

Notes from Barcelona

Presented in the Embryo Physics Course <http://www.embryophysics.org>

May 26, 2010

By

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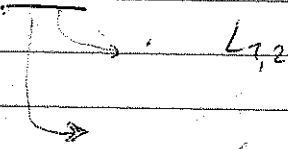
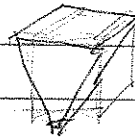
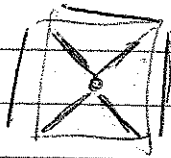


Jose Muñoz

May 25, 2010

pu

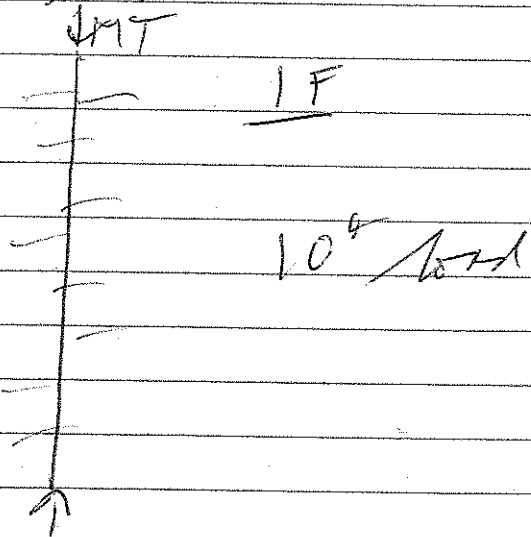
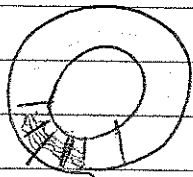
modelling cytoskeleton
Naked Quekfield - died 2002
Dordon J ELENIC



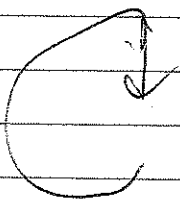
TENSEGRITY

Buckminster Fuller
1970 Don Ingber
stiff - MT
+ elastic - MF

1990 Brodland + R. D.

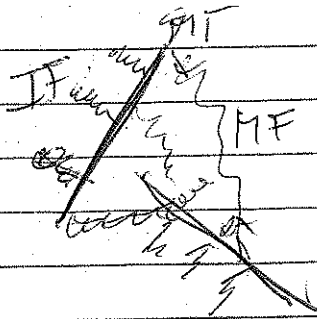


1994 Alpha stiff element
MF = MT with lateral support



circular argument?

— membrane breaks wide

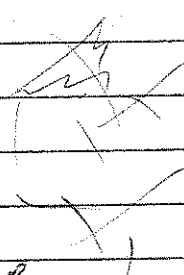


Asyker

rubber band (elastics)
+ sticks

Stomnovic

↓
continuum
modelling



states

are there free MTs in a cell?

4 components to cellular tensegrity

MT

MF

IF

membrane

→ TENSEGRICELL

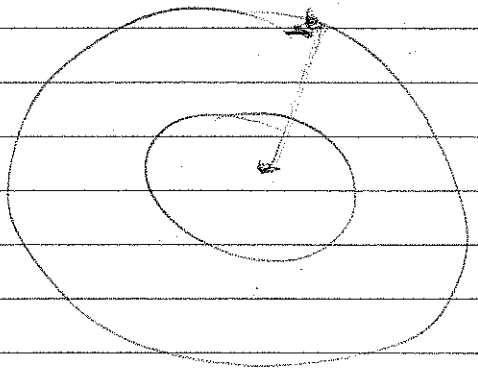
spindle apparatus
tissue contractility - focal pts.
cell state splitter

bitable

physics of cytoplasm

- anomalous diffusion
- power laws in

fast

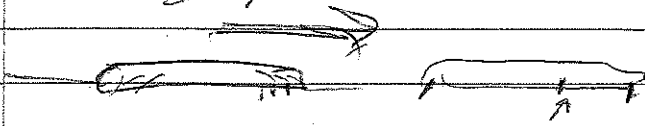


stress waves
transmitting info.
- very fast

fast & slow

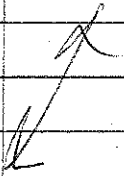
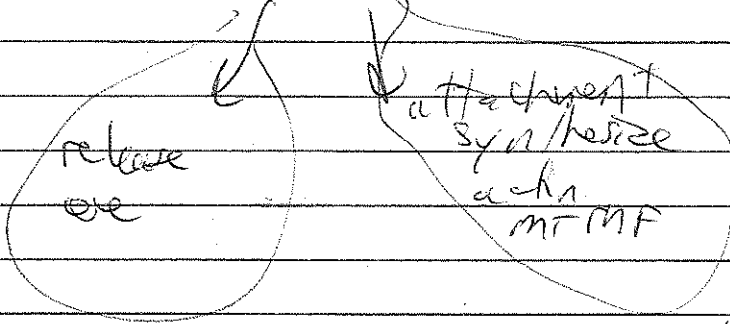
model to incorporate broad
range of cytoplasm physics

