

Yony's day in the life of an artsie

Yony

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[HTTPS://ORCID.ORG/0009-0009-3015-7192](https://orcid.org/0009-0009-3015-7192)

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Contents

I

BME205

1	Fundamentals	11
1.1	Introduction	11
1.1.1	Control Systems	11
1.2	Cells and DNA	12
1.2.1	DNA Structure	13
1.3	RNA Translation	14
1.3.1	RNA Structure	14
1.3.2	Codons	14
1.3.3	Translation	15
2	Transportation and Signal Propagation	17
2.1	Mitochondria and the Membrane	17
2.1.1	ATP	17
2.1.2	Cellular Respiration	18
2.2	Resting Membrane Potential	20
2.2.1	Path-Clamp Recording	21
2.2.2	Nerst Equation	22
2.2.3	Goldman-Hodgkin-Katz (GHK) Equation	22
2.2.4	Graphing Electrochemical Gradients	22
2.2.5	Gibbs Free Energy	23

2.3	Action Potential	24
2.3.1	Gated Ion Channels	24
2.3.2	Graded Potentials	25
2.3.3	Action Potentials	25
2.4	Synapses	26
2.4.1	Excitatory Synapses	29
2.4.2	Inhibitory Synapses	29
3	Nervous Systems	31
3.1	Central Nervous System	31
3.2	Peripheral Nervous System	32
3.2.1	Modality	33
3.2.2	Intensity, Location, Duration	34
3.2.3	Neuromuscular Junction	35
3.3	Autonomic Nervous System	35
3.3.1	Autonomic Nervous System Structure	35
3.3.2	Cholinergic and Adrenergic Receptors	36
4	Muscles	39
4.1	Skeletal Muscles	39
4.1.1	Building Blocks of the Musculoskeletal System	39
4.1.2	Skeletal Muscle Structure	39
4.1.3	Neuromuscular Junction	42
4.1.4	Skeletal Muscle Function (Excitation-Contraction Coupling)	42
4.2	Skeletal Muscle Function	45
4.2.1	Tension Developed by Each Fiber	45
4.2.2	Tension Developed by Several Active Fibers	48
4.3	Cardiac Muscle ECG and Cycle	49
4.3.1	Electrocardiogram (ECG)	50
4.3.2	Sequence of Depolarization	52
4.3.3	Cardiac Filling Action	52
4.4	Cardiac Regulation	53
4.4.1	Stroke Volume	53
4.4.2	Cardiac Output	55
4.4.3	Extrinsic Control of Heart Rate: The Autonomic Nervous System	55
4.4.4	Autonomic Tone	56
4.4.5	Summary: Extrinsic Control of Cardiac Output	59
4.5	Blood Vessels and Blood Pressure	59
4.5.1	Smooth Muscles	59
4.5.2	Vascular System Structure & Function	63

5	Class Notes	71
5.1	Early Films	71
5.1.1	Demolition d' un mur, Le Voyage dans la lune	71
5.2	Entering Modernity	71
5.2.1	Metropolis (and Cabinet of Dr. Caligari)	71
5.3	Disaster Aesthetics	75
5.3.1	Godzilla	75
5.4	The Future	80
5.4.1	La Jetée	80
5.5	Technofutures and the Secret Life of Robots	82
5.5.1	2001: A Space Odyssey	82
5.6	Technophobia and the Surveillance of states	85
5.6.1	THX1138	85
5.7	The Space Within	87
5.7.1	Solaris	87
5.8	Urban Dystopia	89
5.8.1	Blade Runner 1982	89
5.9	Spectacular Bodies	92
5.9.1	The Fly	92
5.9.2	Aliens	92
5.10	Alfrofuturism	94
5.10.1	Neptune Frost	94
5.11	The Posthuman	96
5.11.1	Annihilation	96
5.12	After World, After Film	98
5.12.1	WALL-E	98
6	Review Notes	101
6.1	Films Overview	101
6.1.1	Metropolis	101
6.1.2	The Cabinet of Dr. Caligari	102
6.1.3	Godzilla	103
6.1.4	La Jetée	103
6.1.5	2001: A Space Odyssey	103
6.1.6	THX 1138	104
6.1.7	Solaris	104
6.1.8	Blade Runner	105
6.1.9	The Fly	105
6.1.10	Aliens	106
6.1.11	Neptune Frost	106

6.1.12	Annihilation	107
6.1.13	WALL-E	107
6.2	Reading Summaries	108
6.2.1	Sensuous Elaboration: Reason and the Visible in the Science Fiction Film	108
6.2.2	Technophilia: Technology, Representation and the Feminine	109
6.2.3	The imagination as disaster	110
6.2.4	Godzilla and the Japanese Nightmare	111
6.2.5	Time Travel, Primal Scene and the Critical Dystopia	112
6.2.6	Chris Marker and the Cinema as Time Machine	113
6.2.7	Kubrick's 2001 and the Possibility of a Science-Fiction Cinema	114
6.2.8	Technophobia	115
6.2.9	Technical Progress and the Social Life-World	116
6.2.10	Technology and Science as Ideology	117
6.2.11	Surveillance Societies	118
6.2.12	Tarkovsky's Solaris and the (im)possibility of a Science Fiction Cinema	119
6.2.13	Dialogue with Andrei Tarkovsky about Science Fiction on the Screen	120
6.2.14	Ramble City: Postmodernism and Blade Runner	121
6.2.15	Simulacra and Science Fiction	122
6.2.16	On the Grotesque in Science Fiction	123
6.2.17	Bodies of Fear: The Films of David Cronenberg	123
6.2.18	Evolution of a Space Cadet	124
6.2.19	It's After the End of the World (Don't You Know that Yet?)	125
6.2.20	Katherine Hayles Book	126
6.2.21	The Eco-material Posthuman in the Age of the Anthropocene	127
6.2.22	Animation and Automation, or, the Incredible Effortfulness of Being	128
6.3	Key ideas	129
6.4	Practice	130
6.4.1	Technophilia, role of women	130
6.4.2	Anthropocene	134
6.4.3	Closeups	136
6.4.4	Postmodernity	137
6.4.5	Technophobia	139
6.4.6	Sublime	139
6.4.7	Posthumanism	140
6.4.8	Environmental catastrophe	141
6.4.9	Simulacrum	142
6.4.10	Control vs. Disciplinary society	143
6.4.11	Images of wonder, conventions of scifi	143
6.4.12	Afrofuturism	144
6.4.13	Citationalism	145
6.4.14	Graphic match	145
6.4.15	Discontinuous editing	146
6.4.16	Metacinematic expressions	146
6.4.17	Disasters	147
6.4.18	German Expressionism	147
6.4.19	Time machines	148
6.4.20	Fascist Automation	148

