

- 1) Excel xy scatter graphs**
 - effects of age on height, weight, and heart rate

- 2) Cell Membrane transport Simulation**
 - simple & facilitated diffusion
 - osmosis (rate & pressure)
 - filtration (rate & conc.)

- 3) Neurophysiology Simulation**
 - eliciting neural impulses (action potential)
 - eliciting neural impulses (receptor potential)
 - inhibiting neural impulses (ttx & lidocaine)
 - conduction velocity (3 fibers)

- 4) Skeletal Muscle Simulation**
 - single stim: stimulus intensity
 - multiple stim: stimulus frequency
 - tetanus: unfused and fused tetanus
 - isometric contr.: muscle length
 - isotonic contr.: weights

- 5) CV Dynamics Simulation**
 - vessel resist.: radius, viscosity, length, pressure vs flow
 - pump mech: radius and stroke vol. vs HR

- 6) Frog CV Physio Simulation**
 - elec. stim: baseline, extrasystole
 - vagal stim: vagal escape
 - temp stim: 5, 23, 32 deg ringers
 - chem stim: pilocarpine, atropine, epinephrine, digitalis
 - ion stim: calcium, sodium, potassium

- 7) Respiratory Mechanics Simulation**
 - normal breathing: resp. volumes and capacities
 - effect of radius on resp. activity
 - diseased breathing: normal, emphysema, asthma, inhaler
 - exercise breathing: normal, moderate, heavy exercises
 - effect of surfactant on resp. activity

Excel XY Scatter Graphs

- 1) prepare 4 tabs: data, height, weight, heart rate
- 2) data sheet: input data, include headings
- 3) height graphs: data & 4 graphs - all ages, 1-20, 21-50, 51-100
- 4) weight graphs: see #3
- 5) heart rate graphs: see #3

Graph Data:	age	height	weight	heart rate
	1	1	6	80
	2	1.2	6.5	82
	3	1.6	15	84
	4	1.7	25	85
	5	1.8	36	84
	6	1.9	42	85
	7	2	60	84
	8	2.4	65	85
	9	2.6	70	84
	10	3	80	83
	11	3.2	90	82
	12	3.3	95	82
	13	4	100	82
	14	4.2	120	80
	15	4.6	140	80
	16	5	135	79
	17	5.4	138	79
	18	5.6	145	75
	19	5.6	145	75
	20	5.6	145	75
	25	5.6	145	75
	30	5.6	146	75
	35	5.6	146	75
	40	5.6	147	74
	45	5.6	147	73
	50	5.6	150	72
	55	5.5	152	70
	60	5.4	150	65
	65	5.4	152	62
	70	5.3	145	60
	75	5.3	143	60
	80	5.1	140	58
	85	5	130	55
	90	5	120	55
	95	4.9	110	53
	100	4.8	100	50

Cell Membrane Transport Sim.

A) Simple Diffusion Graphs

Cell Sim. #1 Simulating Dialysis (Simple Diffusion)

1) Effects of increasing pore size on simple diffusion - 4 solutes (excel)

4 graphs : NaCl, urea, glucose, albumin

pore size	NaCl	Urea	Glucose	Albumin
20			?	?
50		0	?	?
100	?		0	?
200	?	?		0

B) Facilitated Diffusion Graphs

Cell Sim. #2 Simulating Facilitated Diffusion

2) Effects of increasing glucose carriers on facilitated diffusion of glucose (excel)

2 graphs : NaCl, urea, glucose, albumin

# carriers	2 mM	8 mM
500	?	?
700	?	?
900	0.0012	0.0038

C) Osmosis Graphs

Cell Sim. #3 Simulating Osmotic Pressure

1) Effects of increasing pore size on osmotic rate - 3 solutes (excel)

2) Effects of increasing pore size on osmotic pressure - 3 solutes (excel)

C1) Osmosis Rate

pore size	NaCl	Glucose	Albumin
20		?	?
50		0	?
100	?		?
200	?		0

C2) Osmotic Pressure

pore size	NaCl	Glucose	Albumin
20	340	?	?
50	0	?	?
100	?		?
200	?		