single cell

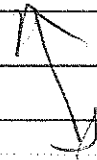


early life

all biochemical

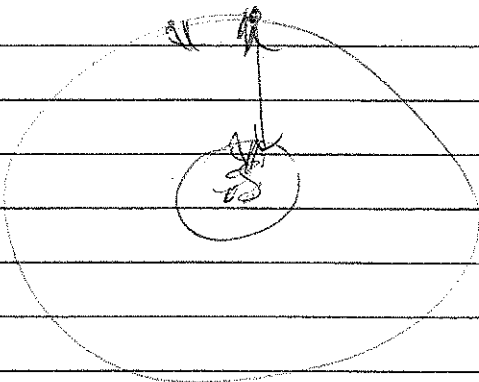


10th week



dephosphorylation
polymerization

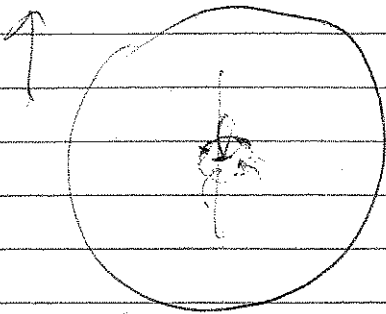
genes involved
in flux



amplified

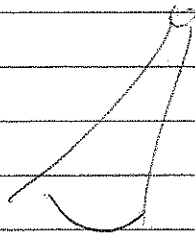
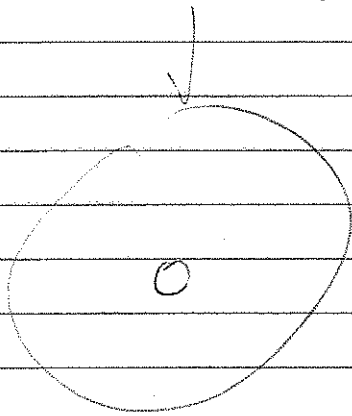
dorsal

INVERSION



ventral

dorsal tip of centrosome
= wave propagating
through ectoderm

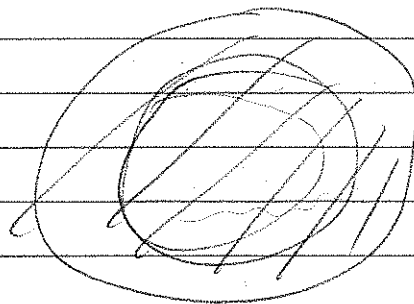
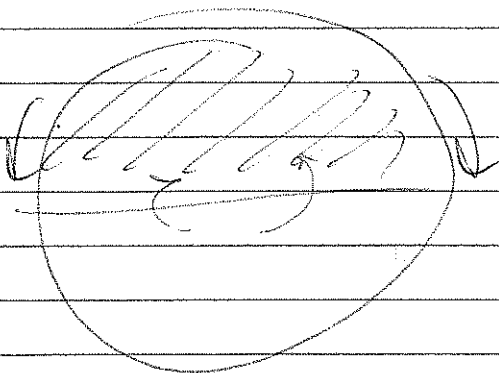


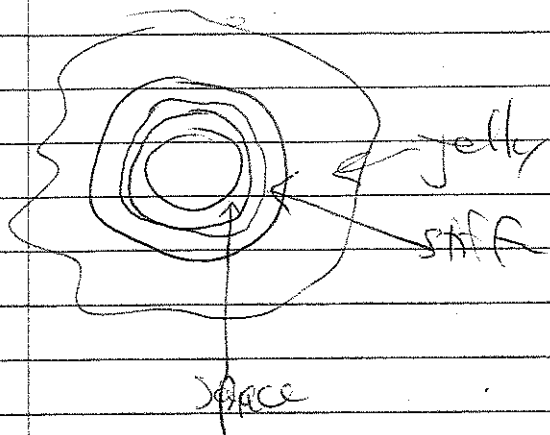
bottle cell

BOTH
INVOLVED

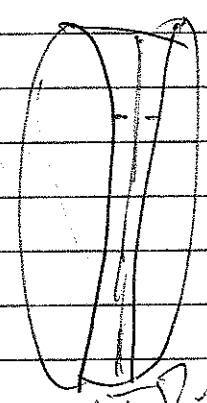
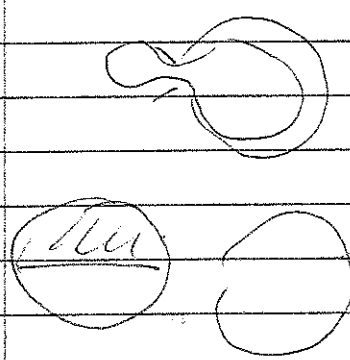
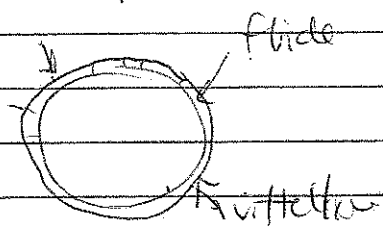
apical
contraction
& expansion

what
activity
generates
forces?



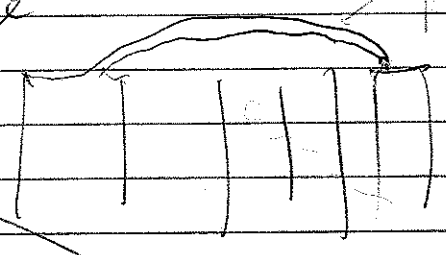
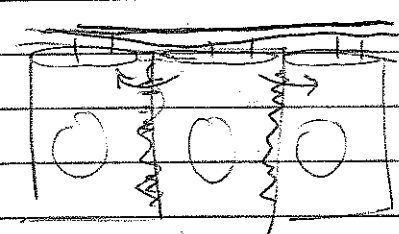


intertine
membrane
like cell phone
- development
normal
removed



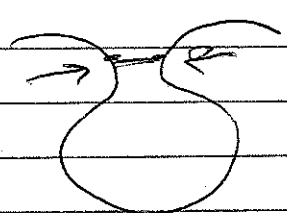
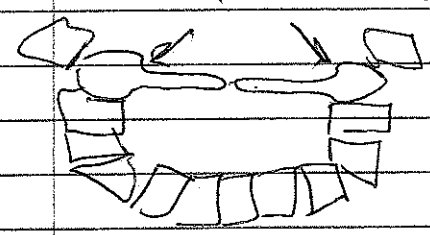
NTD's that run
in specific
boundaries
nerve
nerve tube
closure
fulguration