6.4.21	Hyperreality	148
6.4.22	Andrei Tarkovsky	149
6.4.23	Solaris vs. 2001	149
6.4.24	Primal scene	150
6.4.25	Social functions of genre	150
6.4.26	Film as 24 fps, conventions	150
6.4.27	Sound montage	151
6.4.28	Body Horror	151
6.4.29	Characteristics of genre	152
6.4.30	Intersex	152
6.4.31	Film animation	153

III

PHY294

7	Quantum Mechanics Mathematics	157
7.1	Introduction	157
7.2	The Schrodinger Equation	158
7.3	The Rectangular Box	159
7.3.1	Degeneracy	160
7.4	The Central Force Problem	160
8	Quantum Mechanics Theory	163
9	Statistical Mechanics	171

BME205

1	Fundamentals	11
1.1	Introduction	
1.2	Cells and DNA	
1.3	RNA Translation	
2	Transportation and Signal Propagation	17
2.1	Mitochondria and the Membrane	
2.2	Resting Membrane Potential	
2.3	Action Potential	
2.4	Synapses	
3	Nervous Systems	31
3.1	Central Nervous System	
3.2	Peripheral Nervous System	
3.3	Autonomic Nervous System	
4	Muscles	39
4.1	Skeletal Muscles	
4.2	Skeletal Muscle Function	
4.3	Cardiac Muscle ECG and Cycle	
4.4	Cardiac Regulation	
4.5	Blood Vessels and Blood Pressure	



1. Fundamentals

1.1 Introduction

Definition 1.1.1 — Homeostasis. Tendency of the body and its systems towards a stable, constant internal environment.

It is essential for:

- Individual cell survival
- Maintaining internal environments shared by all cells

Examples:

- Ions, nerve conduction
- pH, bacterial growth
- Glucose concentrations, metabolic disorders

Homeostasis vs. Equilibrium

- Homeostasis refers to entire internal environment
- Equilibrium refers to specific mechanisms, reactions

1.1.1 Control Systems

Control-Integration Center of Brain: thalamus & hypothalamus are the major integrating centers for sensory information going to cerebrum & main output for motor information leaving the cerebrum

Effector: a bodily part (e.g. gland, muscle) that becomes

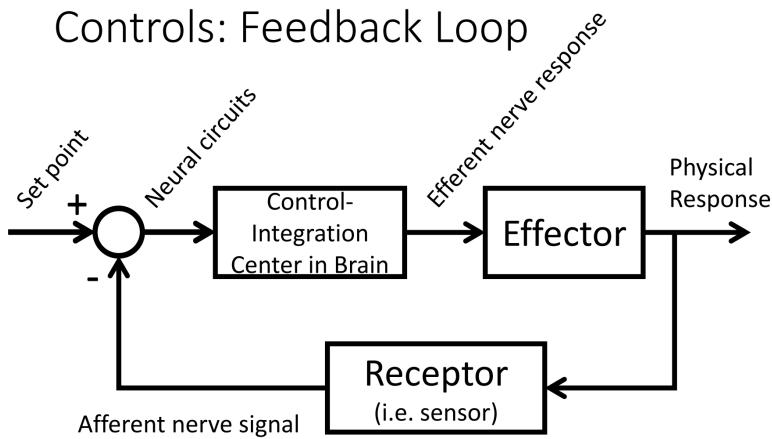
Receptor: cells or proteins which sense & transmit signal

Efferent: conducting or carrying outward/away from something (e.g. nerves that carry signals away from brain) active in response to stimulation (e.g. by a nerve)

Afferent: conducting or carrying inward/toward something (e.g. nerves that carry signals to brain)

Negative Feedback is difference: $\varepsilon = \text{reference} - \text{sensor value}$

Controls: Feedback Loop



Exercise 1.1 For any feedback loop, recognize:

1. physiological variable: eg. body temp
2. sensor: eg. skin
3. control centre in the brain: eg. hypothalamus, thalamus
4. effectors: eg. sweat glands

Exercise 1.2 Which of these statements best describes negative feedback?

1. A change in a regulated variable triggers a response by the effector that opposes the change
2. The input to a system increases the output, and the output limits its own production by inhibiting the input
3. It is the main operating principle of most of the body's homeostatic control mechanisms

1.2 Cells and DNA

Nucleus: membrane enclosed organelle in cell that contains chromosomes

Nucleolus: largest organ in nucleus, spherical structure, produces & assembles cell ribosomes

Ribosome: specialized cell organelles that reads mRNA build amino acids which combine to make proteins

Amino acid: small molecules that are the building blocks of proteins

Proteins: large, complex molecules that perform critical roles in body

- creates structure
- execute functions
- regulate and organize tissues

Chromosome: condensed form of chromatin with threadlike structure of nucleic acids and protein in the nucleus carrying genetic information (i.e. genes); proteins (i.e. histones) form the structure of chromosomes

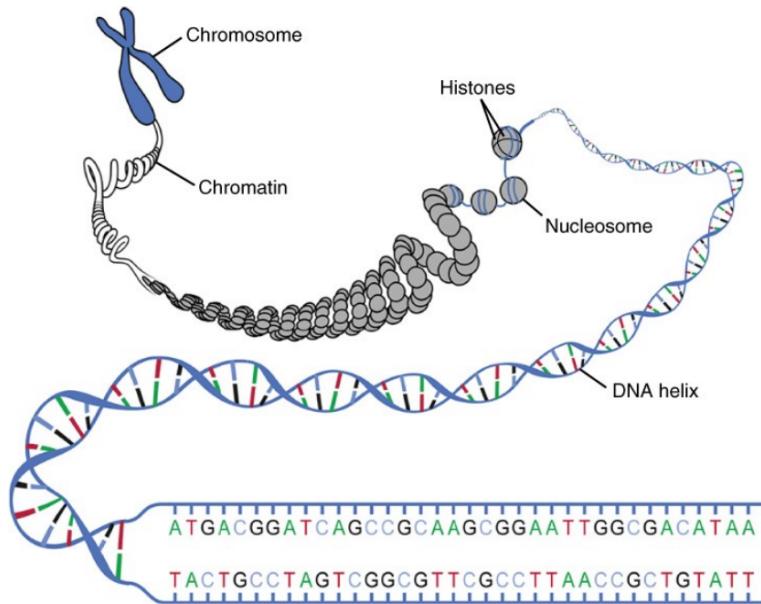
Chromatin: disorganized nucleic acids and protein (e.g. histones)

Nucleosome: basic repeating sub-unit of chromatin

Nucleic acid: complex substance in DNA with molecules made up of nucleotides in linked long chain

Nucleoside: a compound (e.g. adenosine or cytidine) commonly found in DNA or RNA, consisting of a purine or pyrimidine base (e.g. nitrogen base) linked to a sugar

Nucleotide: basic structural unit of DNA composed of a nucleoside and a phosphate group



1.2.1 DNA Structure

DNA supercoiling: the amount of twist in a DNA strand which determines the strain on it

- **Positive supercoiling:** more tightly twisted
- **Negative supercoiling:** less tightly twisted

Nucleobase: one of four amino acids found in DNA (i.e. **cytosine, thymine, guanine, adenine**)

Base pair: pair of nucleobases joined by h-bonds (i.e. **A-T, C-G**). DNA has two complementary strands of base pairs

- C: Cytosine
- T: Thymine (only in DNA), corresponds to U: Uracil (only in RNA)
- A: Adenine
- G: Guanine

Exercise 1.3 Place the following structures in order from least to most complex organization:

1. DNA, nucleosome, chromatin, chromosome
2. DNA, nucleobase, chromatin, chromosome
3. **DNA, chromatin, nucleosome, chromosome**

Exercise 1.4 Which statement correctly describes the organization of DNA in a cell?

