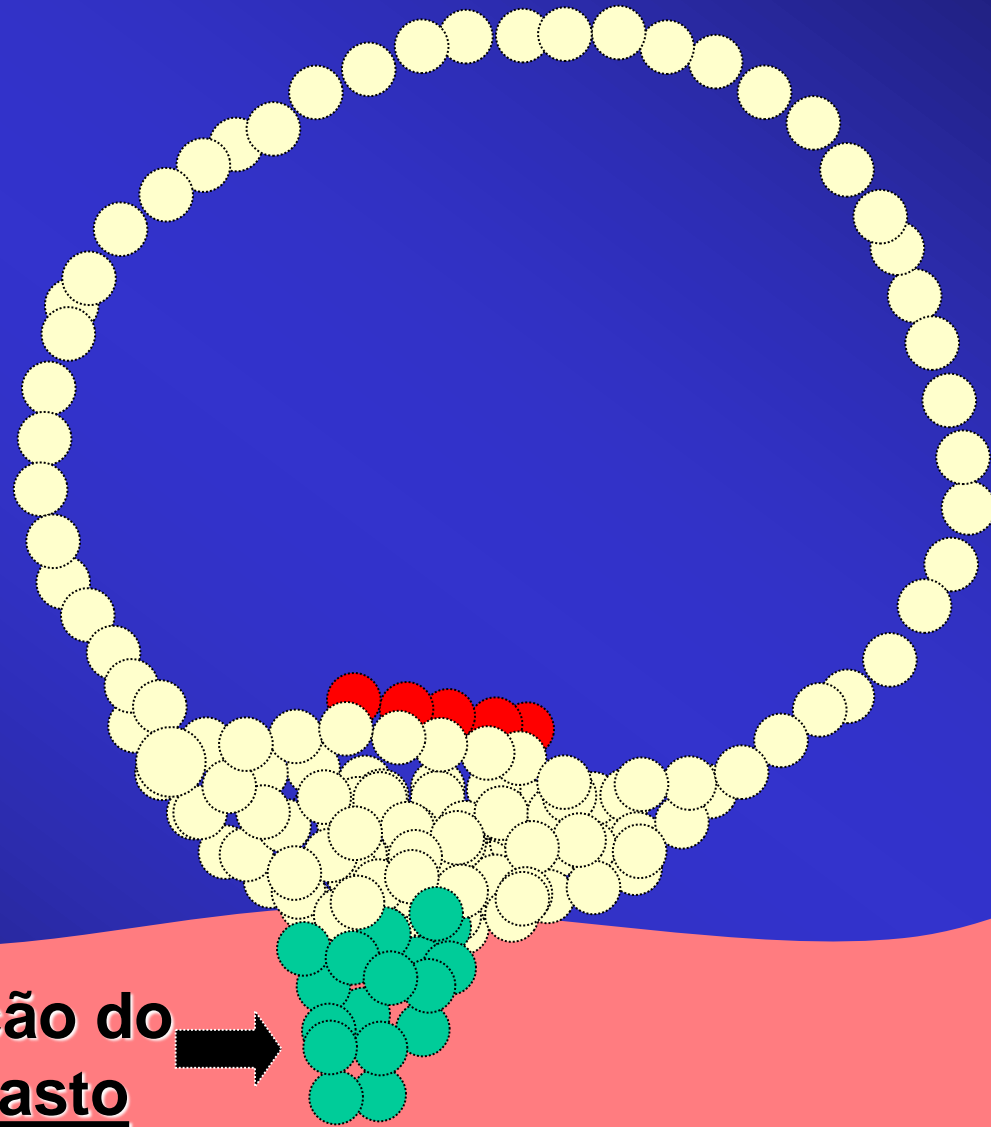


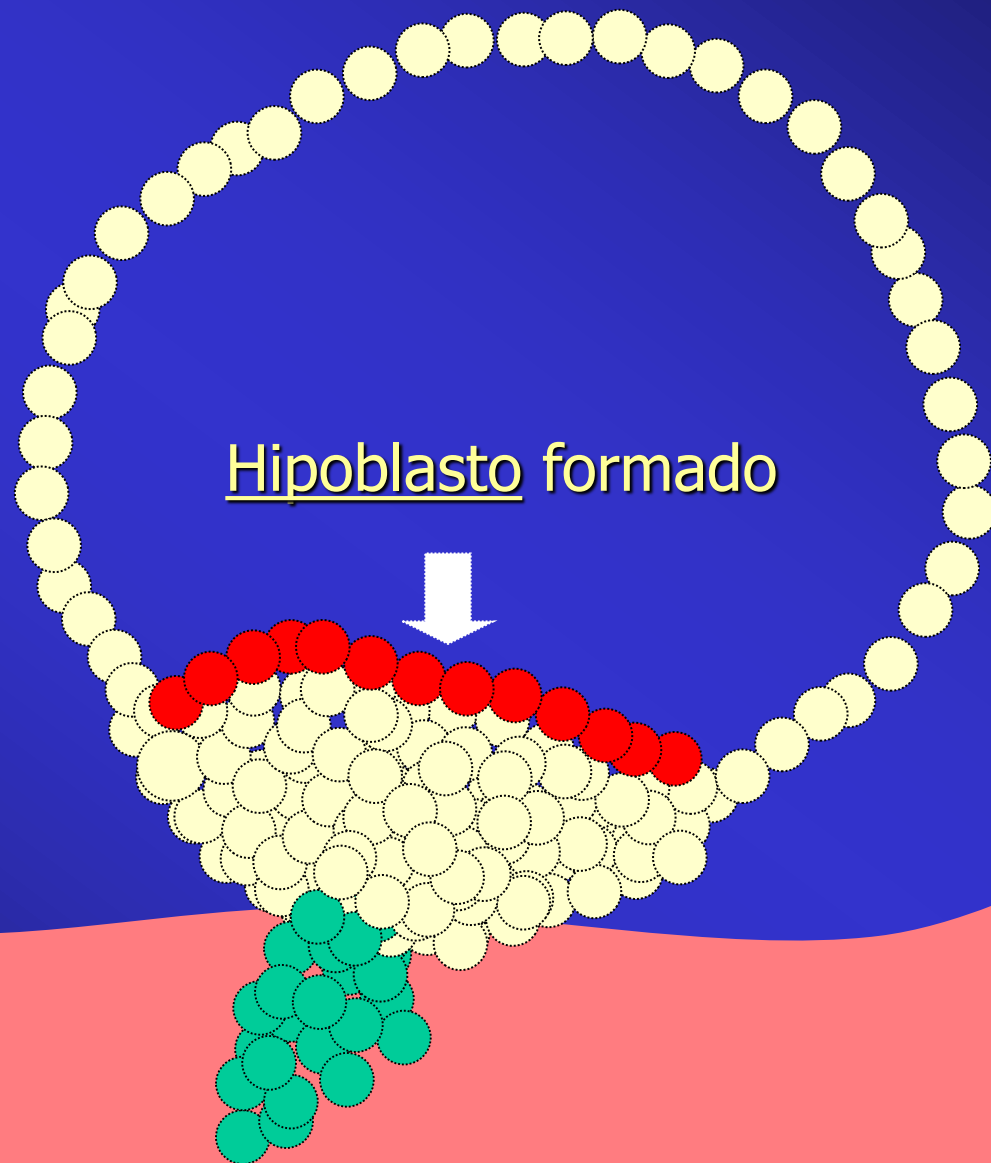
Início da implantação



Início da formação do hipoblasto

Início da formação do sinciciotrofoblasto





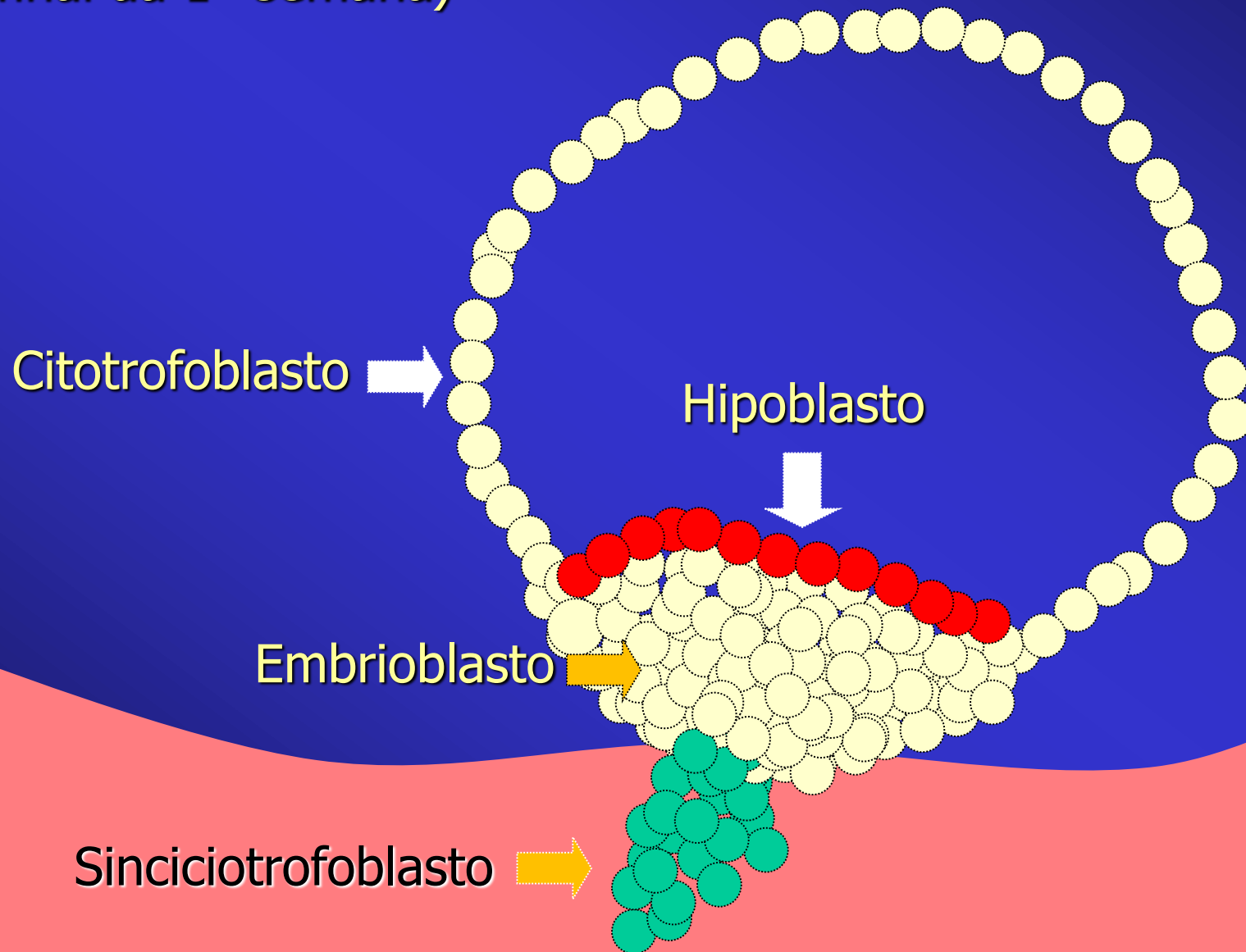
Hipoblasto formado

Final da 1ª Semana

Durante a 1ª semana do desenvolvimento, ocorrem os seguintes eventos:

- ✓ Formação do zigoto;
- ✓ Início da segmentação do zigoto (clivagem), quando este transforma-se em embrião de 2-, 4-, 8-, 16-células;
- ✓ Formação da mórula (16 a 32- células) (3º dia);
- ✓ Formação do blastocisto (4º- 5º dia);
- ✓ Início da implantação (6º dia);
- ✓ Início da diferenciação das células do embrioblasto, com a formação do hipoblasto (7º dia).

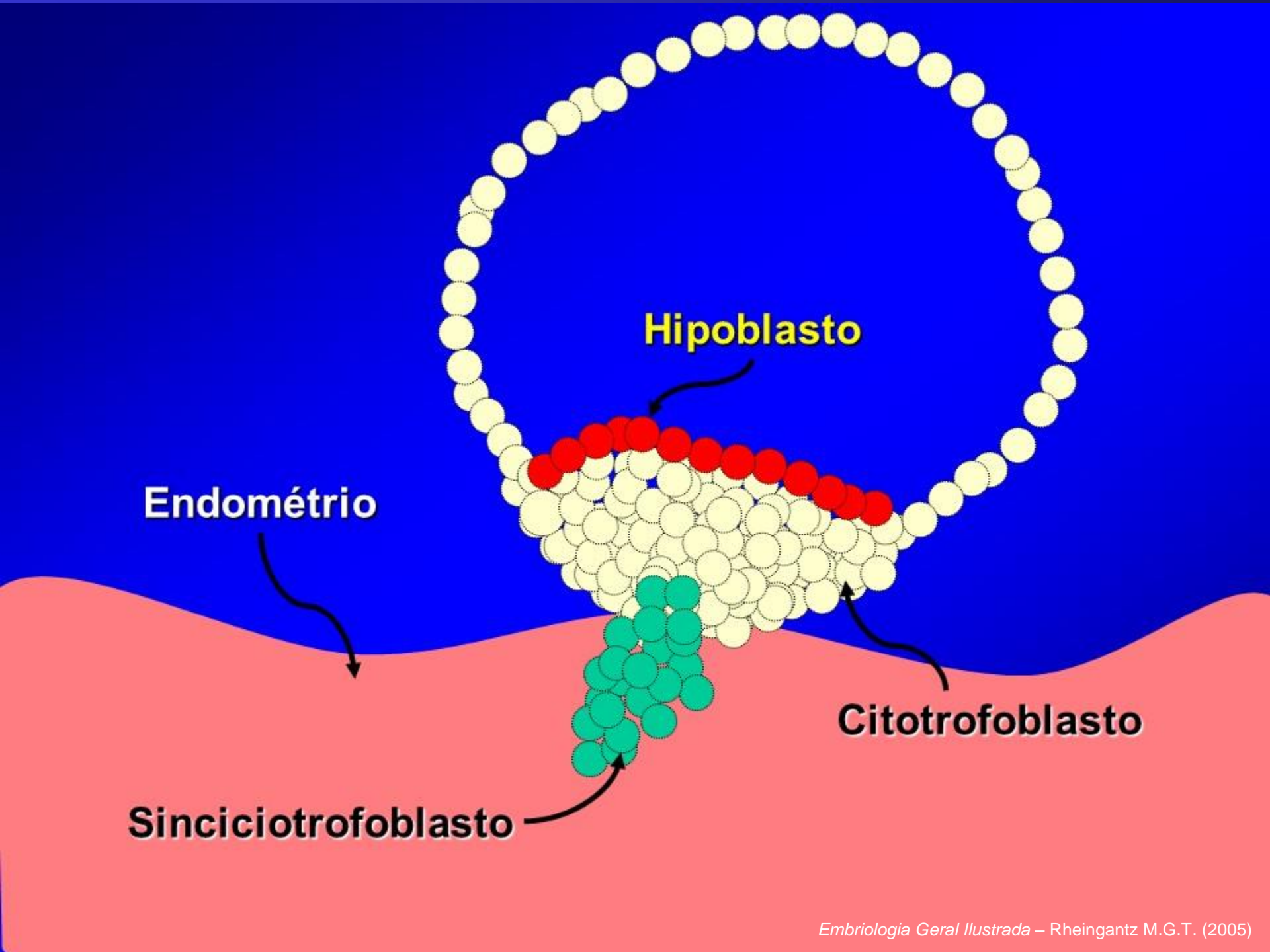
Partes do blastocisto (final da 1ª semana)



2ª Semana do Desenvolvimento Humano

IMPLANTAÇÃO

O processo da implantação do blastocisto no endométrio inicia na 1ª semana do desenvolvimento (6º dia) e termina na 2ª semana (10º dia).

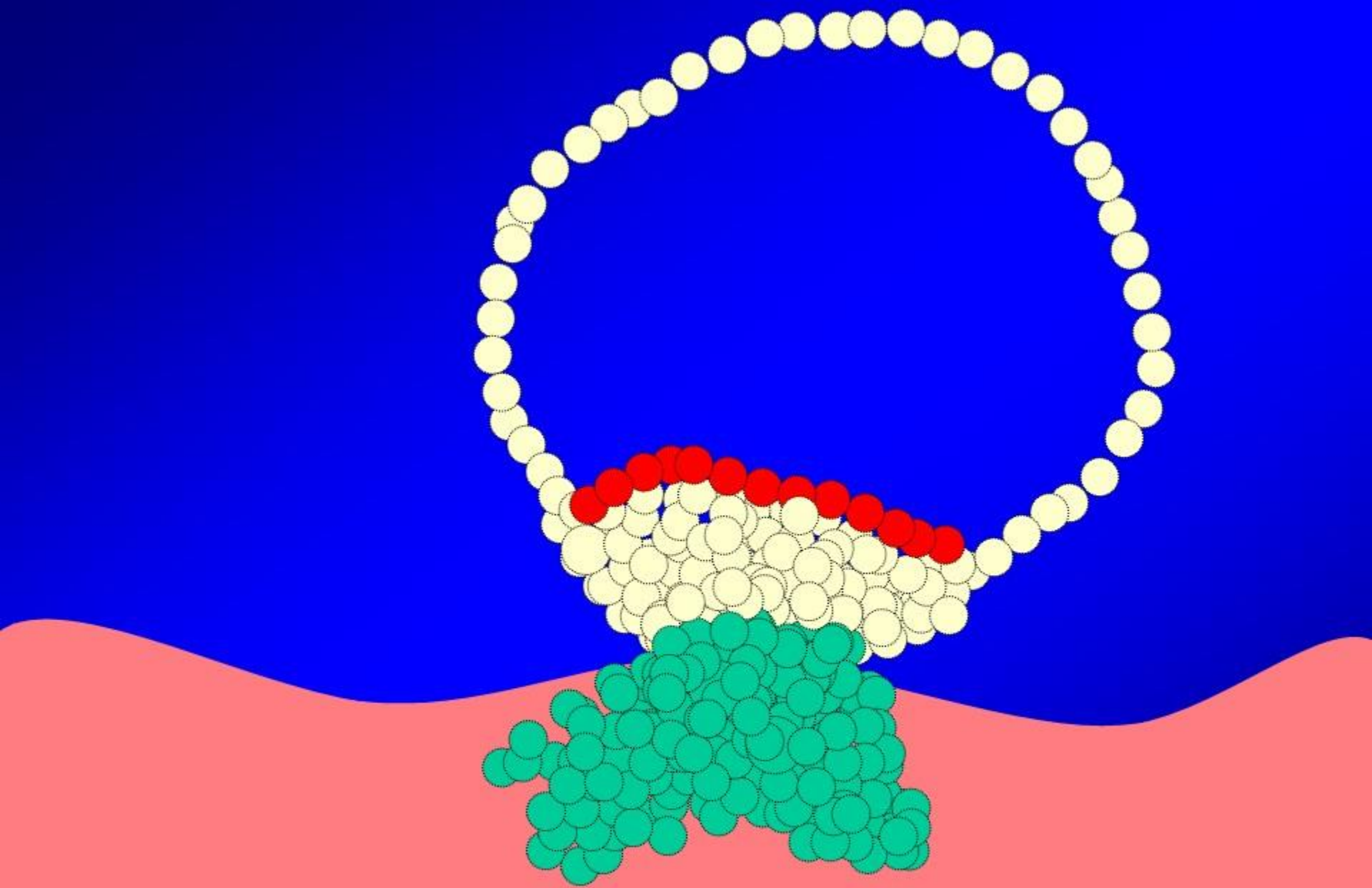


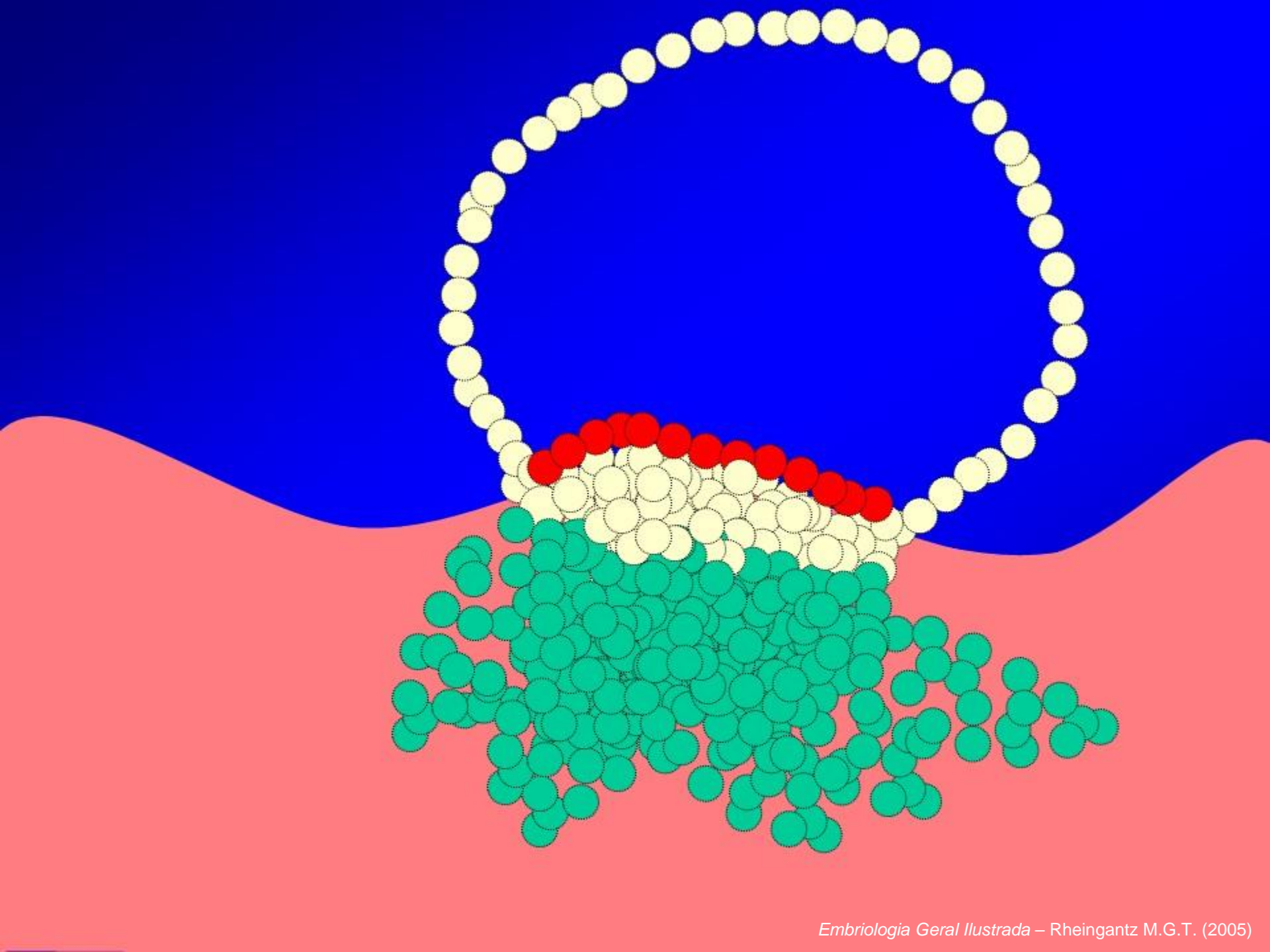
Endométrio

Hipoblasto

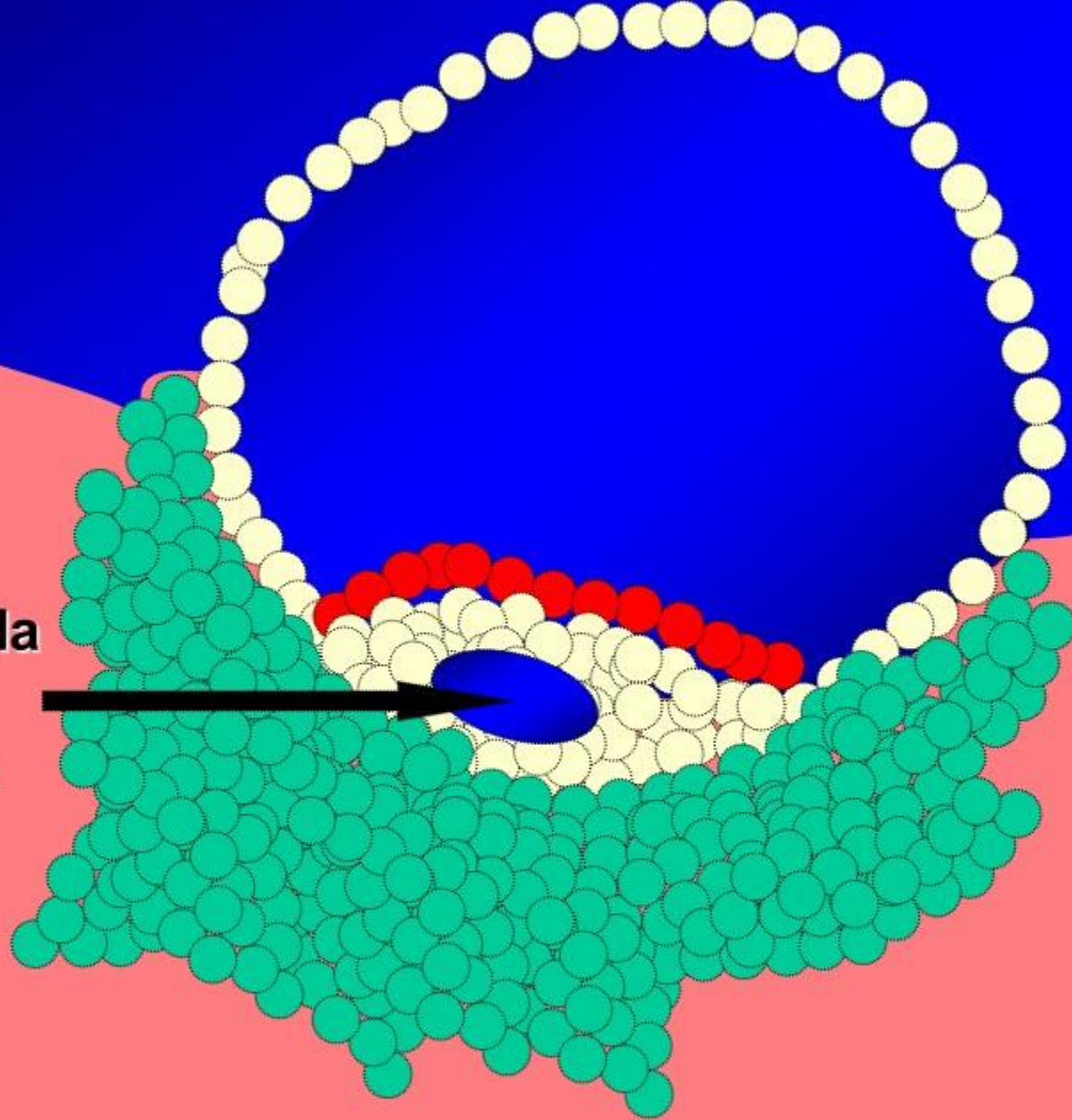
Citotrofoblasto

Sinciciotrofoblasto

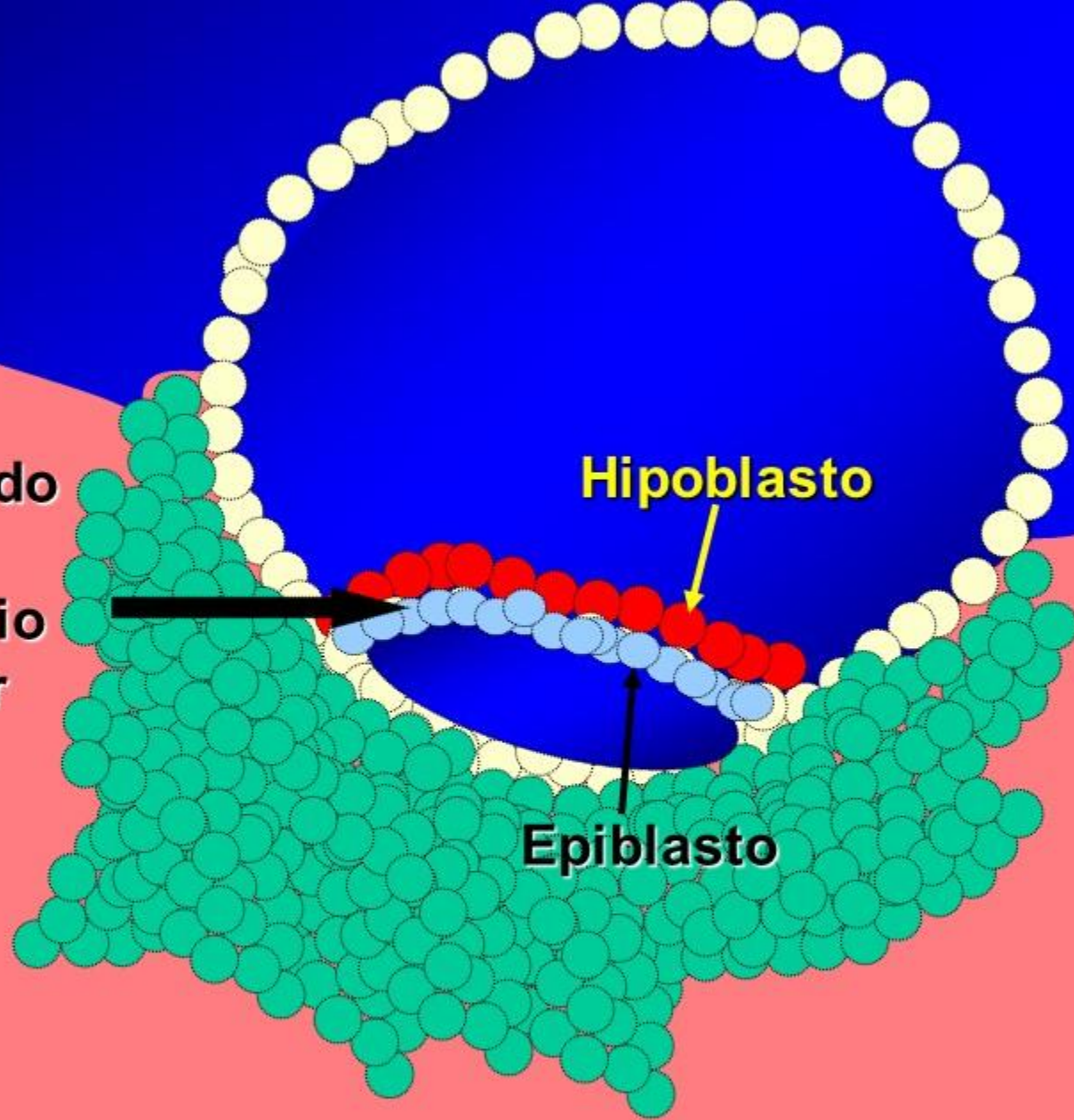




**Formação da
cavidade
amniótica**

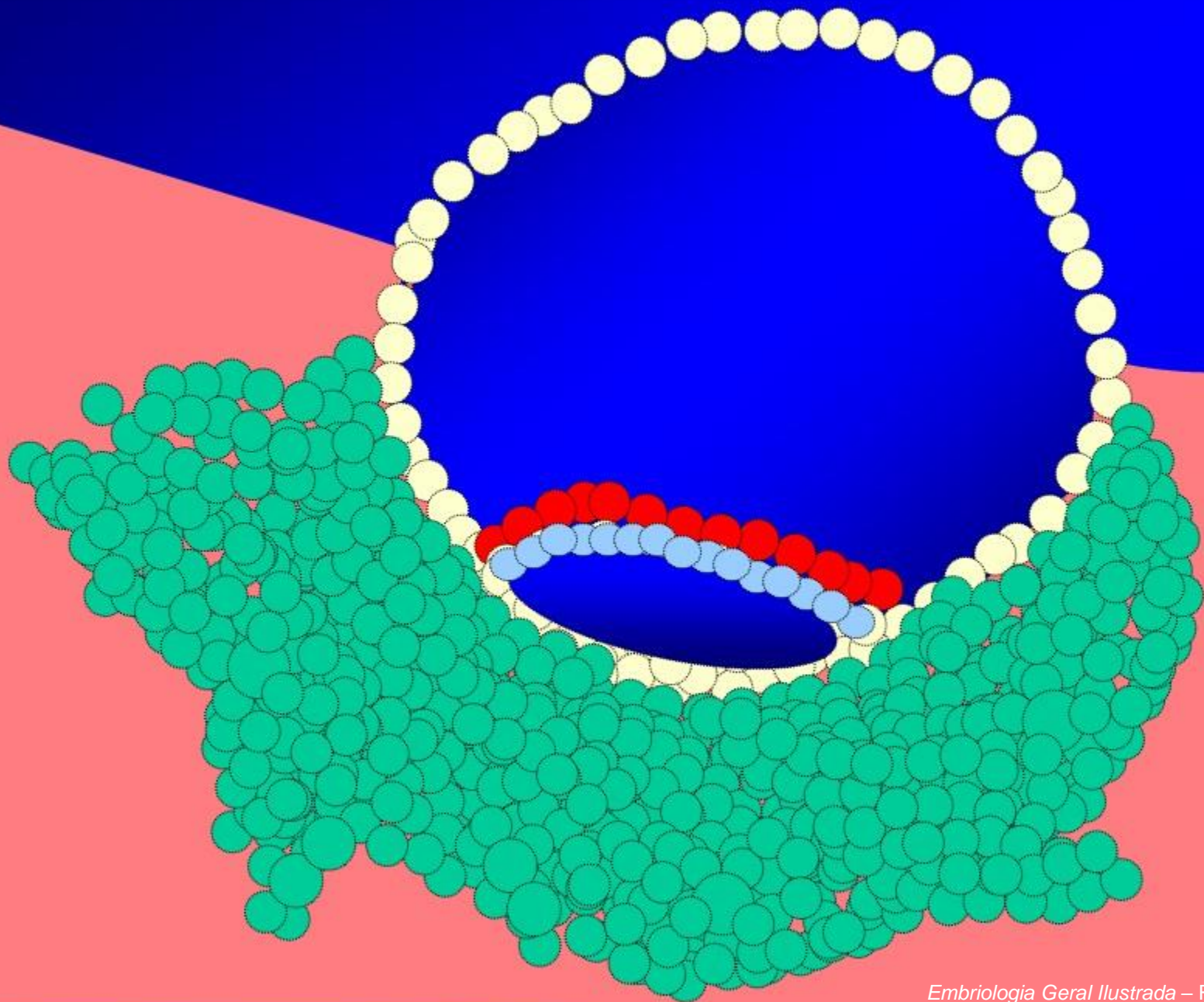


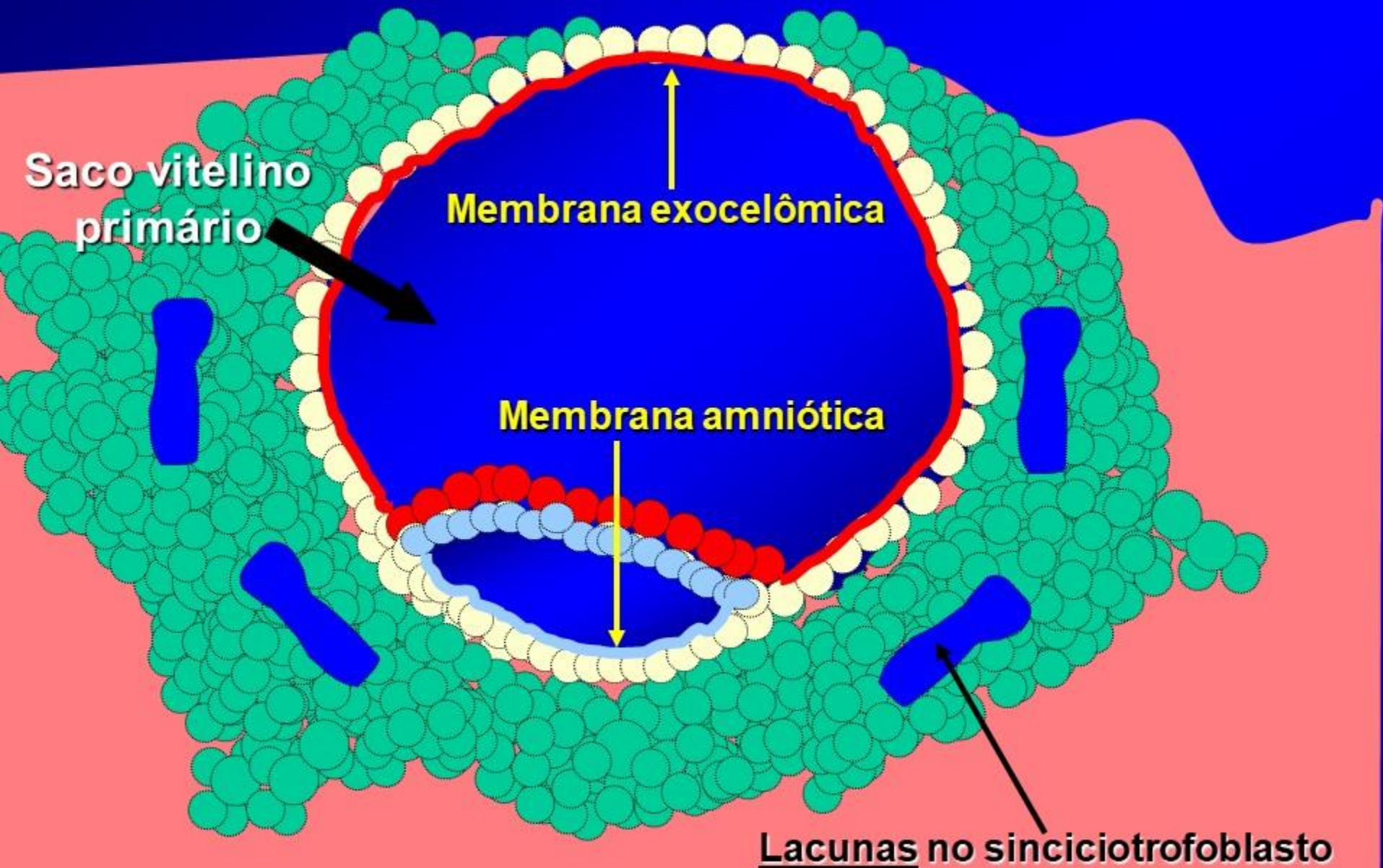
**Formação do
disco
embrionário
bilaminar**