70%



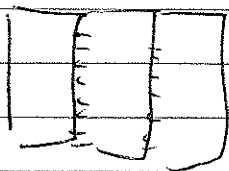
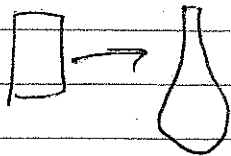
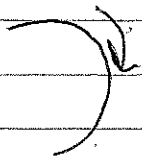
30% NTD

30% NTD
Faulty NTD

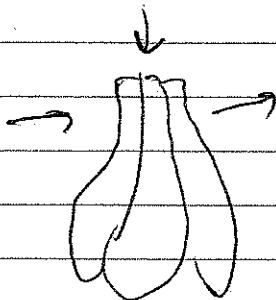
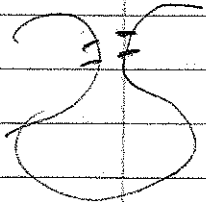


genes
turned
on
in
NTD's
cytologues
of
nerve

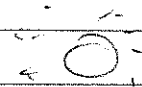
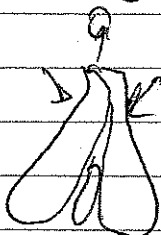
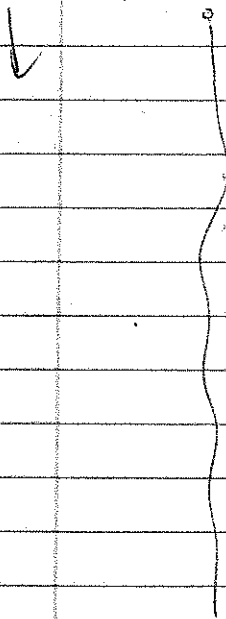
of our cover.
knows in biology + cytology



→ Membrane
 → Pharynx
 → notched cells
 - germ cells
 - non-germ cells

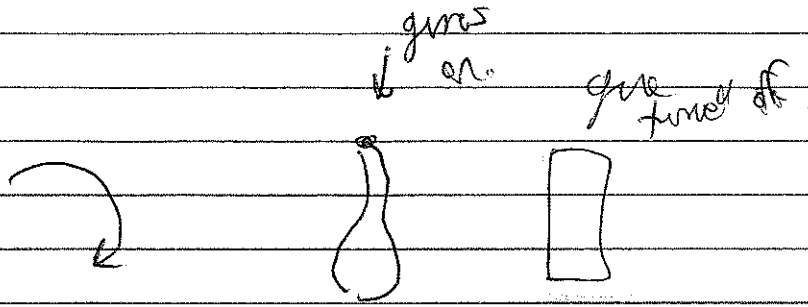


mesoderm
 cells

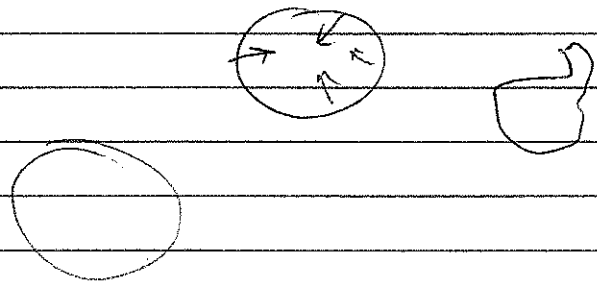


→ make
 migrate
 and new
 differ

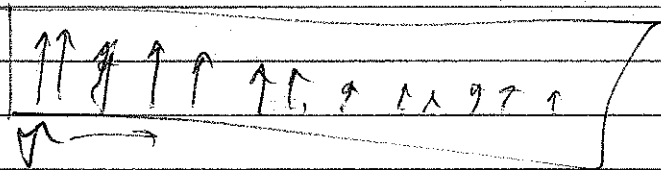
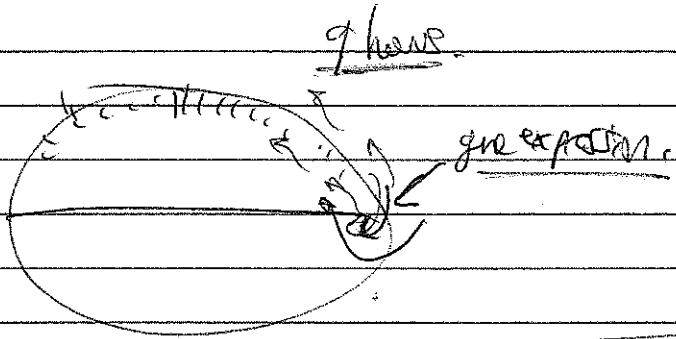
germs.
 germ cell.



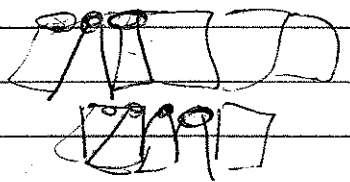
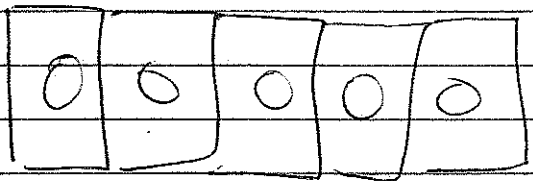
runned in
shape
D give
apparent