1. **DNA is made up of nucleotides and is organized in the form of chromosomes**
2. DNA is made up of nucleotides and is organized in the form of nucleosomes
3. DNA is made up of nucleobases and is organized in the form of nucleosomes
4. DNA is made up of nucleotides and is organized in the form of a double helix

1.3 RNA Translation

Deoxyribose is part of DNA, whereas **ribose** is part of RNA

Transcription: RNA polymerase reads DNA template one nucleobase at a time and builds an mRNA molecule

Translation: Ribosomes decode mRNA and uses information to build a protein (i.e. a chain of amino acids)

1.3.1 RNA Structure

Primary structure: Nucleobase sequence

Secondary structure: H-bonding at different points creates 2D loops, hairpins etc.

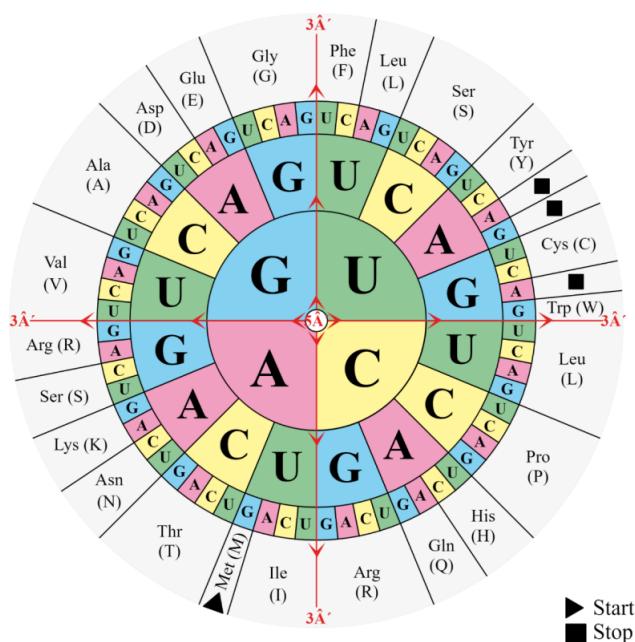
Tertiary structure: Completed 3D structure of RNA (how it bends, twists etc.)

- mRNA**
 - messenger RNA
 - formed during transcription
 - RNA polymerase II
 - carries the instructions to make proteins

- tRNA**
 - transfer RNA
 - formed during transcription
 - RNA polymerase III
 - carries amino acids to the ribosomes

- Ribosomes**
 - reads mRNA
 - receive amino acids from tRNA
 - synthesize proteins

1.3.2 Codons



Codons...

- are RNA sequence of 3 nucleotides (i.e. trinucleotide) holding one unit of genomic information
- holds instructions for
 - encoding a single amino acid **or**
 - signalling termination of protein synthesis

64 codons exist:

- all possible combinations of 4 nucleotides
- 61 for amino acids & 3 stop signals

1.3.3 Translation

tRNA and Amino Acids

Anticodon

- trinucleotide sequence
- located at one end of tRNA
- corresponds to a complementary codon in mRNA

tRNA molecule

- 76-90 nucleotides
- secondary structure: clover leaf

Aminoacyl tRNA synthetase

- Enzyme attaching specific amino acid to tRNA

With tRNA + amino acid

- ready for translation

Initiation

Reads AUG: the start **Pieces for initiation**

- ribosome: 2 pieces, large + small
- mRNA: instructions to build protein
- initiator: tRNA carrying first amino acid, usually Met

Translation initiation

- tRNA + Met + small ribosome
- complex binds to end of mRNA
- complex walks down mRNA until reaching the start codon
- tRNA + Met bind to start codon
- large ribosome joins

Initiation complex

- tRNA
- Met
- Small ribosome unit
- Large ribosome unit
- mRNA

Elongation

Lengthening of amino acid chain

- as each tRNA + amino acid binds to a site mRNA shift forward one codon
- new tRNA + amino acid corresponding to exposed codon arrives & bonds
- mRNA shifts forward one codon

- process repeats up to 33000 times

Termination

Ending of translation process

- when the exposed codon (A-site) is a stopping codon termination occurs
- release factors in and adds a water molecule to end of amino acid chain

Exercise 1.5 Why is RNA better suited than DNA for creating proteins?

1. RNA can leave the nucleus, whereas DNA cannot
2. RNA can be easily modified after transcription, whereas DNA cannot
3. RNA is more stable than DNA

Exercise 1.6 Which of the following is not made wholly out of RNA?

1. the ribosome
2. the transfer molecule
3. the messenger molecule that provides the code for protein synthesis

Exercise 1.7 Which of the following best describes gene expression?

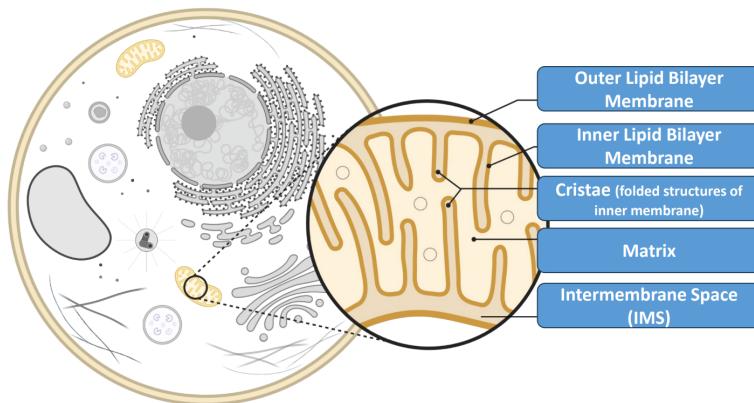
1. The process of copying DNA into RNA
2. The process of creating proteins from RNA
3. The process by which the information in parts of DNA are used to direct the synthesis of proteins and other molecules with specific functions

2. Transportation and Signal Propagation

2.1 Mitochondria and the Membrane

A mitochondrion:

- is a membrane-bound cell organelle
- generates chemicals to power cell biochemical reactions
- stores chemical energy in small molecules called **ATP** (adenosine triphosphate, adenine + ribose + 3 phosphate groups)



2.1.1 ATP

How does ATP store energy? **High Energy Bonds**

- electrons in bond are in high energy state
- if bond is broken:

- energy is released
- electrons move to low energy state

2.1.2 Cellular Respiration

Cellular respiration is the process of:

- combining oxygen with foodstuff molecules
- converting this chemical energy into usable form (ATP)
- Discarding waste products

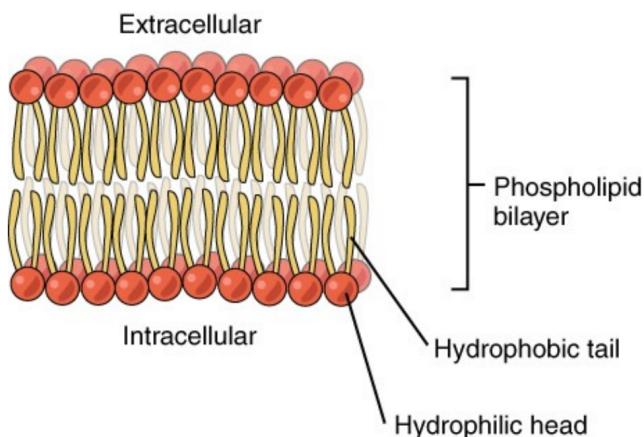
Pathways for ATP Production

1. Glycolysis (≤ 2 ATP)
2. Pyruvate oxidation
3. citric acid cycle (≤ 2 ATP)
4. Oxidative phosphorylation (≤ 34 ATP)

Cell Membrane

Phospholipid Molecule

- cell membrane consists of a semi-permeable lipid bilayer
- phosphate (head, polar & hydrophilic)
- glycerol
- fatty acids (tails, non-polar & hydrophobic)
- polar heads of molecules arrange to maximize distance between



Note:

- channels, pathways, proteins, other lipids etc. all can exist in cell membrane
- different components perform different functions
- cell membrane passage in/out of cell (e.g. security at a concert)
- fat soluble, hydrophobic, non-polar molecules cross quickly

Permeability

- **Permeability coefficient:** describes rate of movement through cell membrane
- Generally, the smaller the molecule & more fat-soluble(i.e. the more nonpolar), the more rapidly it will diffuse across a lipid bilayer

Membrane Transport

Unassisted Membrane Transport (passive diffusion)

- molecule (small uncharged molecules/**concentration gradient**) dissolves into phospholipid bilayer
- molecule diffuses across bilayer
- molecule dissolves in aqueous solution on opposite side of bilayer
- does not require energy, molecules move down concentration gradient
- small, uncharged, nonpolar molecules easy to diffuse whereas charged molecules difficult to diffuse

Assisted Membrane Transport (facilitated diffusion)

1. Channel mediated

- particles $\leq 0.8\text{nm}$
- channel proteins are hydrophilic tunnels across membrane
- allow polar/charged compounds to avoid hydrophobic core of membrane
- **aquaporins:** channel proteins to speed up crossing of water
- some channels open always, others open or close in response to signals (gated)

2. Carrier mediated

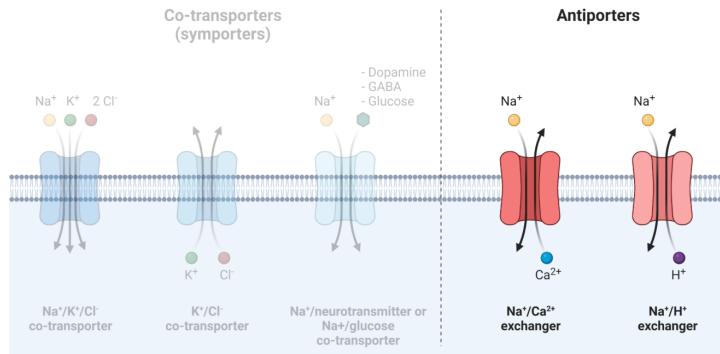
- particles that cannot cross channels
- carrier proteins can change shape to move molecules across membrane
- slower movement than channels
- ion pumps are important example(e.g. $\text{Na}^+ - \text{K}^+$ pump)

Primary Active Transport (carrier mediated)

1. energy source: ATP
2. cytoplasmic Na^+ binds to the Na^+/K^+ pump
3. the Na^+/K^+ pump is phosphorylated by ATP
4. the pump changes its conformation, causing Na^+ to release
5. extracellular K^+ binds to the pump, leading to dephosphorylation
6. the pump returns to its original conformation
7. K^+ is released from the pump

Secondary Active Transport (channel mediated)

- energy source: electrochemical gradient
- primary active transport creates electrochemical gradients which store energy
- energy in gradient can then be used to push/pull substances across membrane
- secondary active transport involves simultaneous transport of ions (e.g. Na^+) down their gradient & transport of other substances by co-transporters
- **symporters:** all crossings occur in the same direction
- **antiporters:** crossings occur in opposite directions



Exercise 2.1 Which of the following is not a function of the cellular membrane?

1. Creates distinct outer structure of cell
2. Facilitates crossing of various molecules, ions, etc.
3. Divides the cell into discrete compartments

Exercise 2.2 Which of the following are components of the cell membrane?

1. Proteins and phospholipids (i.e. nucleotides, fatty acids)
2. Proteins and phospholipids (i.e. glycerol, phosphates, fatty acids)
3. Lipid bilayers, cristae, and a matrix

Exercise 2.3 Which best describes primary active transport?

1. Proteins and phospholipids (i.e. nucleotides, fatty acids)
2. Carrier proteins pull molecules across the cell membrane with the assistance of ATP to create electrochemical gradients
3. Protein channels facilitate simultaneous movement of ions down their electrochemical gradient

2.2 Resting Membrane Potential

Transport Across Membranes

- Key mechanism by which life exists
 - allows oxygen and carbon dioxide movement
 - facilitates nerve conduction (e.g. ion movement & biosignals)
 - feeds cell & life functions (e.g. glucose)
- Ion movement
 - primary active: “pumps”
 - secondary active: “leakage channels”