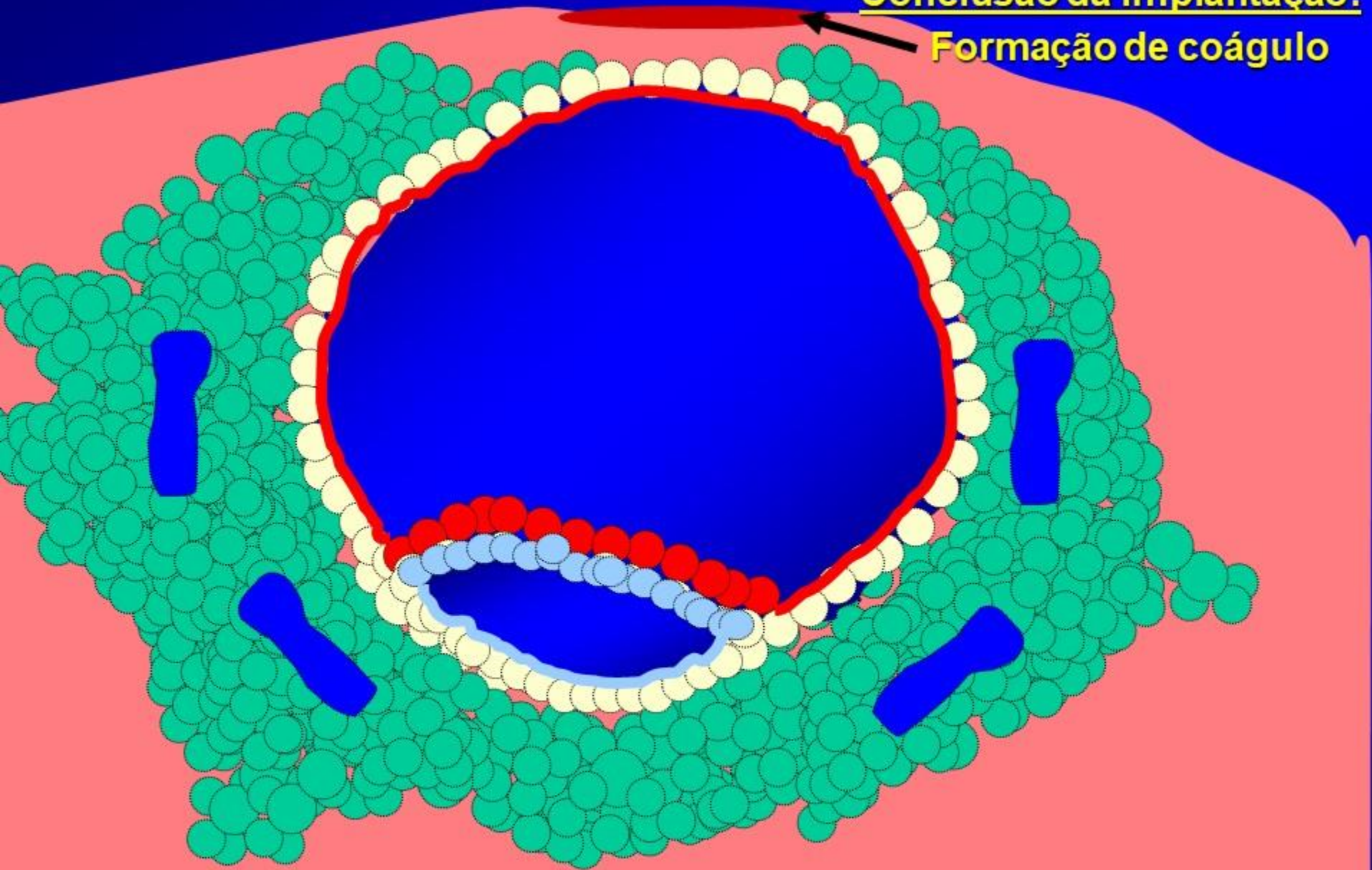
Hipoblasto

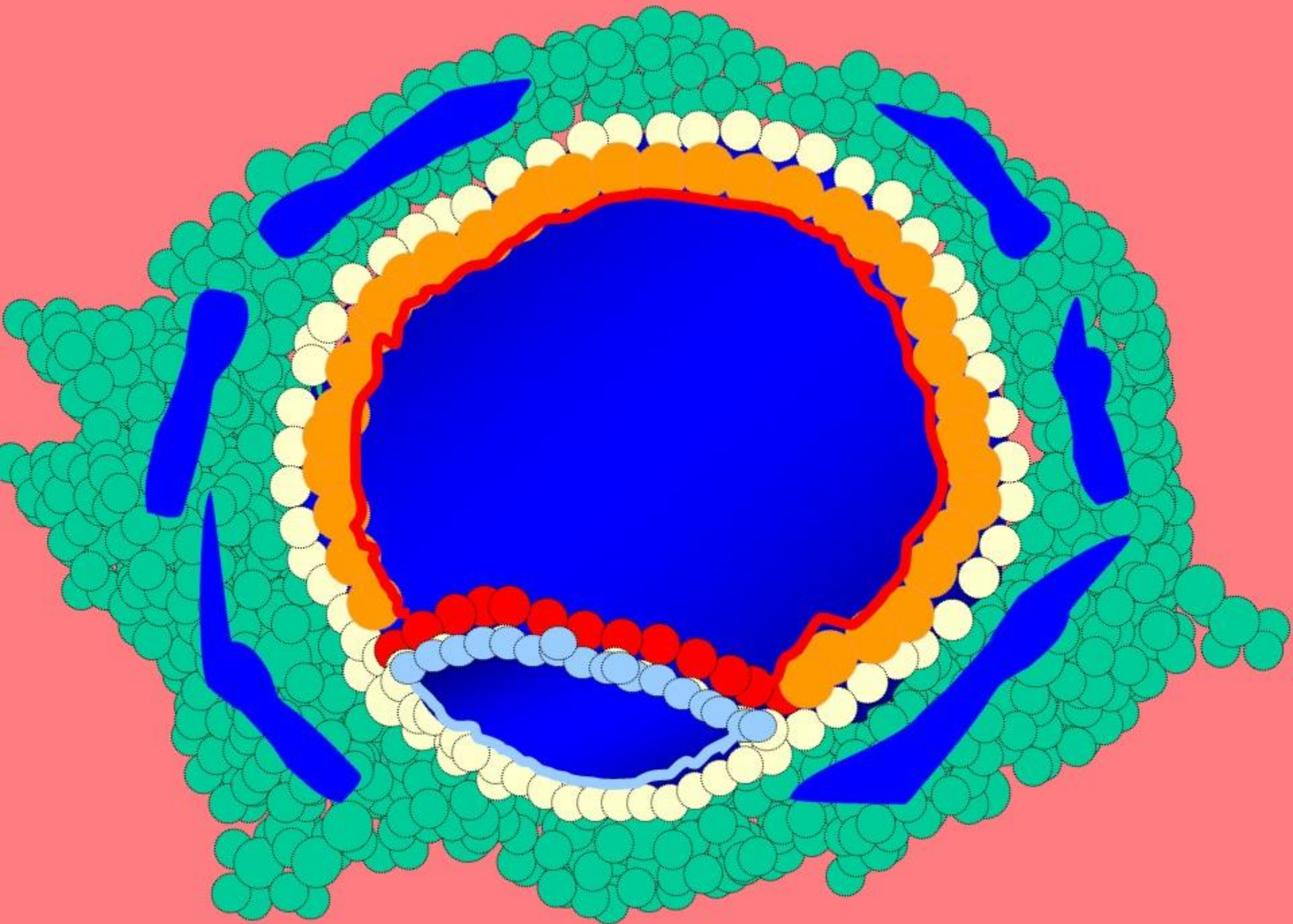
Epiblasto

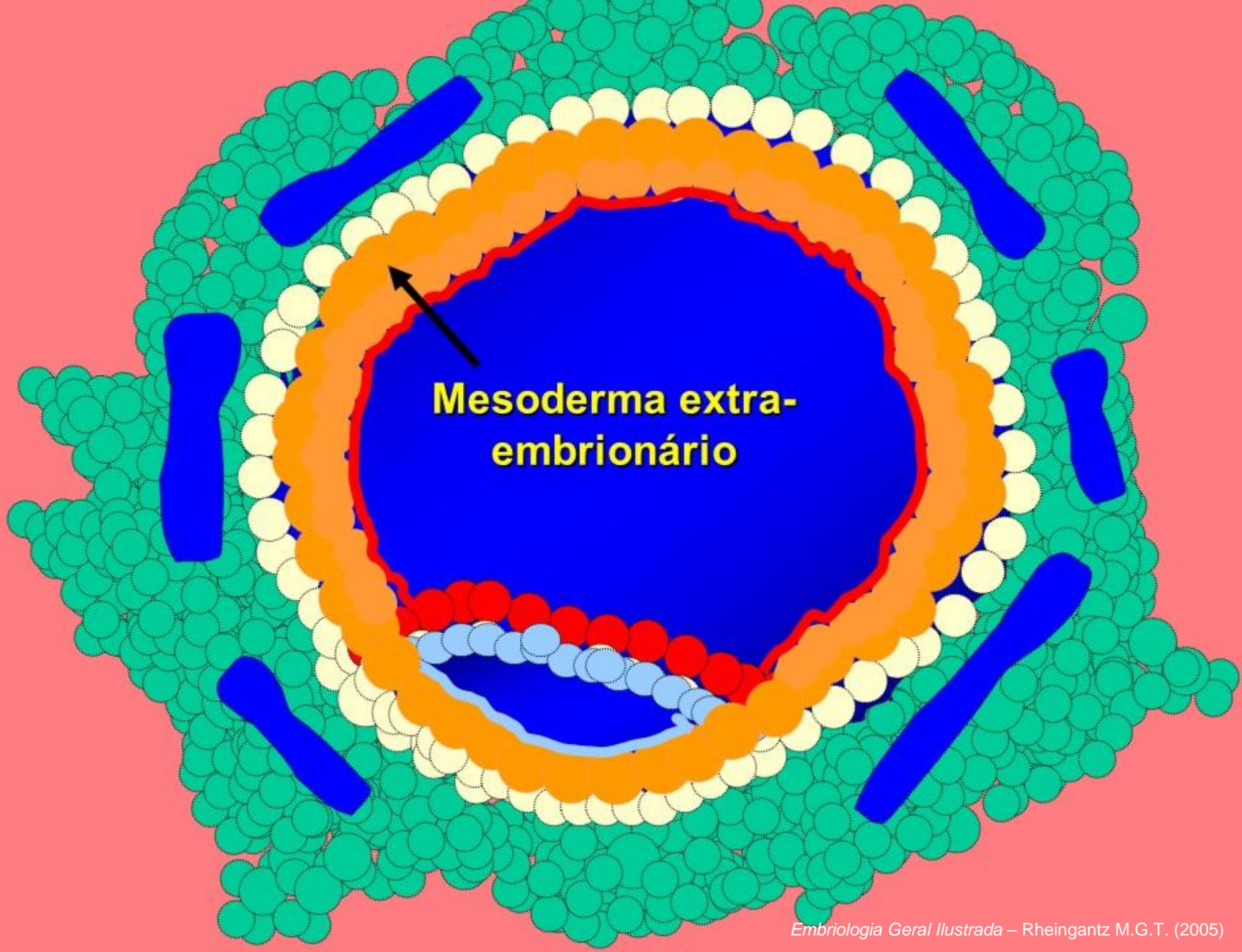




Conclusão da implantação:
Formação de coágulo

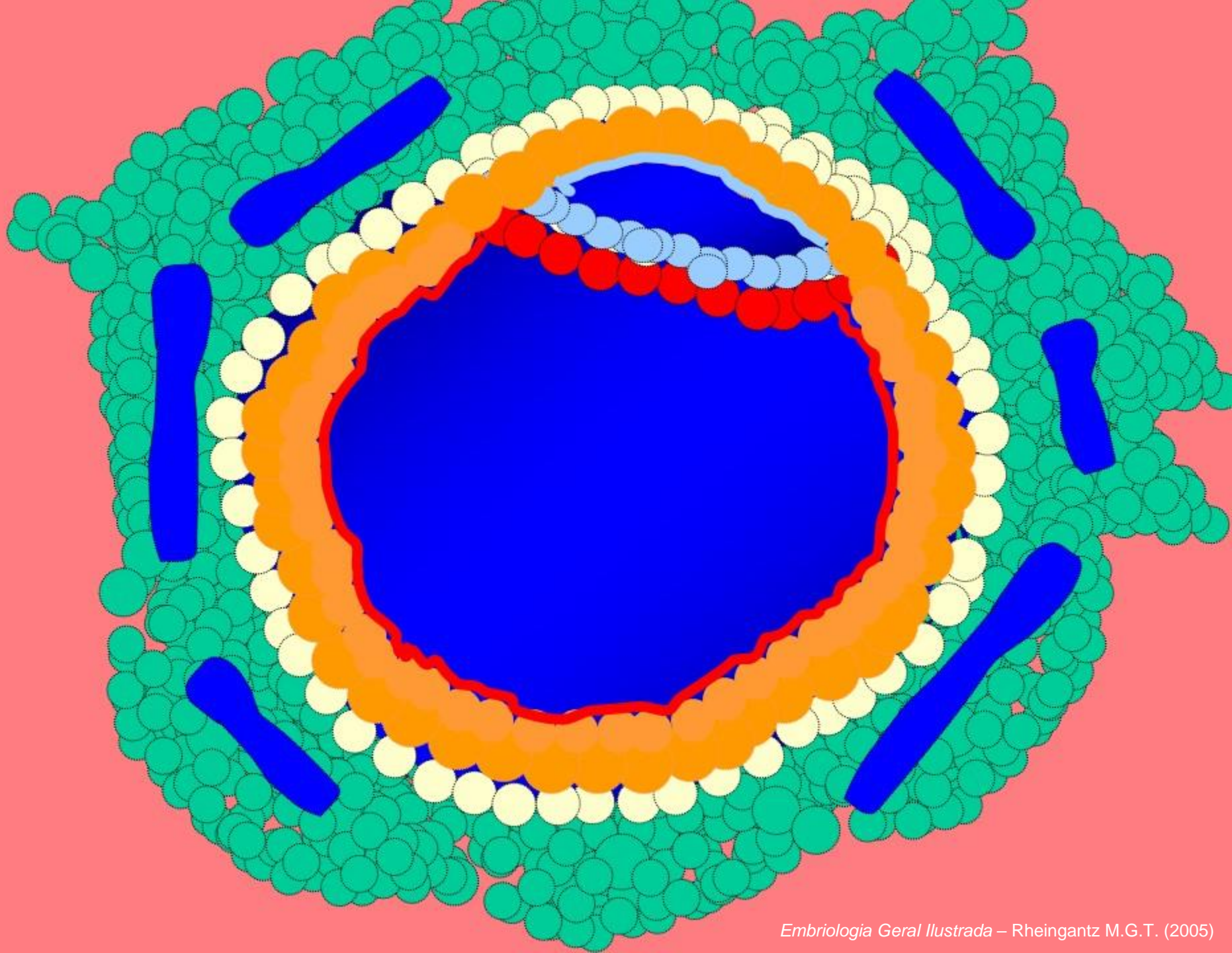


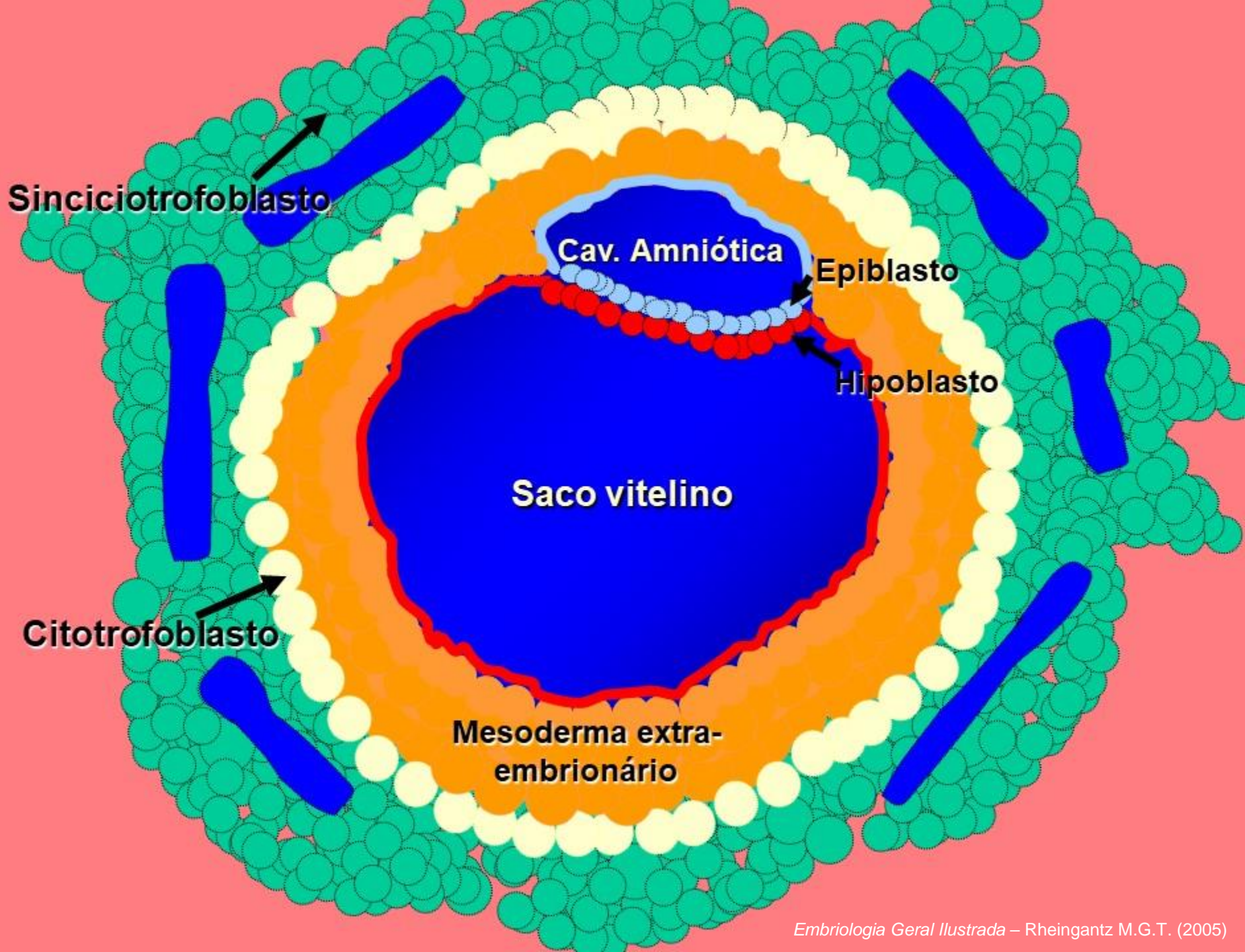




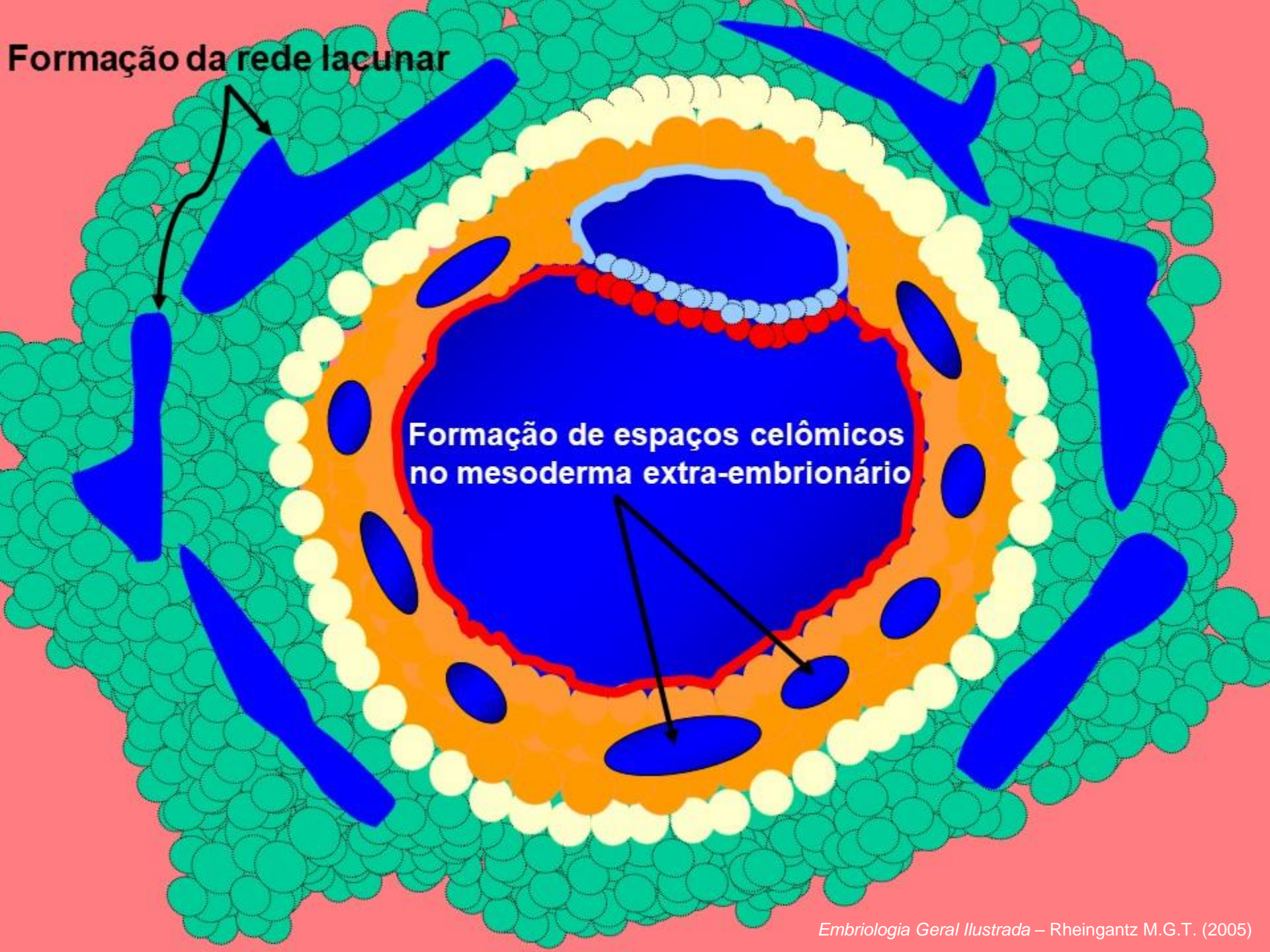
Mesoderma extra-embrionário

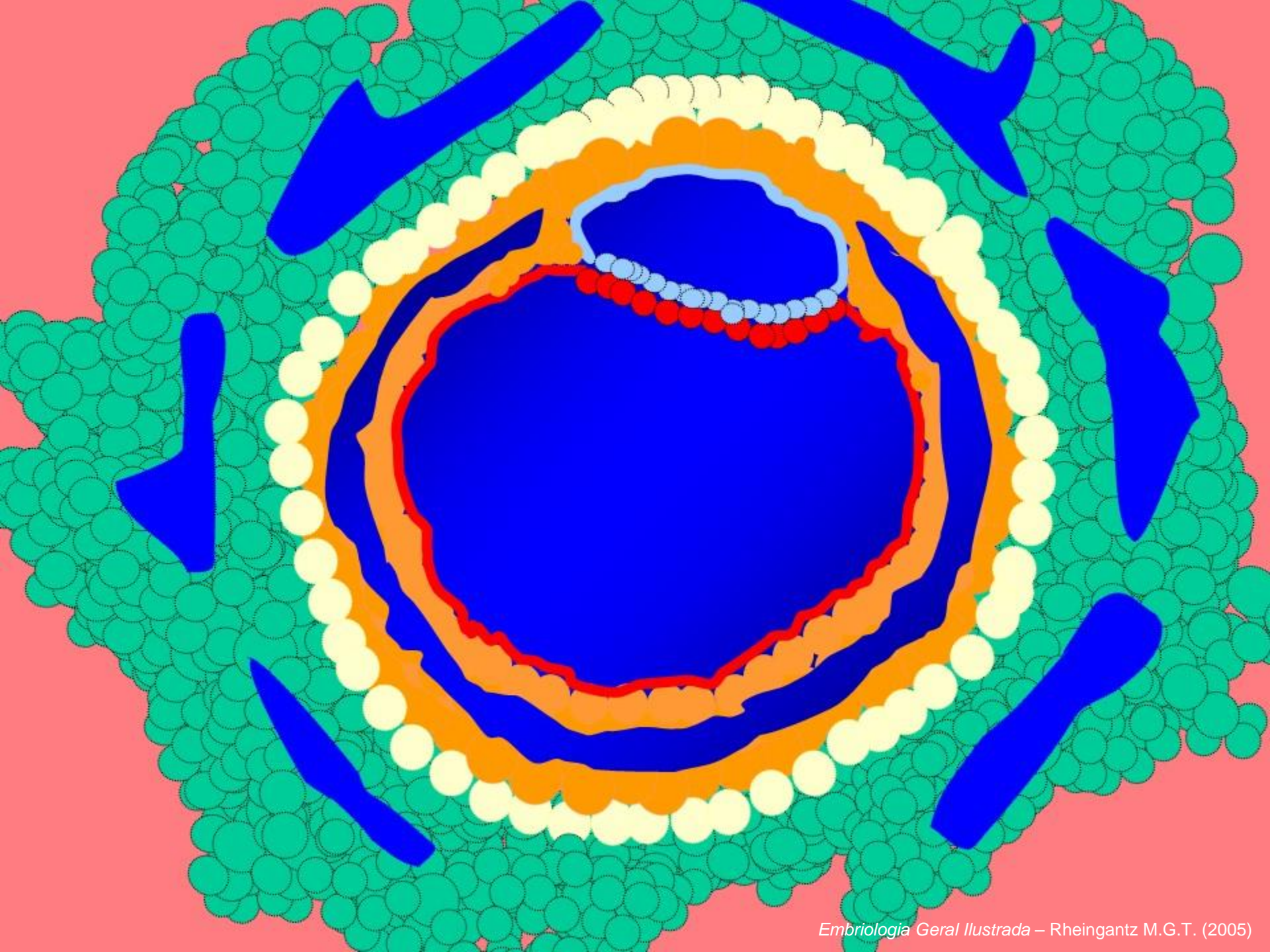
INVERTENDO...

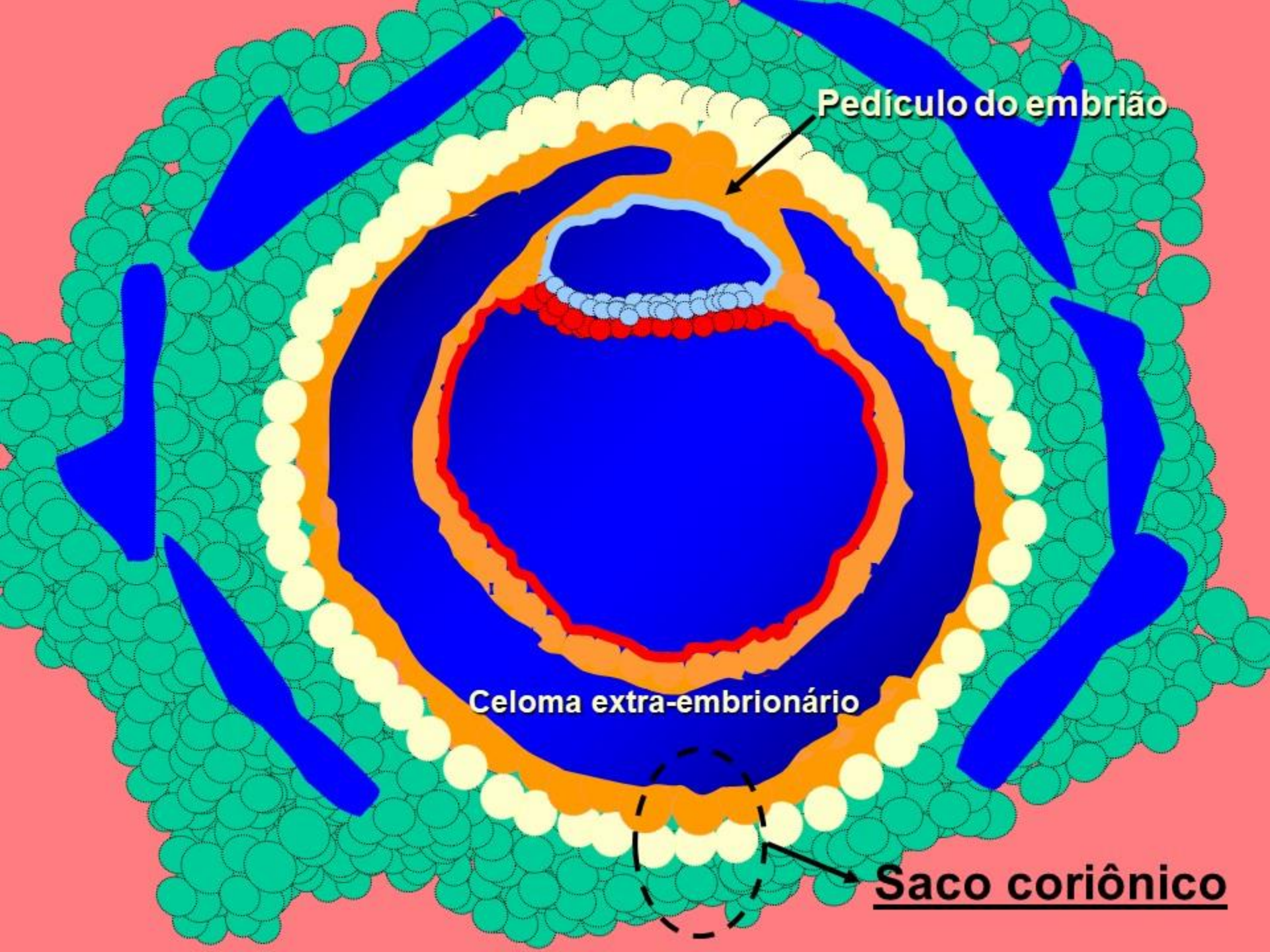




Formação da rede lacunar



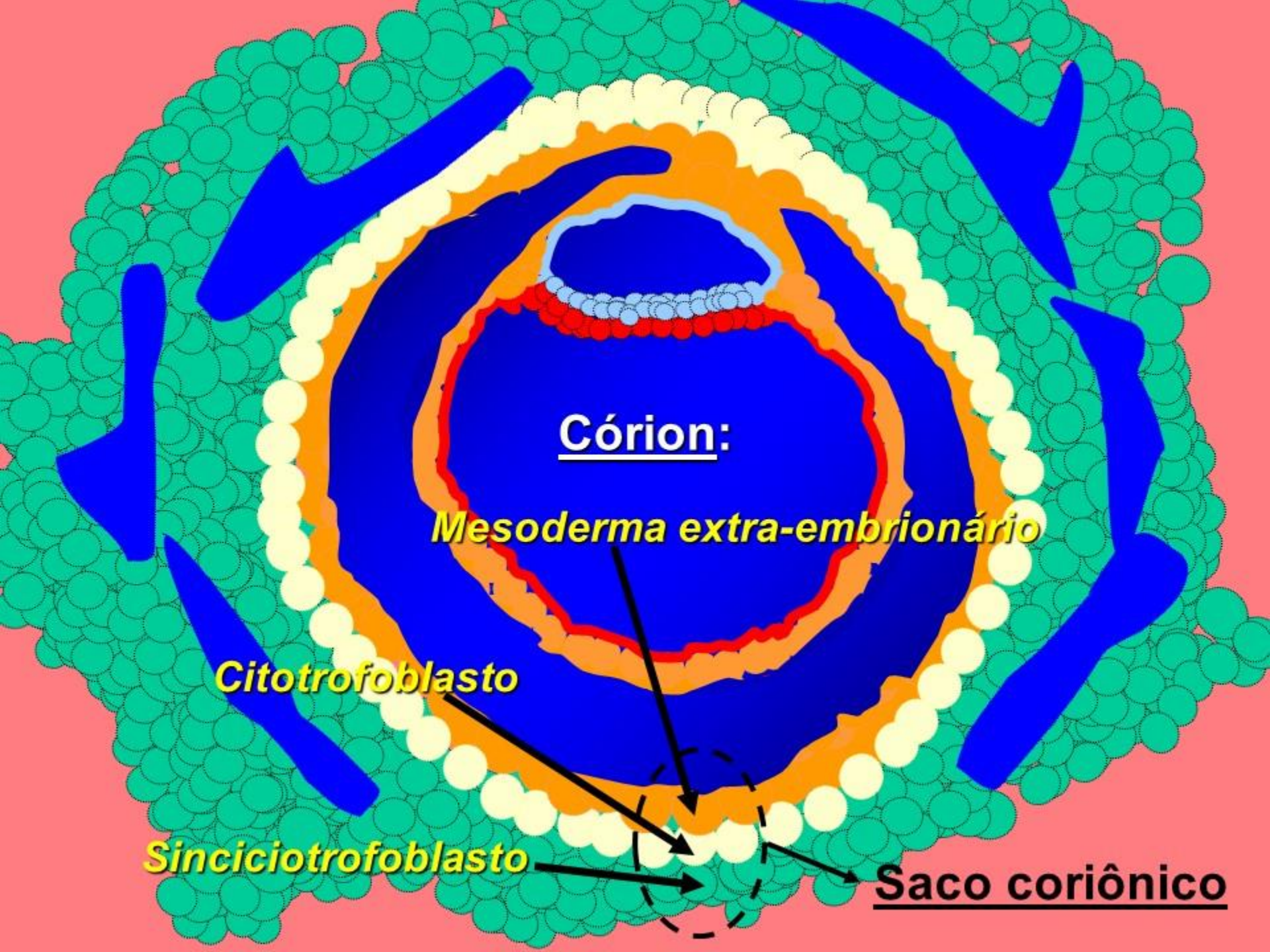




Pedículo do embrião

Celoma extra-embriônico

Saco coriônico



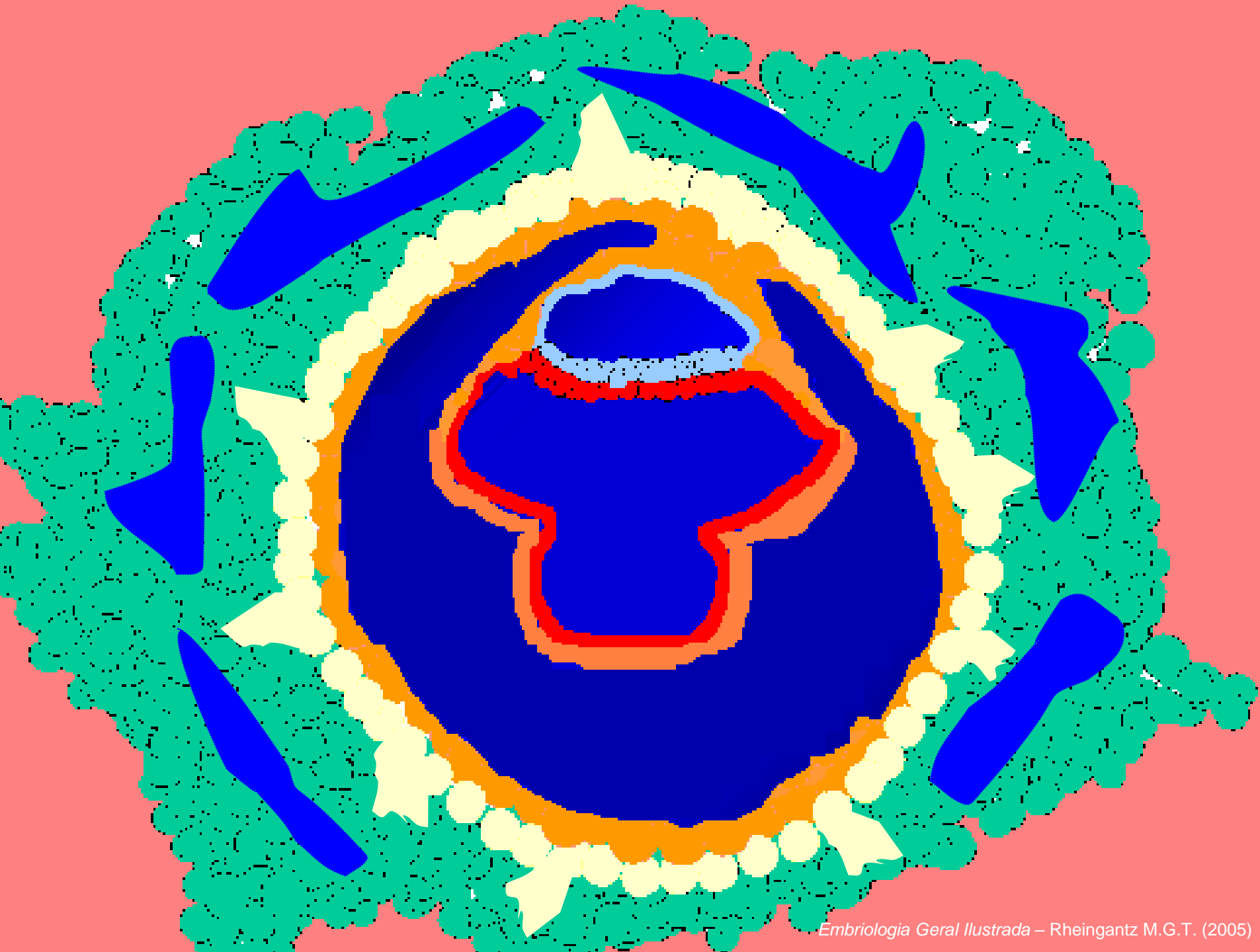
Córion:

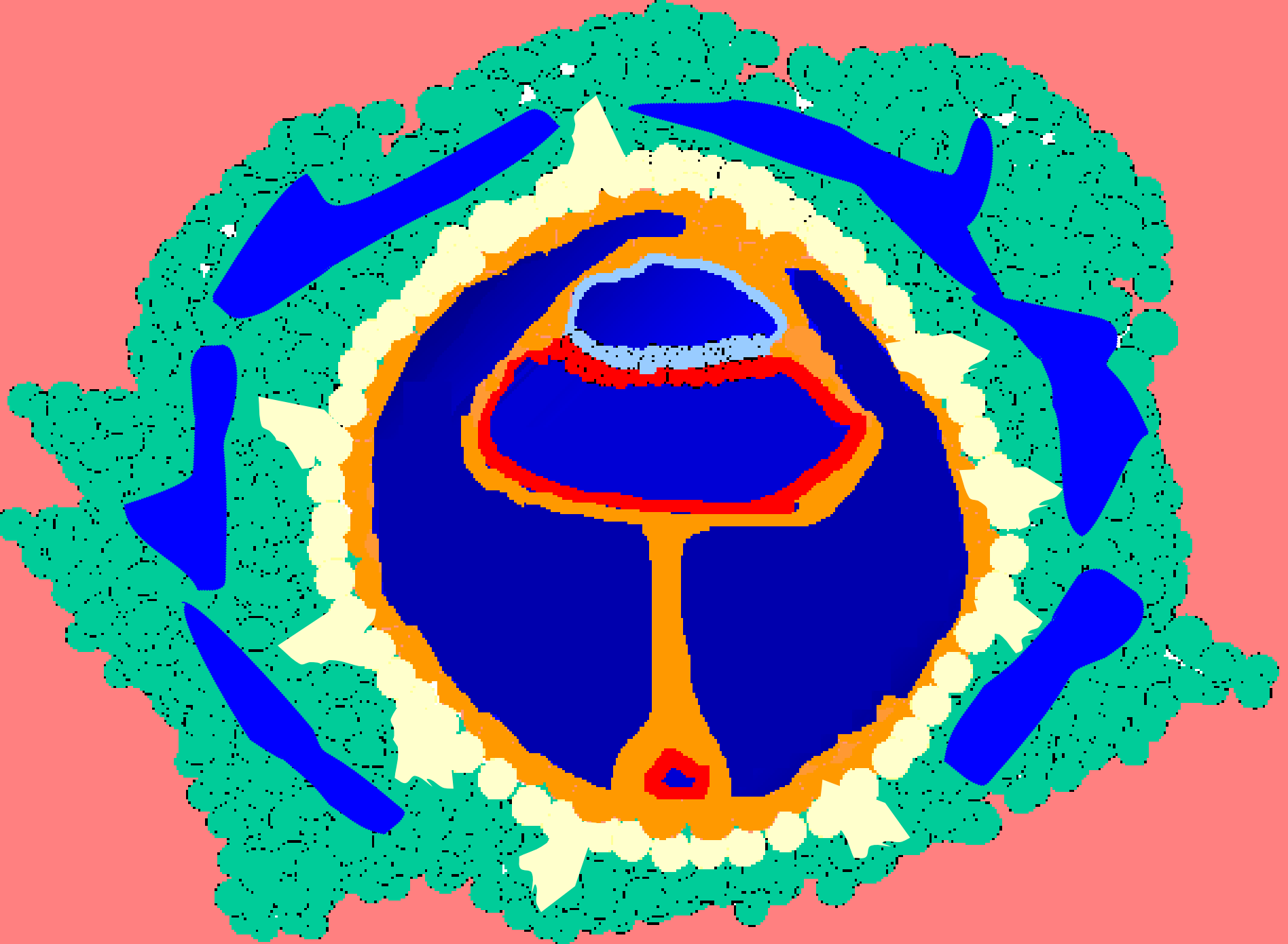
Mesoderma extra-embrionário

Citotrofoblasto

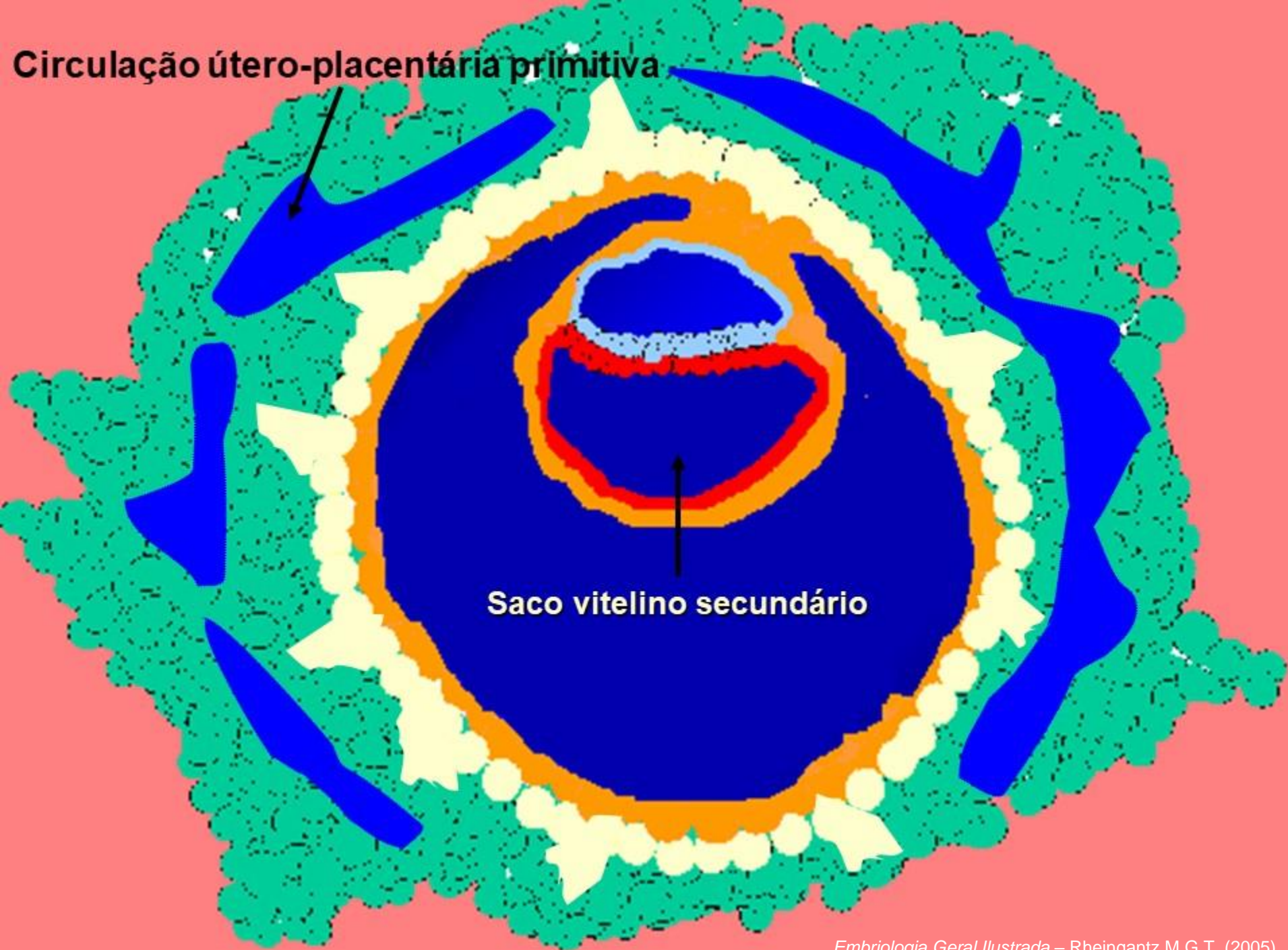
Sincitiotrofoblasto

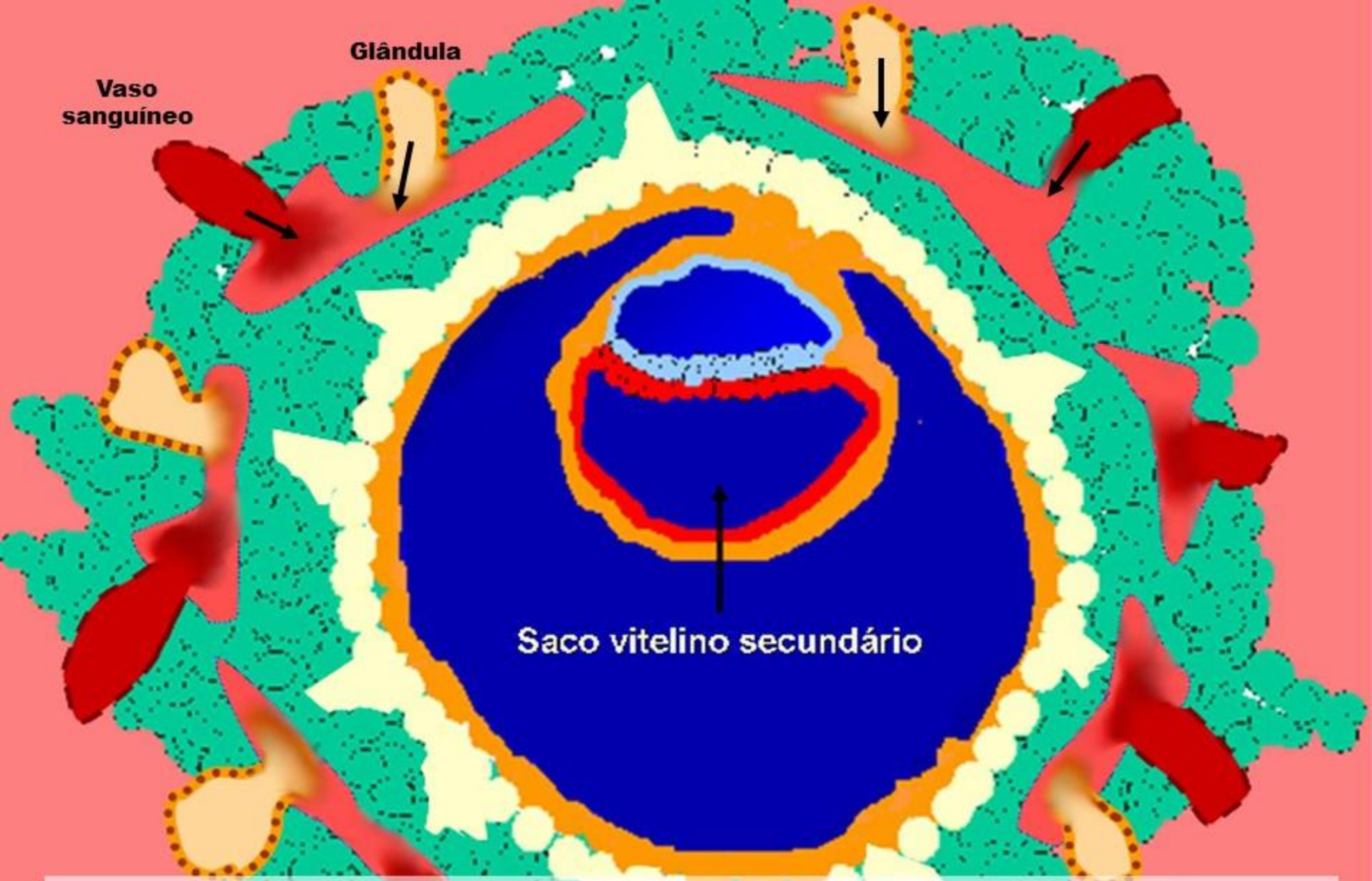
Saco coriônico





Circulação útero-placentária primitiva





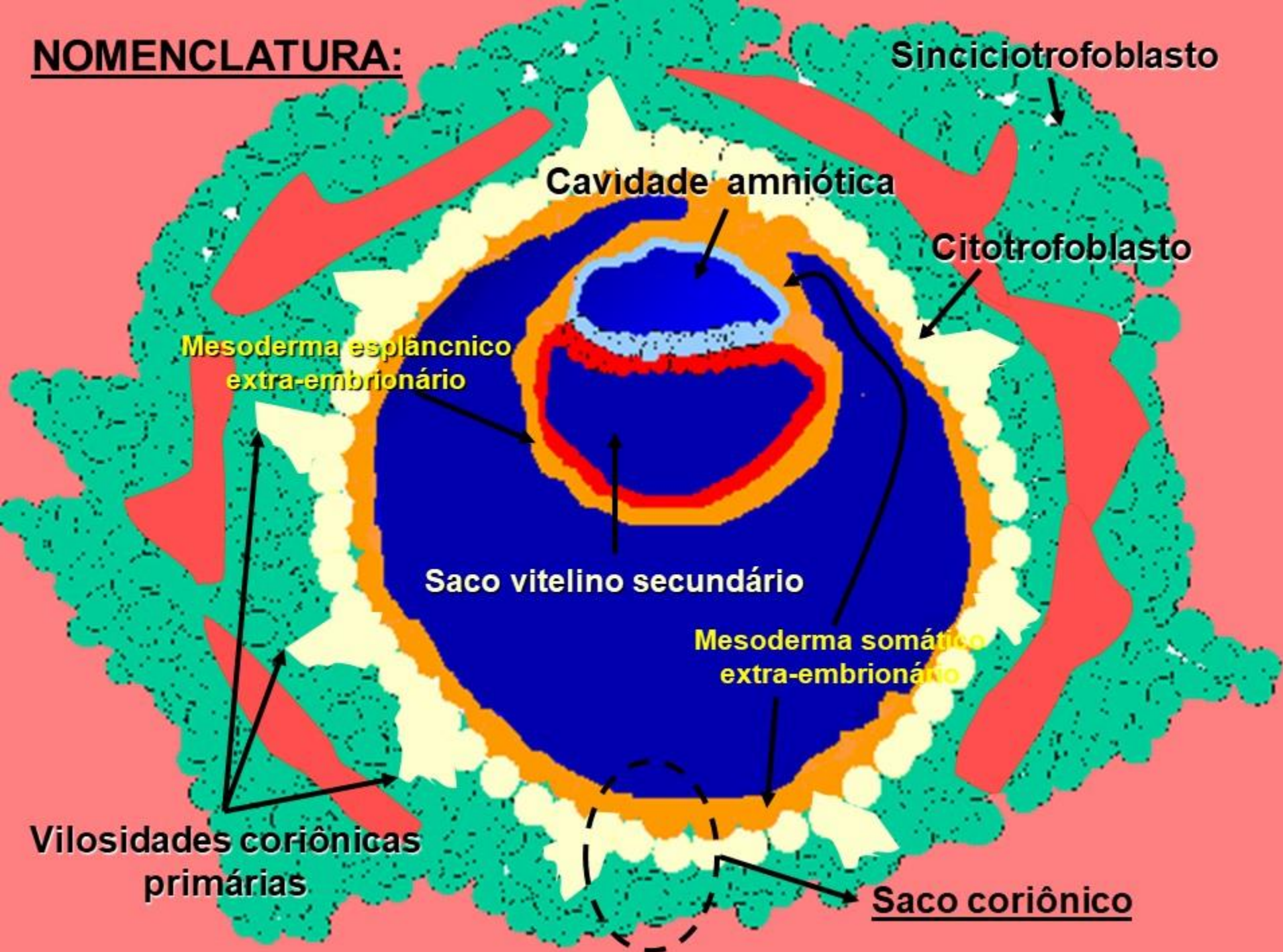
A mistura do sangue materno com a secreção glandular é chamada de embriotrofo, que nutre o disco embrionário por difusão

Final da 2ª Semana

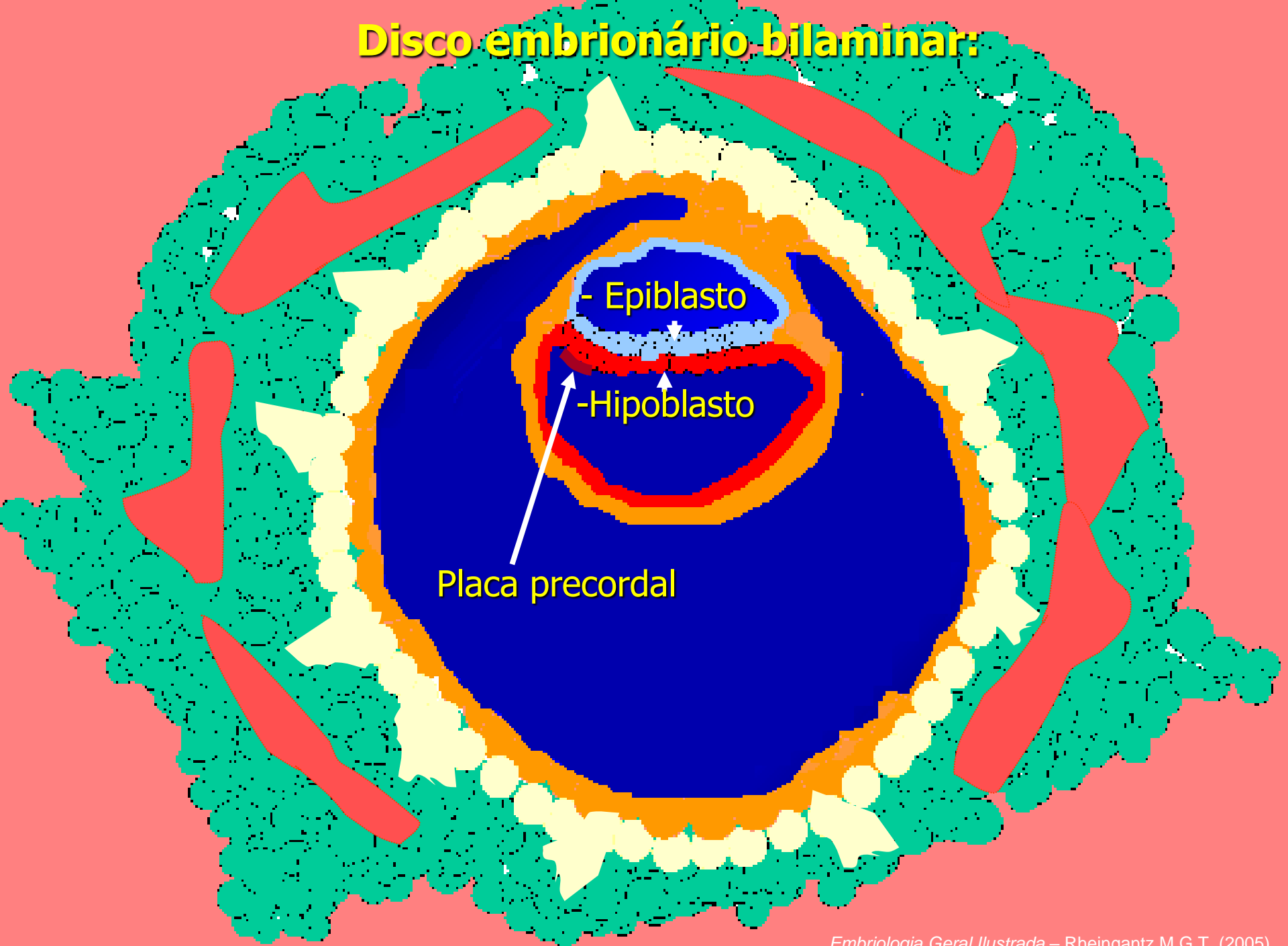
Durante a 2ª semana do desenvolvimento, ocorrem os seguintes eventos:

- ✓ **Formação do disco embrionário bilaminar ou didérmico;**
- ✓ **Formação da cavidade amniótica;**
- ✓ **Formação do saco vitelino;**
- ✓ **Conclusão da implantação;**
- ✓ **Formação do saco coriônico;**
- ✓ **Formação das vilosidades coriônicas primárias;**
- ✓ **Instalação da circulação útero-placentária primitiva.**

NOMENCLATURA:



Disco embrionário bilaminar:

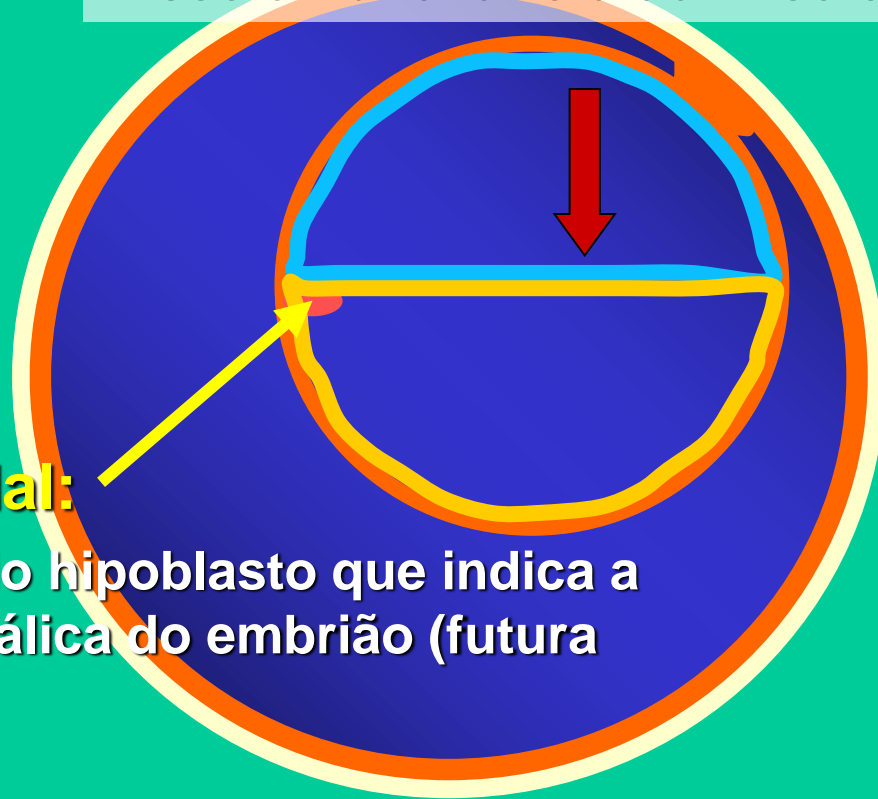


3ª Semana do Desenvolvimento Humano

GASTRULAÇÃO

Processo de transformação do disco embrionário bilaminar em disco embrionário trilaminar, resultando na formação das três camadas germinativas: ectoderma, mesoderma e endoderma.

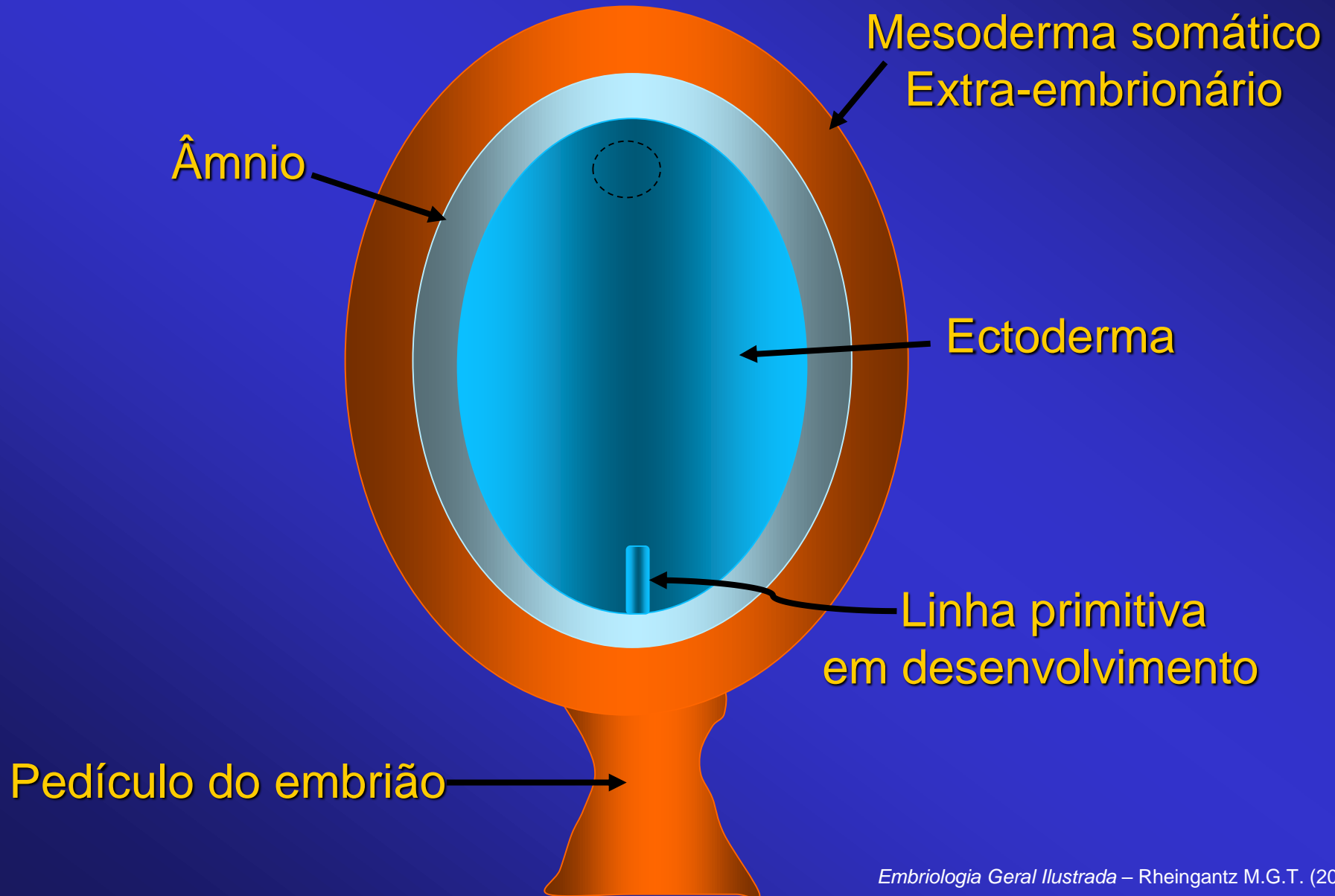
Disco embrionário didérmico ou bilaminar

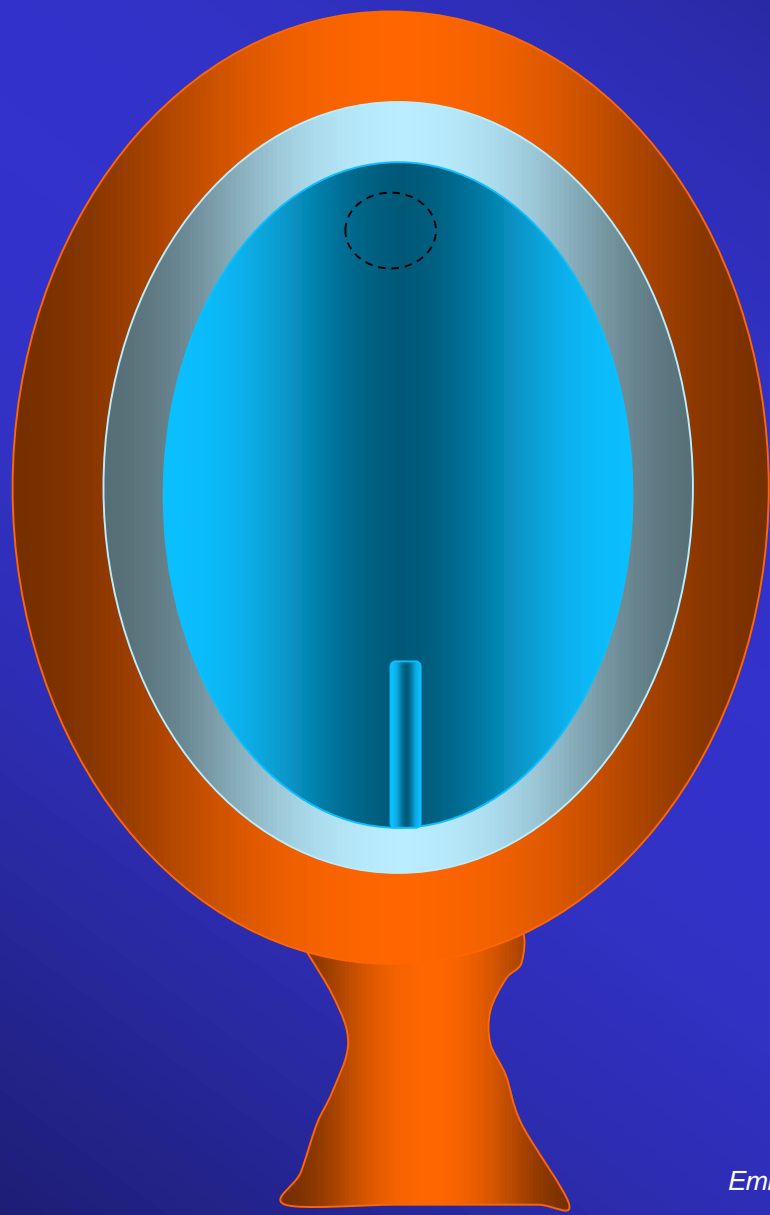


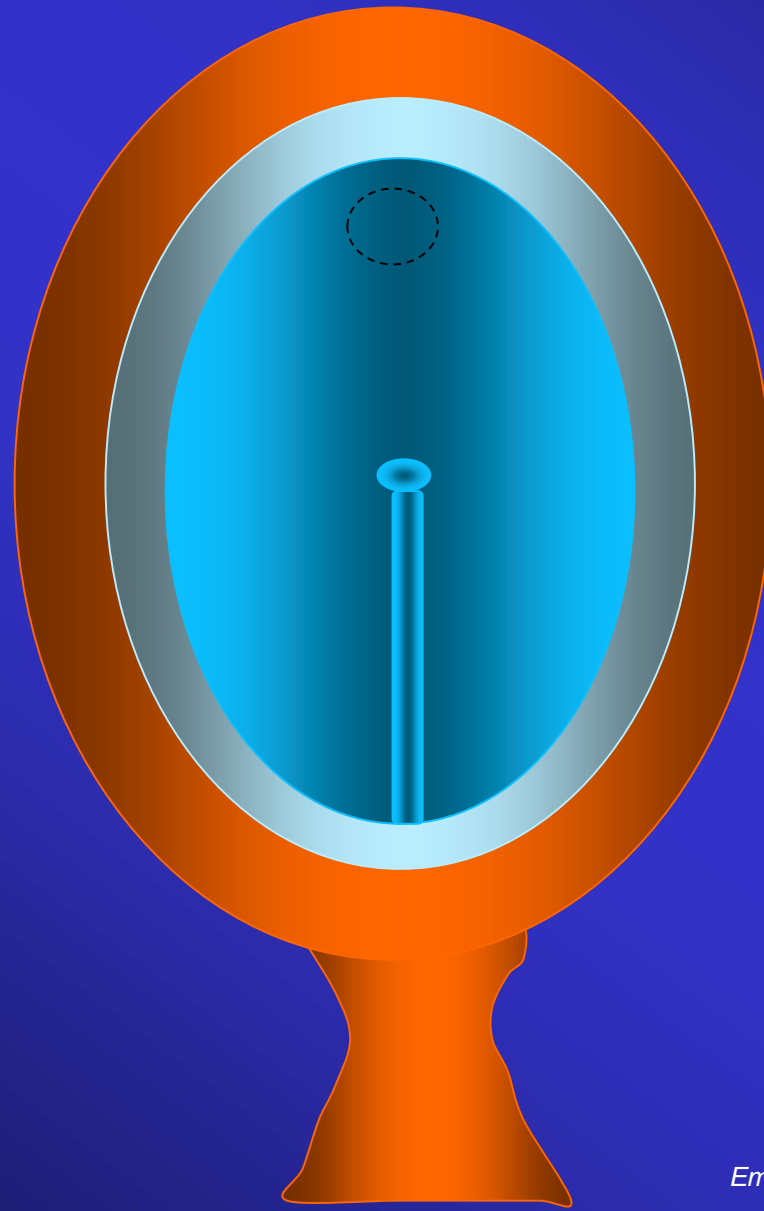
Placa precordial:

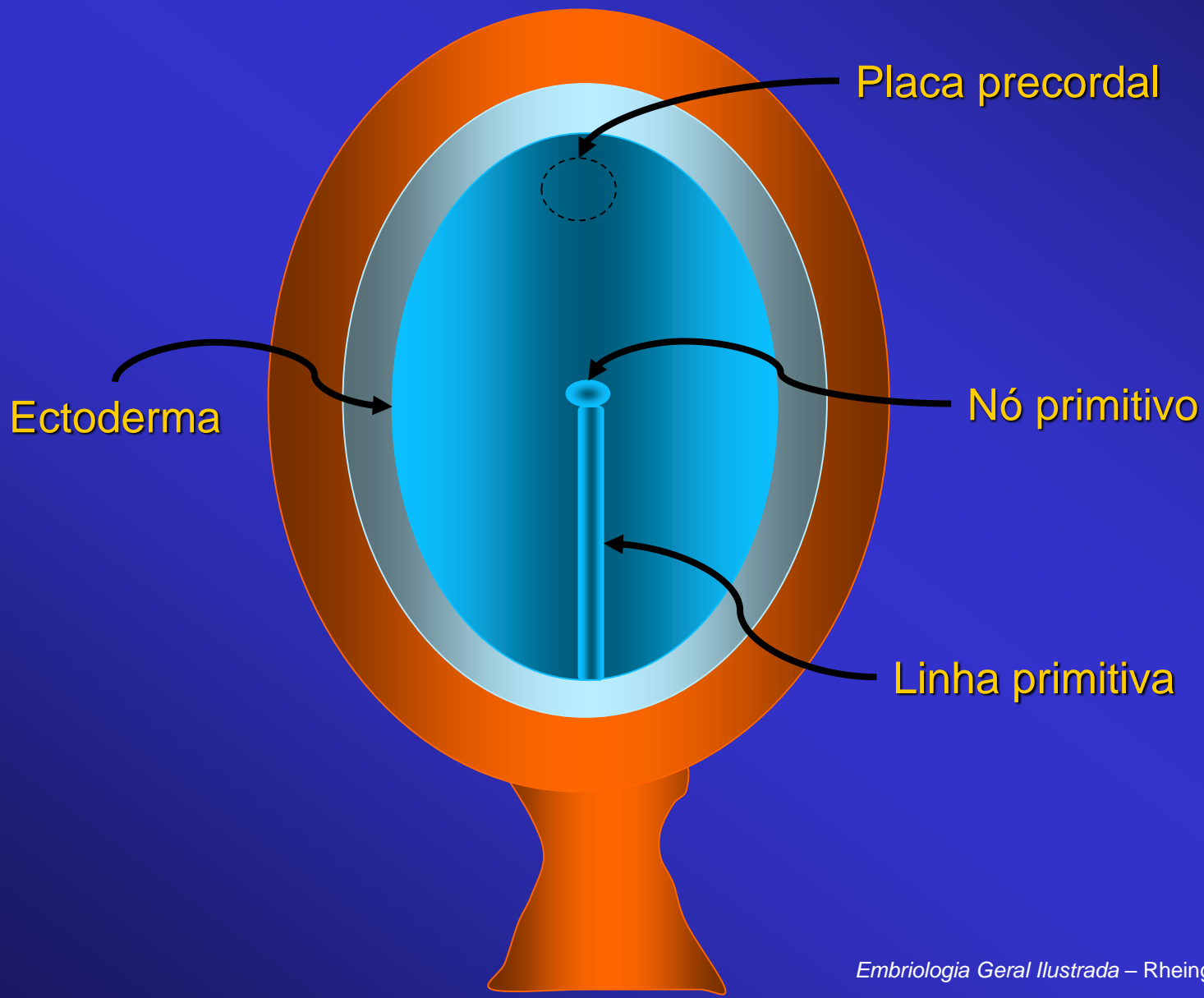
Espessamento do hipoblasto que indica a futura região cefálica do embrião (futura boca).

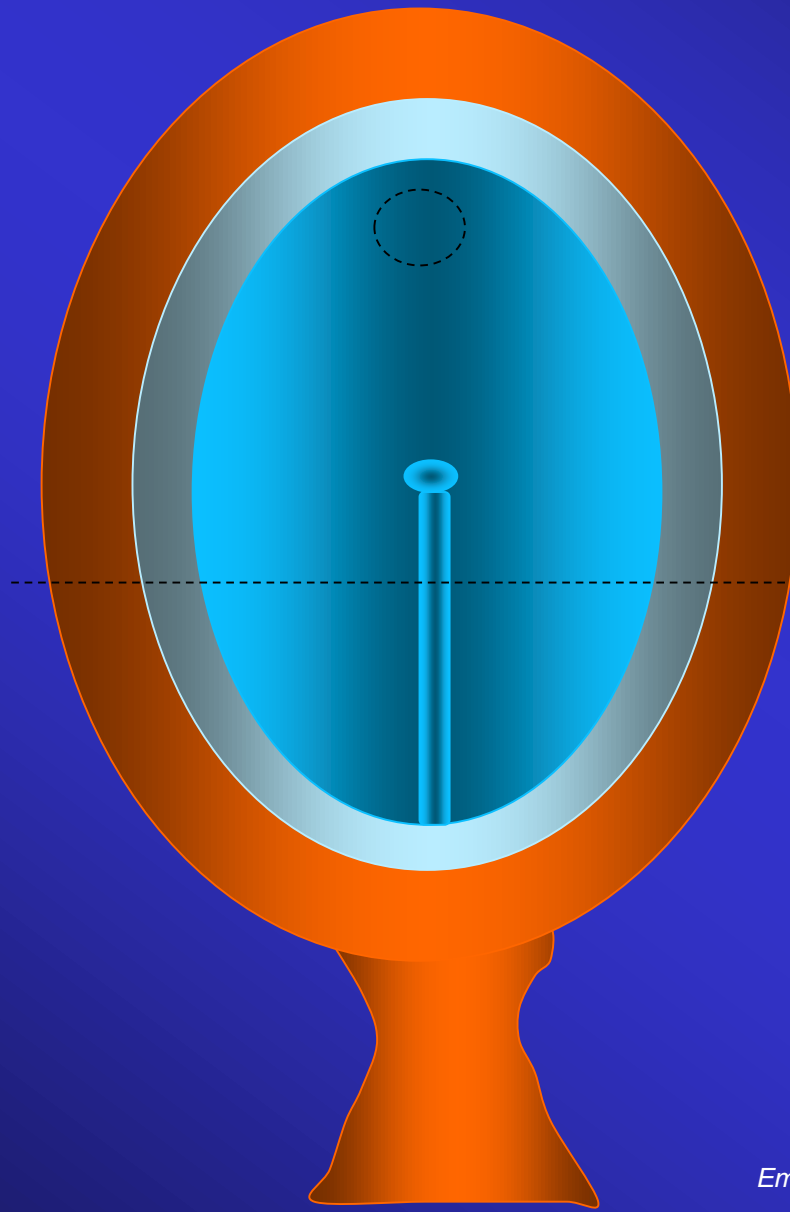
Vista dorsal do disco embrionário:



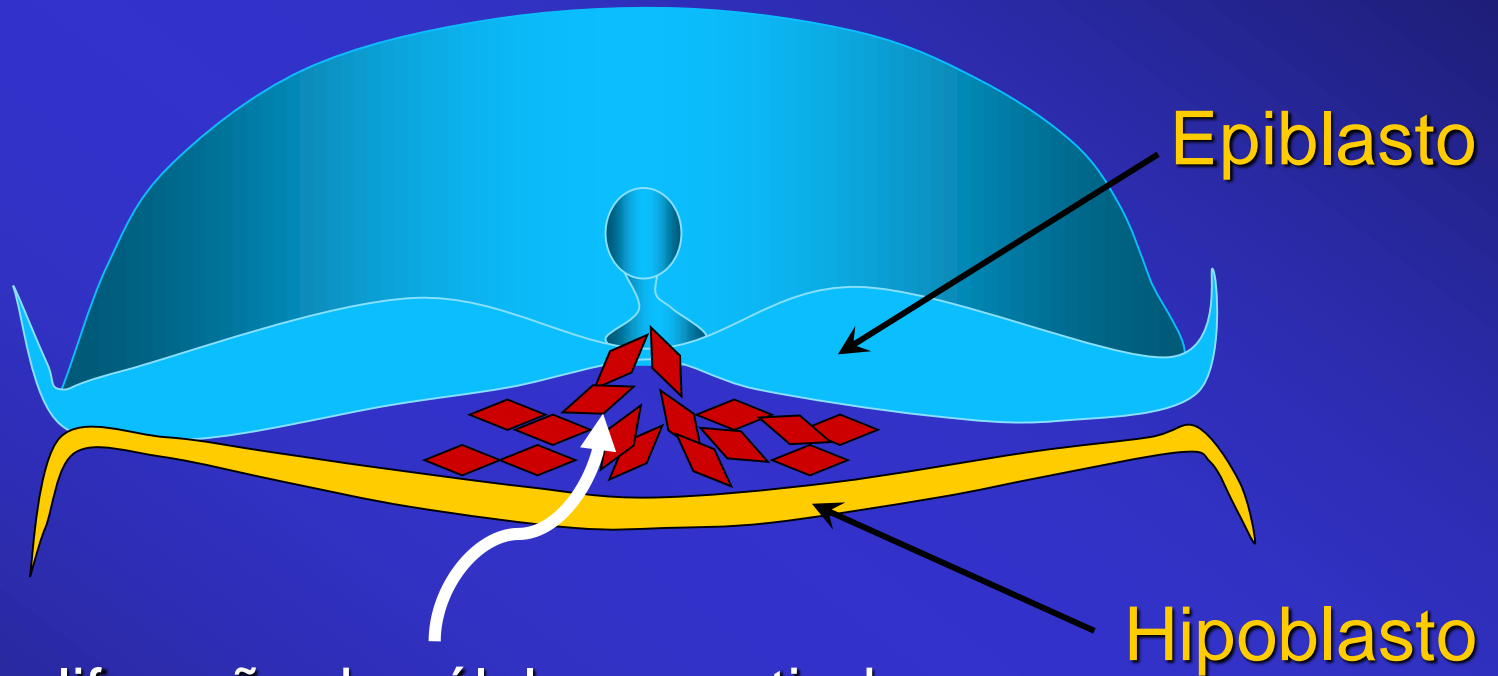




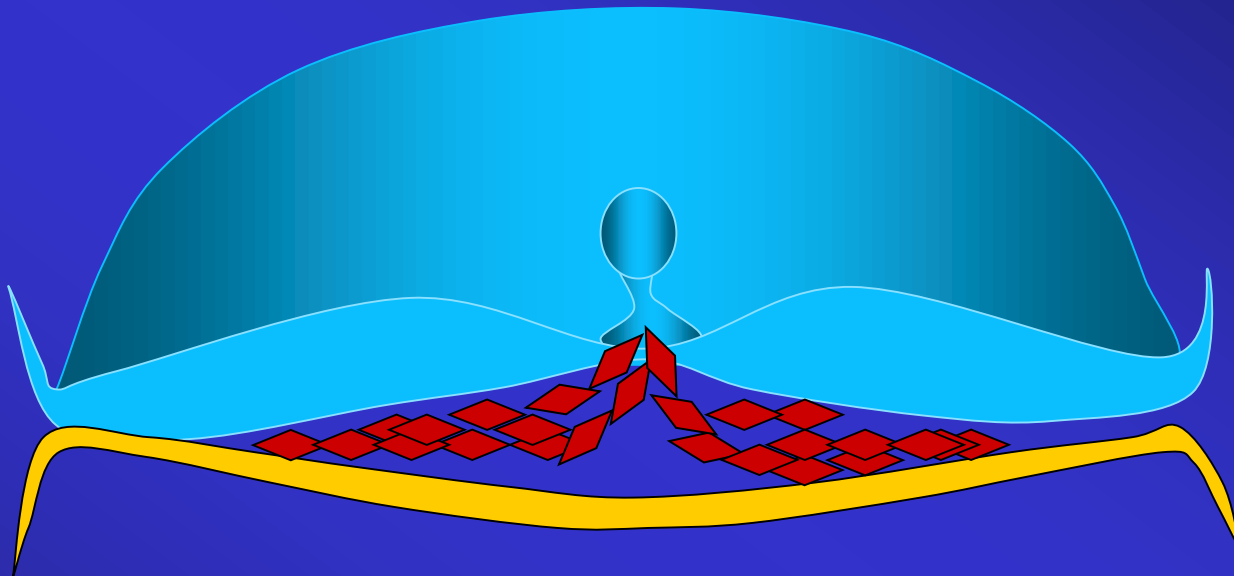


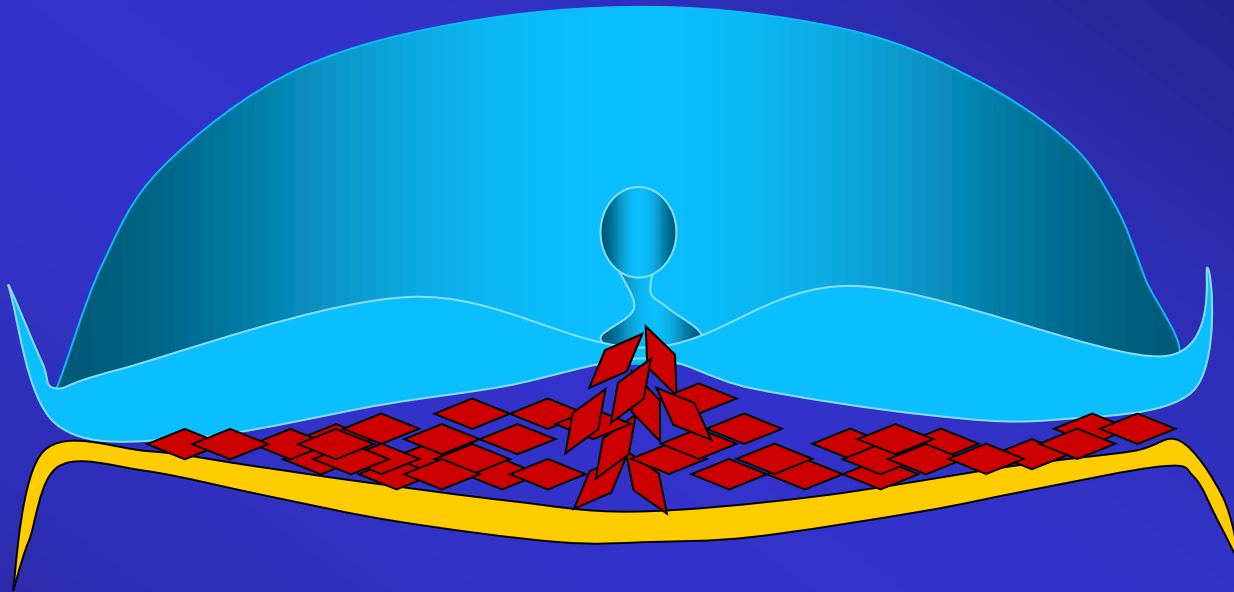


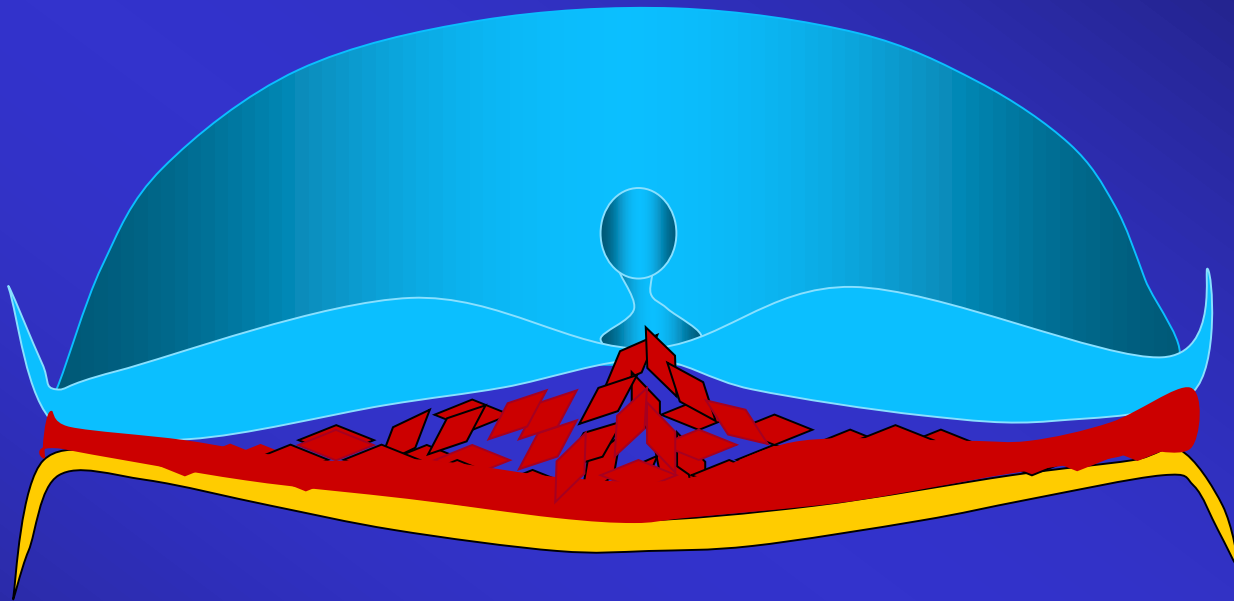
Corte
transversal

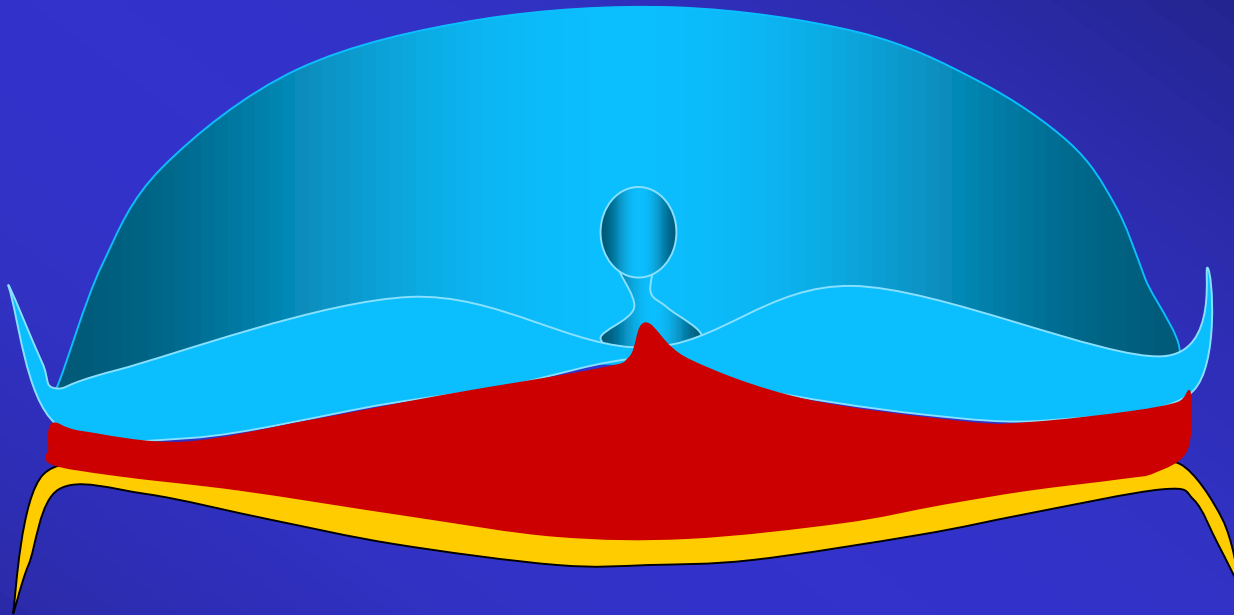


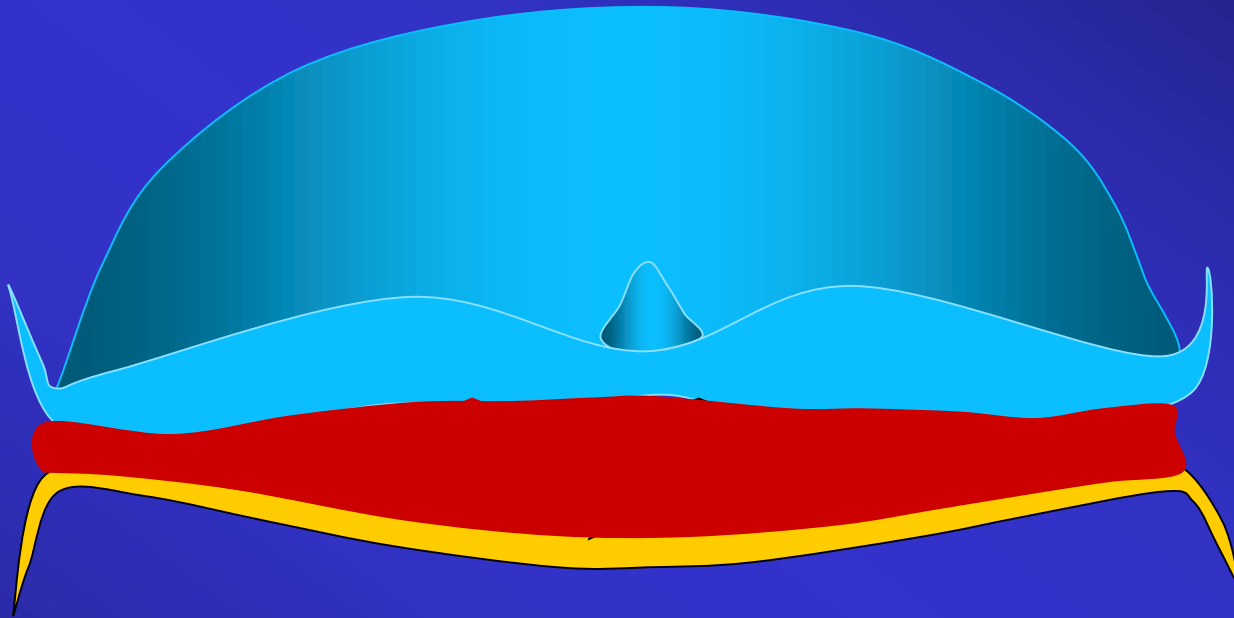
Proliferação de células a partir da
linha primitiva.



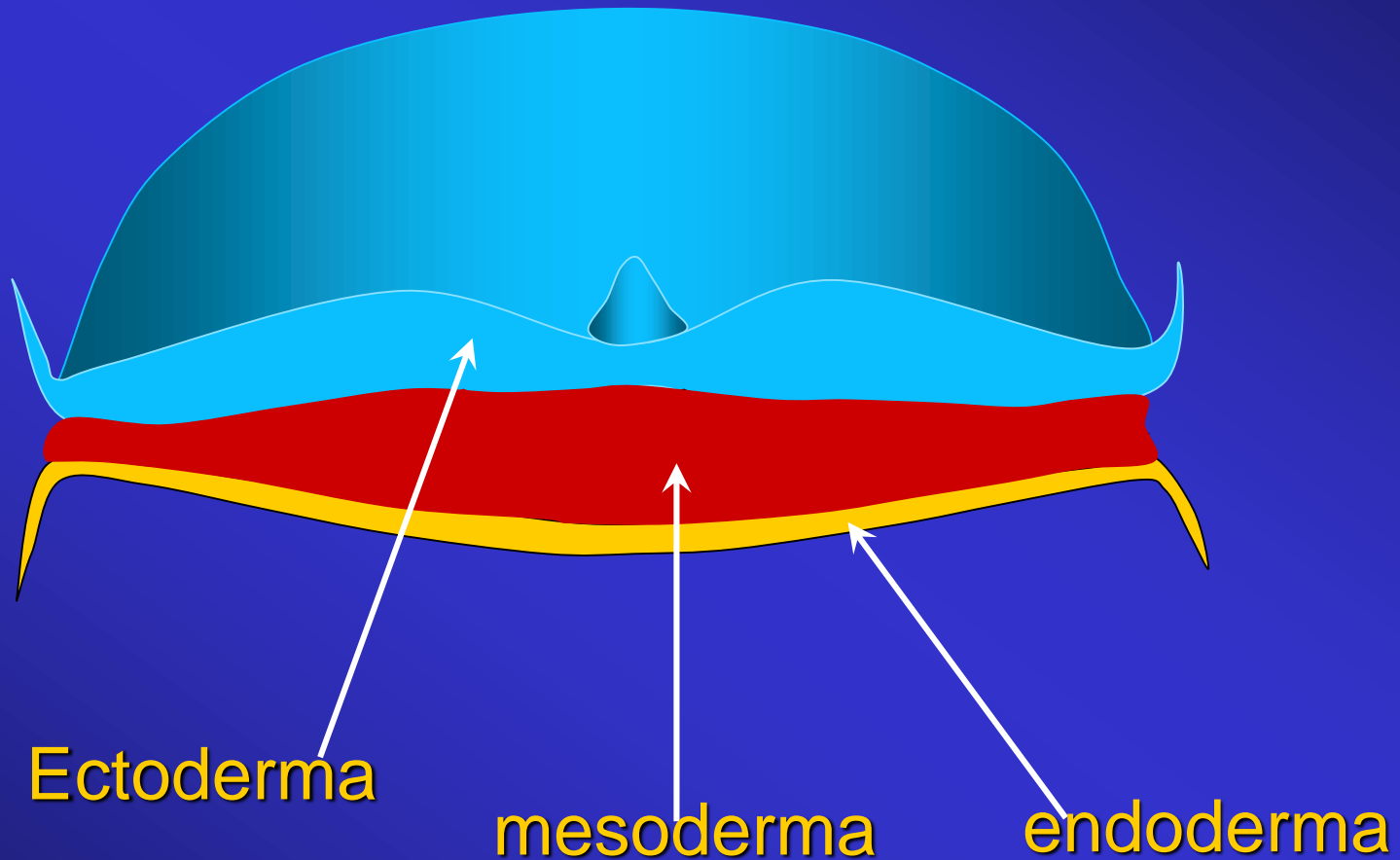






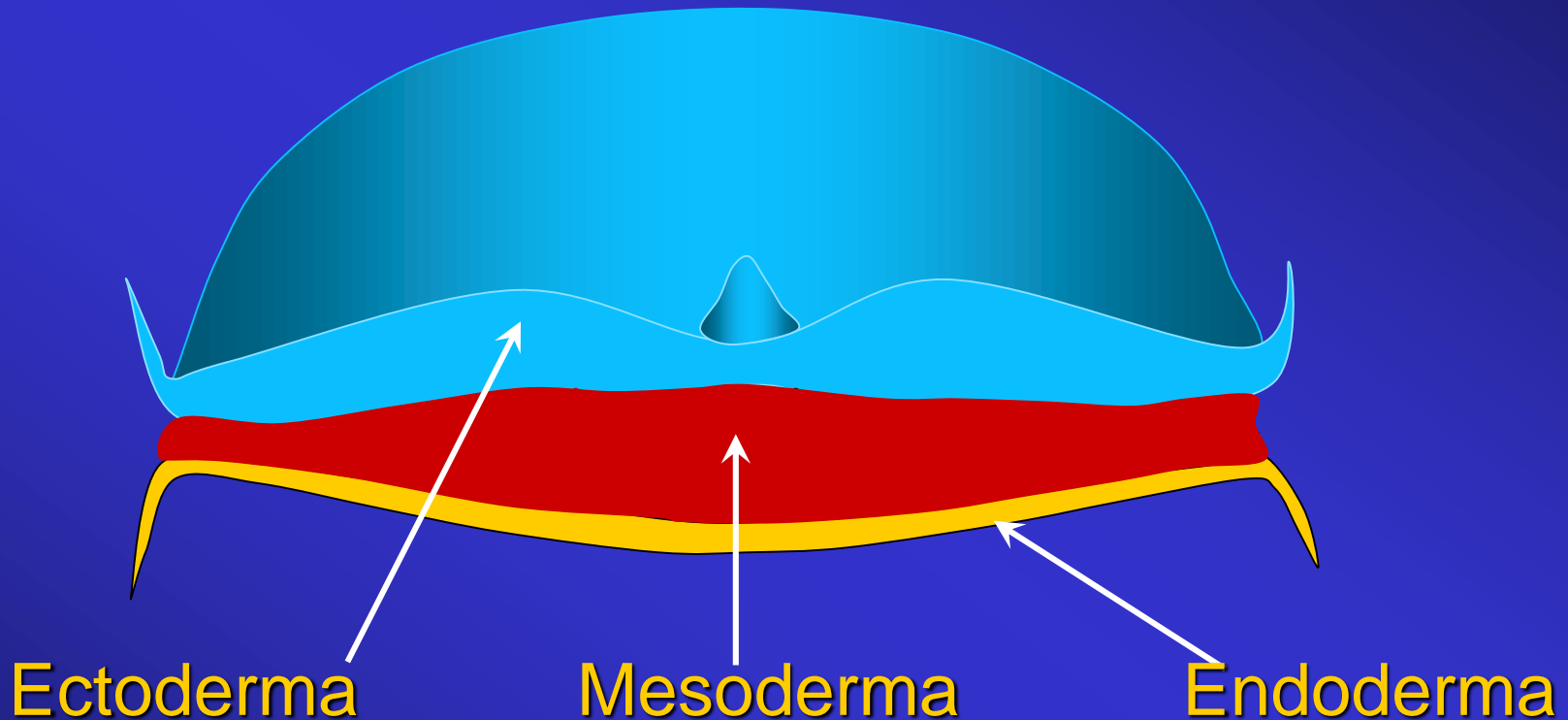


Formação dos três folhetos...



FINAL DA GASTRULAÇÃO

Derivados dos folhetos germinativos:

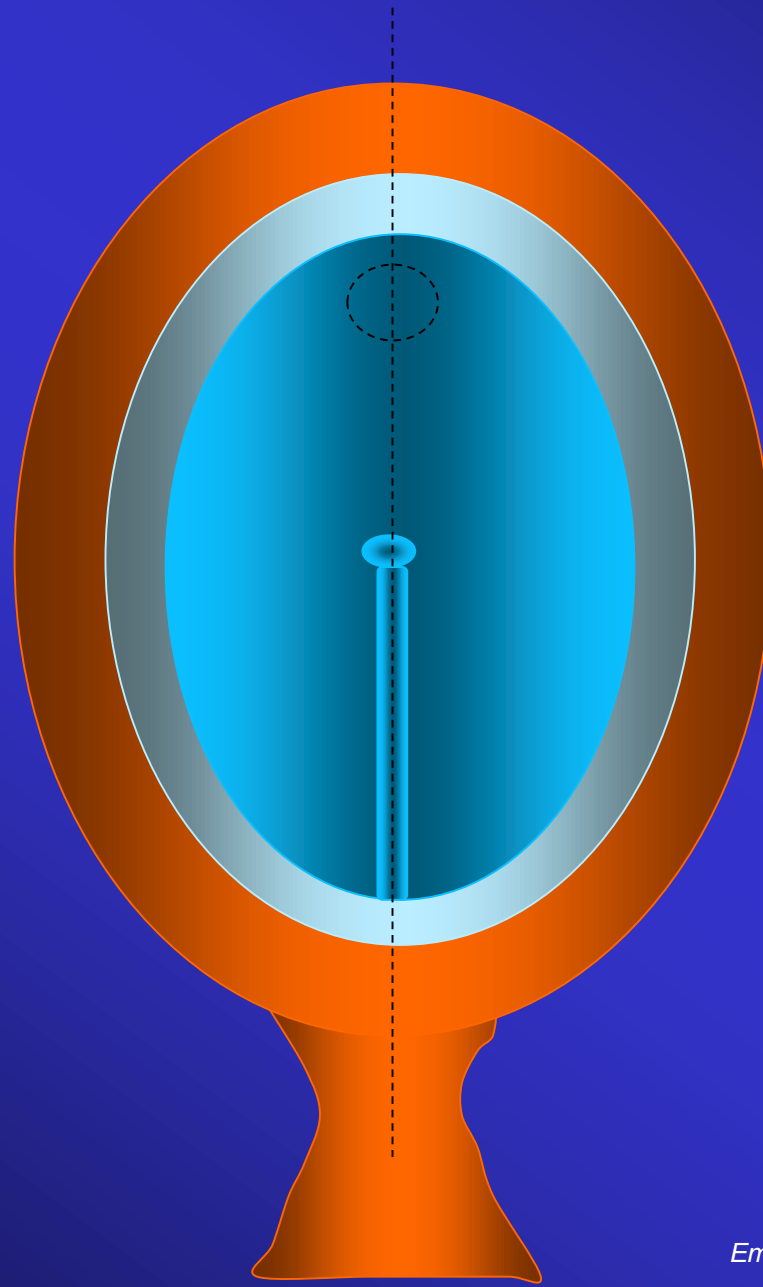


- Epiderme e anexos
- SNC e SNP

- Tec. Conjuntivos
- Músculos
- Sist. Cardiovascular

Epitélios dos Sistemas Respiratório e Digestivo, inclusive glândulas.

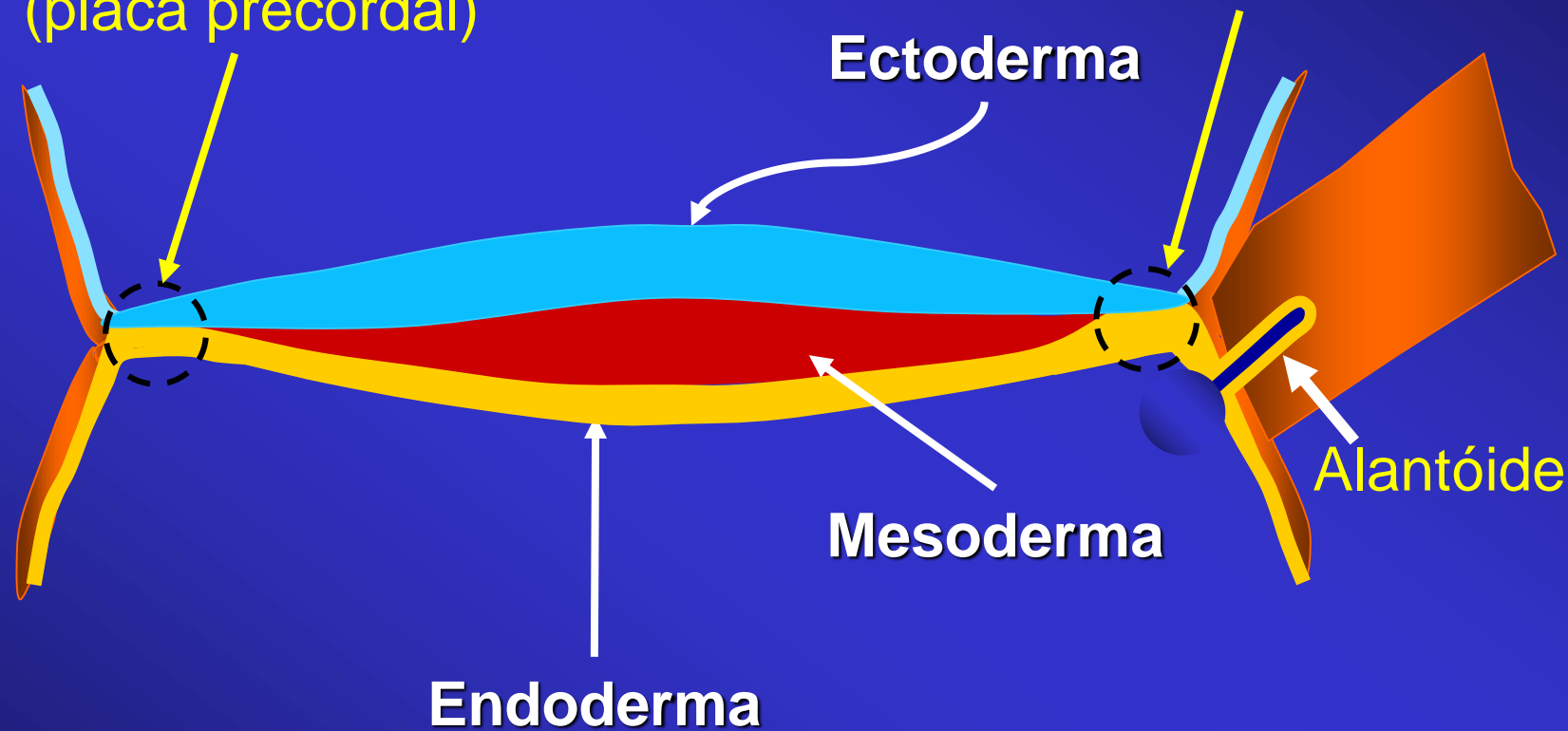
Vista dorsal do disco embrionário:



Corte
longitudinal

Membrana orofaríngea
(placa precordial)

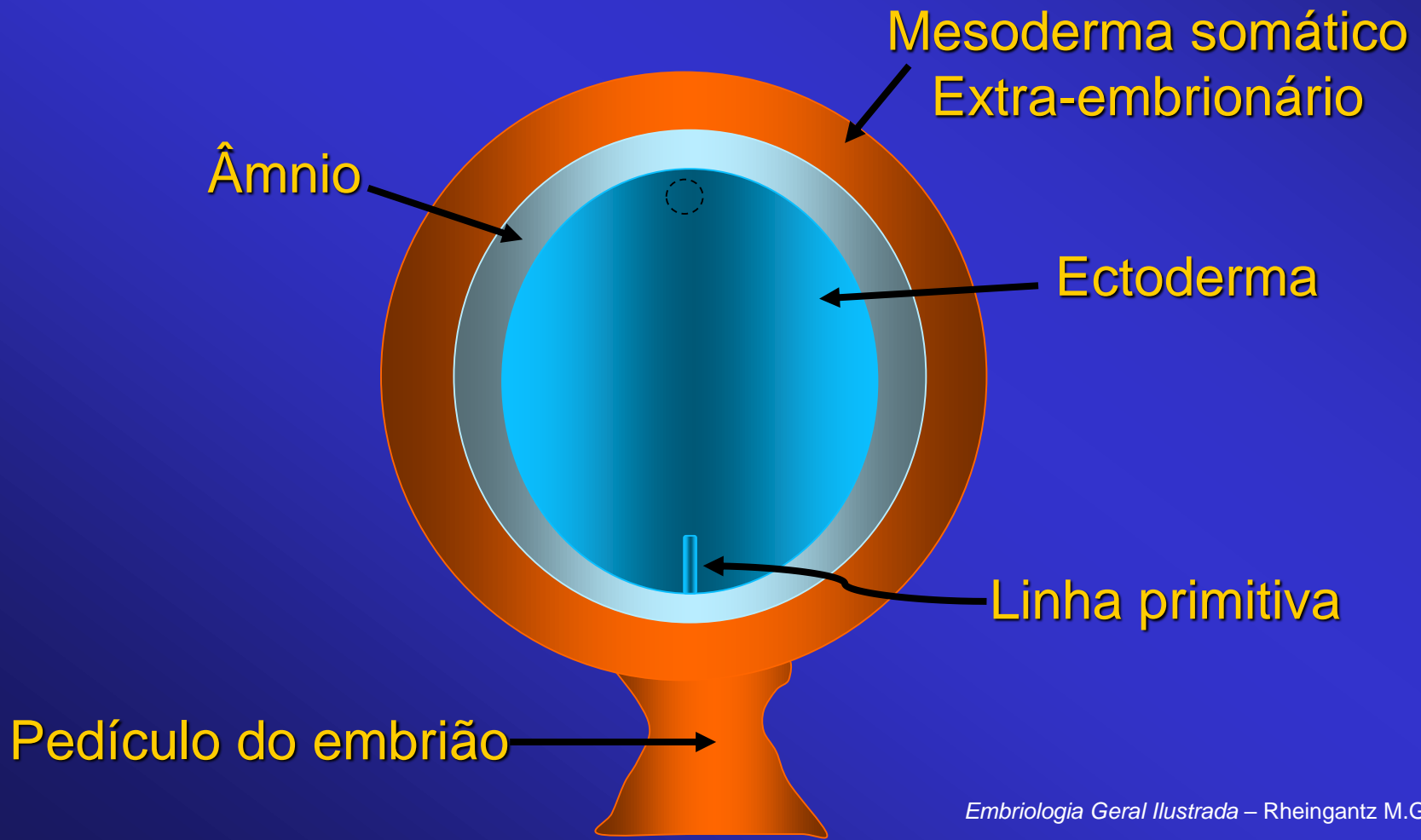
Membrana cloacal

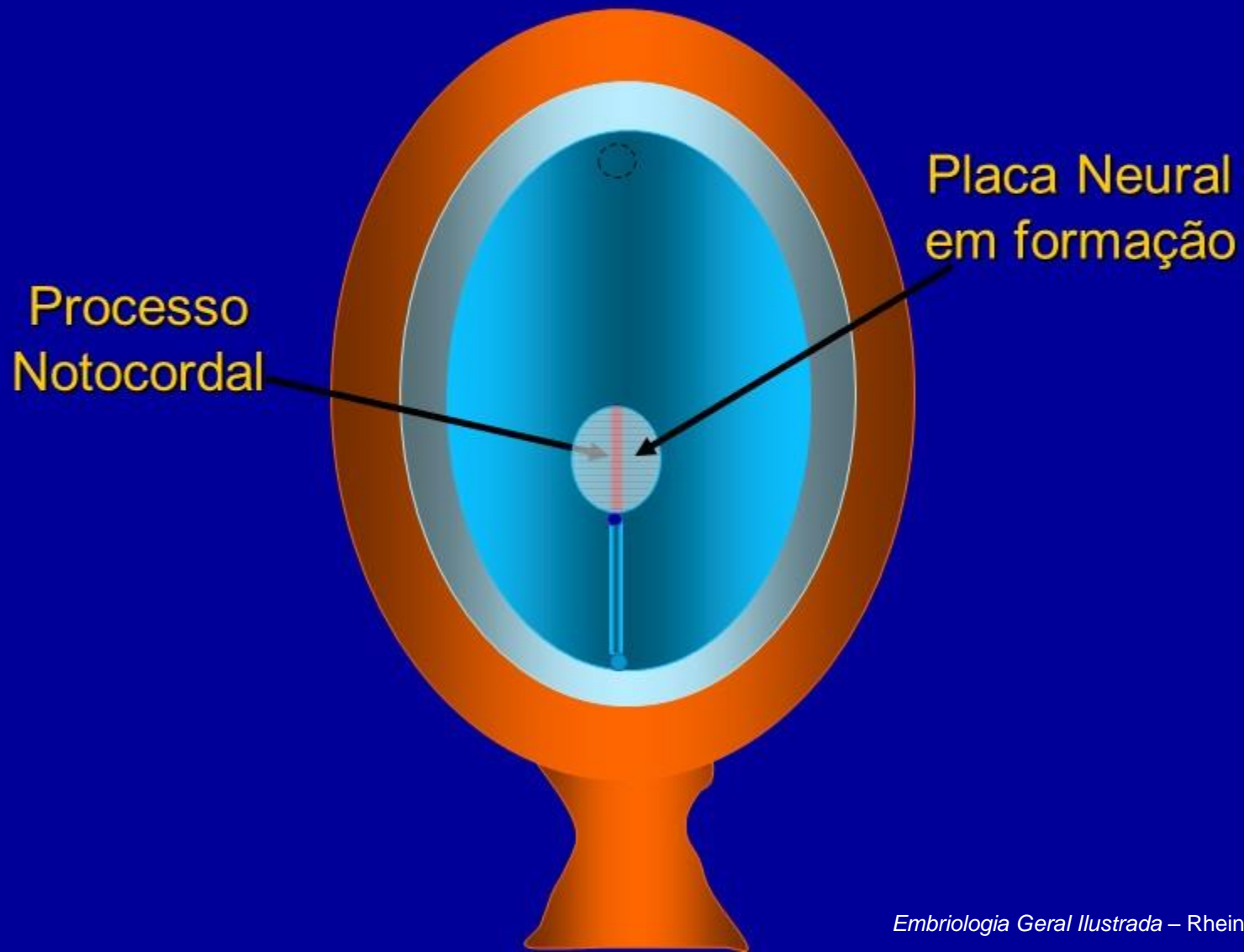


FORMAÇÃO DA NOTOCORDA

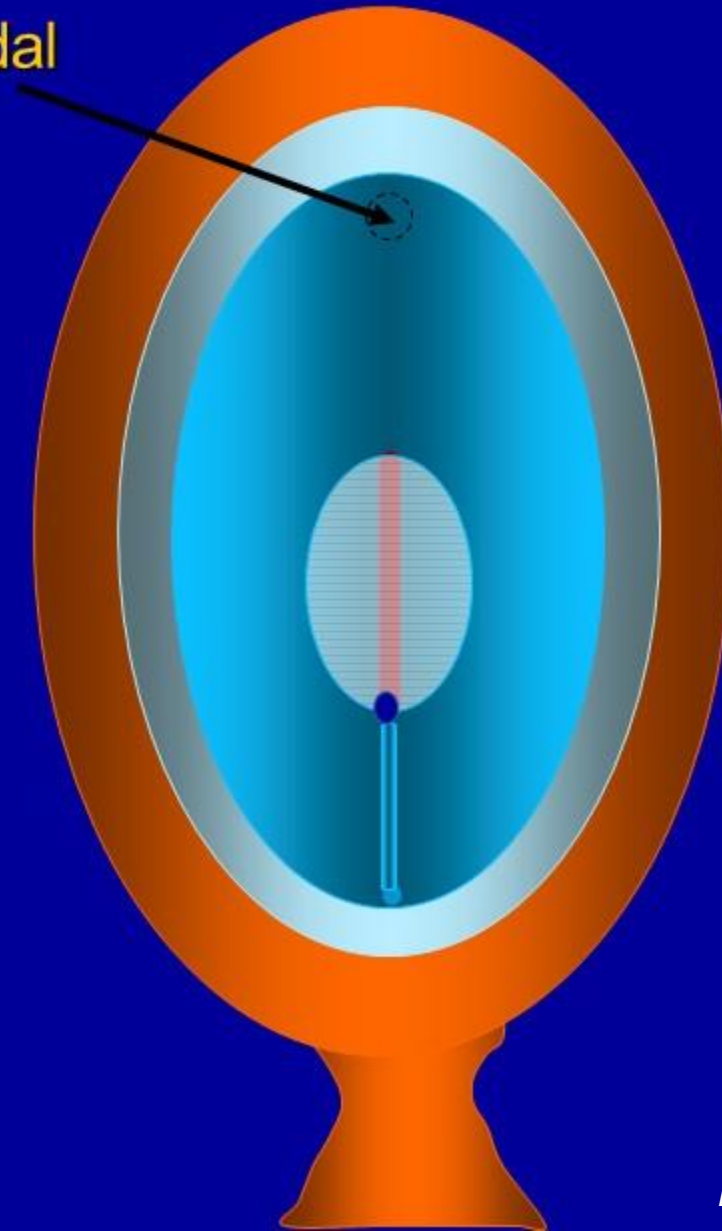
O desenvolvimento da NOTOCORDA induz ao
processo de NEURULAÇÃO

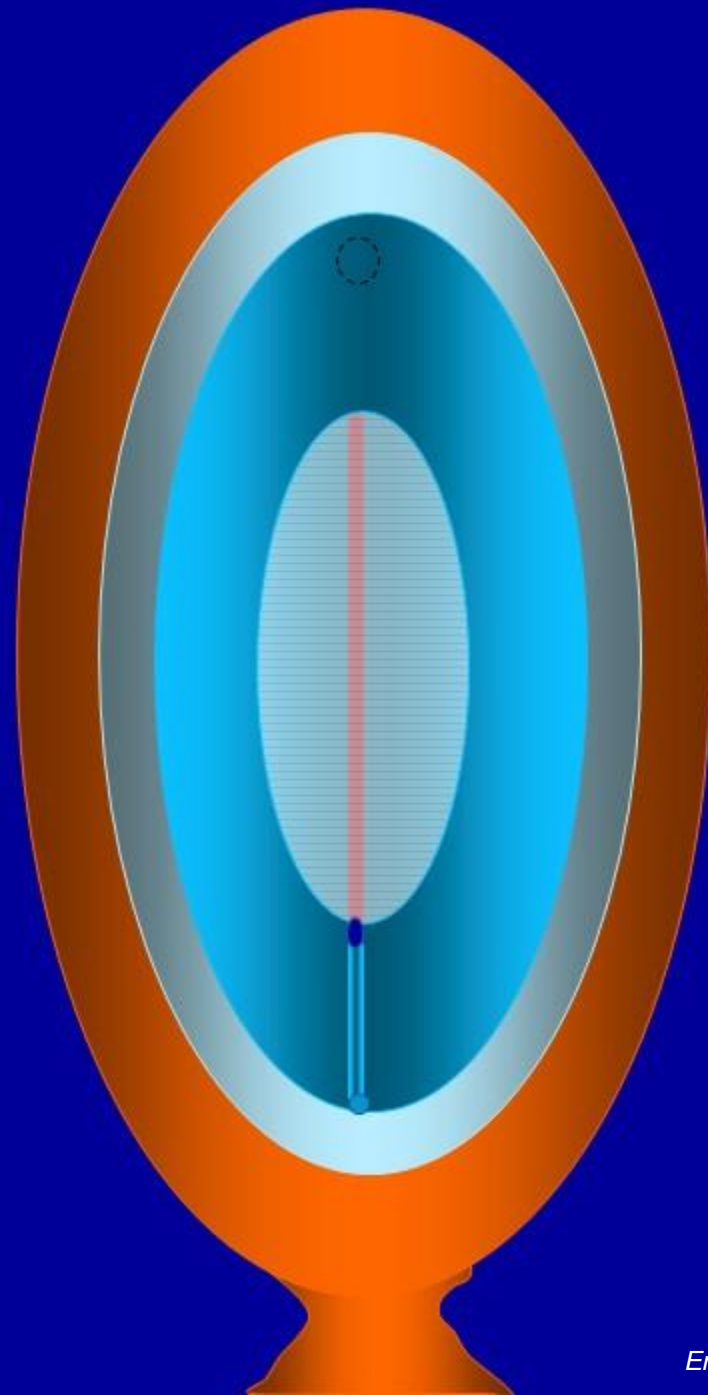
Vista dorsal do disco embrionário





Placa Precordial





Notocorda

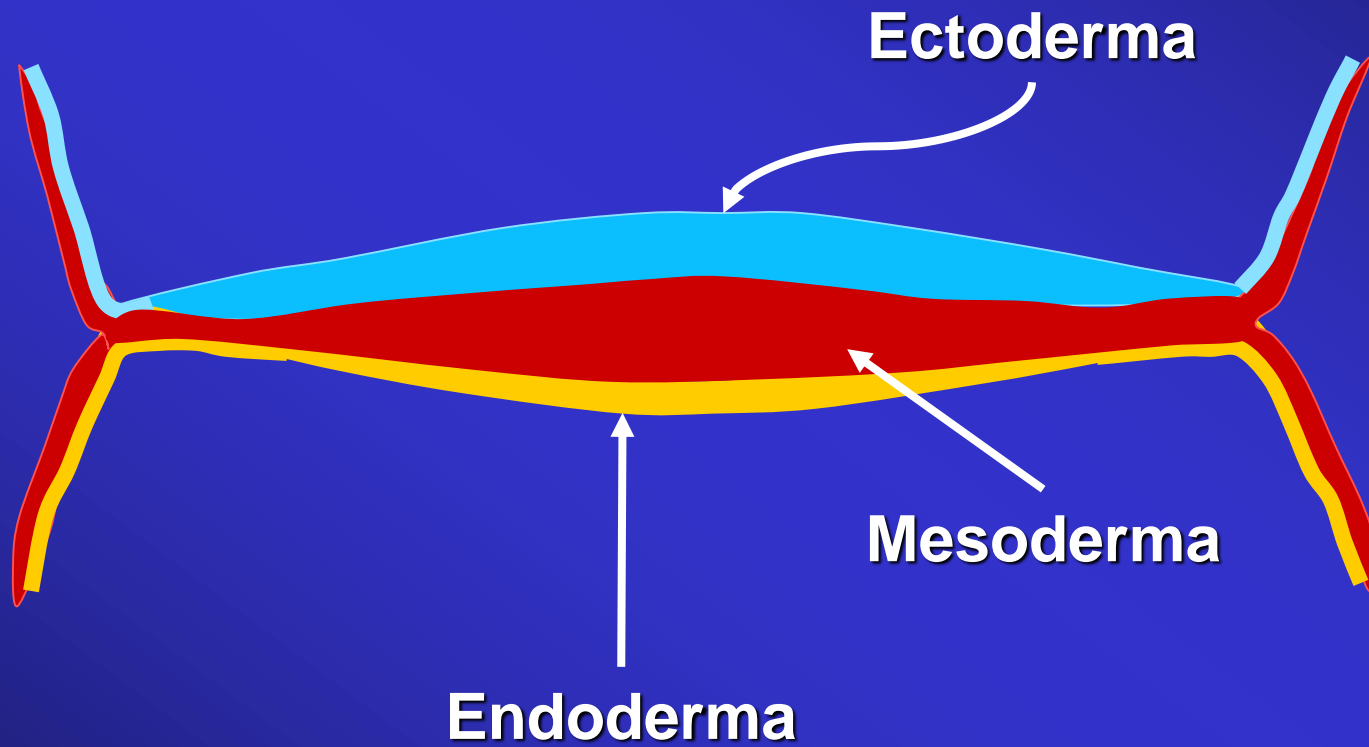
Bastão celular com as seguintes funções:

- Define o eixo primitivo do embrião
- Serve de base para o desenvolvimento do esqueleto axial
- Indica o local dos futuros corpos das vértebras

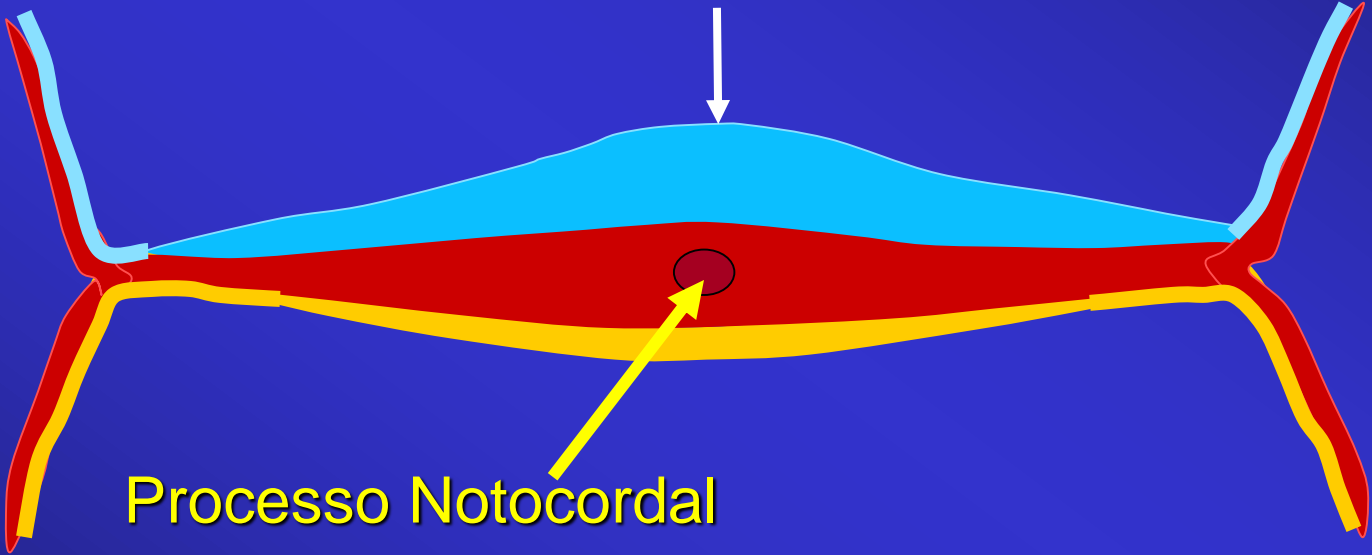
NEURULAÇÃO

(CORTE TRANSVERSAL)

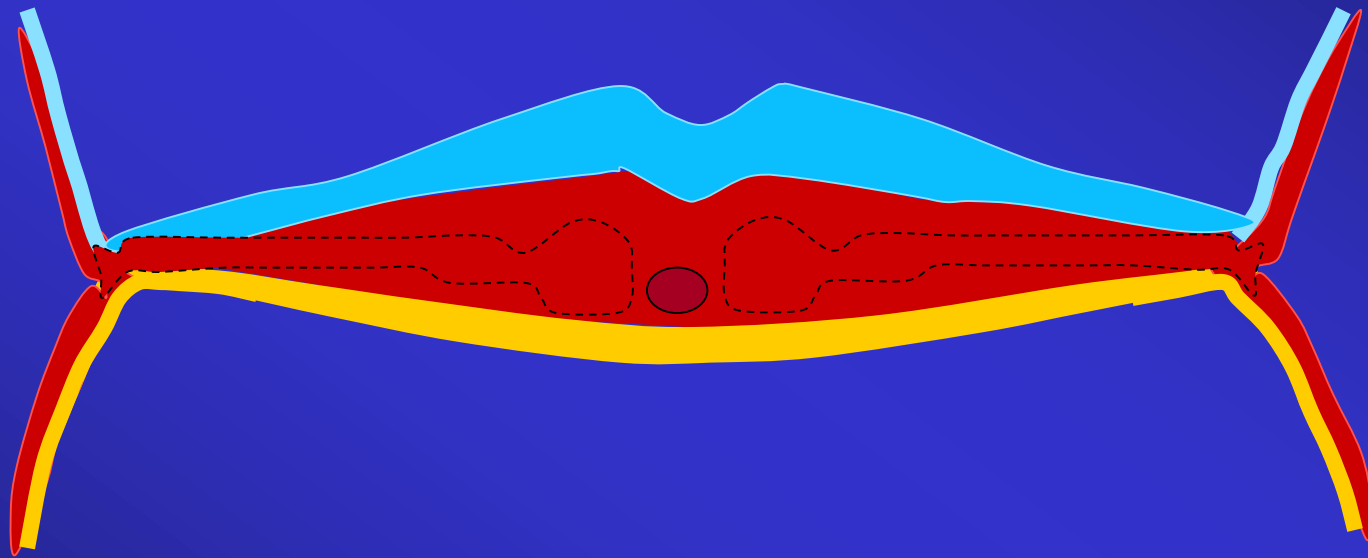
Processo de formação do tubo neural.