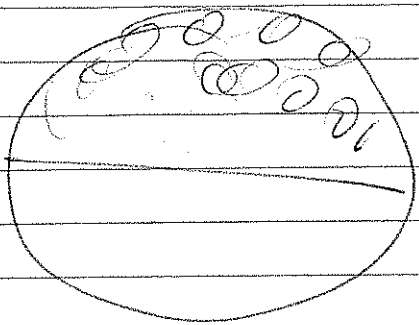


10 minutes
time to
permanently
change
gene
expression



more
models

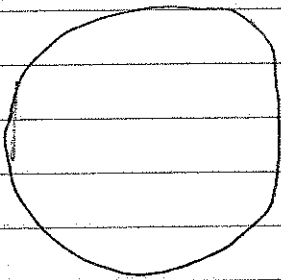




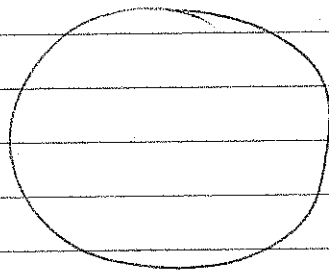
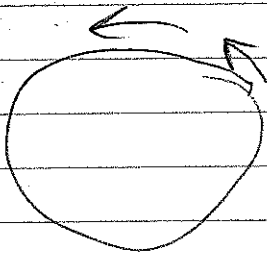
type of contraction
 wave

compaction
 in mammals

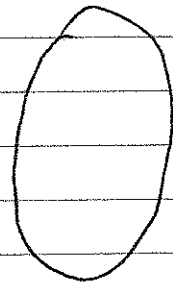
simultaneous
 contraction
 in 10 mins



10 mins. / all wave



→



10 min

Cotte + Brodland
 measuring

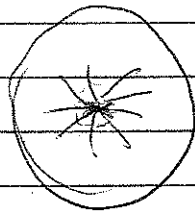
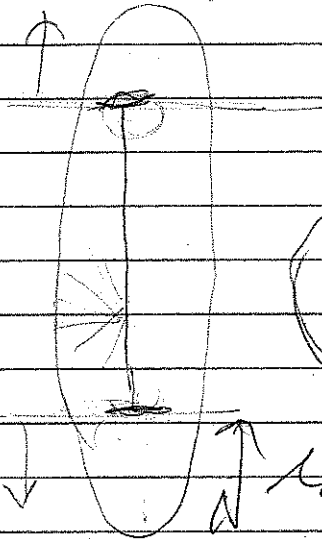
Belousova - hyperrestoration
 - no rate phenomena
 - stress activated contraction
 - opposite

propagation of ~~any~~ contraction wave
 = stress activated
 - of expansion wave, might be
 hyperrestoration

URODELES

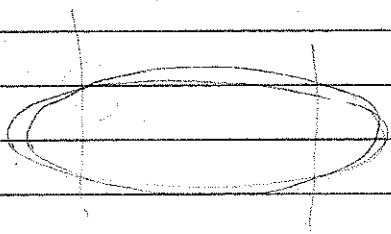
NEWTS

SALAMANDERS

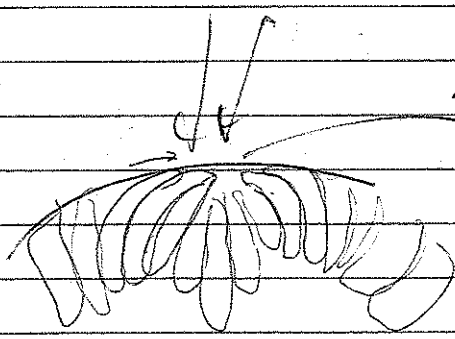


check
HGDW
incub (fly T)
→ near
spherical
eggs
- aberrant

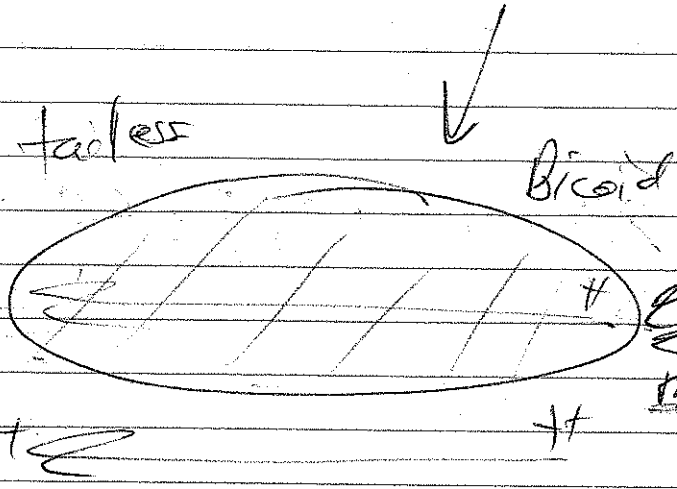
spherical embryos
low stress in axial direction



survey of
spherical egg
shapes
+ correlation
with shape of
nourishing region
fruit fly
breath invagination



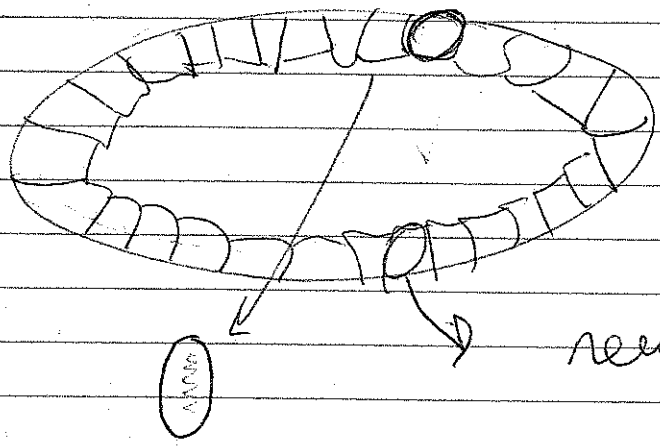
3 days



Mitochond

POLYEMBRYONIC
WASPS

evets



1700
flies

new fly

PLOIDY

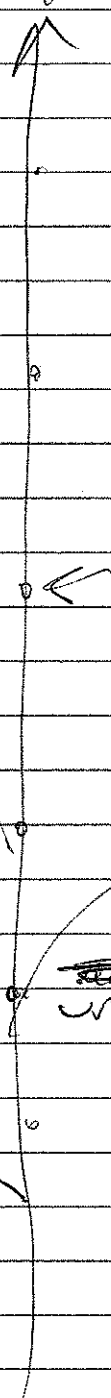
UROPELES - 7-PLOIDY

CELL SIZE = MONOTEMIC (PLOIDY)