Model vs. Reality

- Single protein 2-pore concept is a simplified model

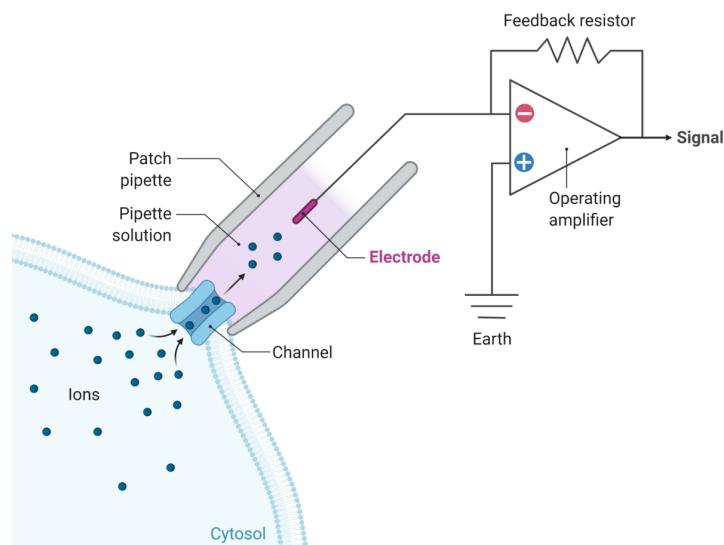
- e.g. reality of K^+ channels
 - family of 15 members “two-pore-domain” channels
 - each encoded by a unique gene
 - regulated by multiple mechanisms
 1. signalling lipids
 2. oxygen tension
 3. pH
 4. mechanical stretch
 5. G-proteins

Voltage Clamp Technique

- electrophysiology: study of electrical properties of cells and tissues
- revealed ion channel events of nerve conduction

2.2.1 Patch-Clamp Recording

- facilitate measure of a cell, piece of cell wall or even a single ion channel
- study of nerve & muscle signalling, function, dysfunction, disease
- clamer circuits:
 - fix voltage and measure current
 - fix current and measure voltage
-



- Single ion channel moves 10 million ions per second
- Resulting current is several picoAmps
- Measurement at this physical size & current range is Very challenging
- Thin pipette ($\approx 1\text{ }\mu\text{m}$) contacts membrane
- Suction applied to create high-resistance seal($G\Omega$)
 - Physically & electrically isolates patch of cell
 - All ions through channel flow into pipette
- Solution mimicking extracellular or intracellular (e.g. cytoplasm) environment placed in pipette
- Ag/AgCl electrodes

- 1 placed in pipette
- 1 placed as reference
- Electrodes connected to voltage clamping circuits
 - Ion flow changes directly reflected in current measurements

2.2.2 Nerst Equation

Theorem 2.2.1

$$E_x = \frac{R_u T}{Z_x F} \log_{10} \frac{[C]_0}{[C]_i} = \frac{61}{Z_x} \log_{10} \frac{[C]_0}{[C]_i}$$

where

- E is equilibrium potential in mV
- x is ion
- Z is charge
- $[C]_0$ is concentration outside cell
- $[C]_i$ is concentration inside cell
- R_u, T, F are gas constant, temperature @36.5°C and Faraday constant respectively

Equilibrium potential: differential at equilibrium across membrane due to ion concentration gradient

2.2.3 Goldman-Hodgkin-Katz (GHK) Equation

Theorem 2.2.2

$$V_m = \frac{RT}{ZF} \ln \left(\frac{P_{Na}[Na]_o + P_K[K]_o + P_{Cl}[Cl]_i}{P_{Na}[Na]_i + P_K[K]_i + P_{Cl}[Cl]_o} \right)$$

where

- V_m is the membrane potential (mV)
- R is the universal gas constant (8.314 J/mol K)
- T is the absolute temperature (K)
- F is the Faraday constant (96485 C/mol)
- P_{Na}, P_K, P_{Cl} are the permeabilities of Na+, K+, and Cl- ions
- $[Na]_o, [K]_o, [Cl]_o$ are the outside concentrations of Na+, K+, and Cl- ions
- $[Na]_i, [K]_i, [Cl]_i$ are the inside concentrations of Na+, K+, and Cl- ions

Membrane potential: potential difference across a cell membrane that accounts for ion concentrations and permeabilities. **Resting membrane potential** is usually approximately -70 mV

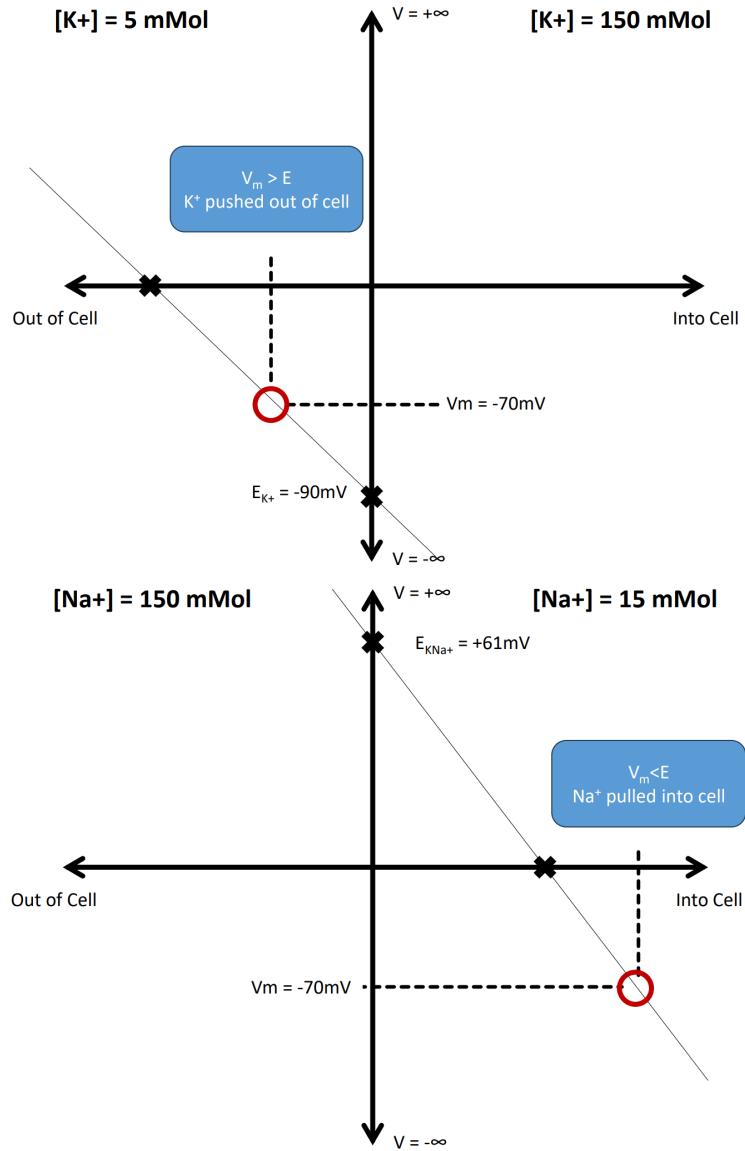


Note that $E_{ion} \neq V_m$

2.2.4 Graphing Electrochemical Gradients

1. Set up graph with the Electrical Driving Force (V) on y-axis and Concentration Driving Force on the x-axis
2. Write concentration inside & outside cell
3. Mark an 'X' on the side of the x-axis that the concentration gradient moves the ion
4. mark an 'X' where E is on y-intercept
5. Draw line between two 'X's

