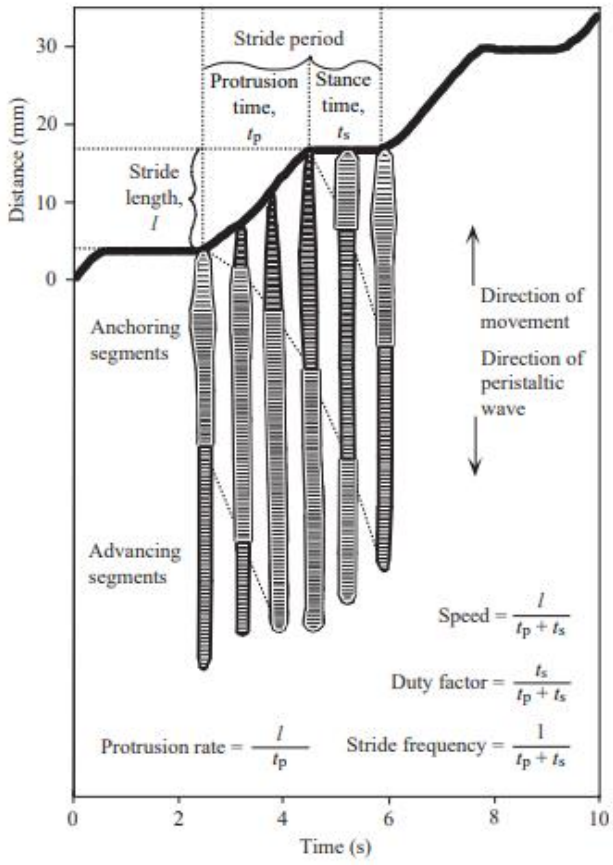
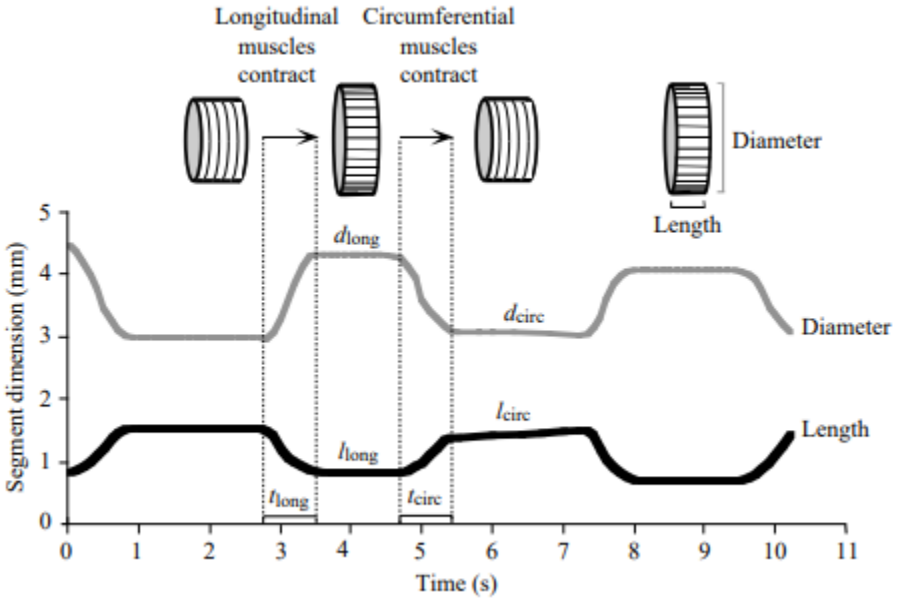
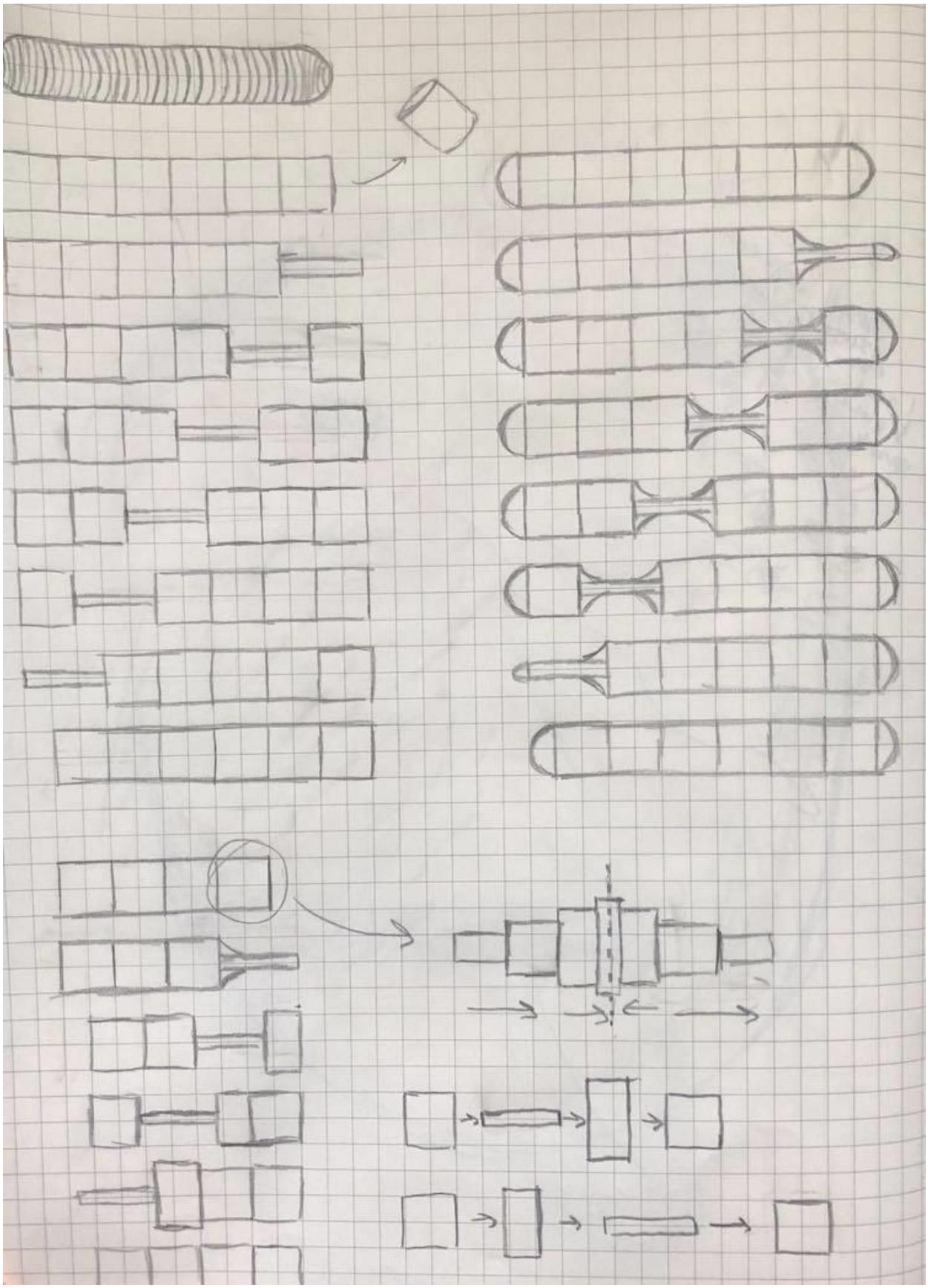
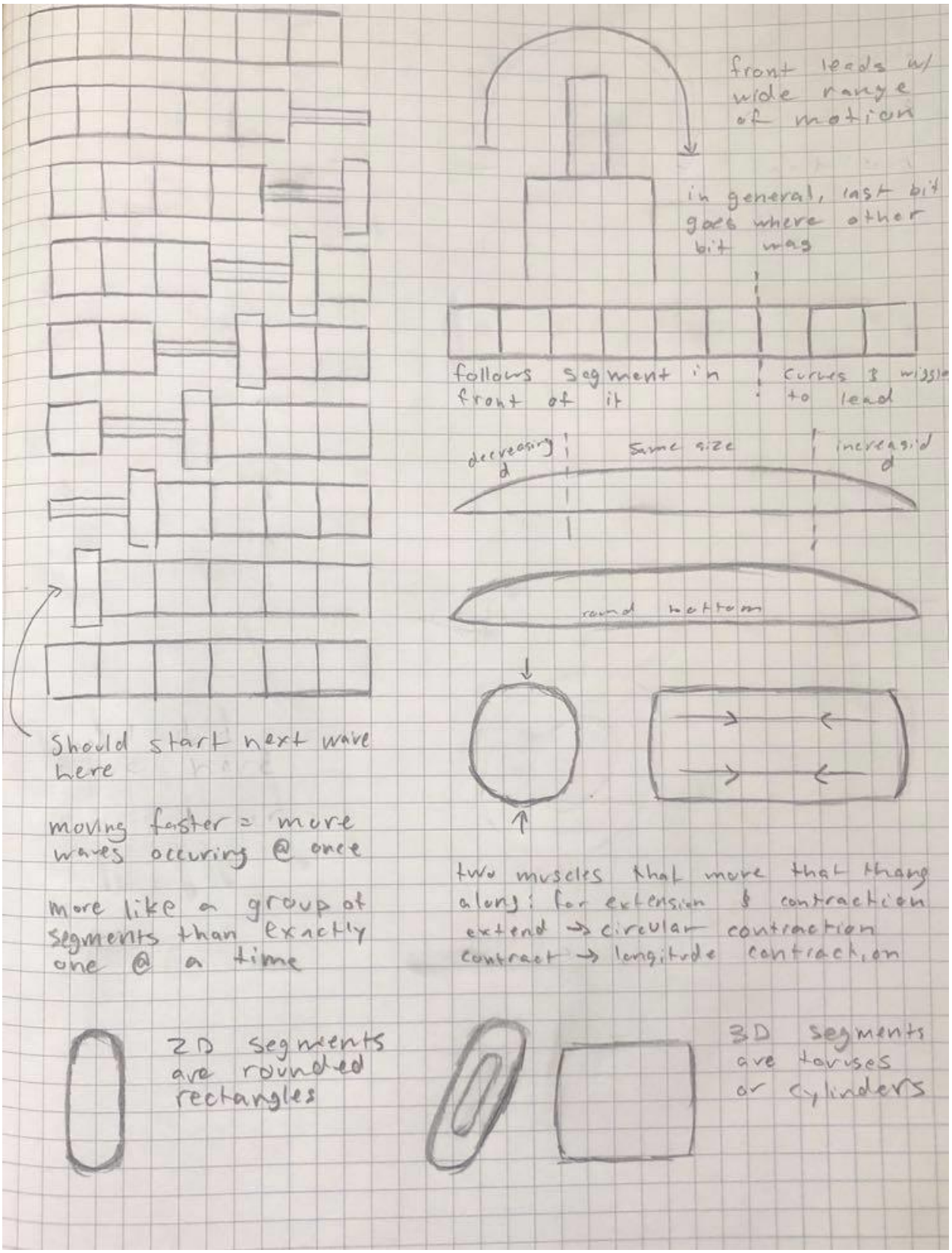
- Worms body undergoes extension, anchoring, and contraction
    - Peristalsis
        - Waves of alternating contraction and relaxation of muscles move along the length of a radially flexible tube
        - Radially expanded regions anchor the organism while the radially contracted regions advance
    - Extending the body, anchoring it to a surface with setae, and contracting body muscles
- Begins at interior end and travels posteriorly
    - Circular muscles at the anterior end contract, extending the head forward
    - Wavelike contraction originating in the circulatory muscles then passes toward the posterior end
    - When the wave nears the mid-region of the body, longitudinal muscles contract, shortening the region
    - A wave of contraction of longitudinal muscles follows
    - Retrograde waves
- Travels about 25-30cm in one minute
- Made up of segments
    - Segmented worm
- Rhythmic and metachronal