KELF - 100m
 - CELLULAR
 - SYNCTIAL

multicellular

with
LP



Xenopus

~~secondary~~
water

Drosophila

one cell

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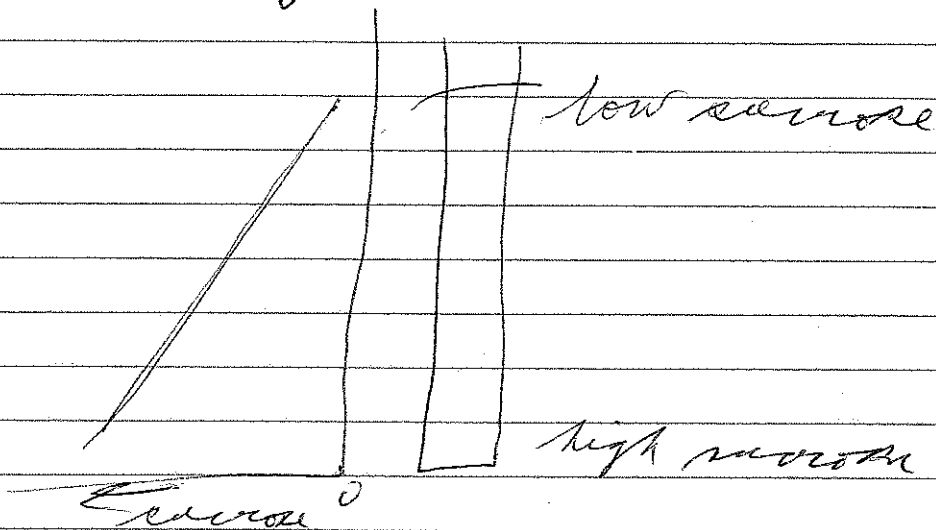
Twitty (1966) of Science and Laboratories Freeman & Co.

neural induction

mu

Ross Flint

density gradient



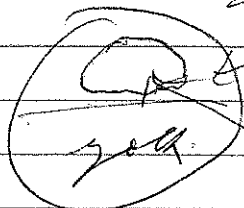
axotoll egg
hard
bodies

need to be repeated

impregnation

linear gradient of yolk

cutting through
nucleus could
give density reversal



clear cytoplasm

cell nucleus

= germinal vesicle

N

ASSUME
ORDERED

SUSCBS

UT₁ IN

NE AT
A TIME

don't have basic density data

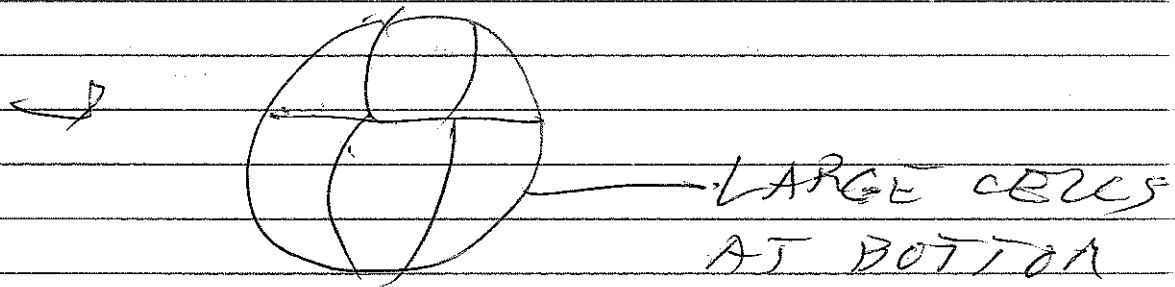
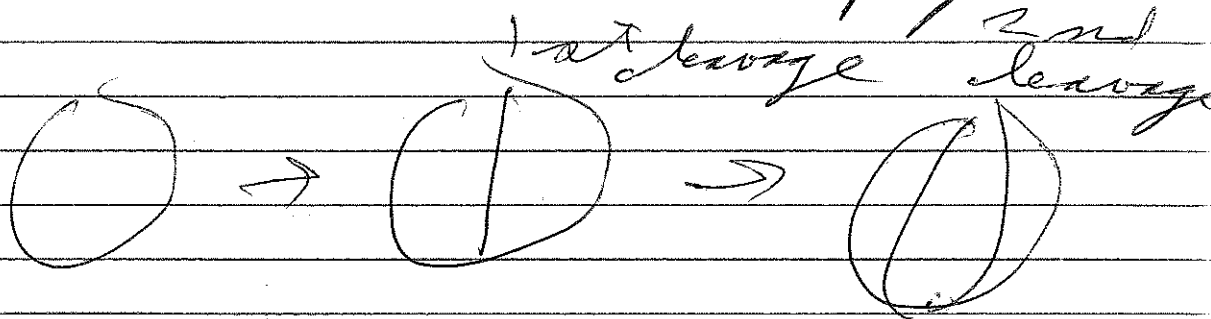
nor:

1) variation of density gradient
between:

a) individuals

b) spawnings

nutrition → "condition" of yolk



QUESTIONS:

what determines orientation
of cleavage?