D) Filtration Graphs

Cell Sim. #4 Simulating Filtration

1) Effects of increasing pore size on filtration rate - 4 solutes (excel)

2) Effects of increasing pore size on filtration concentrate - 4 solutes (excel)

D1) Filtration Rate

D2) Filtrate Concentrate

pore size	NaCl	Urea	Glucose	Charcoal	pore size	NaCl	Urea	Glucose	Charcoal
20	?	?	?	?	20				
50		?	?	?	50				
100	5	5	?	?	100	?	?	?	?
200					200				

A) Eliciting Neural Impulses - AP

Neuro Sim #3 AP - Threshold

- settings: 1) electrical stimulus intensity = 10, 20, 30, 40, 50 mV
2) stimulus location: axon of neuron
3) stimulus distances: stimulus to R1 = 2 cm, R1 to R2 = 2 cm

response: action potential

1) Effects of increasing stimulus intensity on neural response (physio-ex)

5 graphs: x = time (msec), y = stimulus (mV), voltage R2 & R1 (uV)

B) Eliciting Neural Impulses - PSP

Neuro Sim #2 - Receptor Potential

- settings: 1) stimulus intensity - low, moderate, high
2) modalities - pressure, chemical, heat, and light
3) stimulus location: dendrite or soma of neurons
4) 3 receptors: Pacinian corp., olfactory receptor, free nerve end.

response: PSP

1) Effects of increasing stimulus intensity on 3 receptors (physio-ex)

9 graphs: x = time (msec), y = stimulus and membrane potential (mV)

note: only ositive reactions, record intensity level & modality

C) Inhibiting Neural Impulses

Neuro Sim #4 - AP - Voltage-Gated Na Channels

- settings: 1) single stimulus - no drugs
2) multiple stimuli: no drug, ttx. lidocaine

response: inhibition of AP

1) Effects of anesthetics on inhibiting AP (physio-ex)

4 graphs: x = time (msec), y = stimulus (mV), voltage R2 & R1 (uV)

D) Nerve Conduction Velocity

Neuro Sim #7 - AP - Conduction Velocity

- settings: electrical stimulation of 3 fibers
response: different conduction velocity of 3 fibers

1) Effects of stimulation on 3 fibers (physio-ex)

3 graphs: x = time (msec), y = stimulus (mV), voltage R2 & R1 (uV)

A) Single Stimulus Graphs

Muscle Sim.- #2 Stimulus Voltage

settings: single stimulus, stim. intensity = 0-10 v

- 1) Effects of increasing stimulus intensity on the twitch
2 graphs : a) stim. intensity : a) 0.0 - 0.8 v, b) 1.0 - 10 v
x = time (ms), y = force (g)
- 2) Effects of increasing stimulus intensity on active force (excel)
1 graph: x = intensity (V), y = force (g)

B) Multiple Stimuli Graphs

Muscle Sim.- #3 Stimulus Frequency Muscle Sim. - #4 Tetanus

settings: multiple stimuli, stim. intensity = 8.5v, frequency = 1-150 #/s)

- 1) Effects of increasing stimulus frequency on graded muscle response
8 graphs: muscle force: 2 - 6, incr. 0.5

C) Tetanus Graphs

Muscle Sim. - #4 Tetanus

- 1) Effects of stimulus frequency on tetanus (physio-ex)
 - a) unfused tetanus - single, continued, fatigue
 - b) fused tetanus - single, continued, combined with unfused tetanus

D) Isometric Contraction Graphs

Muscle Sim.- #6 Muscle Length-Tension

settings: stim. intensity = 8.5v, muscle length: 50 - 100 mm

- 1) Effects of increasing muscle length on isometric contractions
2 graphs: a) muscle length: a) 50 - 75 mm, b) 80-100 mm
- 2) Effects of increasing muscle length on 3 forces (excel)
1 graph: x = muscle length (mm), y = force (g)