6. Determine what the ion will do at the V



2.2.5 Gibbs Free Energy

Theorem 2.2.3 — Equilibrium Potential Balances: Diffusion and Electrical Potential.

$$\Delta G_{\text{chem}} = RT \ln \frac{[C]_o}{[C]_i}, \quad \Delta G_{\text{elec}} = ZFV_m$$

where at equilibrium,

$$\Delta G_{\text{chem}} = \Delta G_{\text{elec}}$$

Proposition 2.2.4 — Free Energy Moving Out of a Cell.

$$\Delta G = \Delta G_{\text{chem}} - \Delta G_{\text{elec}}$$

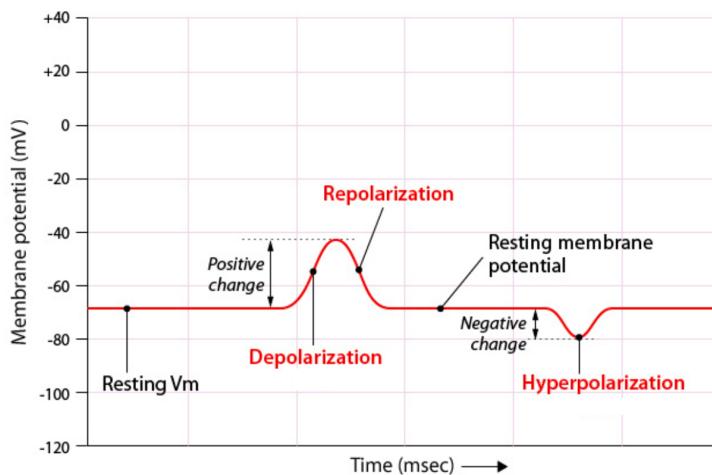
If $\Delta G < 0$, movement is spontaneous
 If $\Delta G > 0$, movement is not spontaneous

2.3 Action Potential

Depolarization: rapid rise in membrane potential due to a large influx of positive ions

Repolarization: rapid decrease in membrane potential towards the resting membrane potential due to a large efflux of positive ions

Hyperpolarization: lowered membrane potential below resting membrane potential due to a large efflux of positive ions



2.3.1 Gated Ion Channels

Carrier Mediated Proteins

- ion pumps
- contribute to maintaining resting membrane potential

Ungated Channels

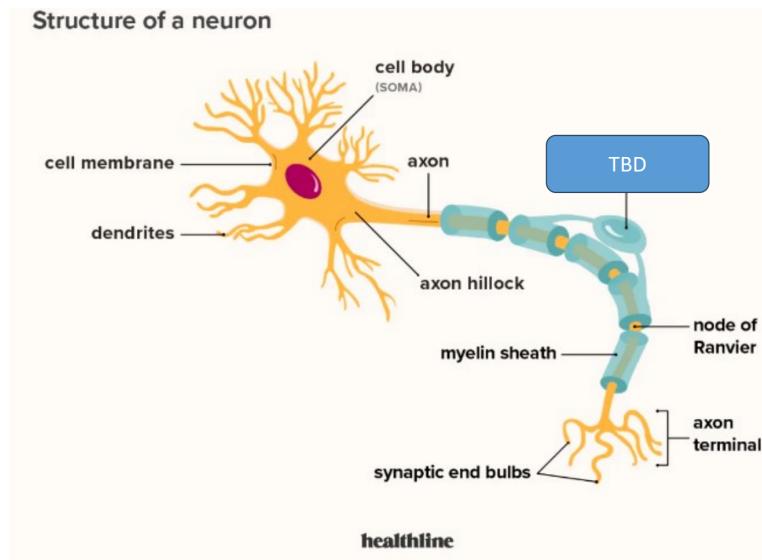
- leak channels (approx. constant permeability)
- contribute to maintaining resting membrane potential

Gated Channels

- **ligand-gated** (chemically gated): open/close state determined by binding of chemical ligand
 - ligands are neutral molecules or ions
 - binds to central atom or ion
 - water, ammonia, carbon monoxide, chloride, hydroxide are examples
- **voltage gated**: open/close state determined by membrane potential
- **mechanically gated**: open/close state determined by mechanical loading

2.3.2 Graded Potentials

Neuron Structure



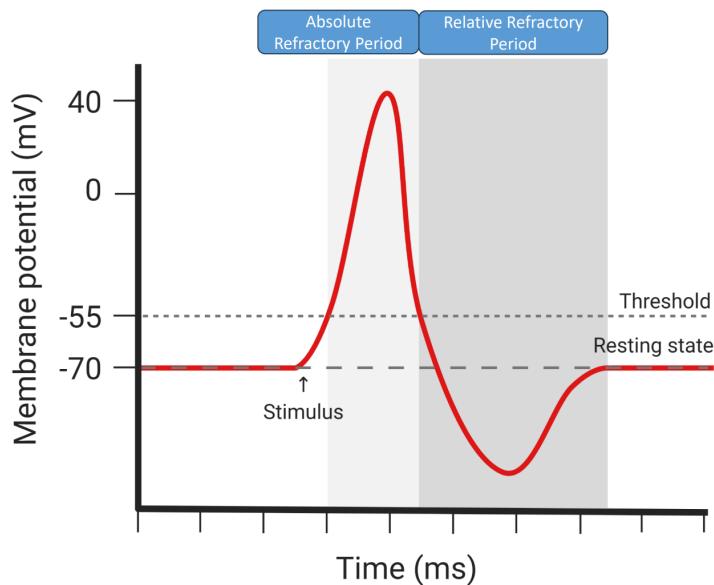
- Soma and dendrites typically at resting membrane potentials of -70 mV
- Inputs from certain stimuli can increase (depolarize) or decrease (hyperpolarize)
- Transient changes to membrane potential at soma/dendrites
- Do not pass into axons of most neurons
- Size & duration determined by size & duration of stimulus

Propagation of Graded Potential

- system begins at resting membrane potential
- stimulus triggers opening of gated ion channel
- eg. Na^+ channel opens & Na^+ ions flow into cell
- depolarization begins at gated channel
- adjacent regions of cell membrane are at resting membrane potential still
- current starts to flow along cell membrane (i.e. differential)
- depolarization spreads
- graded potentials don't spread into axon

2.3.3 Action Potentials

- graded potentials propagate to axon hillock and then die
- once potential reaches threshold at axon hillock action potential is triggered



Contiguous conduction:

velocity between 0.5 and 2 m/s

Saltatory conduction:

velocity between 100 and 300 m/s

Myelin sheath

- insulates axon
- assembles voltage gated channel clusters at discrete nodes
- signal jump between nodes of Ranvier
- **Schwann cells:** myelin production, maintenance, repair