- why are bottom cells
bigger?

varies with

- microgravity -

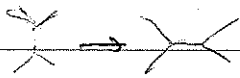
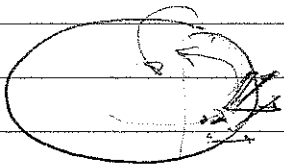
- reviewed by Susan Crawford Young

Neff et al. (1993)

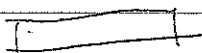
QUESTION: DONE AT sedimentation
equilibrium? - don't know

notograde = supranotograde
region of the neural plate

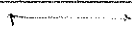
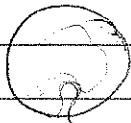
Jacobson lost original height data
as figured heights are relative
pattern of height programs
never explained



Drosophila
germ band extension
kinematics
in Nature 2008
- all cells tracked



L. Taber



$$\dot{g} = \beta (\sigma - \sigma_T)$$

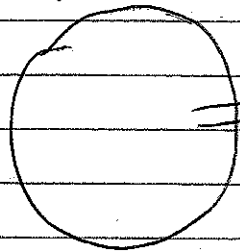
σ_e

Given that morpho development
is independent of gravity

→ need a scale-free models
for embryogenesis
- where cell size does not matter

caveat:
within a limit of range of
cell sizes

density of cytoskeleton is independent
of cell size
1 cell embryo



= needle

- withdraw material

→ healing of membrane

can one inflate and get healing?

stochastic transformation

DNA
→ methyl

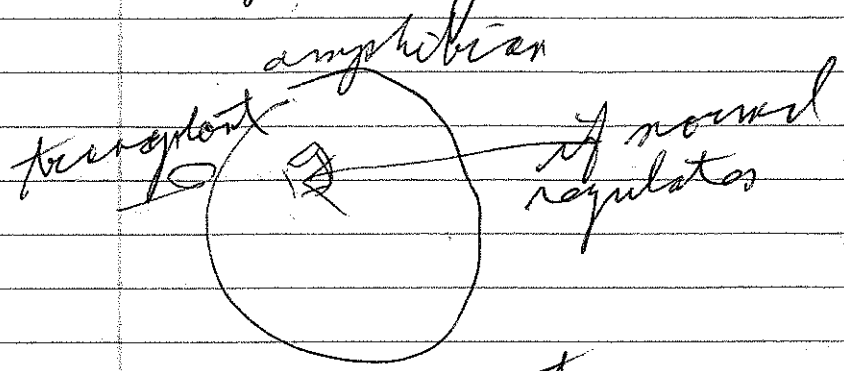


use alkyl seltzer

nuclear state splitter

- needs updating

regulating or mosaic embryos



C. elegans

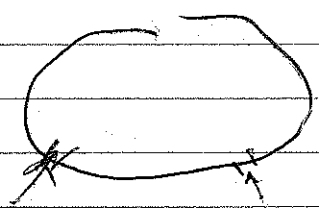
mosaic

900 cells

850 kinds of cells

850 unique cells
+ 50 germs

if not then say "determined"



sperm entry

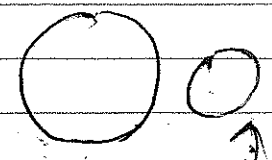
division asymmetric worm

if many cells in a tissue

→ regulating

- coordination by differentiation waves

most cell divisions are asymmetric



↑ expansion wave

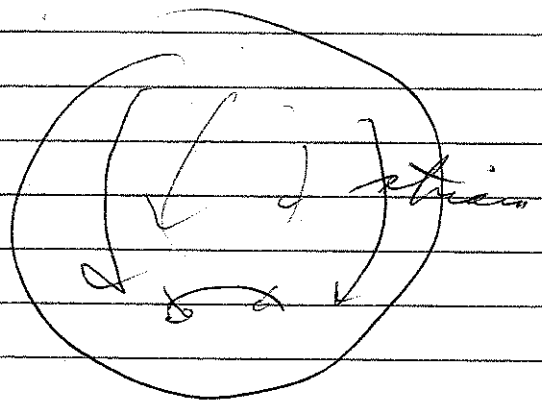
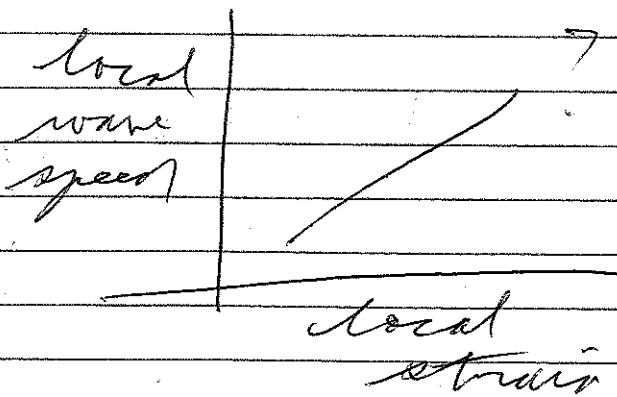
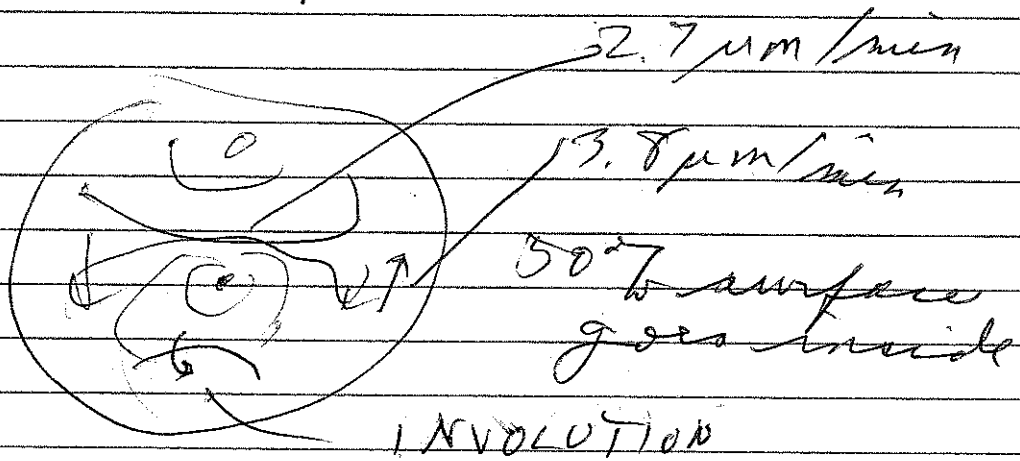
↑ contraction wave

correlation of diff. waves with
mitosis?

conservation of mass?