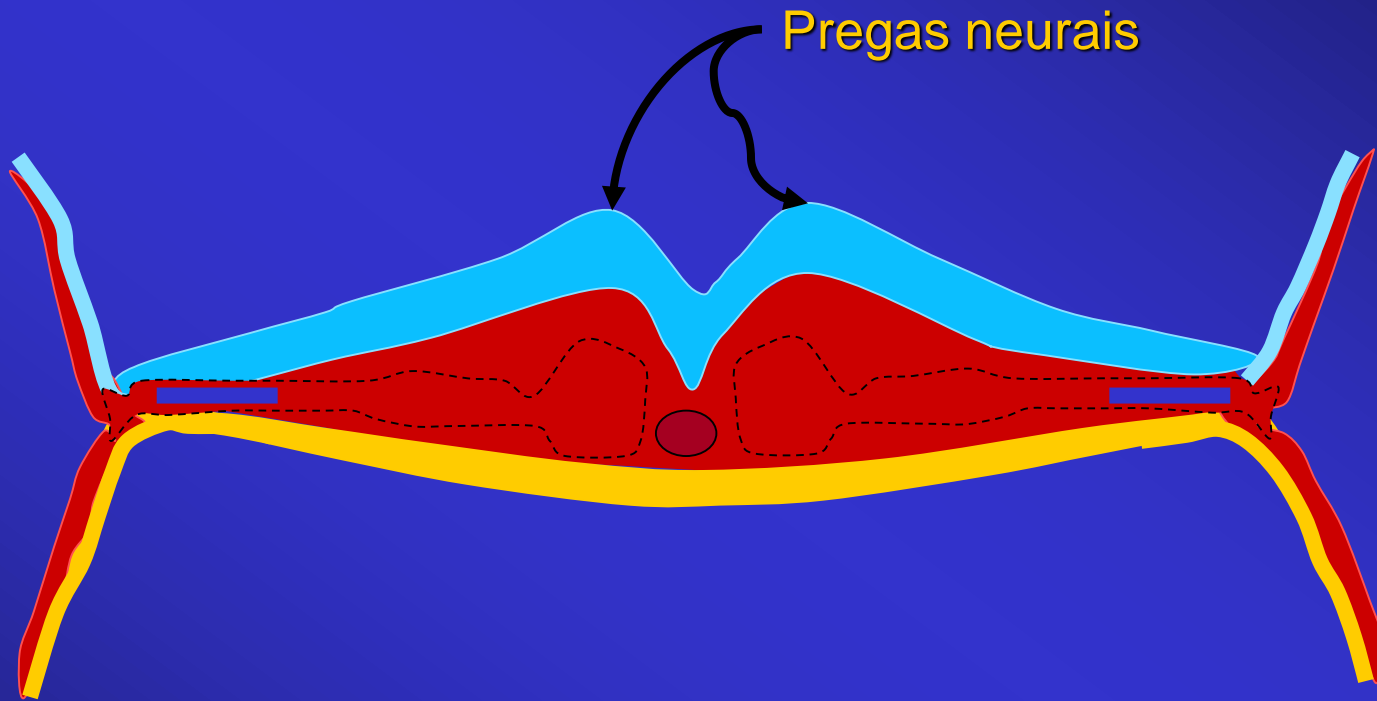


Espessamento do ectoderma

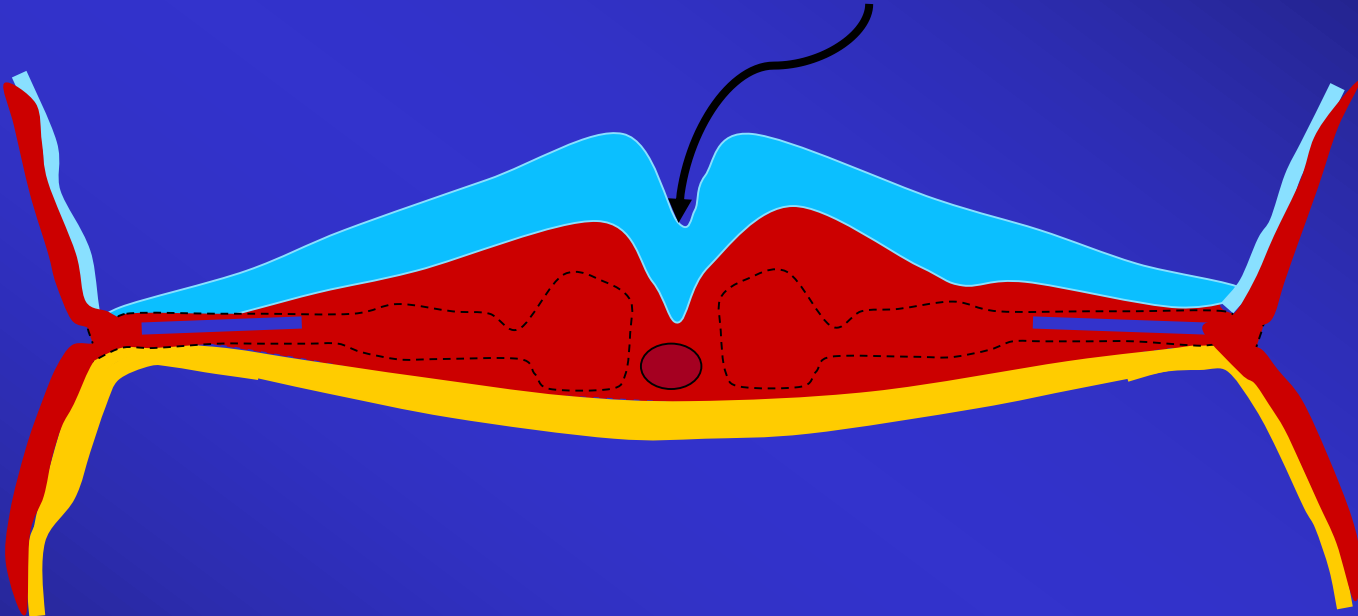


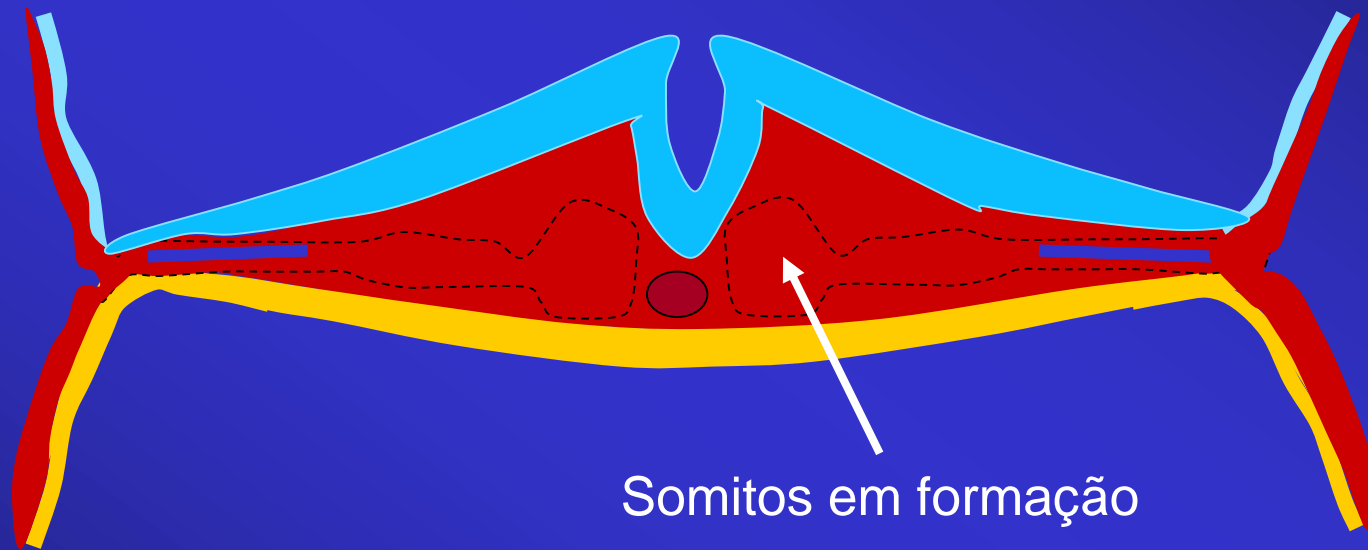
Processo Notocordal



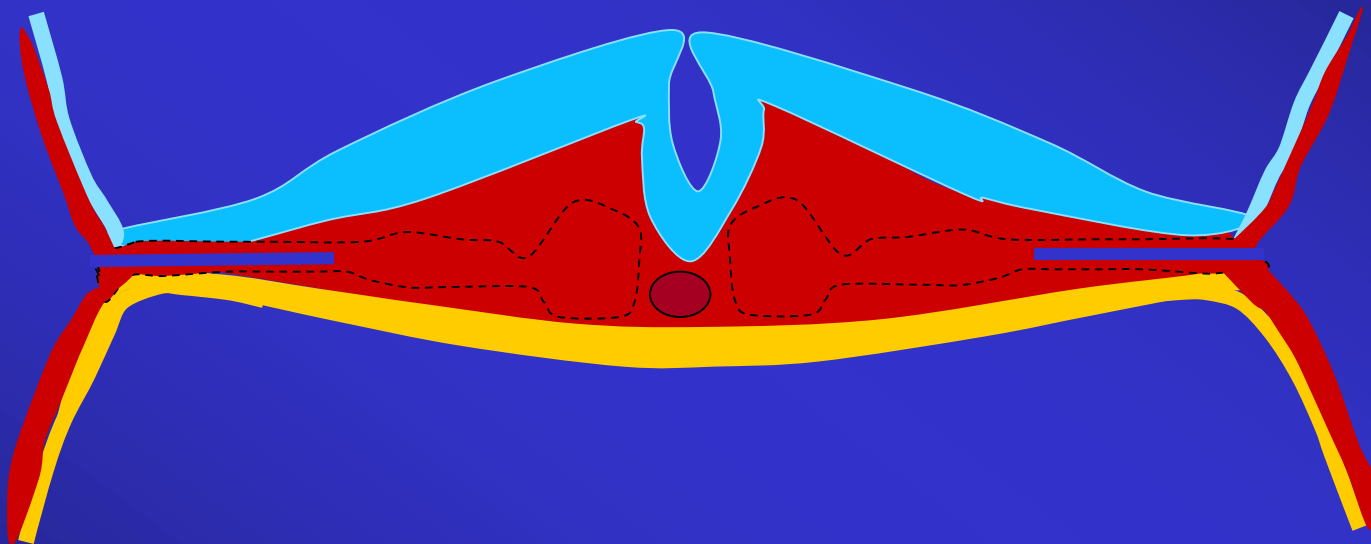


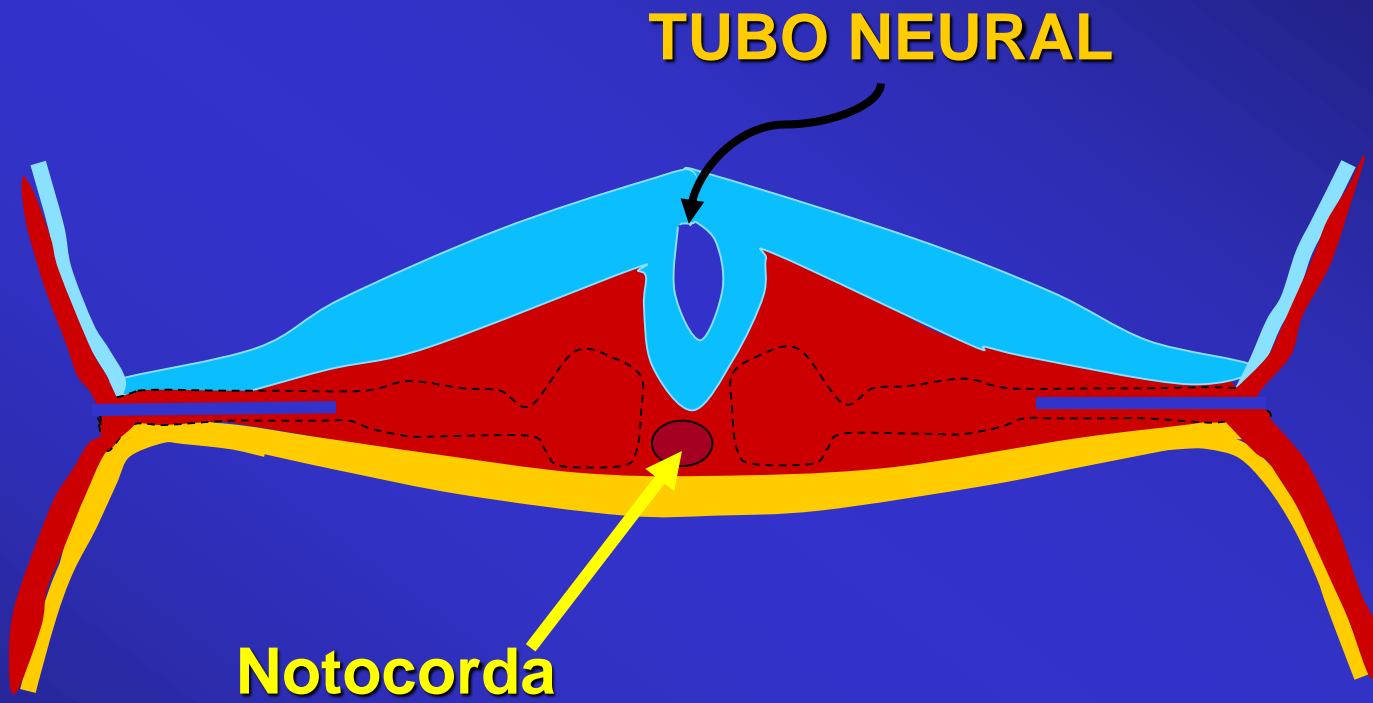
Sulco neural



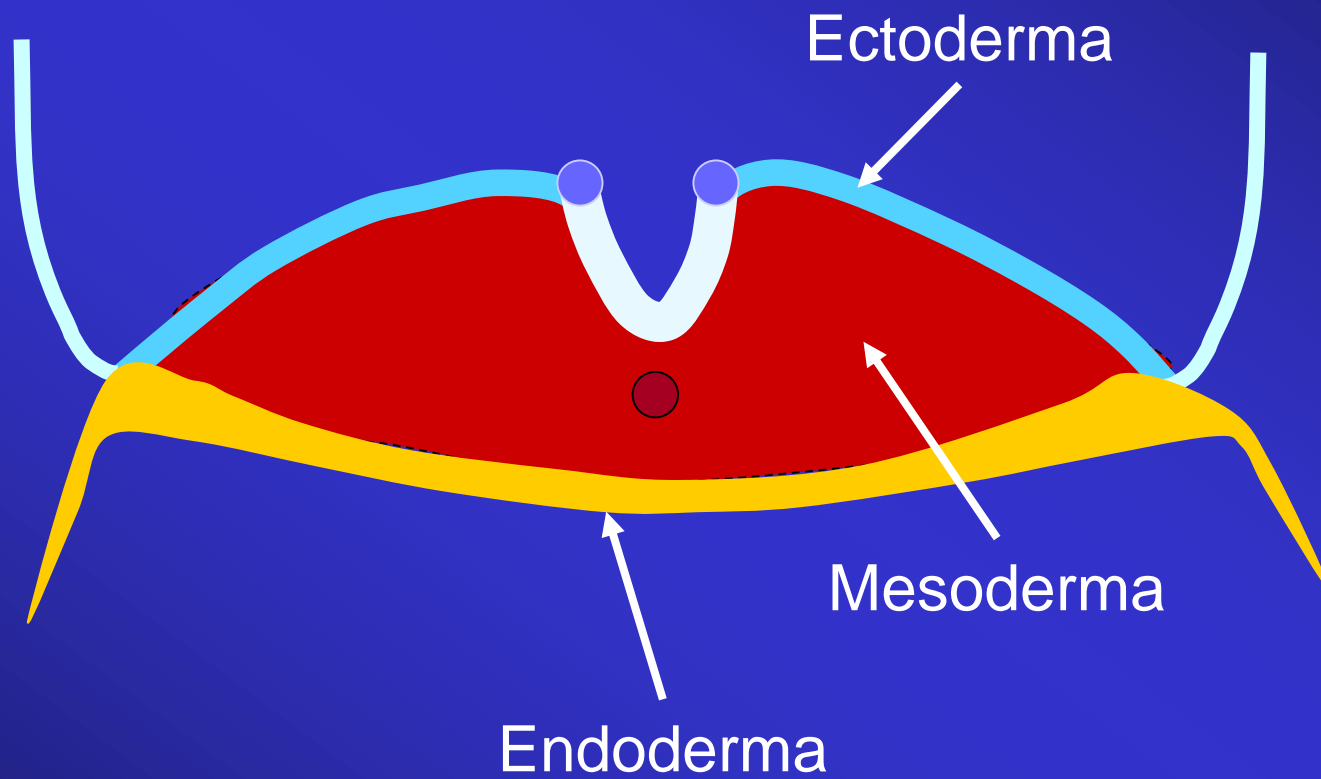


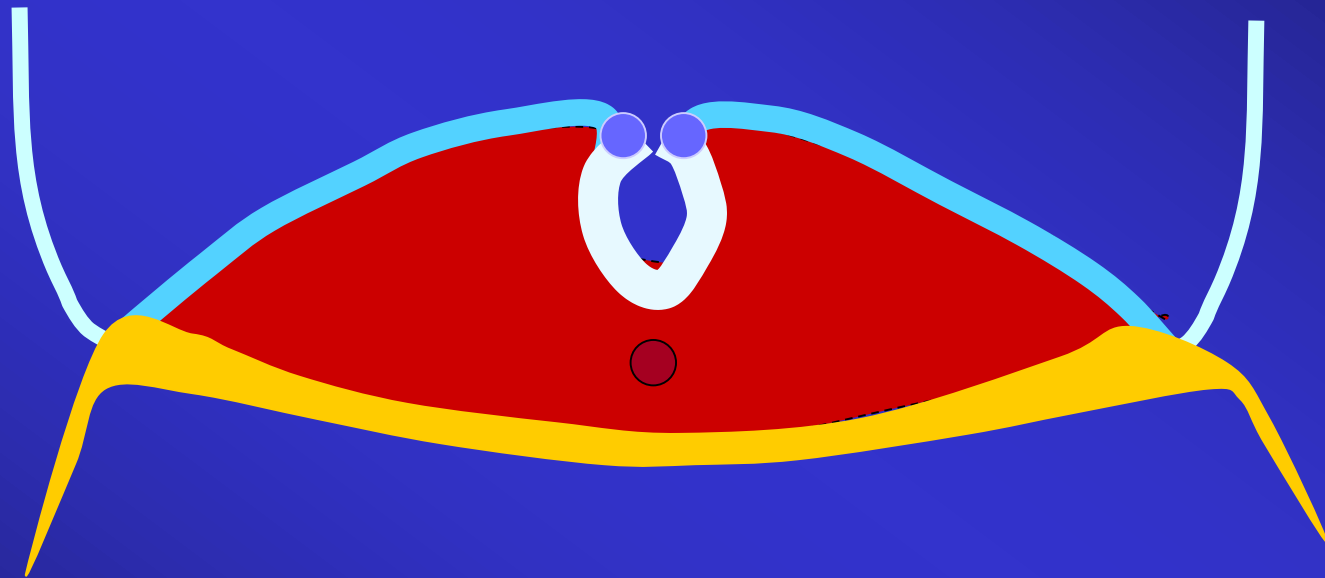
Somitos em formação



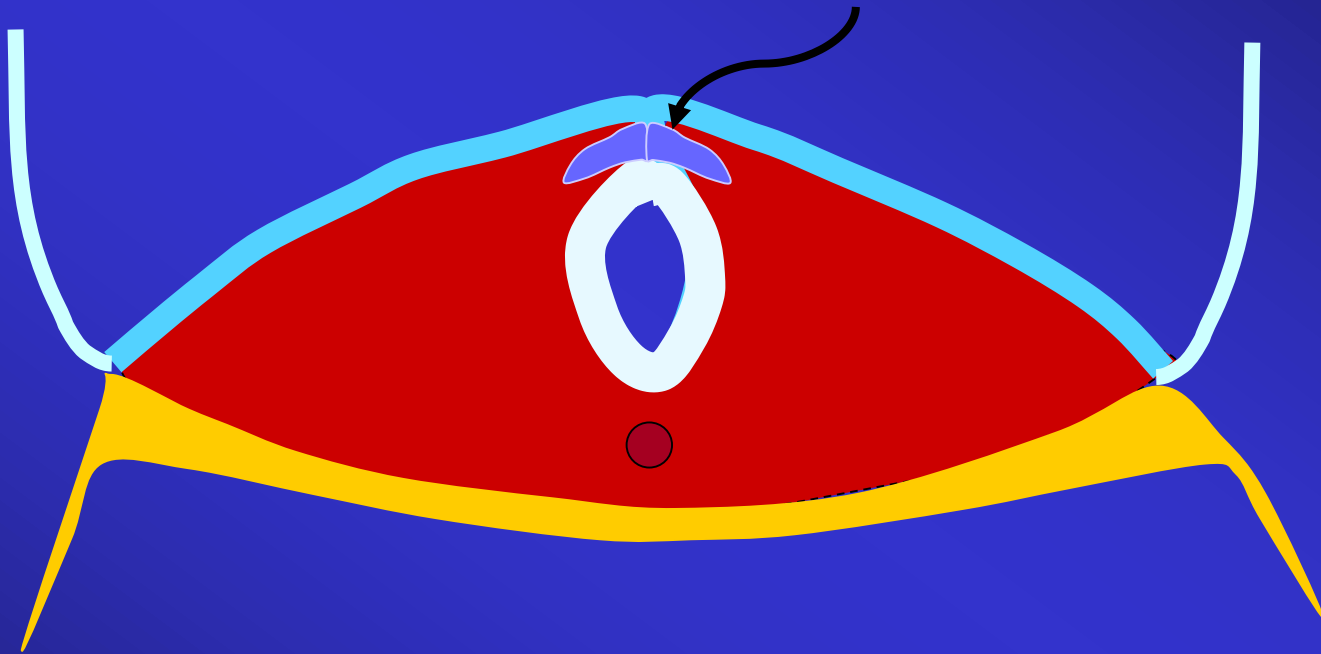


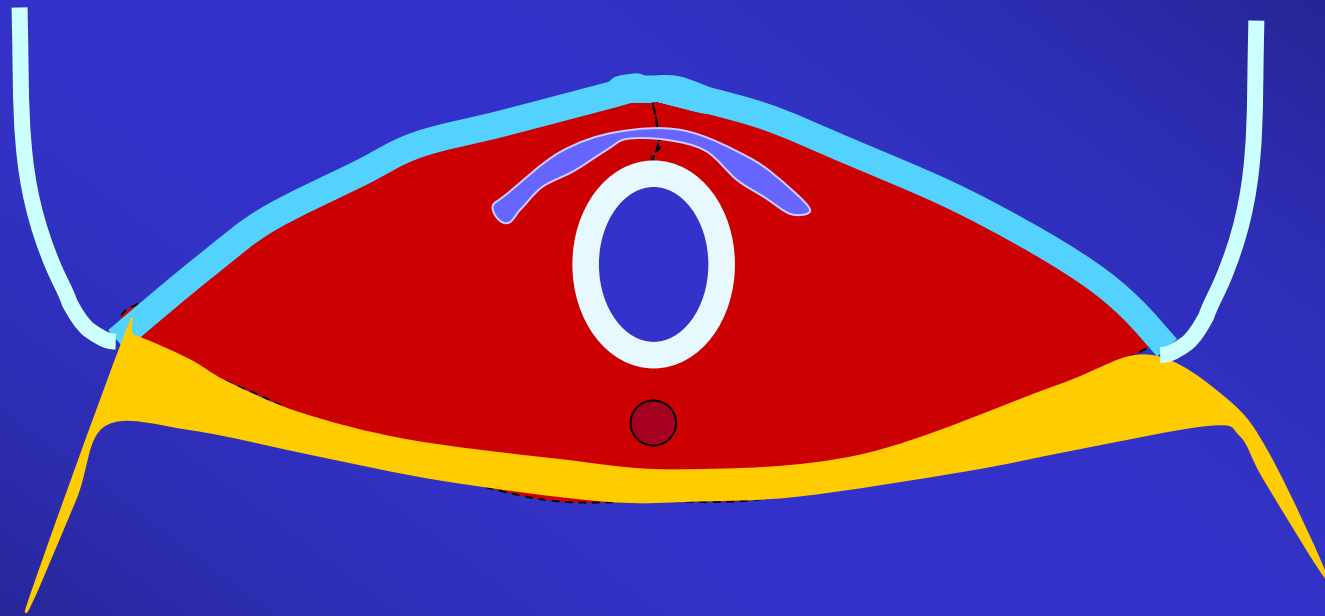
A CRISTA NEURAL

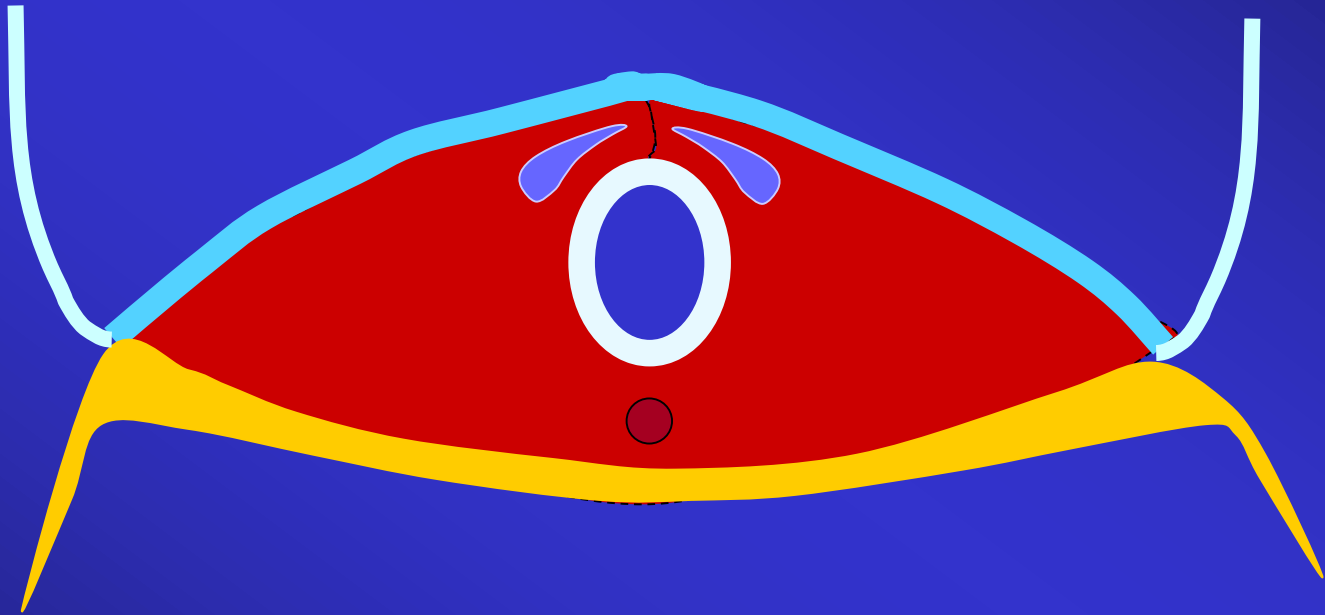


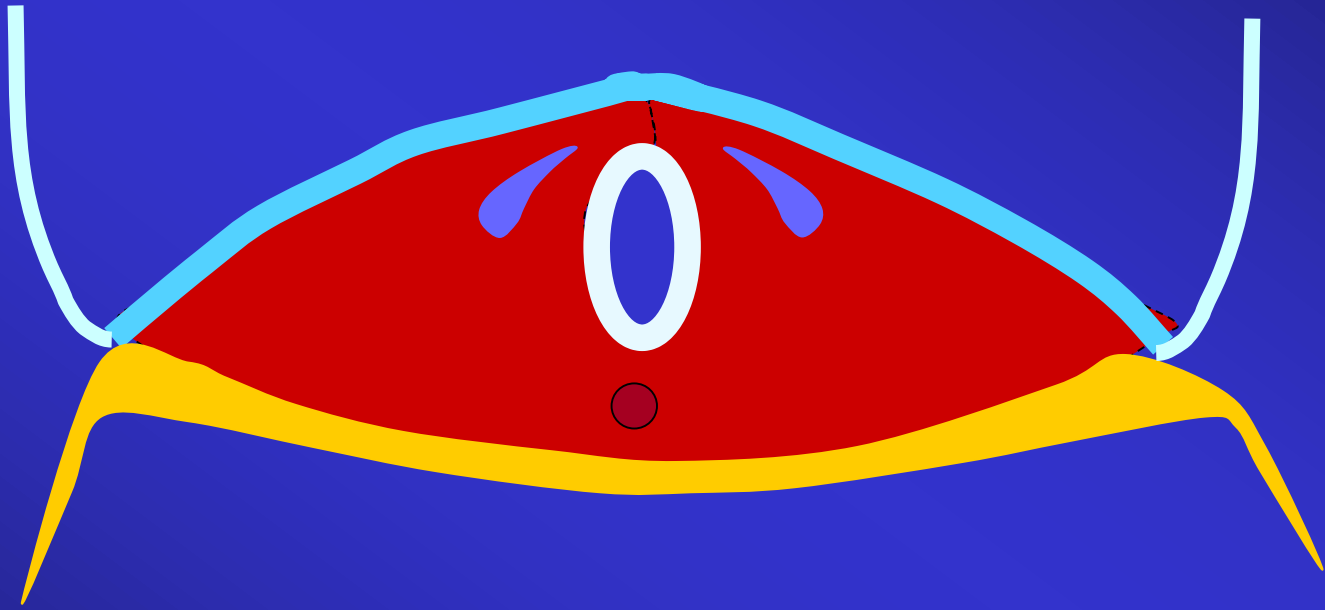


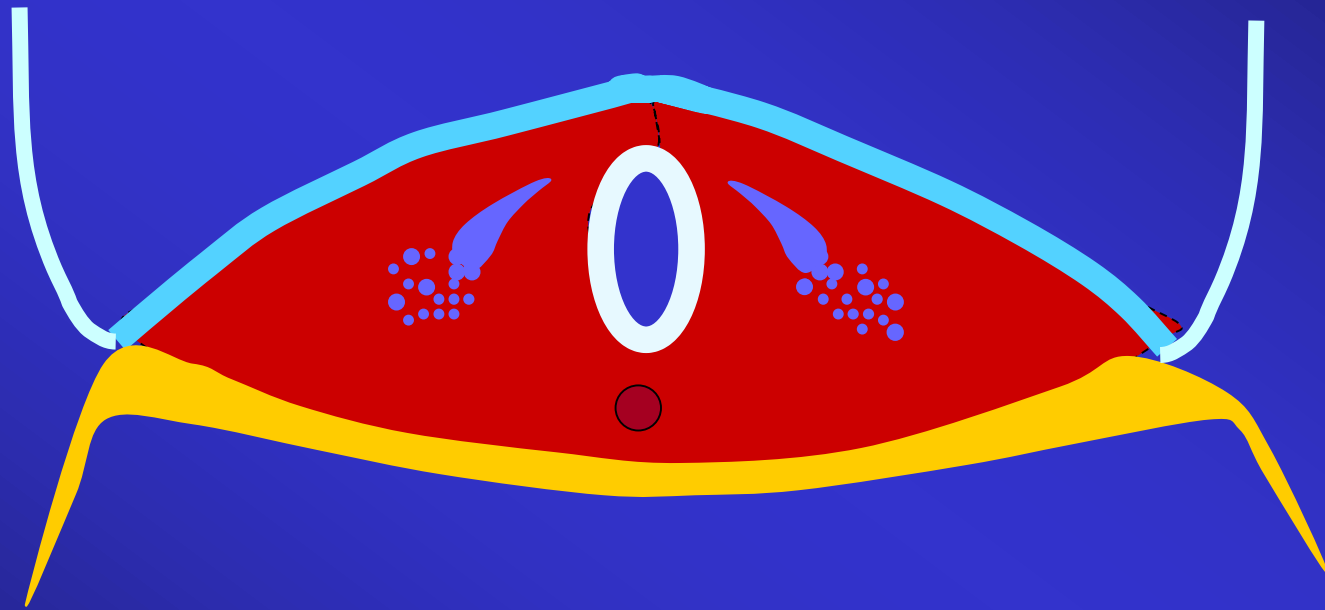
Crista neural













DERIVADOS DA CRISTA NEURAL:

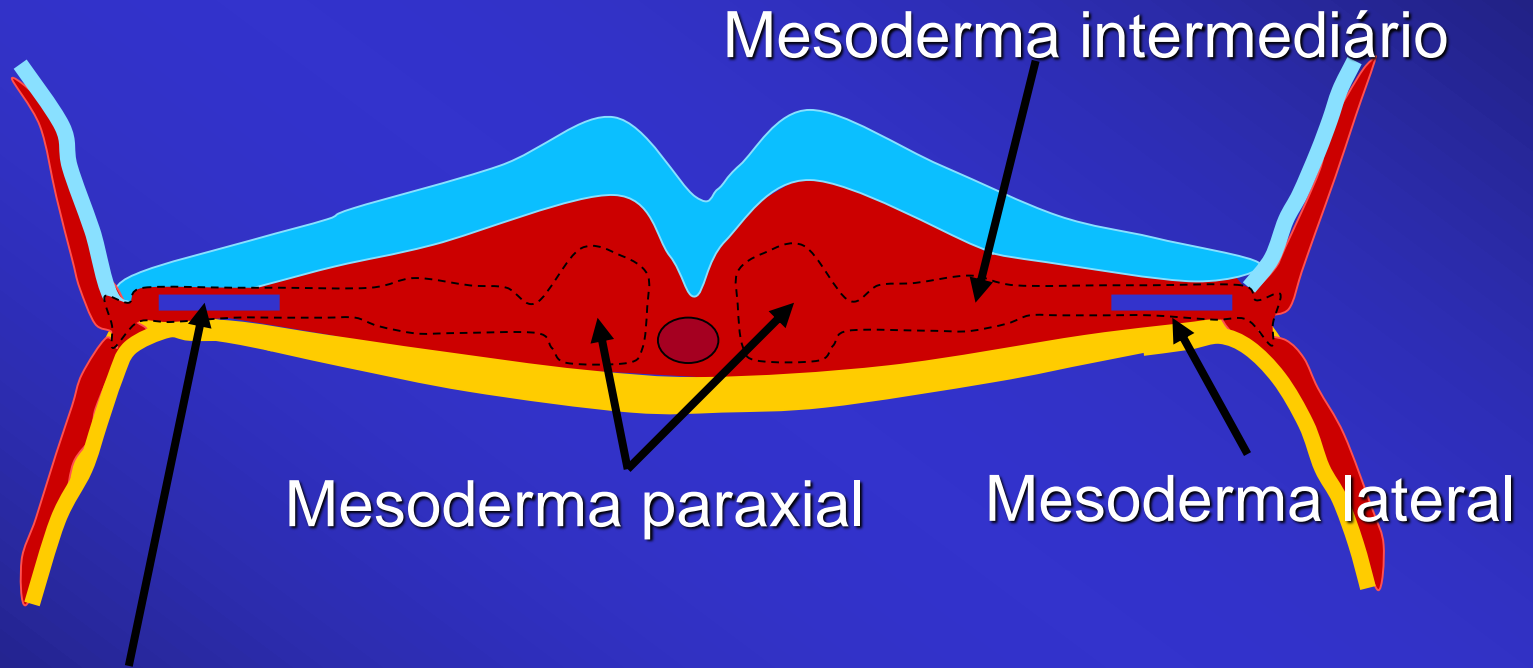
- Gânglios espinhais
- Gânglios do SNA
- Células de Schwann
- Meninges

Formação dos somitos:

O mesoderma intra-embrionário sofre modificações que resultam na formação dos somitos - blocos cubóides de mesoderma que se localizam dos dois lados do tubo neural em desenvolvimento.

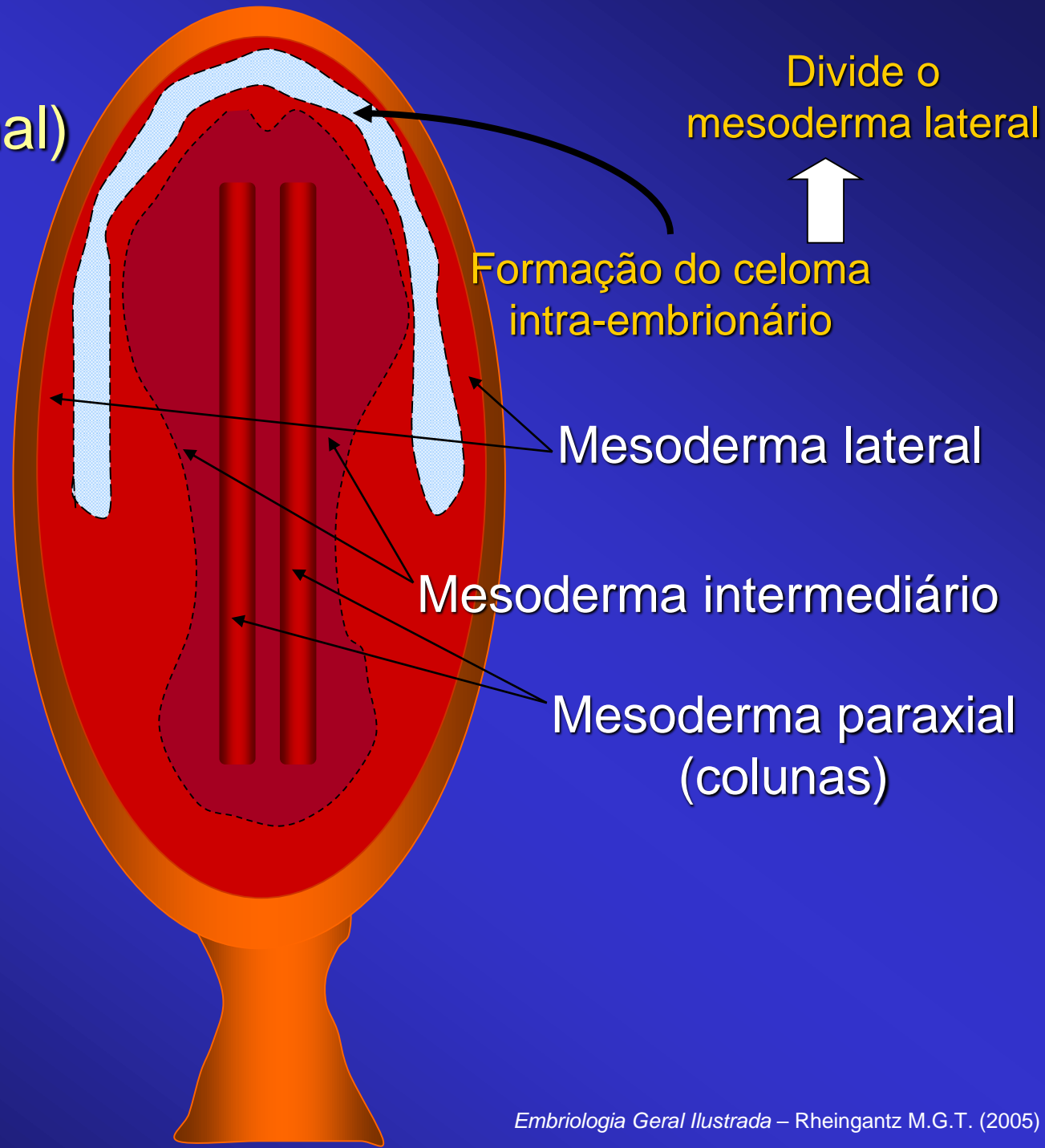
Durante o chamado “período somítico do desenvolvimento”, formam-se 38 pares de somitos.