- Hydrostatic skeleton
    - Movement based on the changing of dimensions and deformations of body segments
- The stride length of a hydrostat is the distance traveled during one cycle of peristalsis
- Stride period is the duration of one stride, which for an earthworm can be divided into two parts
    - Protrusion time when the segments are advancing over the substratum
    - Stance time when the segments are anchored against the substratum
- Approximately 145 segments that advance and anchor at different times
- "EARTHWORMS DO NOT PERFORM WELL ON TREADMILLS" – A REAL PAPER
- Body wall extends by more than 10%
- Increase stride length in order to increase crawling speed, but smaller worms had a slightly greater tendency than larger worms to increase their frequency in order to increase their speed
- Did not change gaits as speed is increased
- Large earthworms crawl at a greater absolute speed than small earthworms, but at the same relative speed and do so by taking slightly longer strides at a slightly lower frequency
- Kinematically similar when the motions are normalized by body length
- In general no good overall scaling of size with speed


Stride period
Protrusion time, t_p
Stance time, t_s
Stride length, l
Anchoring segments
Advancing segments
Direction of movement
Direction of peristaltic wave
Speed = $\frac{l}{t_p + t_s}$
Duty factor = $\frac{t_s}{t_p + t_s}$
Protrusion rate = $\frac{l}{t_p}$
Stride frequency = $\frac{1}{t_p + t_s}$
Distance (mm)
Time (s)


Longitudinal muscles contract
Circumferential muscles contract
Diameter
Length
d_{long}
d_{circ}
l_{circ}
l_{long}
t_{long}
t_{circ}
Diameter
Length
Segment dimension (mm)
Time (s)




front leads w/ wide range of motion
in general, last bit goes where other bit was
follows segment in front of it
curves & wiggle to lead
decreasing d
same size
increasing d
round bottom
Should start next wave here
moving faster = more waves occuring @ once
more like a group of segments than exactly one @ a time
two muscles that move that thang along: for extension & contraction
extend → circular contraction
contract → longitude contraction
2D segments are rounded rectangles
3D segments are toruses or cylinders