KISS

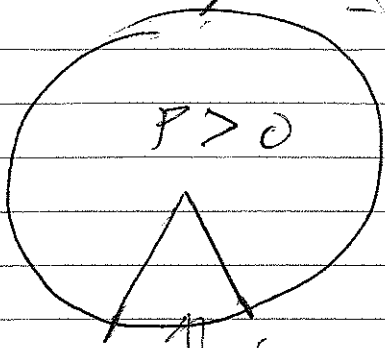
Virginia Joe
- mitotic waves
- diff. waves



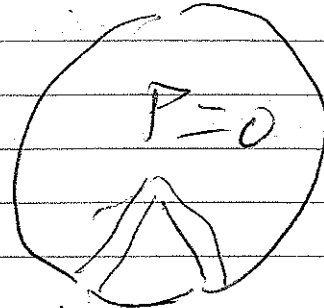
Lev Bellosor

Kenguar

- early gastrulation



cut out



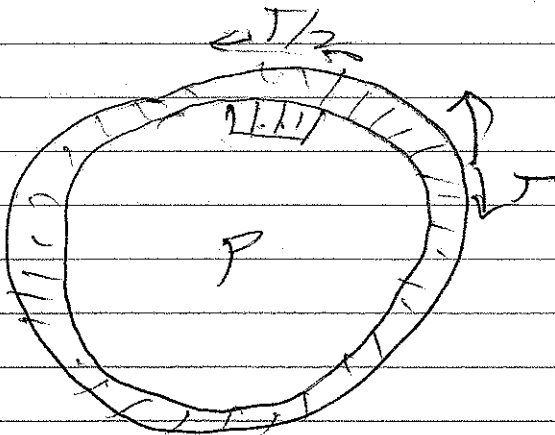
tension in surface relaxed

known

1 neural plate

many neural plates

whole surface
No EPIDERMIS

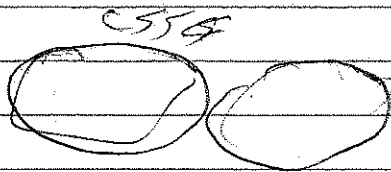


$$F_{MT} + T = F_{MP}$$

WAVE EVERYWHERE

$$F_{MT} + \frac{T}{2} < F_{MP}$$

$$\leq MF_{min}$$



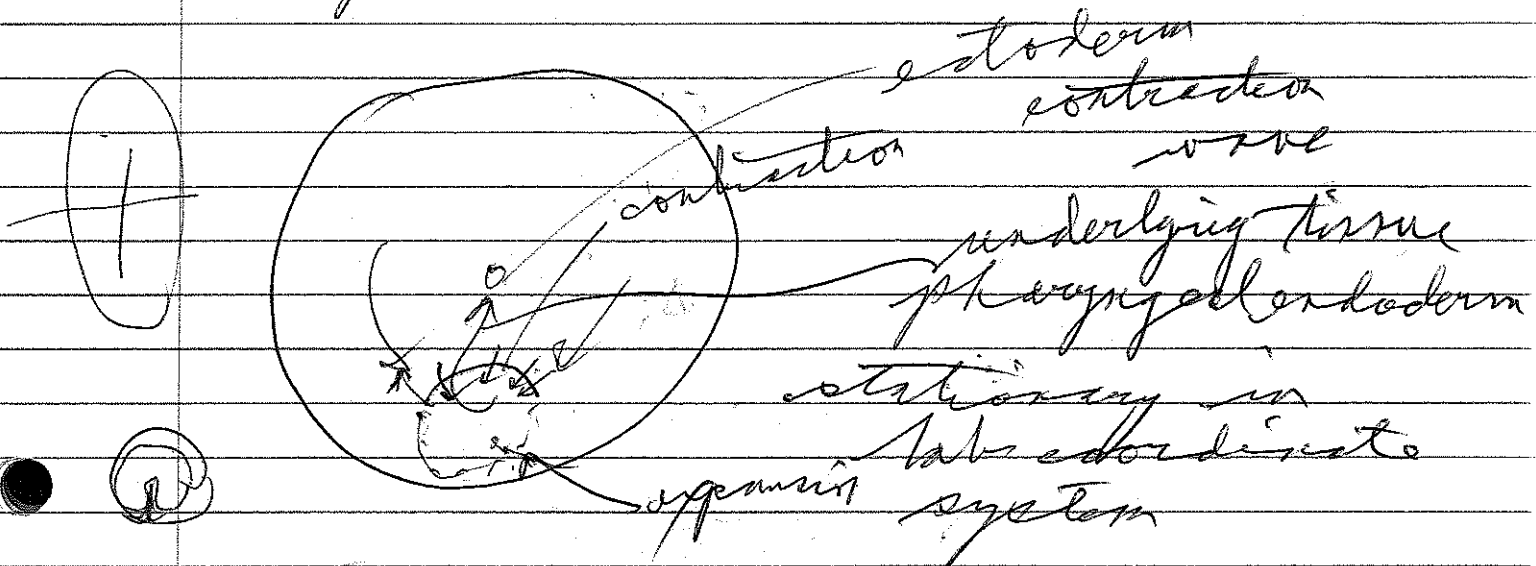
$$P_{MT} + T = F_{MP}$$

contraction starts

INITIATES

- $T \rightarrow T/2$ for primary neural induction

maybe works involute?