Alterações do mesoderma: (Corte transversal)



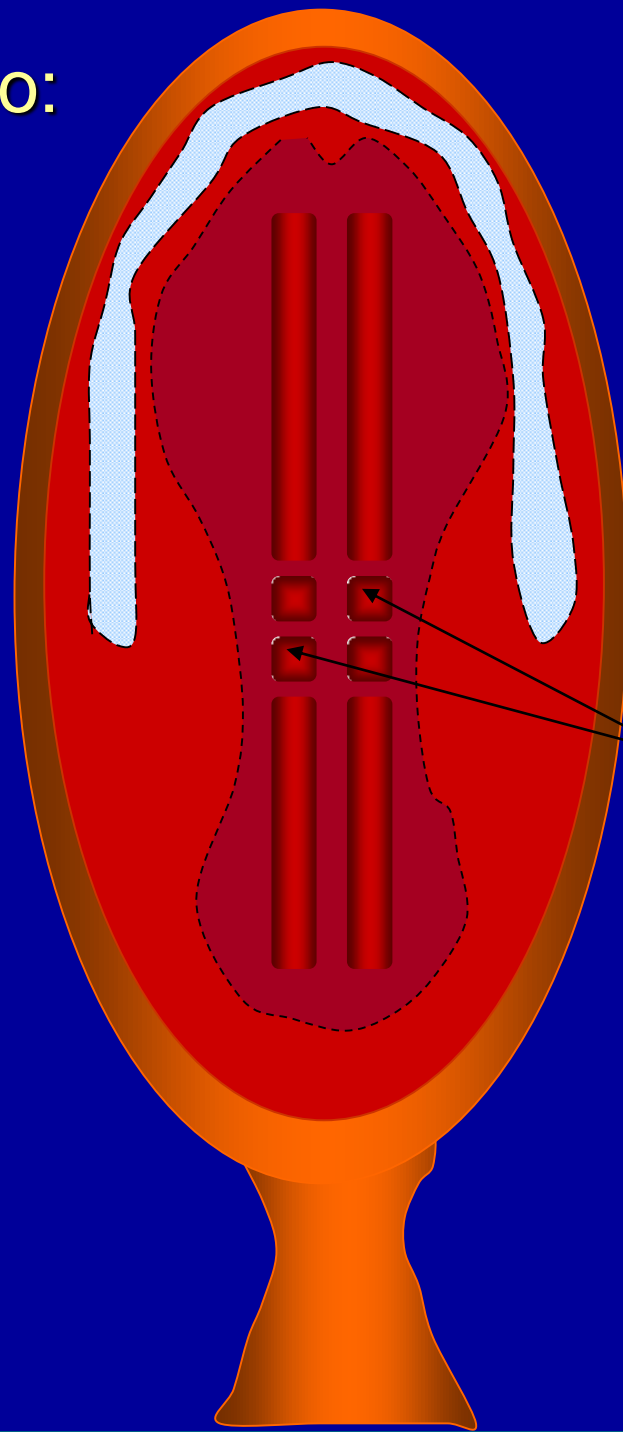
Celoma intra-embrionário
em desenvolvimento

Mesoderma: (Corte longitudinal)



Período somítico:

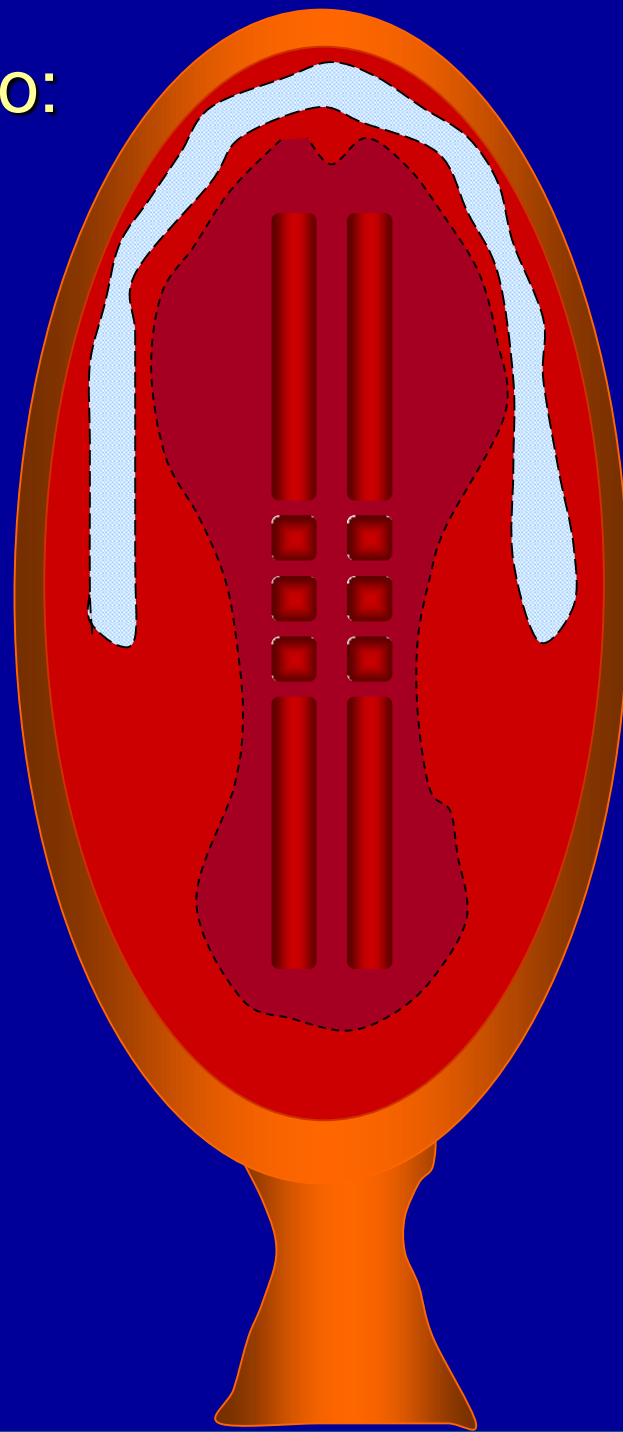
(20° ao 30° dia)



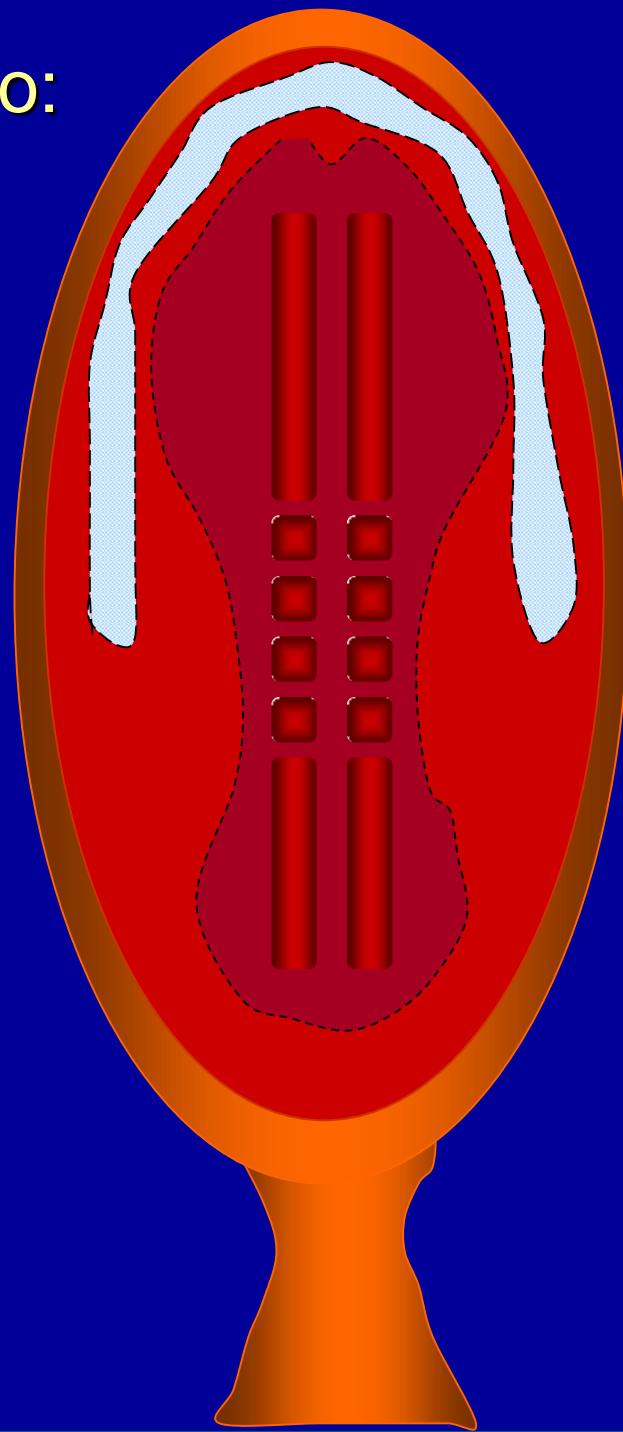
Segmentação do
mesoderma paraxial:

**Formação dos
somitos**

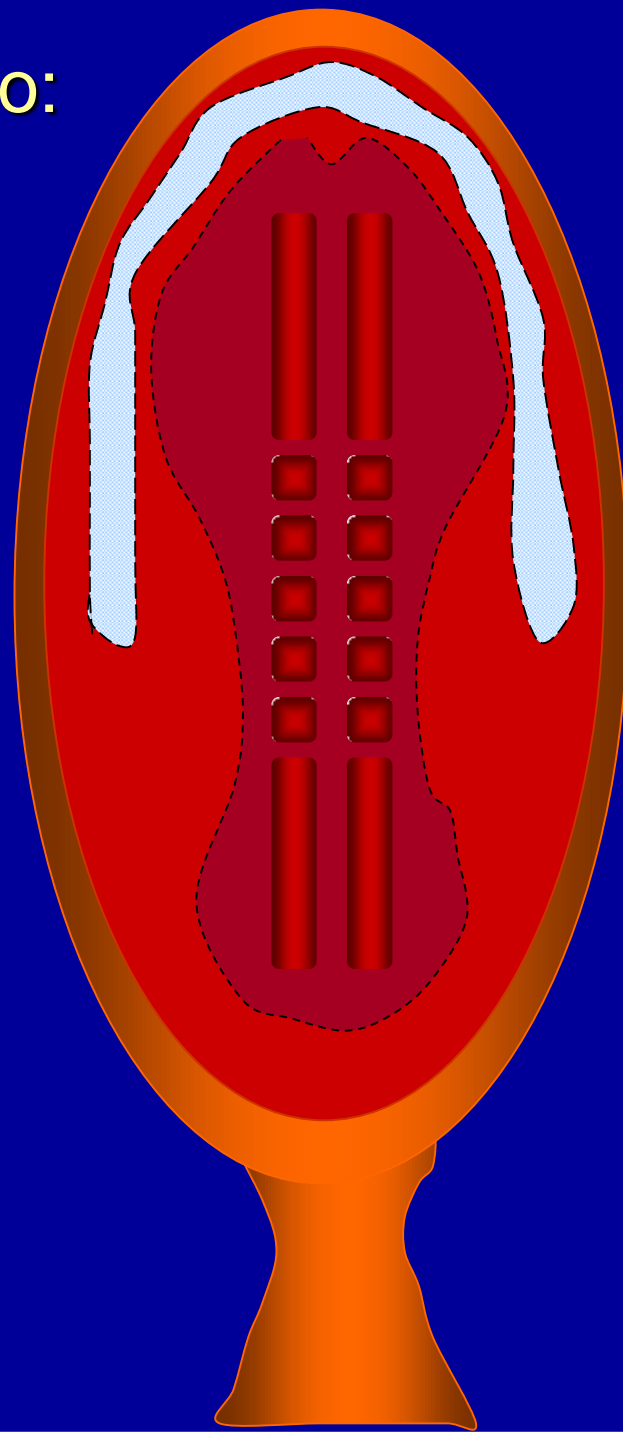
Período somático:



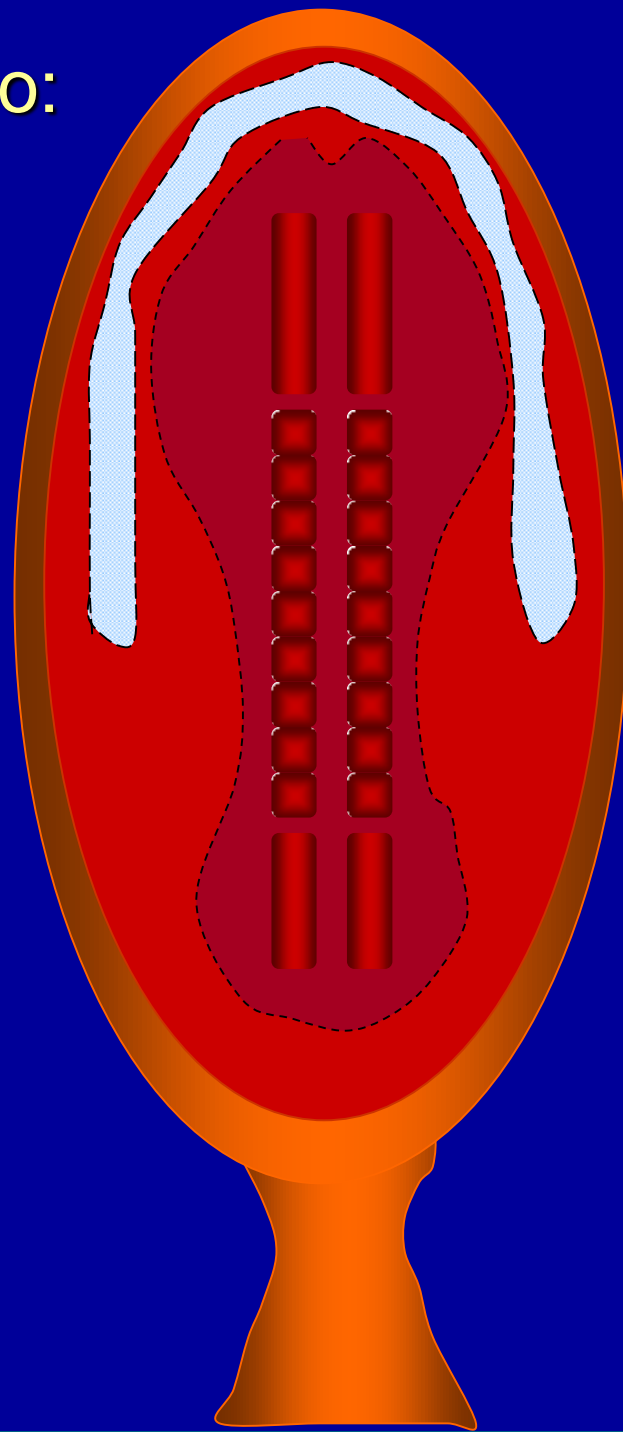
Período somático:



Período somático:



Período somático:

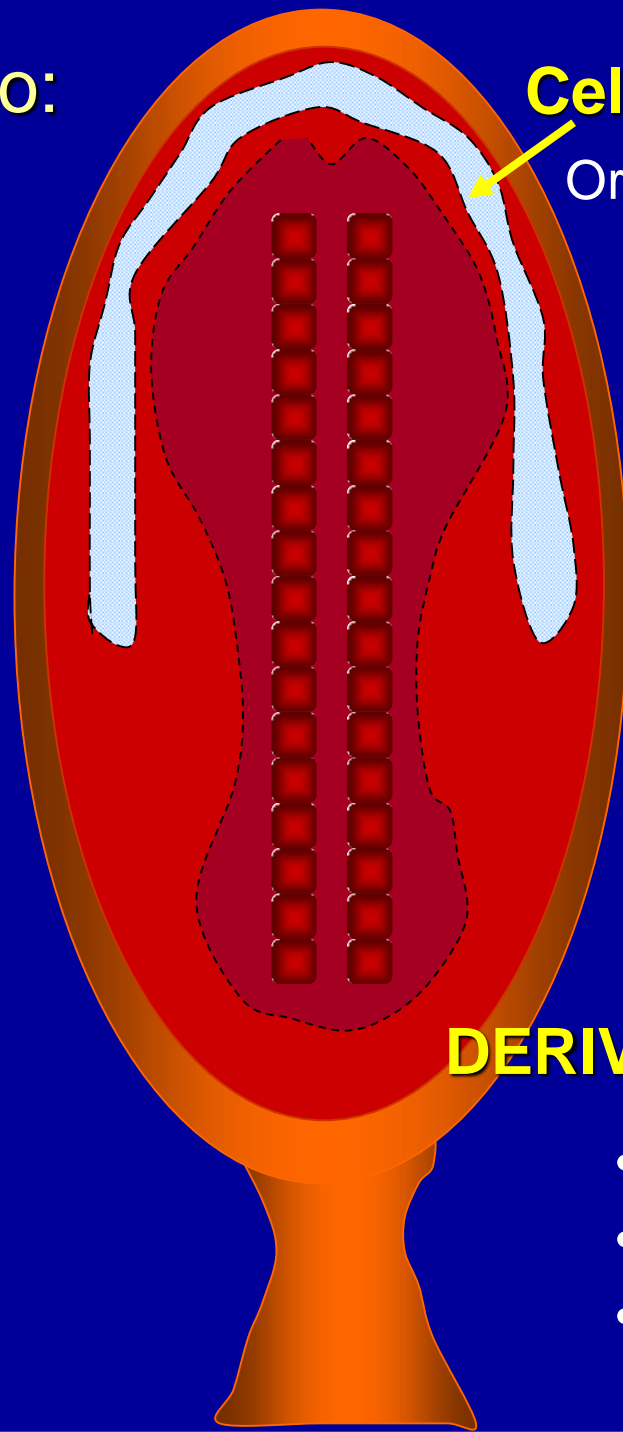


Período somítico:

Celoma intra embrionário

Origina as cavidades do corpo:

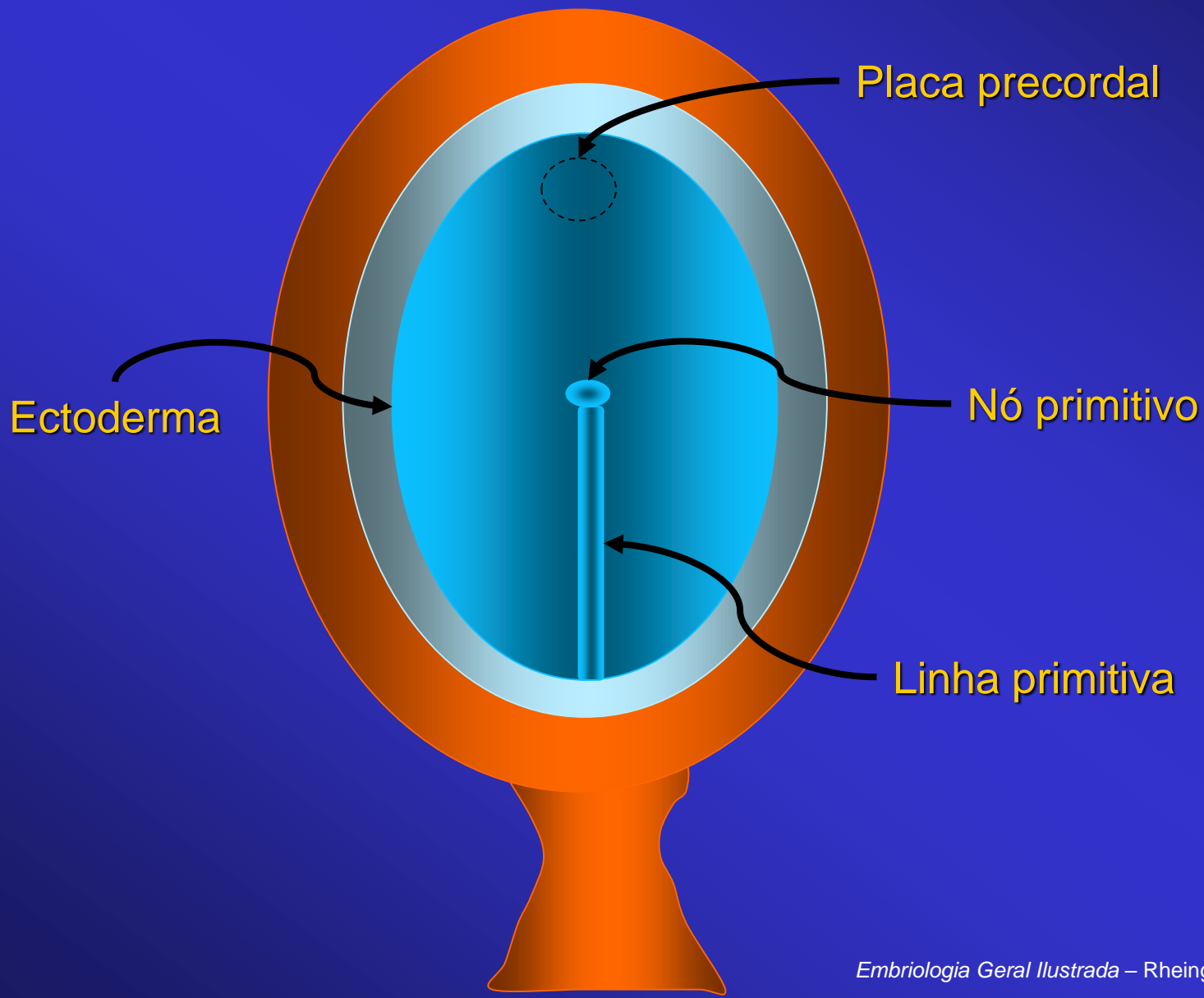
- Pericárdica
- Pleurais
- Peritoneal

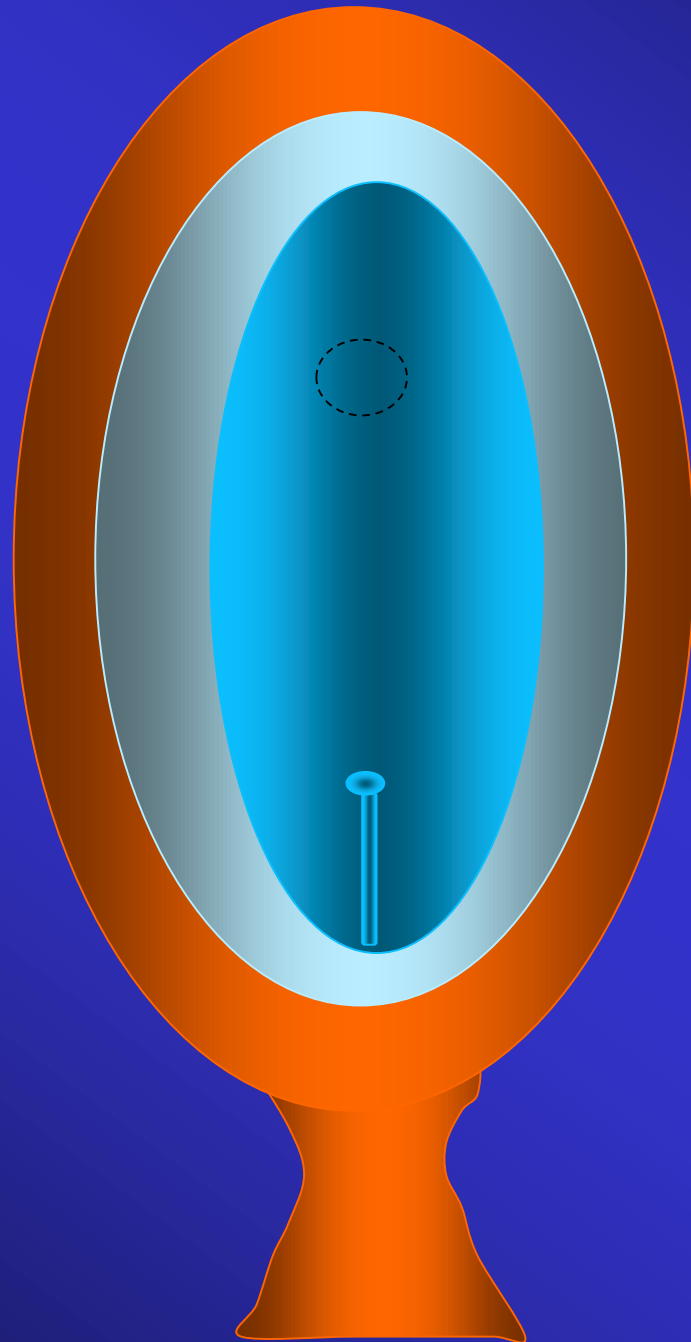


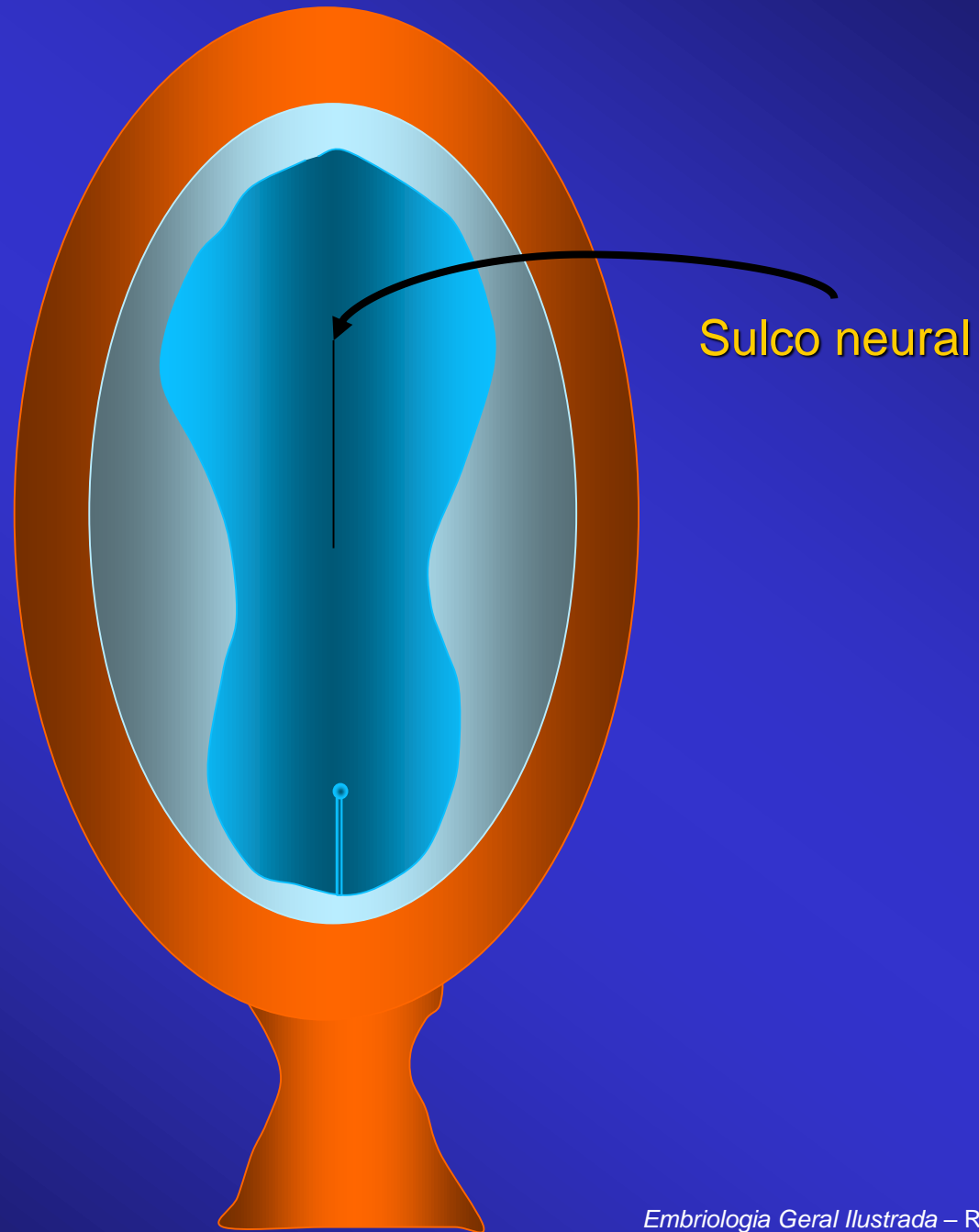
DERIVADOS DOS SOMITOS:

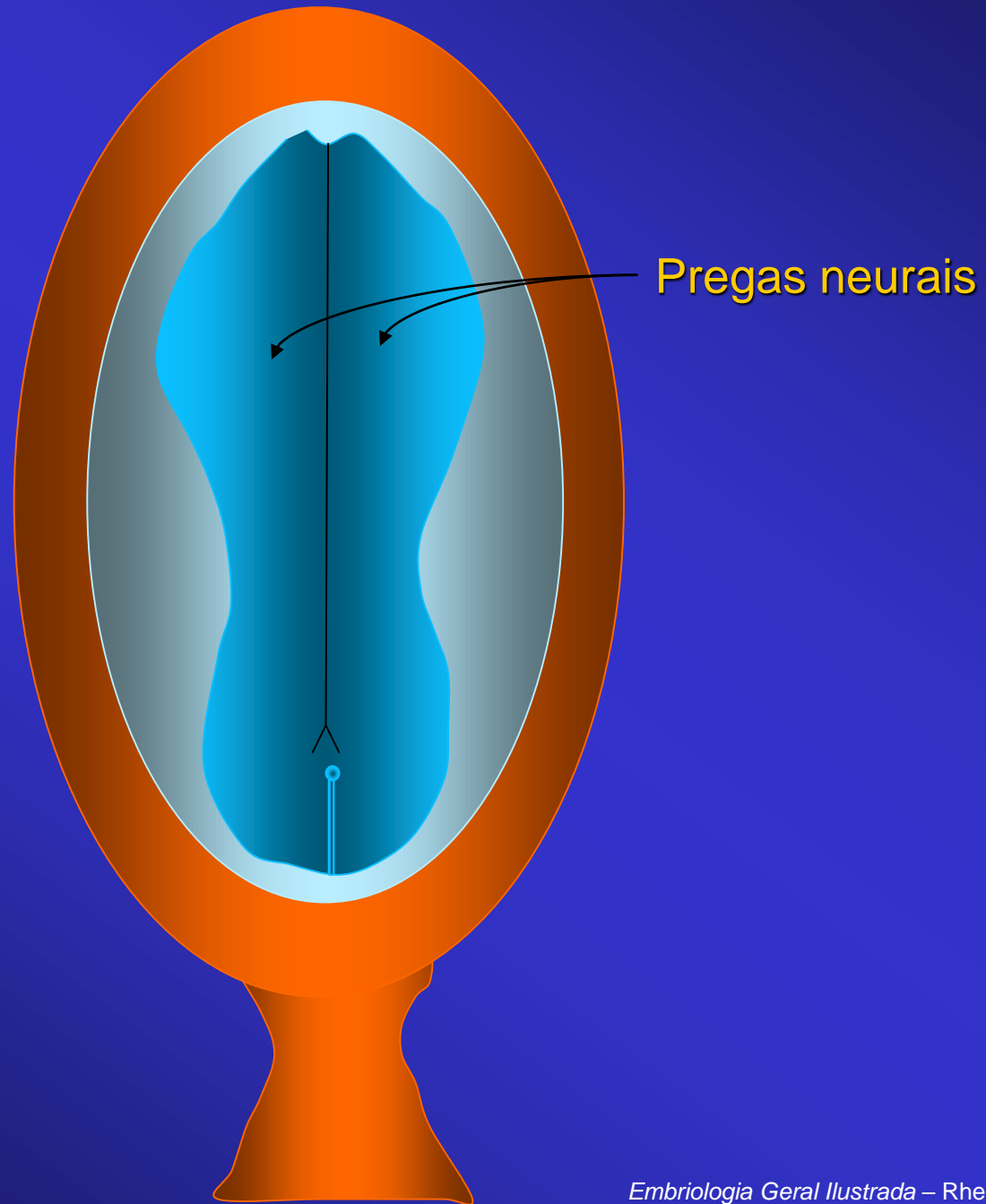
- Vértebras
- Costelas
- Musculatura axial