Factors that affect speed of propagation

- amount of myelination
- axon diameter
- temperature

2.4 Synapses

Electrical synapse:

Synapse at which transfer of information (e.g. voltage potential) occurs via direct connection at gap junction

- info relayed through voltage potential
- fast but inefficient
- signal same or less in post-synaptic neuron (no gain)
- urgent response systems (instinct, defense, cardiac)
- excitatory response only
- Electrical signal in pre-synaptic neuron → electrical signal in post-synaptic neuron

Presynaptic neuron:

Neuron that transmits signal towards synapse

Gap junction

- Gap between adjacent neurons (pre- & post-)

- Composed of ≈ 100 intercellular channels called **connexons**
- Connexons are inserted into cell membranes of adjacent neurons
- Voltage-gated channels
- Open/close state depend on voltage differential between interior of 2 cells
- Can be modulated by:
 - Ca^{2+} , though it can block function
 - protein phosphorylation, though can degrade channels and accumulate clusters of channels via connexin trafficking from golgi apparatus

Connexons

- Tunnels (channels) between adjacent neurons made of small proteins
- Allow electrical synapse to share information via transfer of ions & signalling molecules between cells

Postsynaptic neuron

- Neuron that transmits signal away from synapse
- Interface between synapse of presynaptic neuron & dendrites of post-synaptic neuron

Chemical synapse:

Synapse at which transfer of information occur via release of neurotransmitter

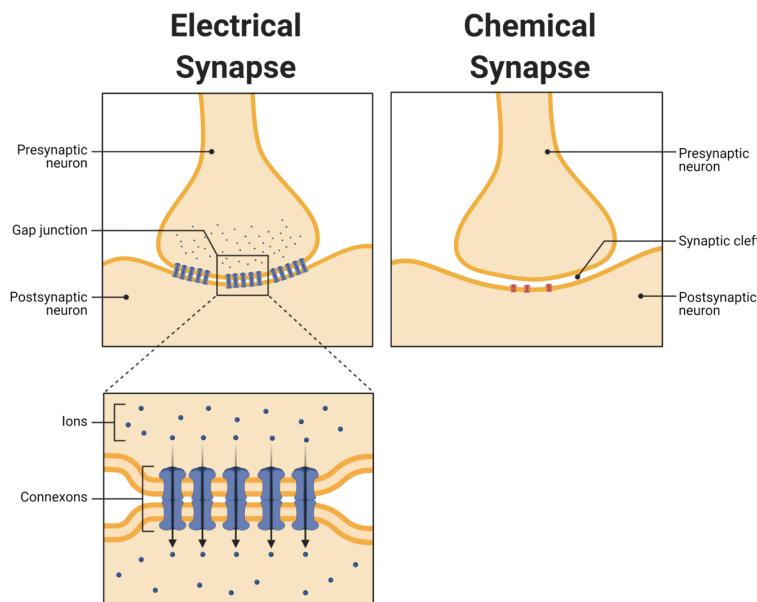
- info relayed through chemicals
- slow, sturdy, efficient
- signal can increase (gain possible)
- less urgent response systems (CNS, perception, thought)
- excitatory or inhibitory response
- Electrical \rightarrow chemical pre-synaptic neuron \rightarrow Electrical in post-synaptic neuron

Vesicle

- Thin walled sac filled with fluid
- Structure within or outside of cell containing fluid or cytoplasm enclosed in lipid bilayer
- Synaptic vesicles also contain neurotransmitters

Synaptic cleft

- Gap between pre- and post- synaptic neuron at a chemical synapse
- Post-synaptic neuron contains ligand-gated channels whose open/close state is controlled by neurotransmitters binding to receptors on channels



R **Electrical synapse:** ions transferred from pre-synaptic neuron to post-synaptic neuron. Only excitatory.

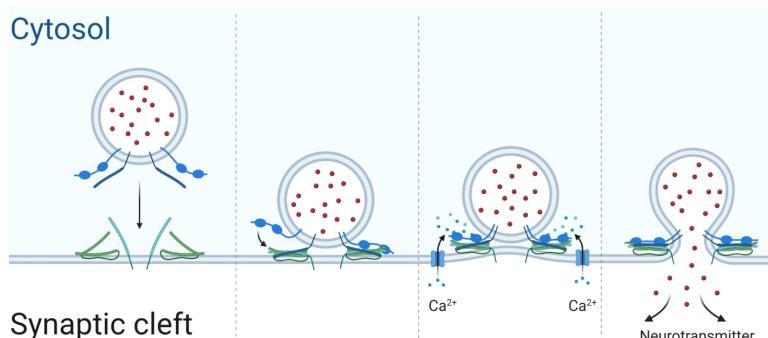
Chemical synapse: ions are transferred from extracellular environment to post-synaptic neuron (process triggered by AP). Can be both **excitatory** and **inhibitory**.

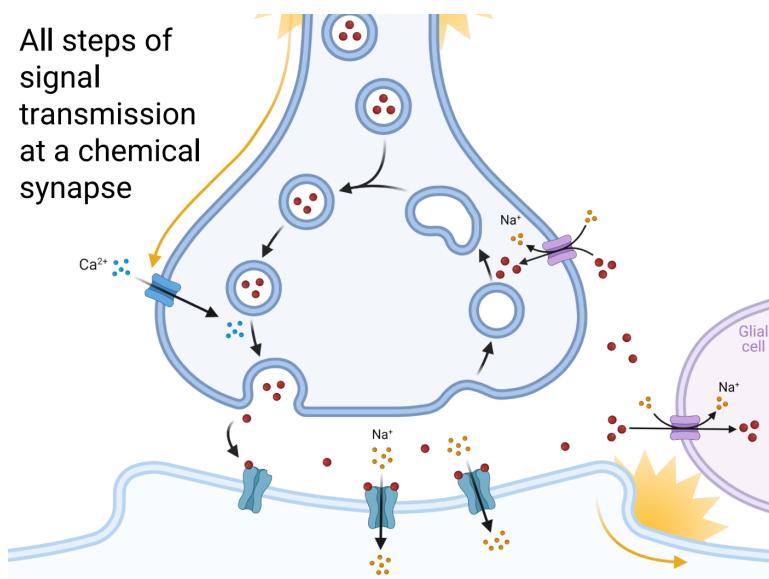
Chemical Synapse Transmission

- neurotransmitters are synthesized and stored in vesicles
- action potential arrives at the presynaptic terminal
- voltage-gated Ca^{2+} channels open, allowing influx of Ca^{2+}

Synaptic Vesicle Behavior

- Ca^{2+} ions bind to receptors on vesicles causing them to dock at cell membrane & release neurotransmitters
- Ca^{2+} allows vesicle docking and neurotransmitter release
- neurotransmitter binds to receptors, causing channels to open or close
- excitatory or inhibitory postsynaptic potential is generated
- neurotransmitter is removed by glial/neuron uptake or enzymatic degradation vesicular membrane is retrieved from the plasma membrane