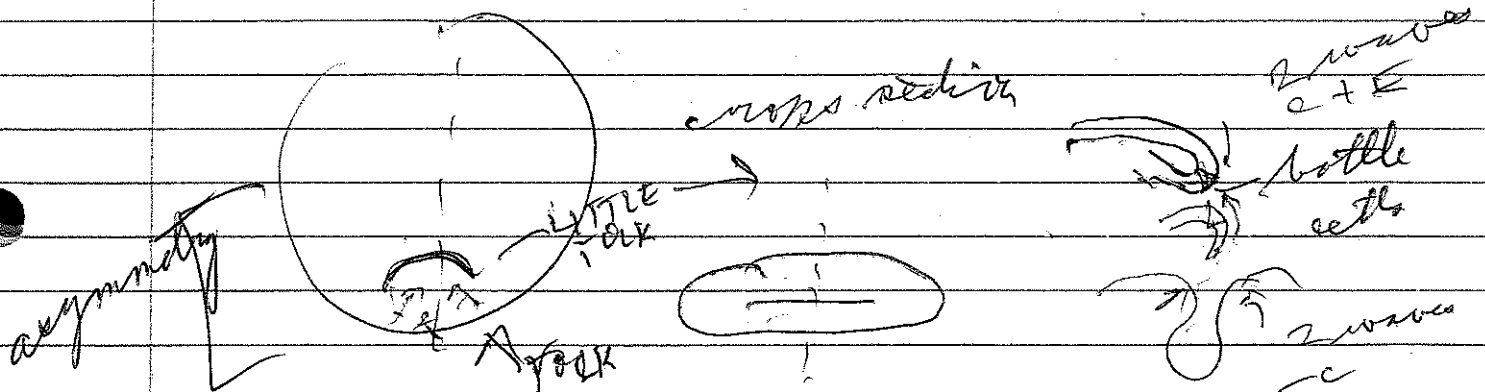


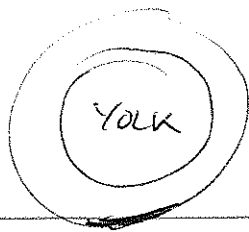
Transplanting a wave

involute is a diff. wave or more than one

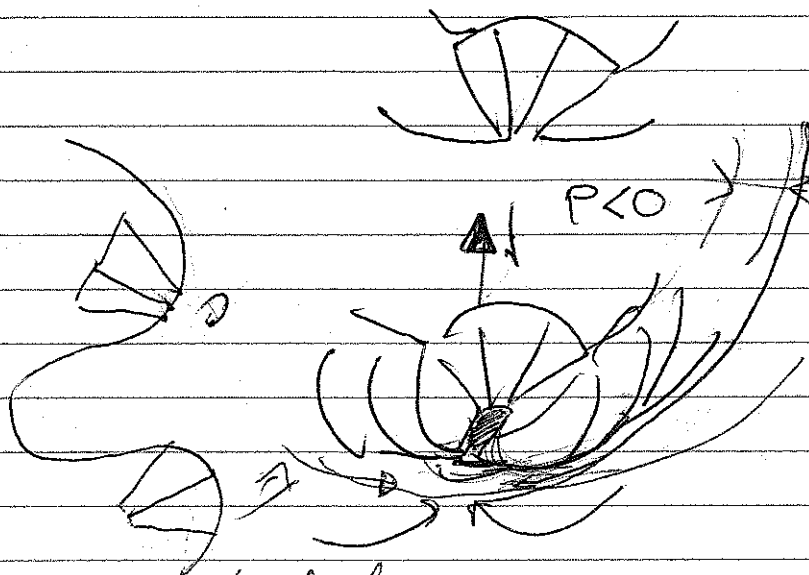
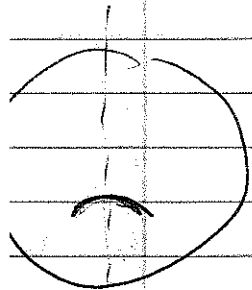
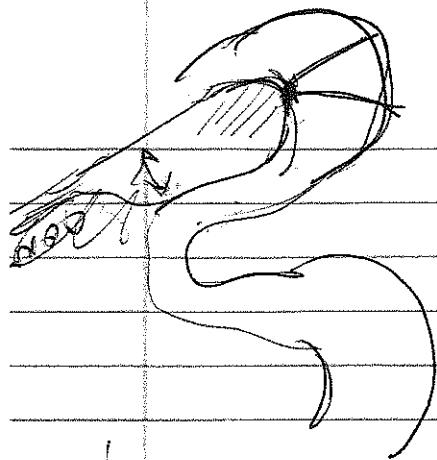
Wegert (1929) plate maps

what happens to involuted cells?





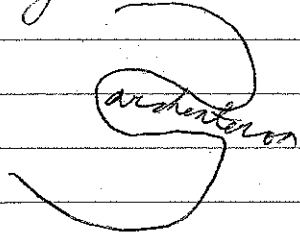
pm



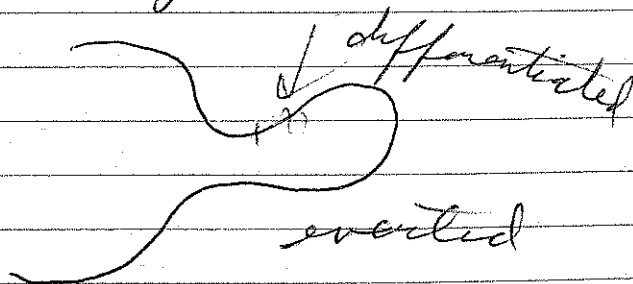
pm

gastrulation

exogastrulation



venter



differentiated

everted

- flow out

does exogastrulation occur if vitelline membrane is intact?

in *C. elegans*

sperm entry pt \rightarrow chirality