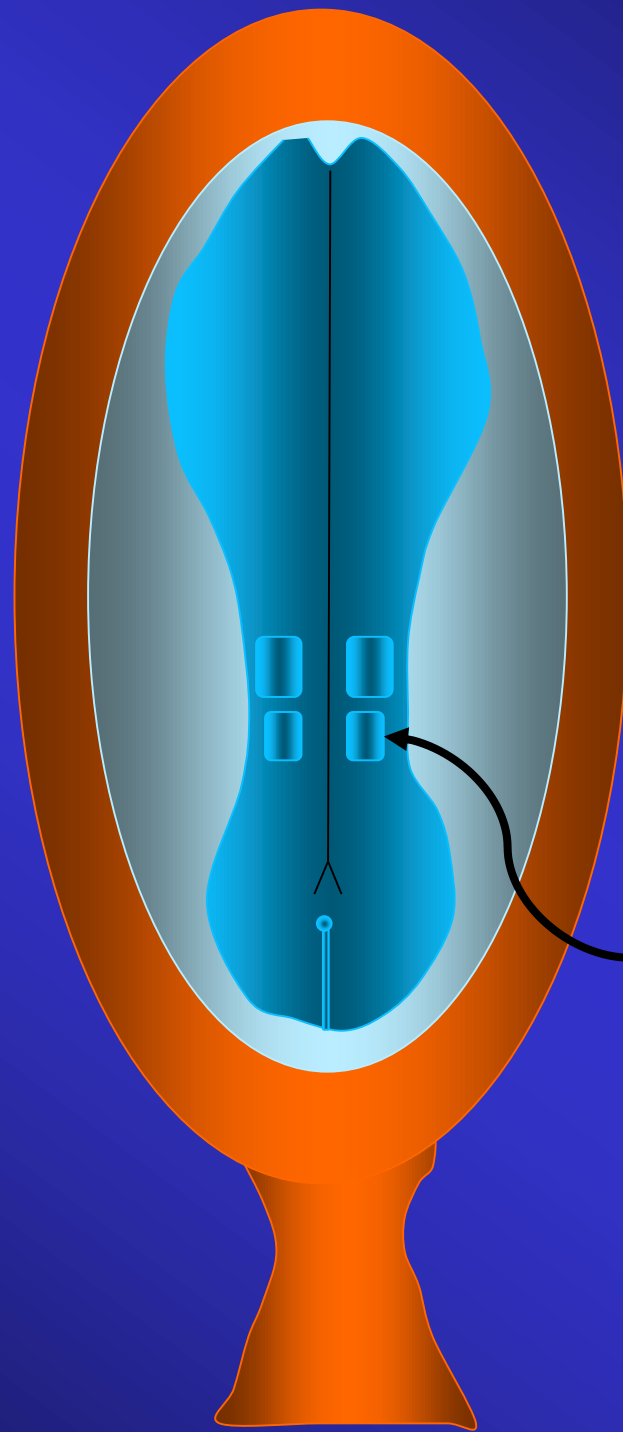
VISTA DORSAL DO DISCO
EMBRIONÁRIO:
MUDANÇA DE FORMA



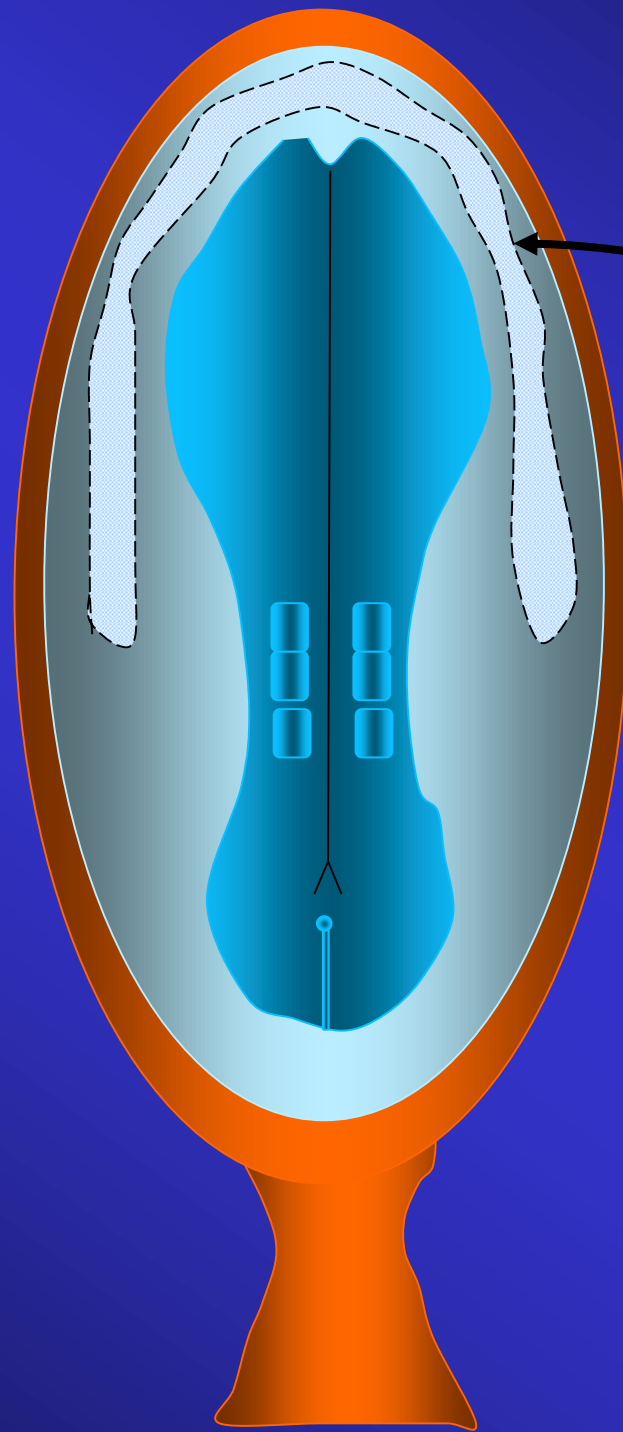






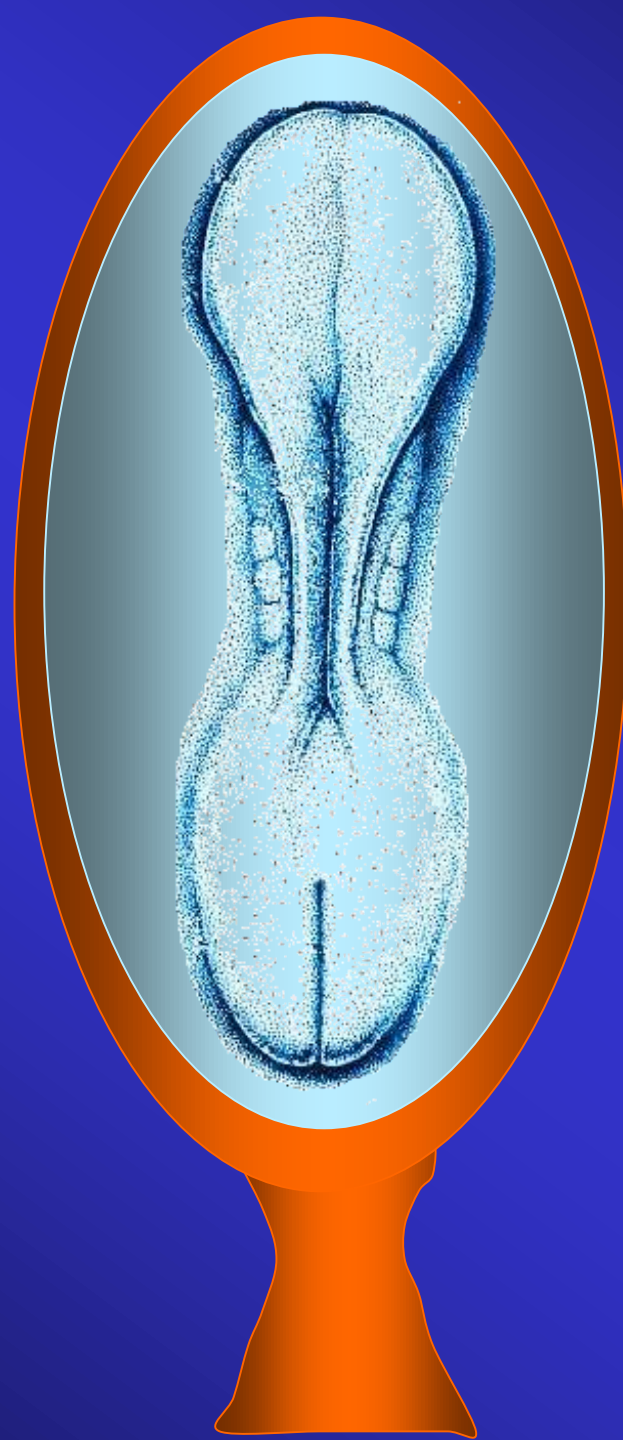


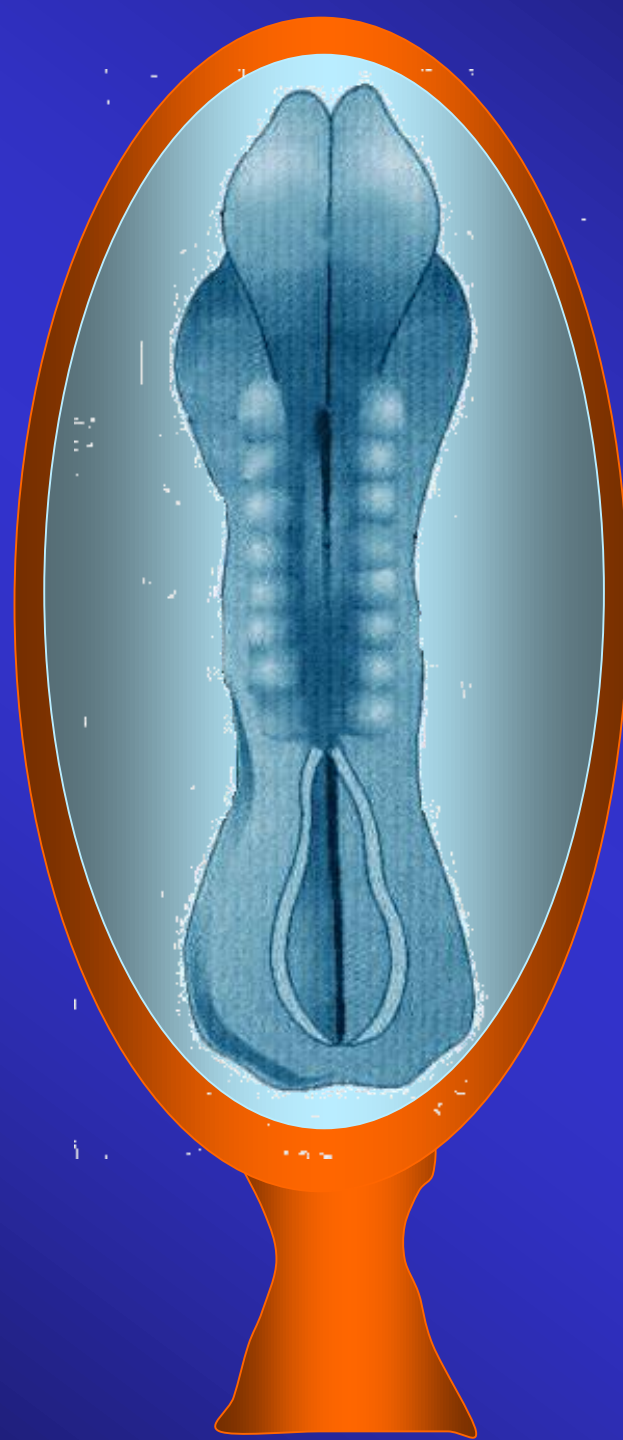
Formação dos somitos

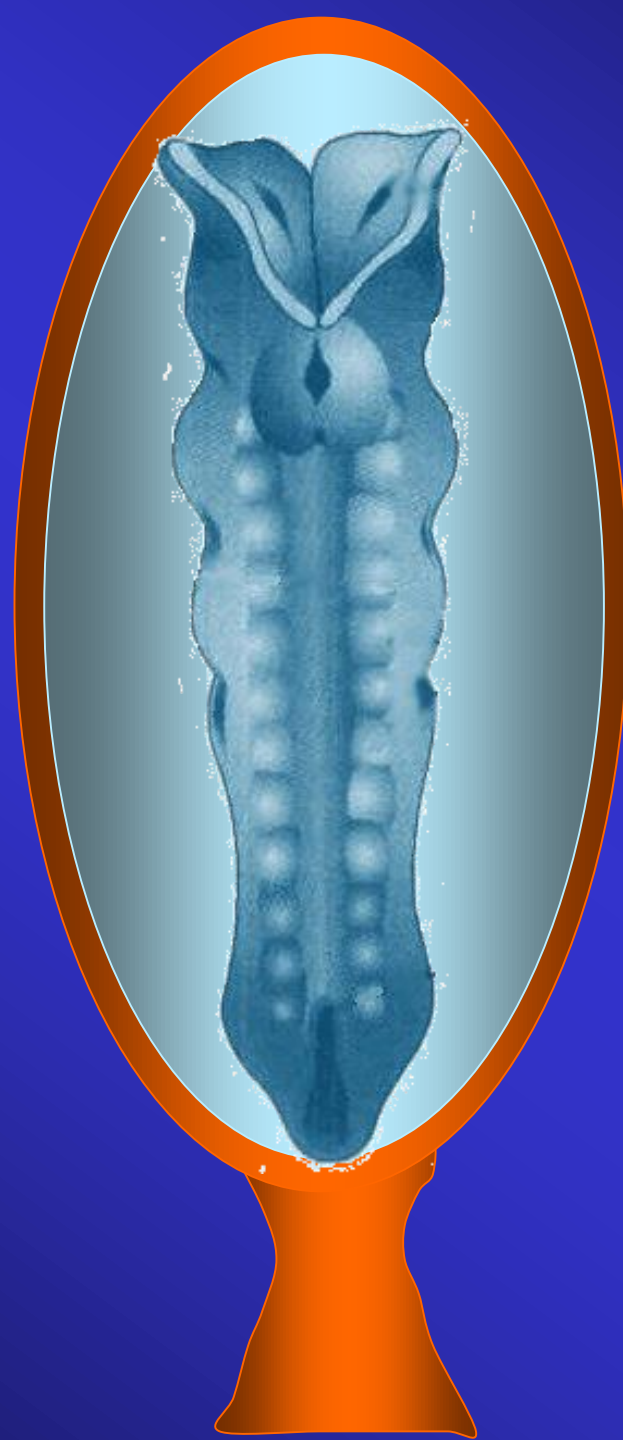


Formação do celoma
intra-embrionário

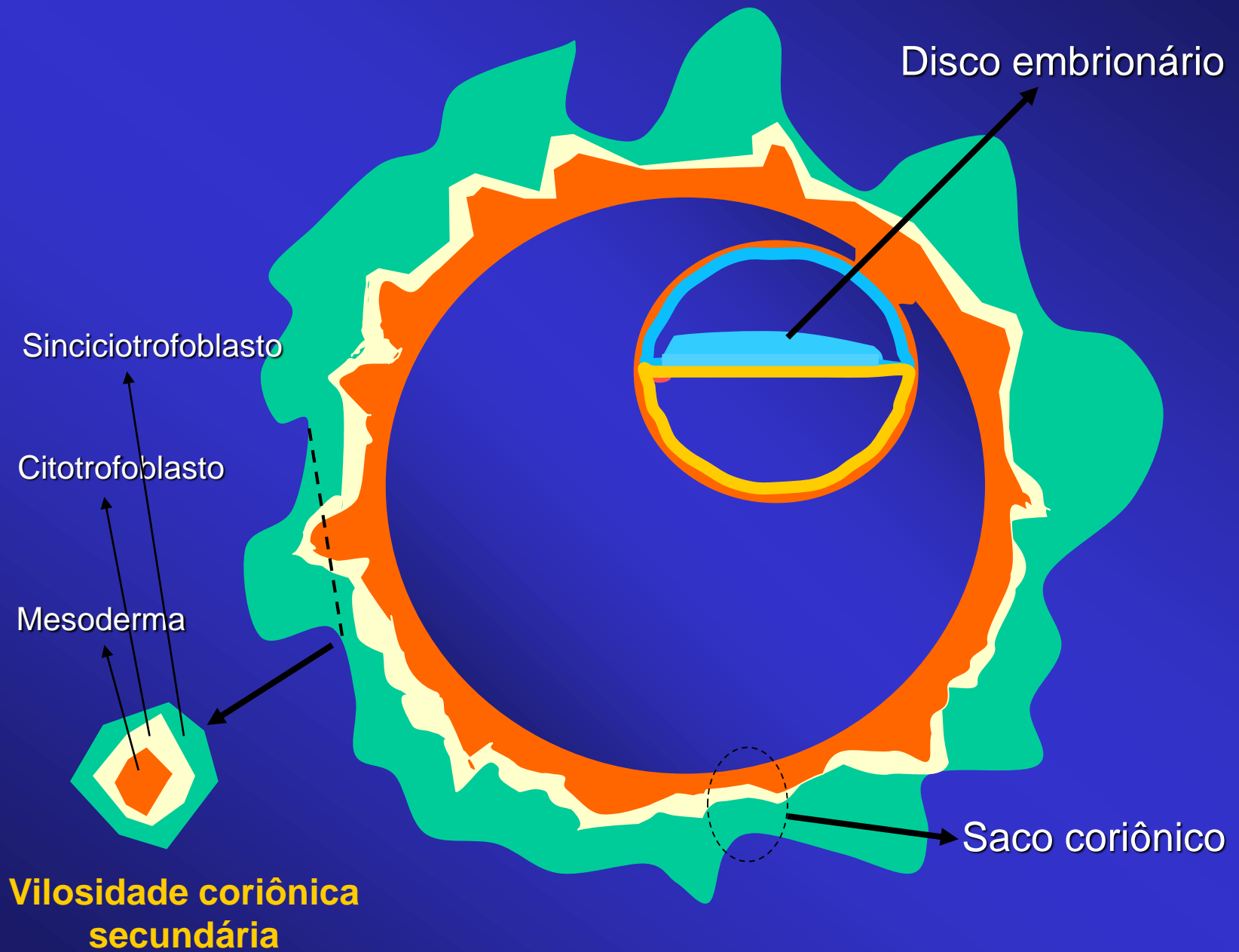




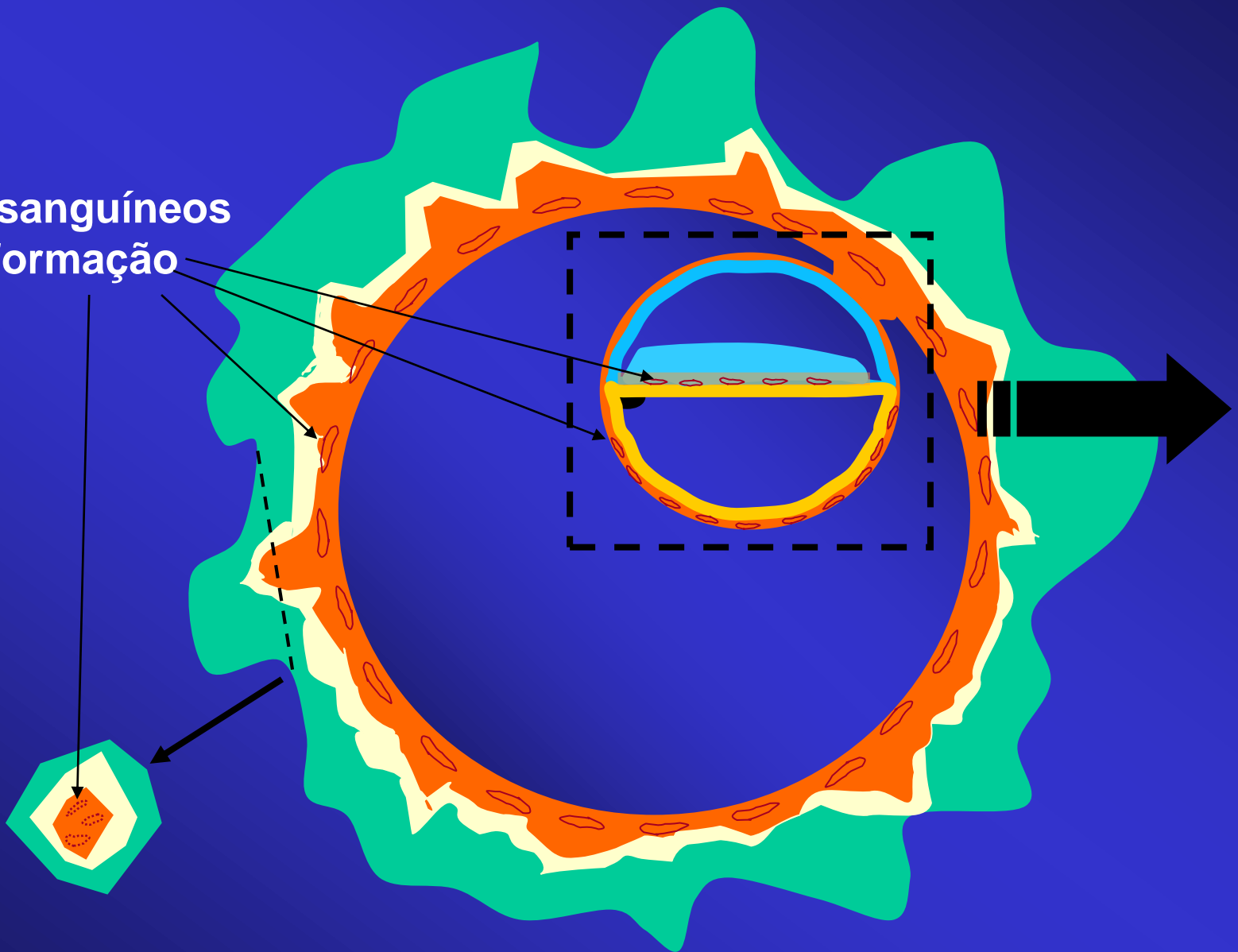


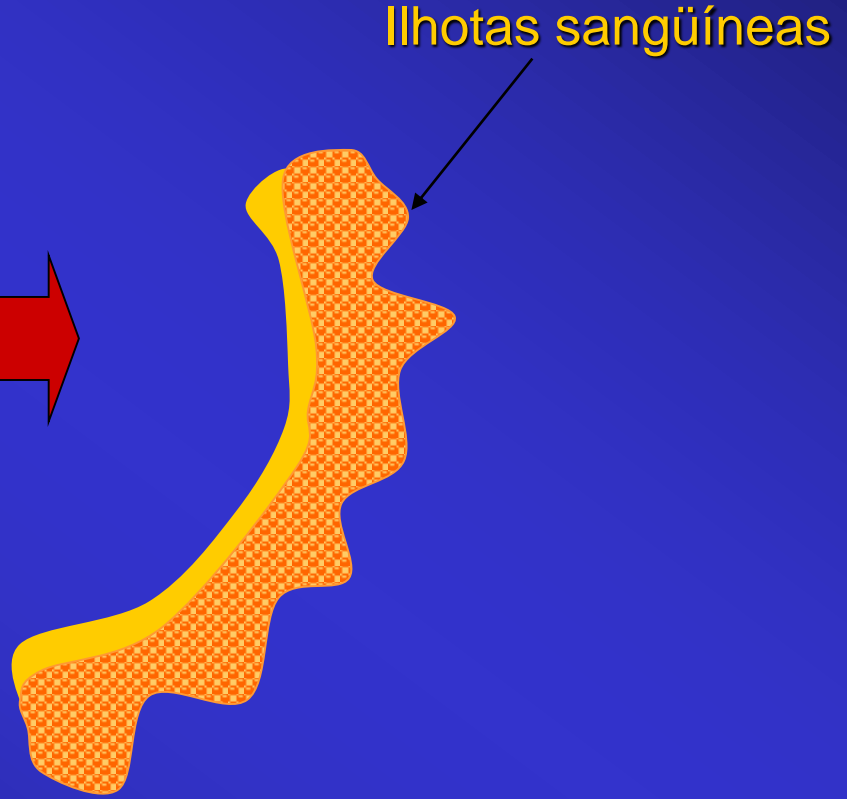
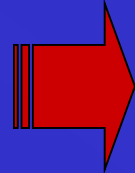
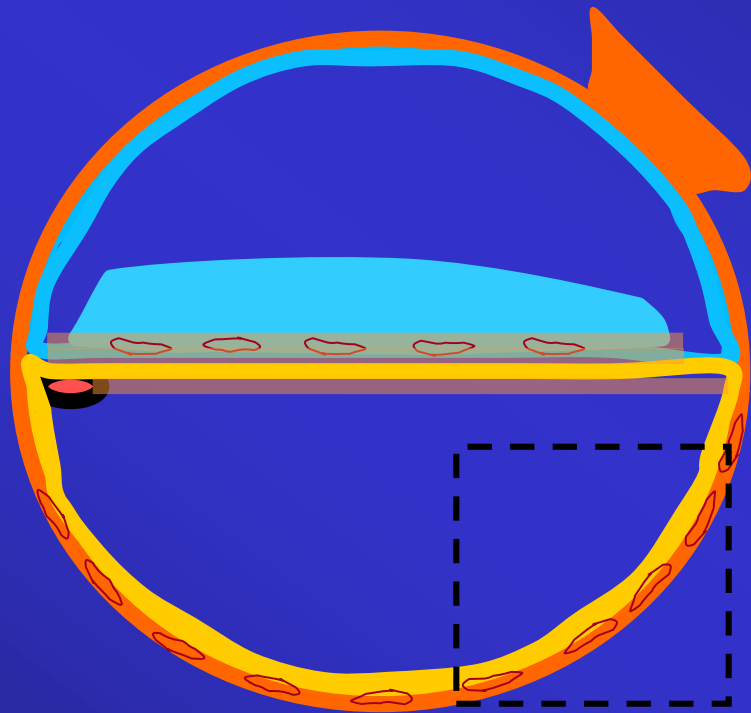


Desenvolvimento das
vilosidades coriônicas
e do
sistema cardiovascular
primitivo

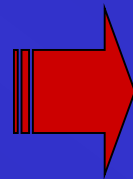
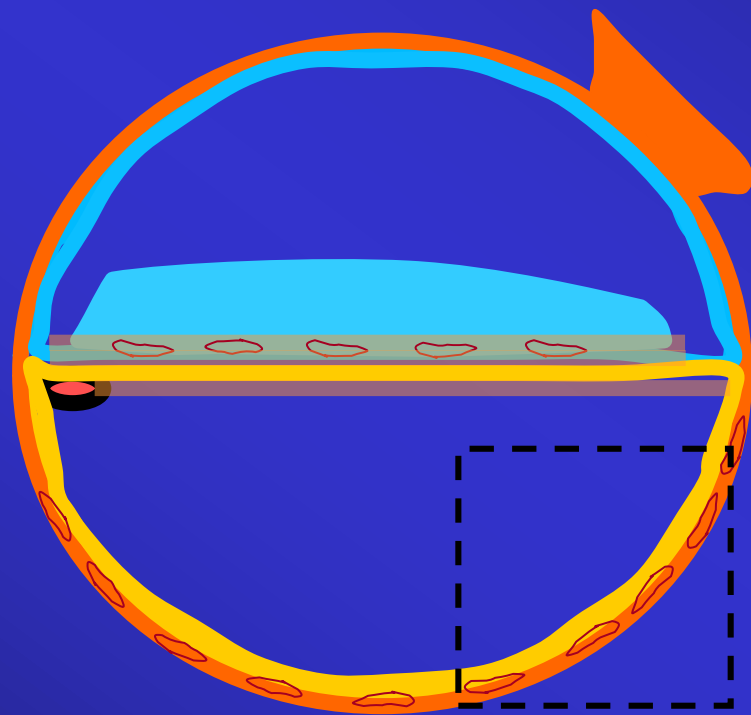


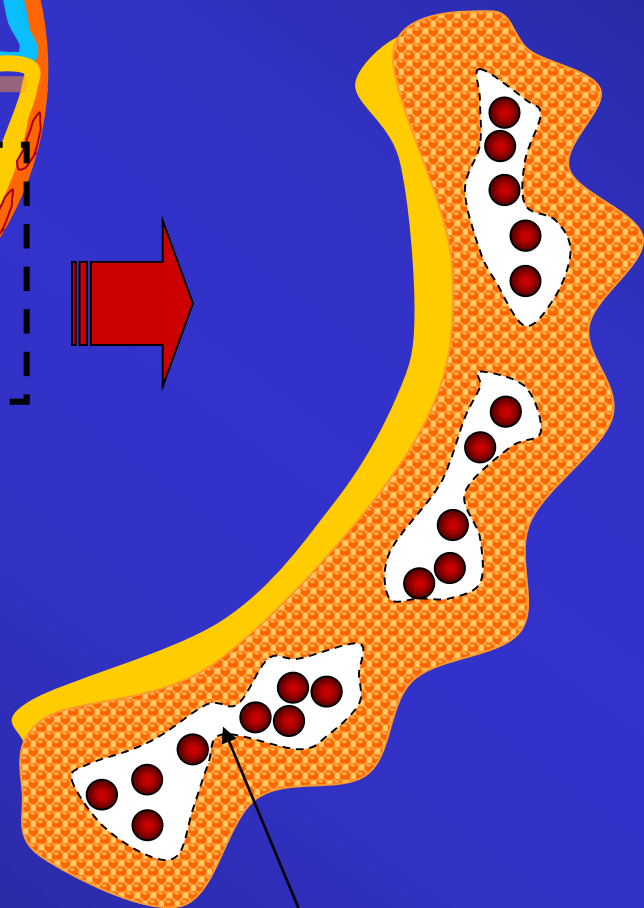
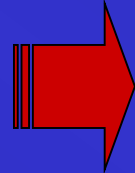
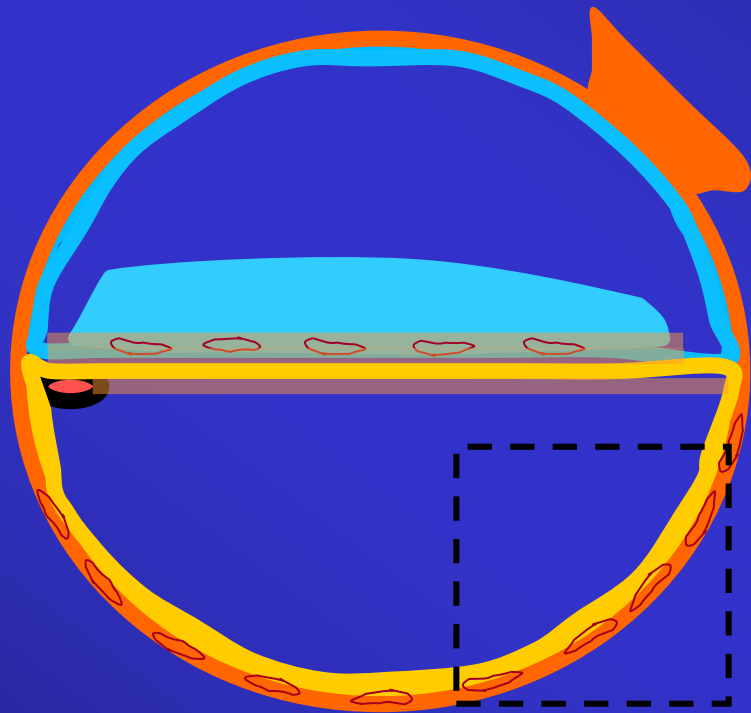
Vasos sanguíneos
em formação





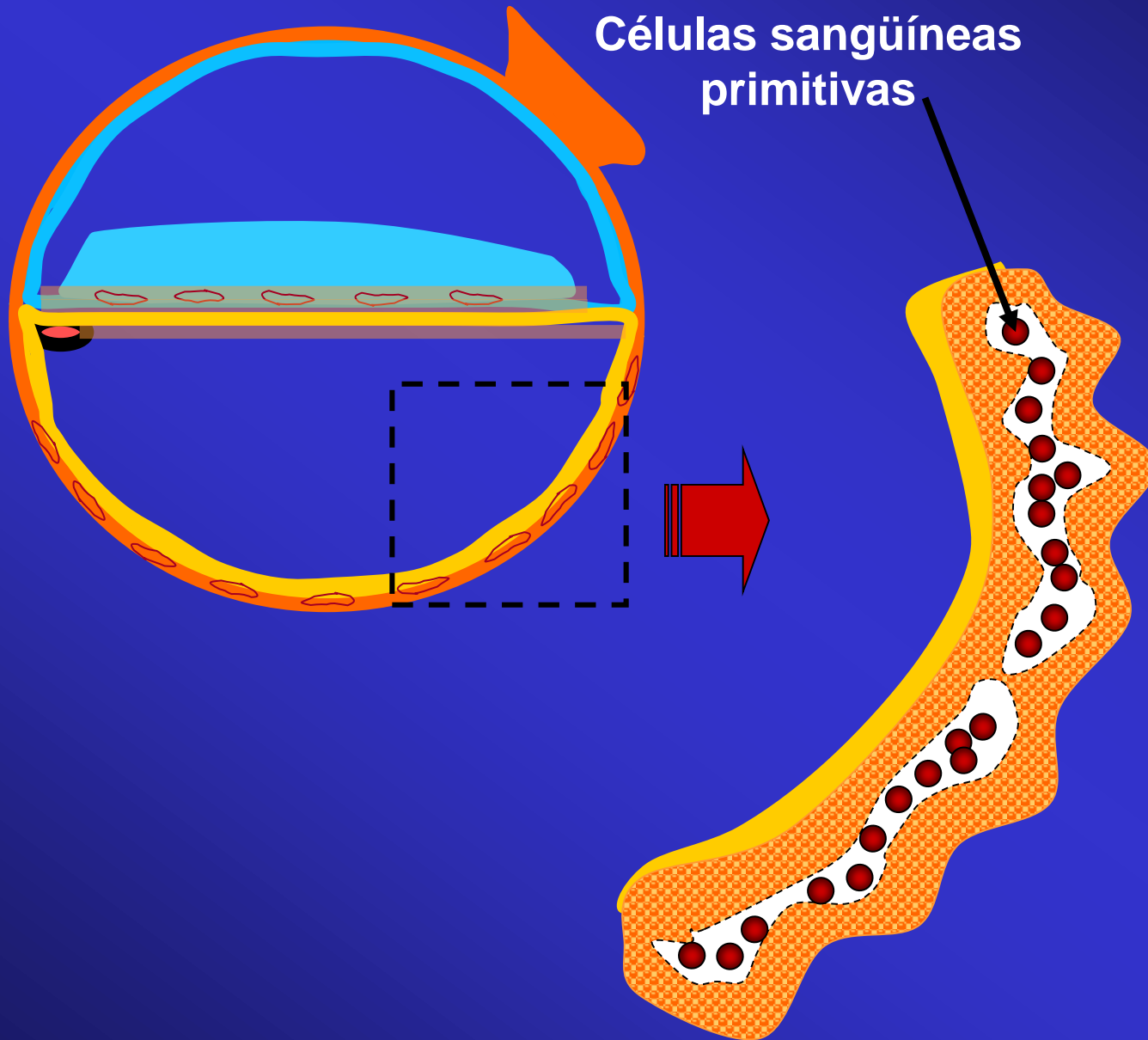
Ilhotas sangüíneas

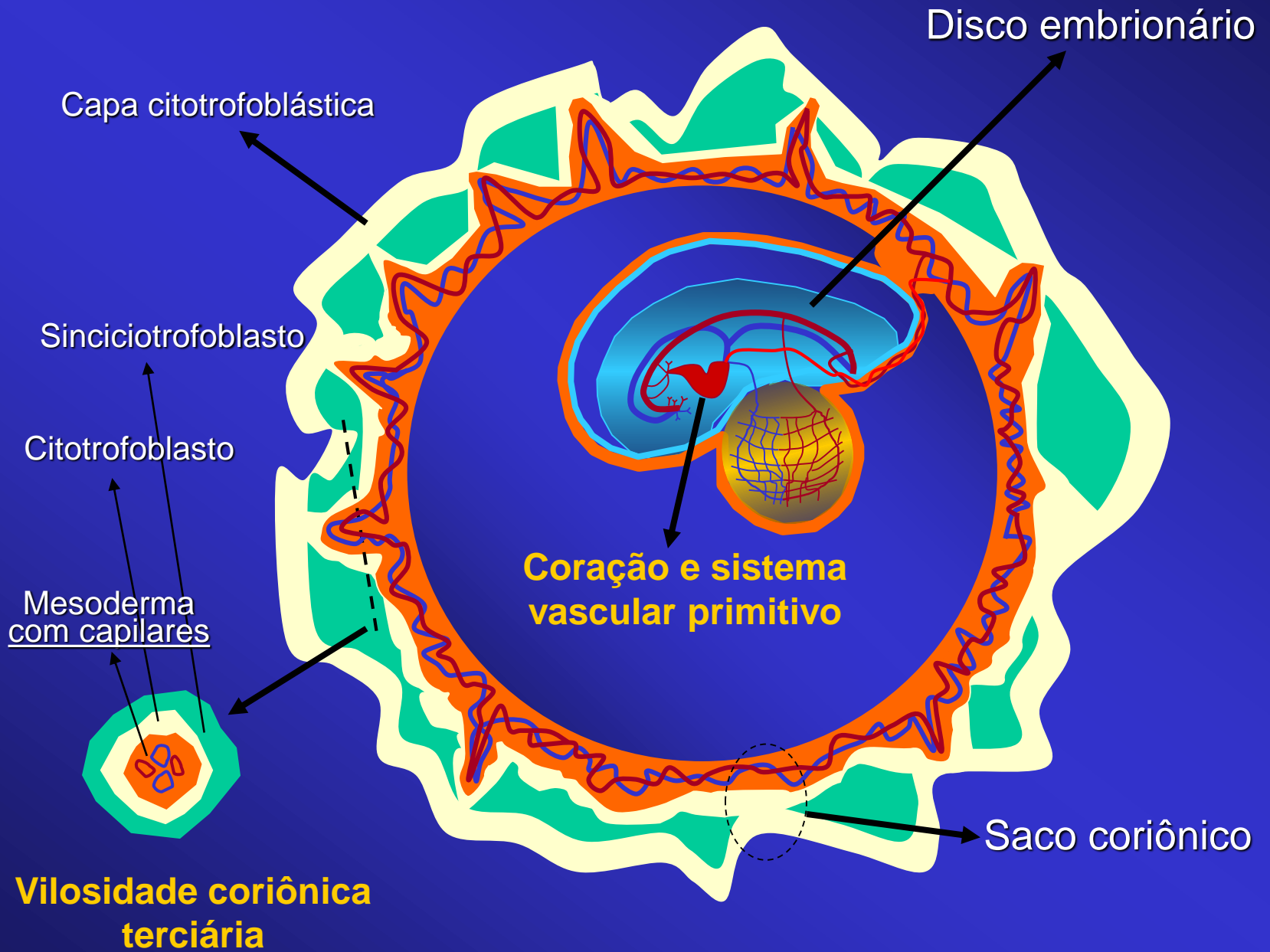




Fusão das cavidades iniciais para formar os vasos

Células sangüíneas primitivas





Final da 3ª Semana

3ª Semana do Desenvolvimento: Principais eventos

- ✓ Gastrulação: formação das camadas germinativas;
- ✓ Neurulação: formação do tubo neural;
- ✓ Desenvolvimento dos somitoss;
- ✓ Desenvolvimento do celoma intra-embrionário;
- ✓ Desenvolvimento do sistema cardiovascular primitivo;
- ✓ Término do desenvolvimento das vilosidades coriônicas.

QUARTA A OITAVA SEMANAS:

PERÍODO EMBRIONÁRIO

Período em que ocorre a ORGANOGÊNESE,
com desenvolvimento dos principais órgãos e
sistemas do corpo.

QUARTA SEMANA:

O DOBRAMENTO DO EMBRIÃO

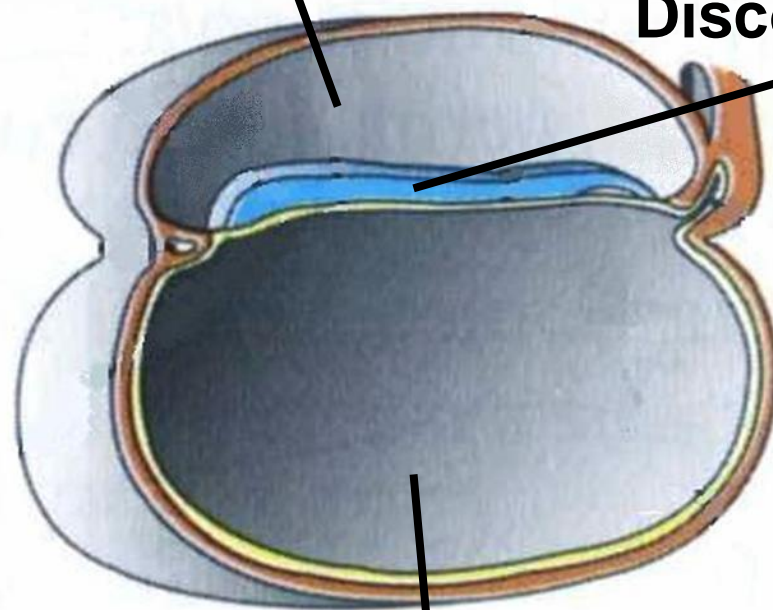
O rápido crescimento do embrião (disco embrionário), principalmente do sistema nervoso central, que se desenvolve a partir do tubo neural, induz ao dobramento do embrião.

O DOBRAMENTO DO EMBRIÃO NO PLANO MÉDIO:

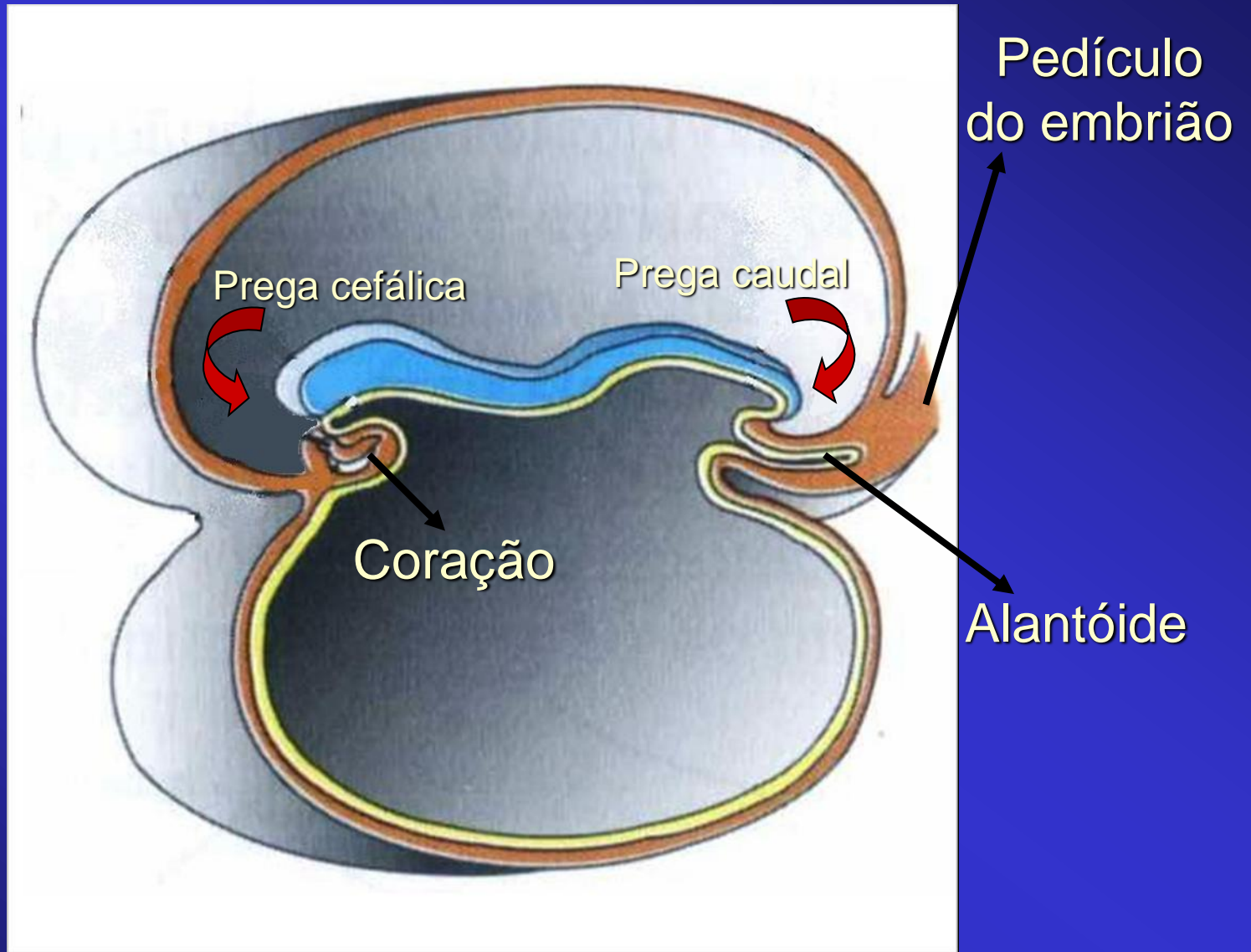
Induz a formação das pregas cefálica e caudal.