E) Isotonic Contraction Graphs

Muscle Sim.- #7 Isotonic Contractions

settings: muscle length = 75 mm, weights 0.5 - 2.0 g, incr. 0.5 g

- 1) Effects of increasing weights on isotonic contractions
1 graph: weights 0.5 - 2.0 g, incr. 0.5 g
- 2) Effects of increasing weights on 3 factors (excel)
x = weight (g), y = a, b, c
 - a) Velocity of Shortening (mm/ms)
 - b) Twitch Duration (ms)
 - c) Distance Lifted (mm)

A) Vessel Resistance

Basic data: $p = 100$ mm Hg, $n = 1.5$, $l = 50$ mm, $r = 3$ mm

- 1) effects of radius on flow
 - radius changes: 1 - 6 mm, incr. 0.5 mm
 - $x =$ radius (mm), $y =$ flow (ml/min)
- 2) effects of viscosity on flow
 - viscosity changes: 1 - 10, incr. 1
 - $x =$ viscosity, $y =$ flow (ml/min)
- 3) effects of length on flow
 - length changes: 10 - 50 mm, incr. 5 mm
 - $x =$ length (mm), $y =$ flow (ml/min)
- 4) effects of pressure on flow
 - pressure changes: 50 - 225 mm Hg, incr. of 25 mm Hg
 - $x =$ pressure (mmHg), $y =$ flow (ml/min)

B) Pump Mechanics

Basic data: pressure: left = 40, pump = 120 mm Hg, right = 80
max stroke: 10, auto pump
volume: start = 120 ml, end = 50 ml
radius: left & right = 3.0 mm

- 1) Effects of radius on HR
 - right radius changes: 2.5 - 6 mm, incr. 0.5 mm

A) Electrical Stimulation Graphs

CV Phys Sim.- #1 Cardiac Muscle

- 1) baseline - normal frog heart rate
- 2) extrasystole - refractory period for frogs

B) Vagal Stimulation Graphs

CV Phys Sim.- #2 Vagal Nerve Stimulation

- 1) baseline - normal frog heart rate
- 2) vagal stimulation and vagal escape

C) Temperature Stimulation Graphs

CV Phys Sim.- #3 Effect of Temperature on Heart Rate

- 1) Cold Temp: 5 deg Ringers
- 2) Room Temp: 23 deg Ringers
- 3) Hot Temp: 32 deg Ringers

D) Chemical Stimulation Graphs

CV Phys Sim.- #4 Effect of Chemical Modifiers on Heart Rate

- 1) pilocarpine
- 2) atropine
- 3) epinephrine
- 4) digitalis

E) Ion stimulation Graphs

CV Phys Sim.- #5 Effect of Various Ions on Heart Rate

- 1) calcium
- 2) sodium
- 3) potassium

Respiratory Mechanics Sim.**A) Normal Respiratory Volumes & Capacities**

Resp. Sim.- #1 Meas. Resp. Volumes & Capacities

normal breathing pattern; include 4 volumes, 2 capacities

- 1) Normal Breathing Pattern - Volumes & Capacities

B) Effect of Radius on Respiratory Activity

Resp. Sim.- #1 Meas. Resp. Volumes & Capacities

settings: radius: 3-5 mm, incr. 0.5 mm

- 1) Effect of radius on flow rate (excel)
x = radius, y = flow rate (ml/min)
- 2) Effect of radius on respiratory volumes (excel)
x = radius, y = 4 resp. volumes (ml)

C) Diseased Breathing Pattern Graphs

Resp. Sim.- #2 Comparative Spirometry

- 1) 4 breathing patterns: normal, emphysema, asthma, plus inhaler
- 2) Comparison of Resp. Vol. - 4 Patterns
- 3) Comparison of FEV1 & FEV1% - 4 Patterns

D) Exercise Breathing Pattern Graphs

Resp. Sim.- #2 Comparative Spirometry

- 1) 3 breathing patterns: normal, moderate exercise, heavy exercise
- 2) Comparison of Resp. Vol. - 3 Patterns

E) Surfactant Graphs

Resp. Sim.- #3 Surfactant & Intrapleural Pressure

- 1) Effects of Increasing Surfactant on Resp. Flow

setup: surfactant levels: 0, 2, 4

graph: x = respiratory flow, y = vol. of surfactant