Cavidade amniótica

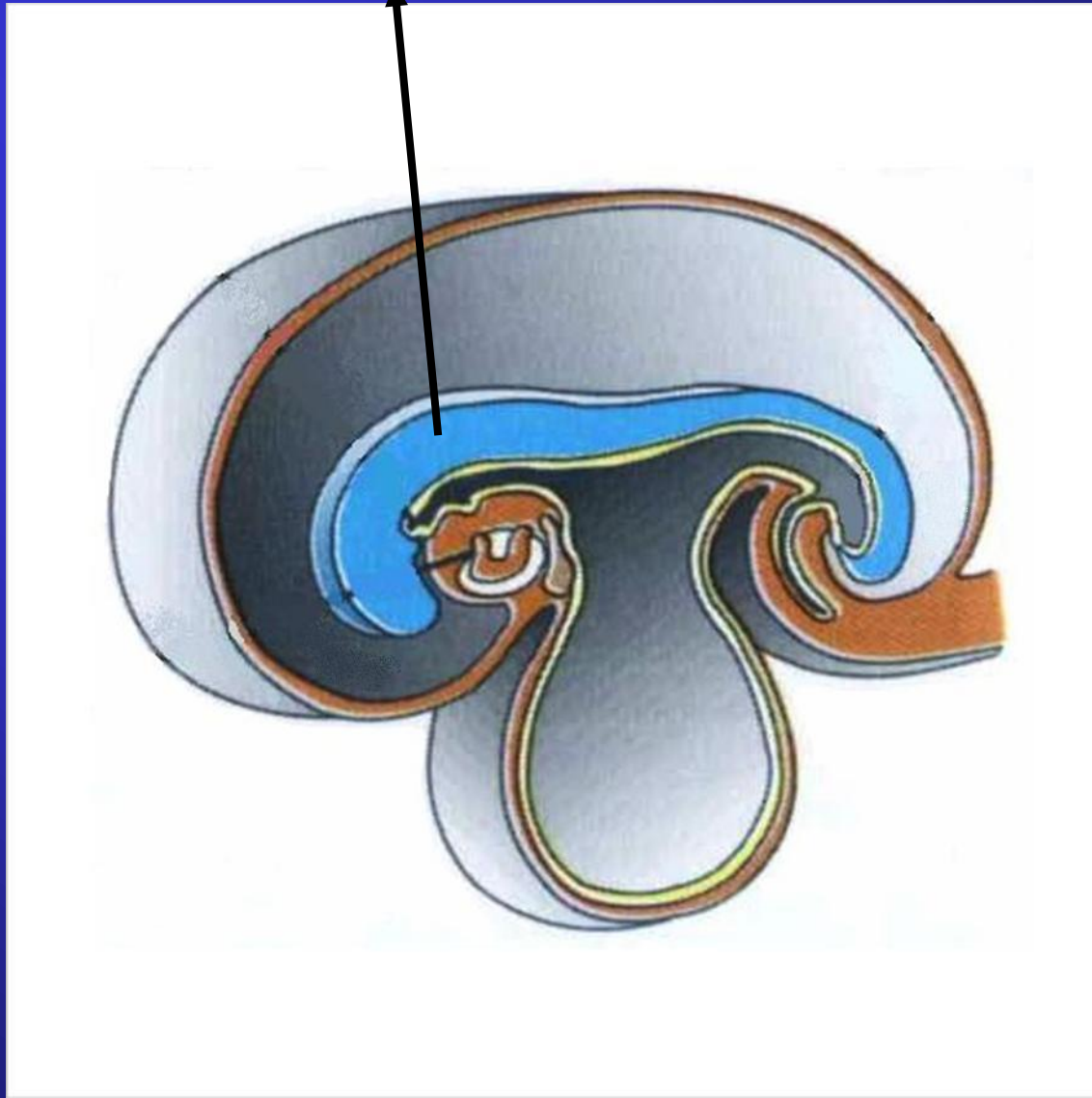
Disco embrionário



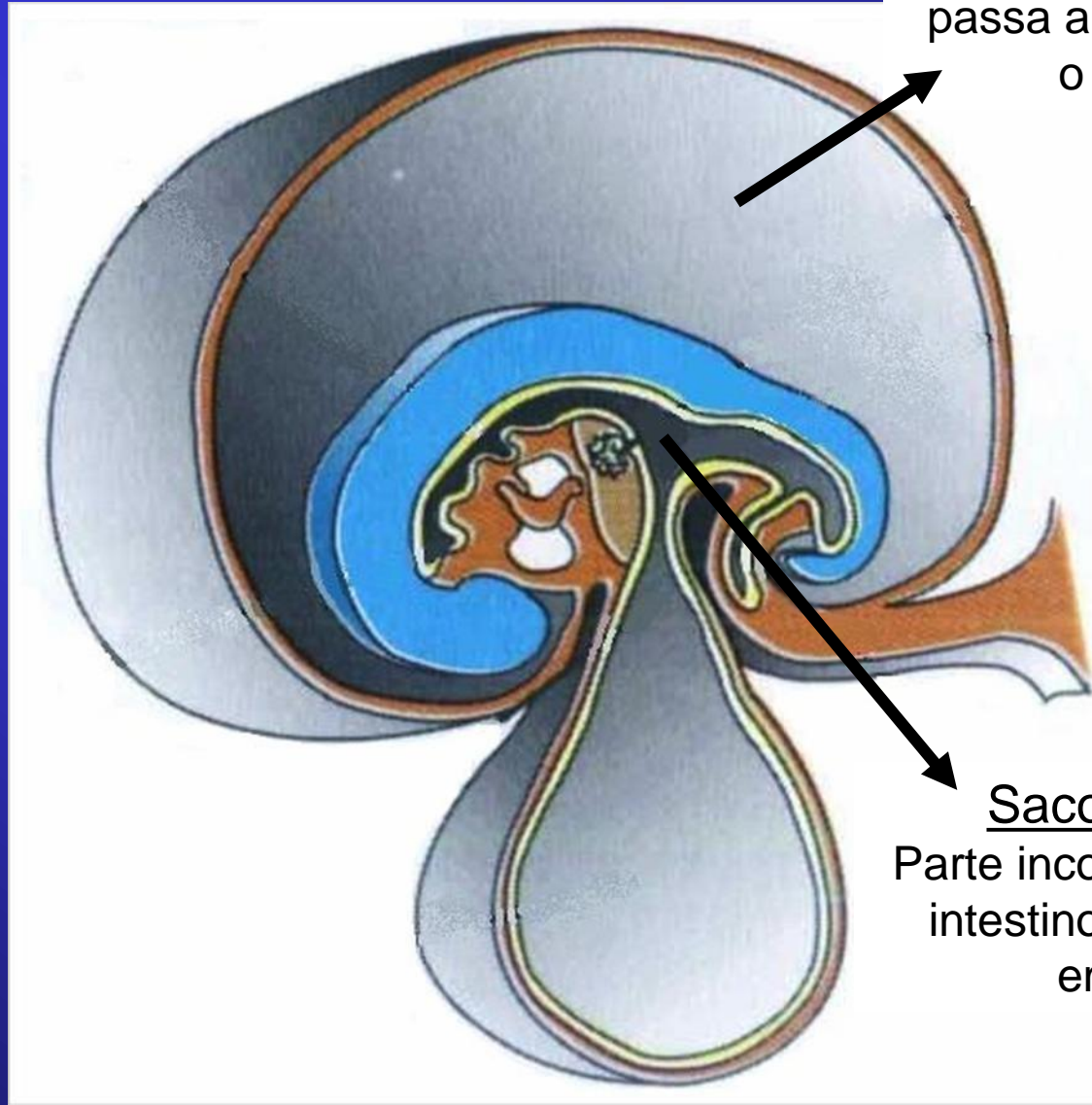
Saco vitelino



Sistema nervoso central em desenvolvimento

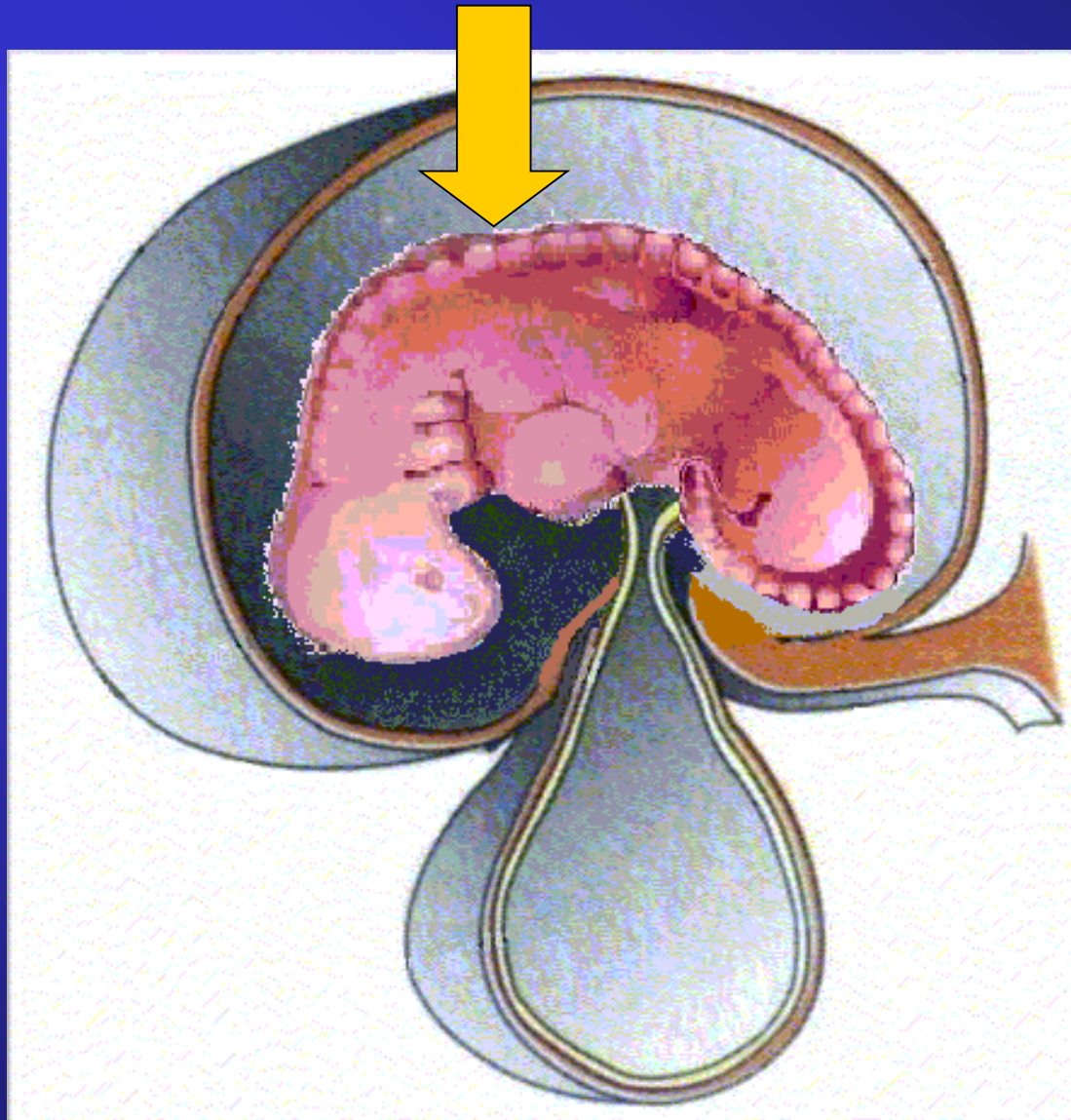


Cavidade amniótica:
passa a envolver todo
o embrião



Saco vitelino:
Parte incorporada como
intestino primitivo do
embrião

Aspecto externo do embrião, nesta fase

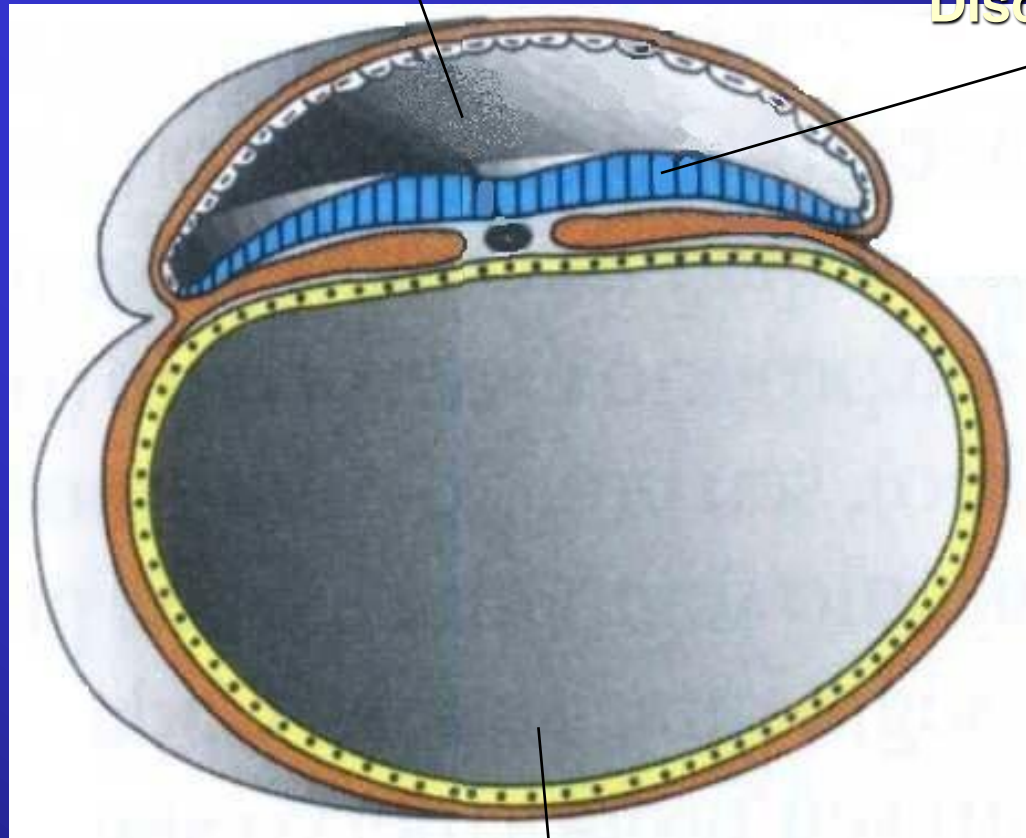


O DOBRAMENTO DO EMBRIÃO NO PLANO HORIZONTAL:

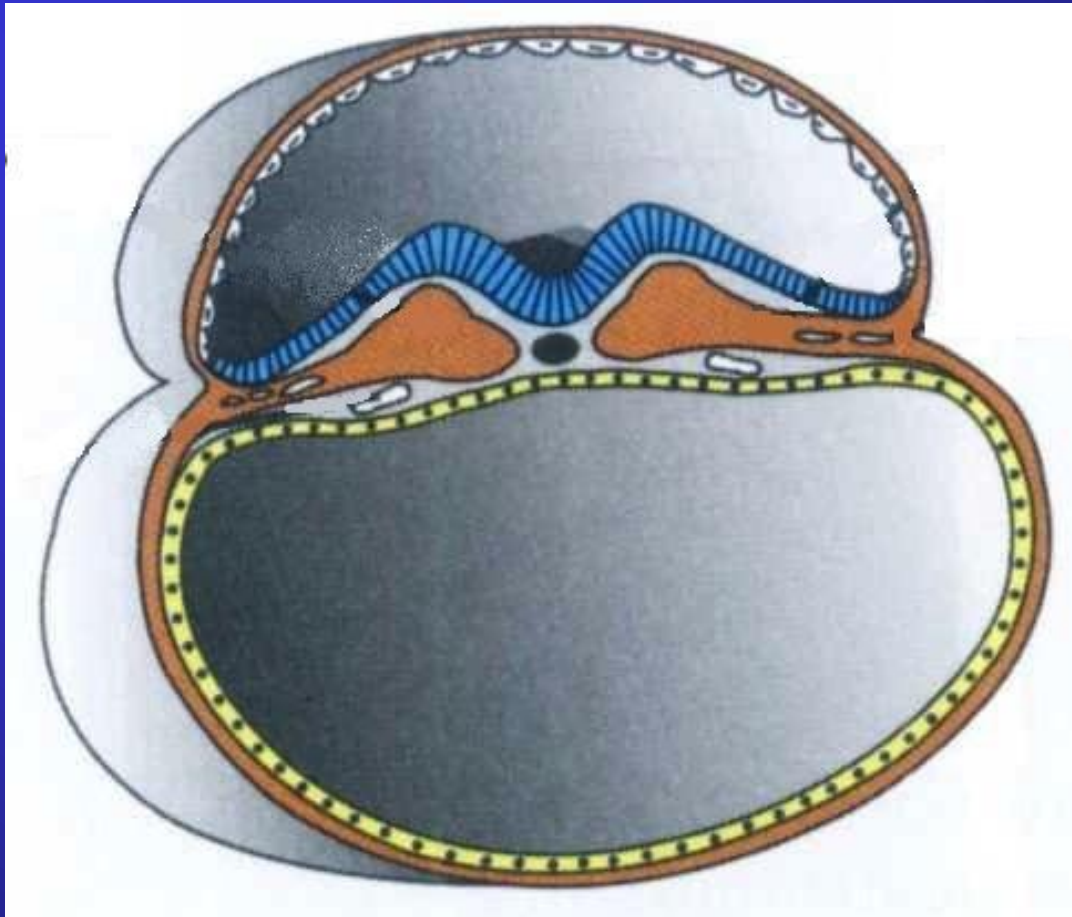
Induz a formação das pregas laterais

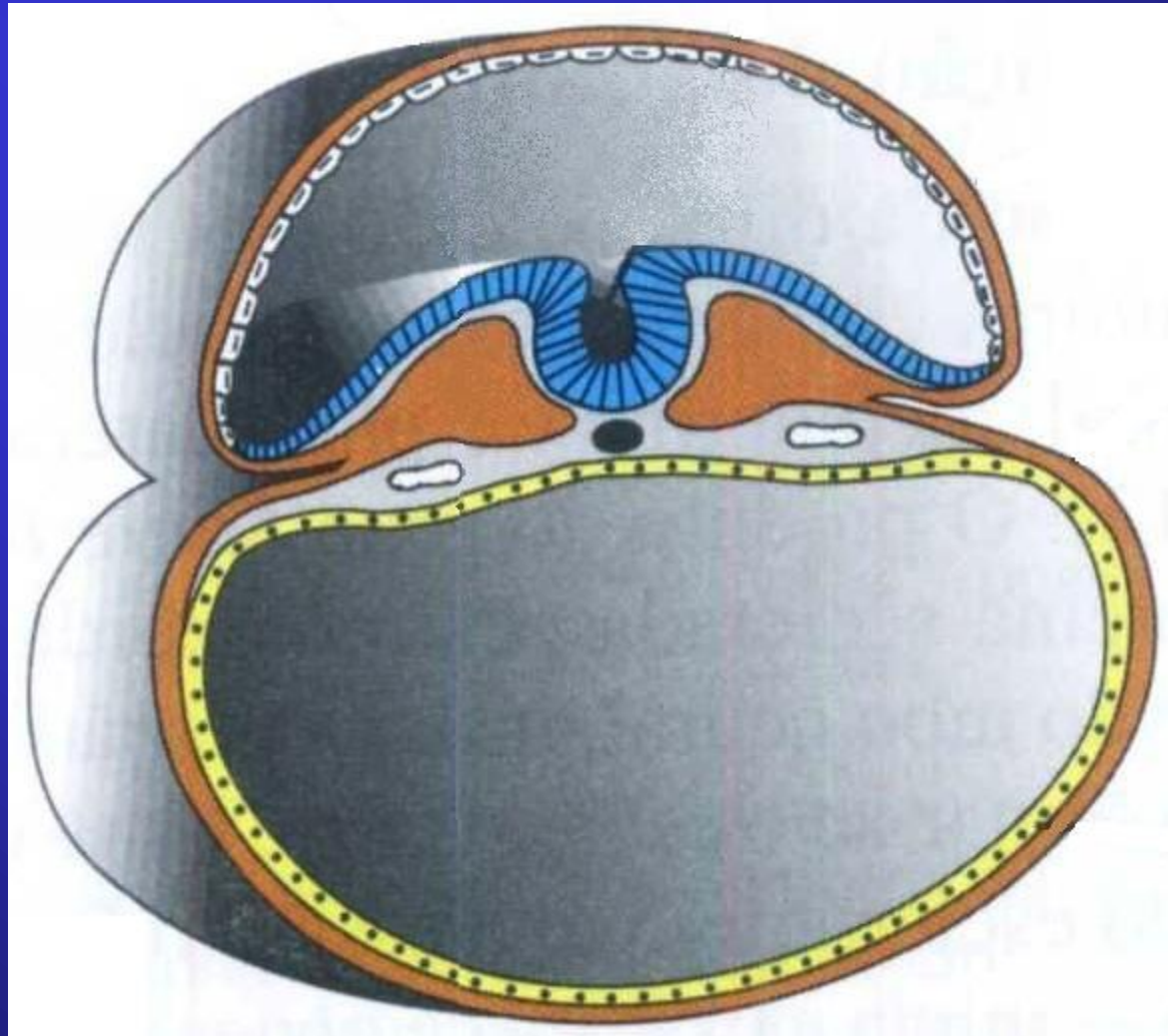
Cavidade amniótica

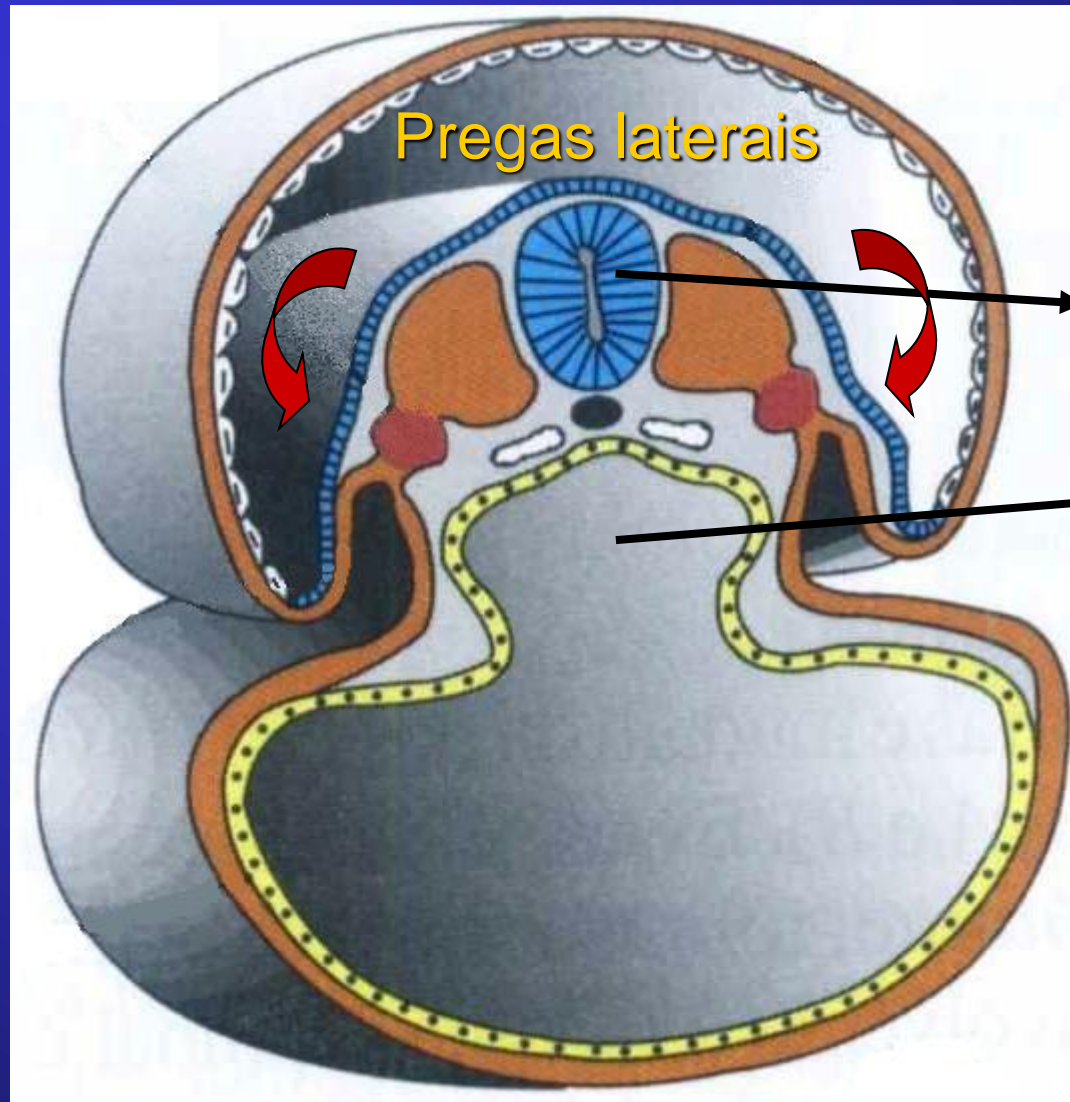
**Disco embrionário
(ectoderma)**



Saco vitelino







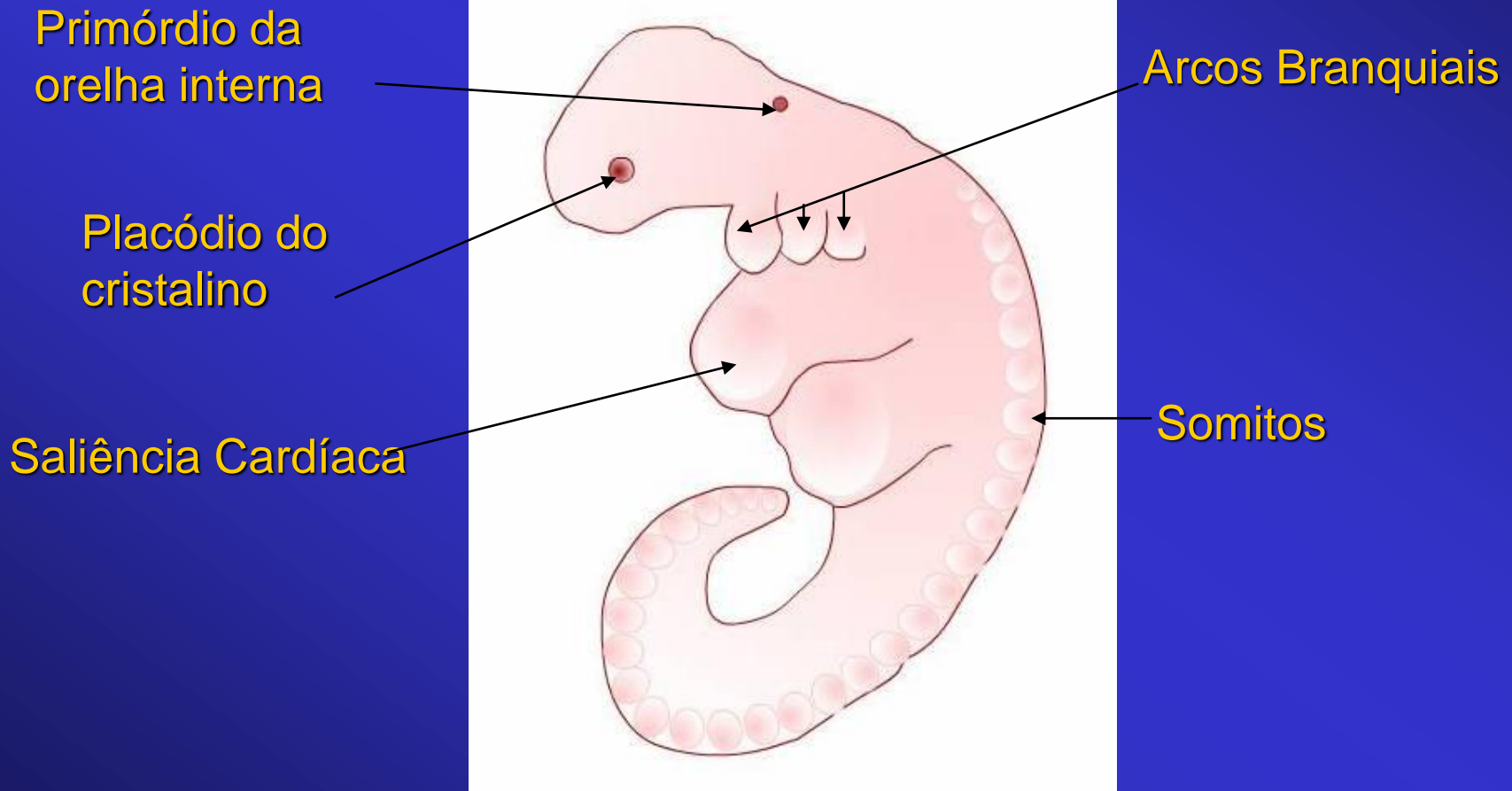
Tubo neural

Saco vitelino
(formação do
intestino primitivo)

QUARTA A OITAVA SEMANAS:

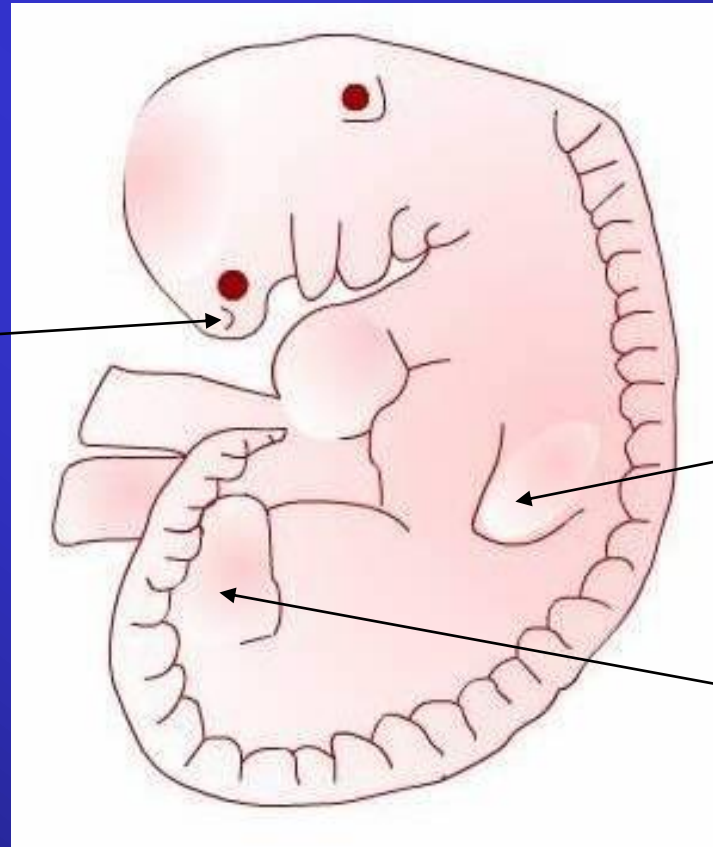
**O DESENVOLVIMENTO EXTERNO DO
EMBRIÃO**

Quarta Semana - 26 DIAS



Quarta Semana - 28 DIAS

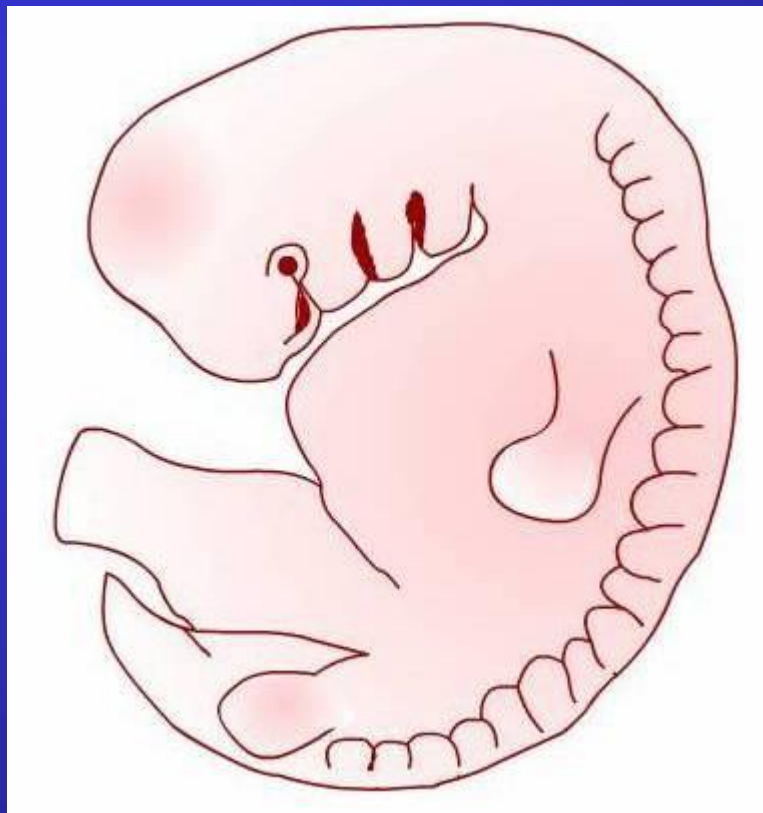
Placódio nasal



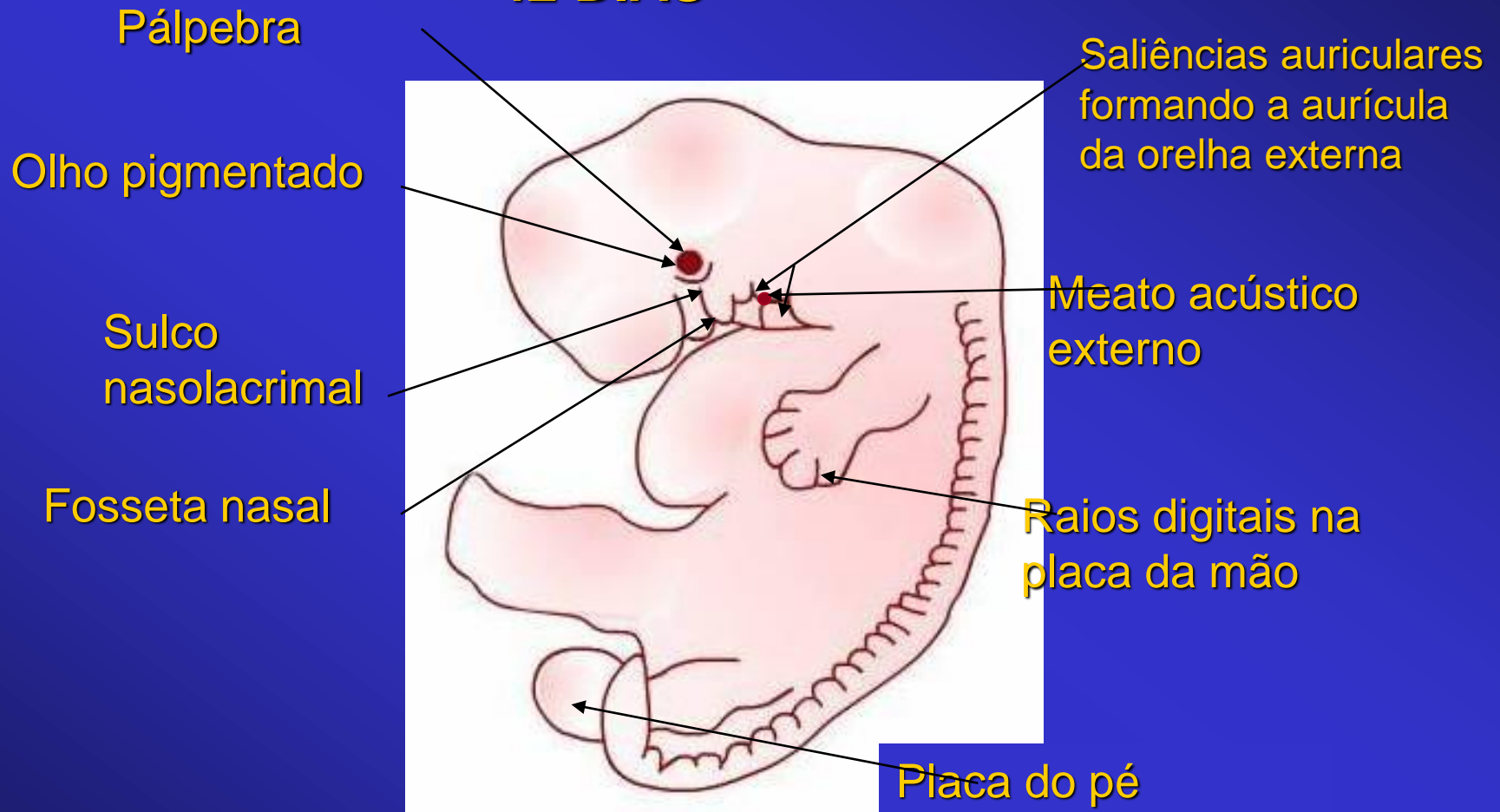
Broto de membro superior

Broto de membro inferior

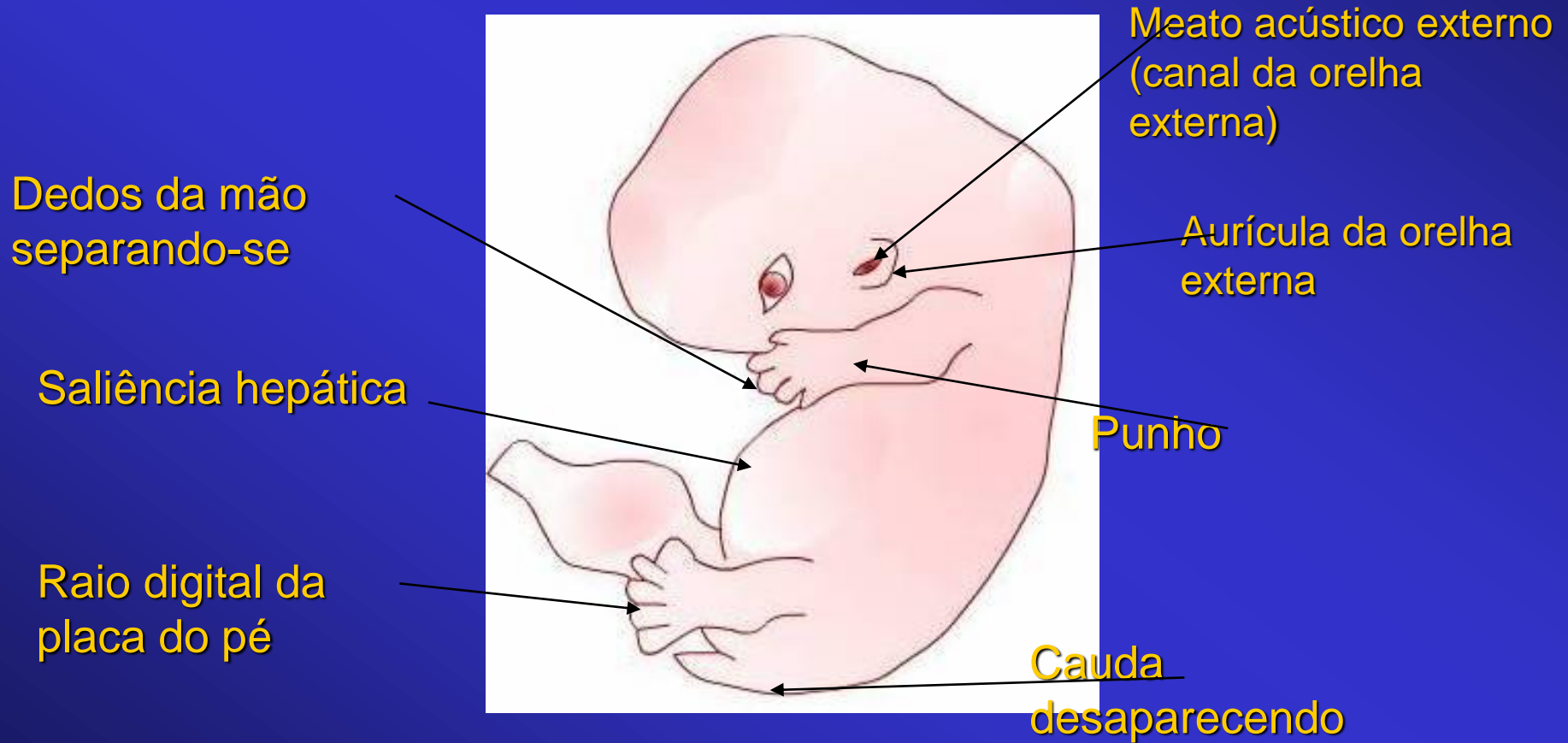
Quinta Semana - **32 DIAS**



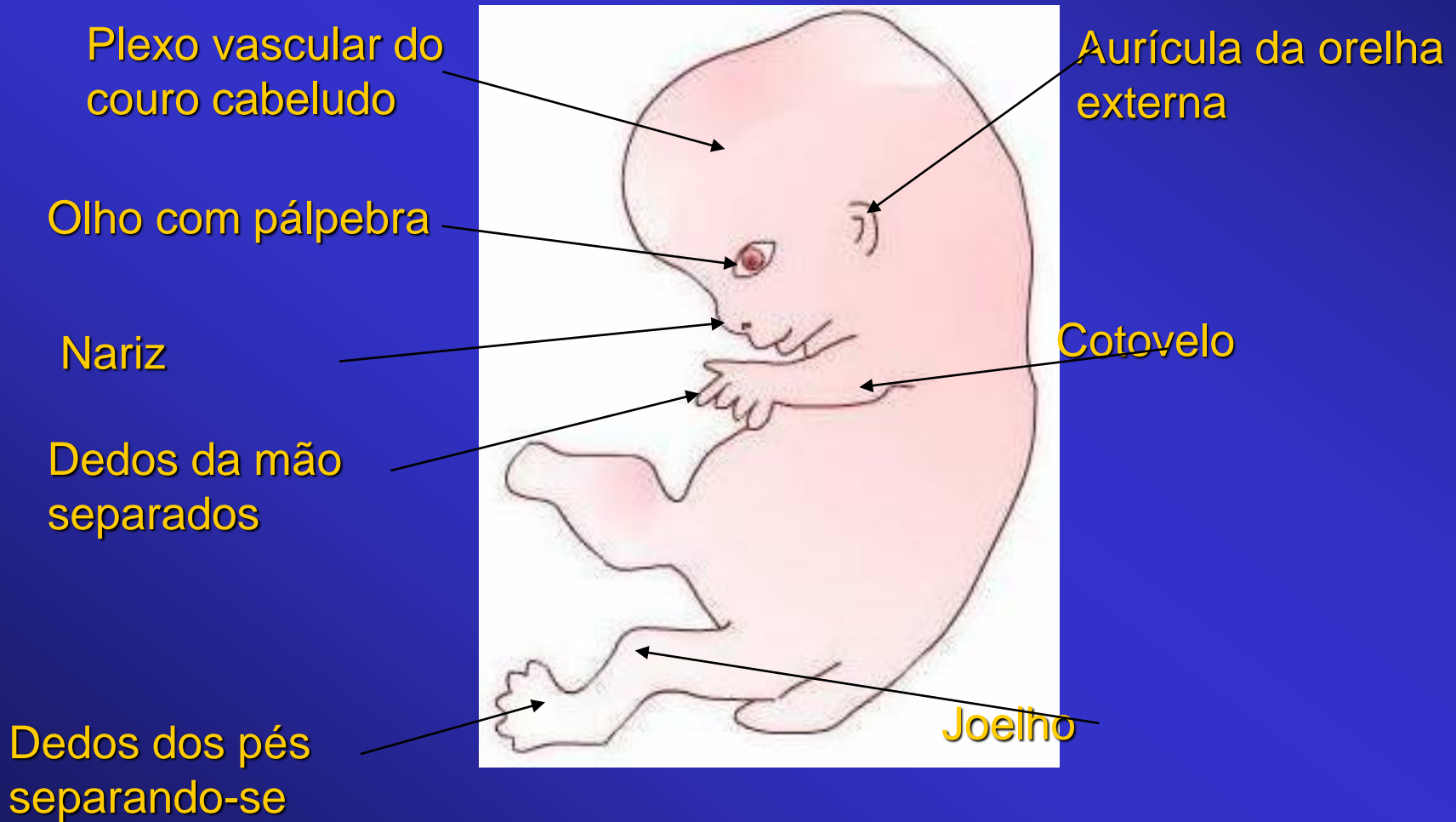
Sexta Semana - **42 DIAS**



Sétima Semana - 48 DIAS



Oitava Semana - **52 DIAS**



Oitava Semana - **56 DIAS**

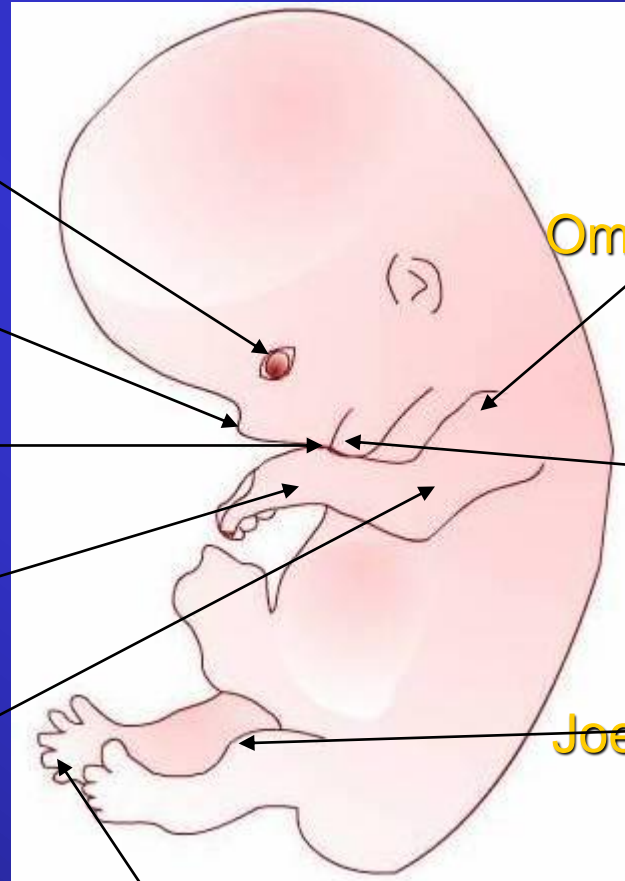
Pálpebra
fechando-se

Nariz

Boca

Punho

Braço



Ombro

Mandíbula inferior

Joelho

Dedos dos pés
separados

BIBLIOGRAFIA

CATALA, M. Embriologia – Desenvolvimento Humano Inicial. Guanabara Koogan, Rio de Janeiro, 2003.

MOORE, K.L. & PERSAUD, T.V.N. *Embriologia Básica*. Guanabara Koogan, Rio de Janeiro, 2000.

MOORE, K.L. & PERSAUD, T.V.N. *Embriologia Clínica*. Guanabara Koogan, Rio de Janeiro, 2000.

SADLER, T.W. *Langman - Embriologia Médica*. Guanabara Koogan, Rio de Janeiro, 2001.