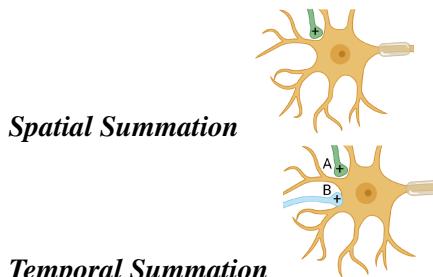




Excitatory PostSynaptic Potential: potentials that **depolarize** and increase the likelihood of an action potential

Inhibitory PostSynaptic Potential: potentials that **hyperpolarize** and decrease the likelihood of an action potential

2.4.1 Excitatory Synapses



Grand postsynaptic potential: combination of all temporal & spatial summation

2.4.2 Inhibitory Synapses

Postsynaptic inhibition

- Release of inhibitory neurotransmitter by presynaptic neuron directly inhibits depolarization of postsynaptic neuron
- Triggers influx of negatively charged ions (usually Cl^-) or efflux of positive ions (usually K^+) and hyperpolarizes postsynaptic neuron (this dampens a neuron's ability to fire)
- May be a single signal (hyperpolarization) or a combined signal(hyper + depol) from multiple synapses in cell body of postsynaptic neuron
- Inhibitory neuron synapse at **axon terminal** of presynaptic neuron indirectly inhibits depolarization of postsynaptic neuron
- Inhibitory neuron sends signal and releases neurotransmitters

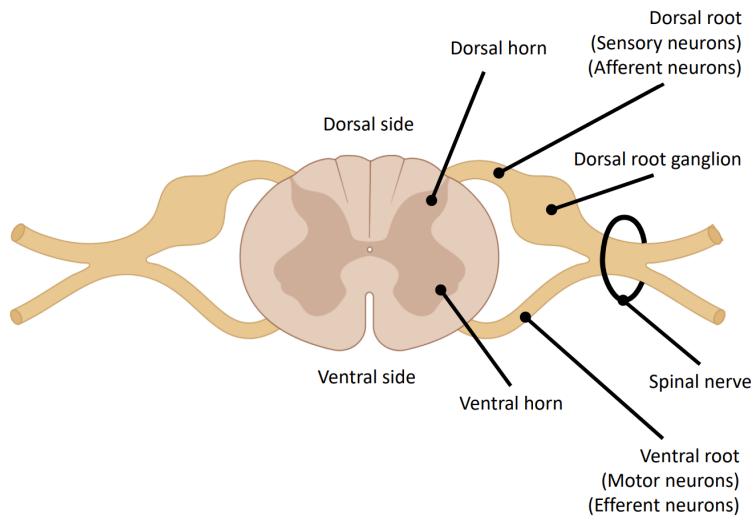
- Neurotransmitters bind to receptors on presynaptic synapse and closes calcium channels (Limits neurotransmitters released from excitatory neuron, so not as many channels open on postsynaptic neuron)
- **Function:** modulates synaptic strength, allows for filtering of sensory information, regulation of neural circuits, prevents excessive excitation leading to neuron damage

3. Nervous Systems

3.1 Central Nervous System

Sensory Pathways (Ascending): pathways along the spinal cord for transmitting sensory (ascending) and motor (descending) signals

Motor Pathways (Descending): motor tract specifically conveys voluntary muscle control signals



Exercise 3.1 How do neurons enter and exit the spinal column and how they travel to and from the brain?

1. Neurons (specifically axons) get bundled into fascicles to become a nerve
2. Spinal cord consists of grey matter (located in center, shaped like butterfly, contains neuron

- cell bodies) and white matter (contains myelinated axons that carry signals)
3. Neurons connect to spinal cord through either dorsal (posterior, sensory) or ventral (anterior, motor) roots
 4. **Ganglia:** structure of oval shape containing neuron cell bodies, glial tissue (support and function), and connective tissue
 5. Sensory neurons enter spinal cord through dorsal roots, cell bodies are located in dorsal root ganglia
 6. Motor neurons have cell bodies in grey matter of spinal cord and axons go out via ventral roots to innervate muscles

Exercise 3.2 What is the difference between efferent and afferent nerve fibres (axon)?

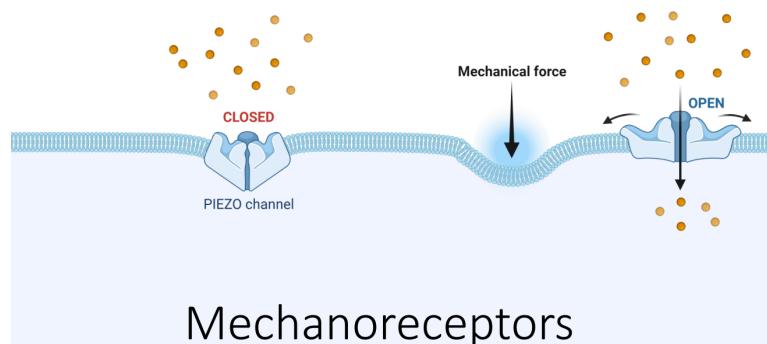
They are the same: Sensory Afferent (In); Motor Efferent (Out)

Exercise 3.3 What components do reflex arcs have?

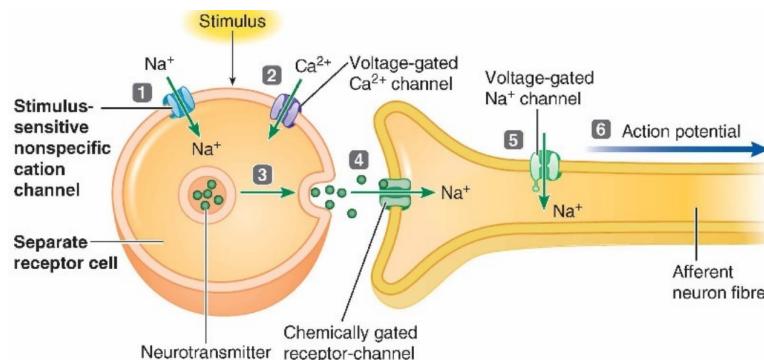
- receptor
- sensory neuron (afferent pathway)
- integration centre
- motor neuron (efferent pathway)
- effector

3.2 Peripheral Nervous System

Mechanically-gated (mechanosensitive) ion channels



Receptor potential to action potential: Receptors may be a part of the afferent neuron (e.g. touch, pain, itch, tickle, pressure, smell) or there may be whole receptor cells that interface with the afferent neuron (e.g. vision, hearing, equilibrium)



MILD

- Modality
- Intensity
- Location
- Duration

3.2.1 Modelity

Modelity: Type or nature (e.g. touch, pain, sound) is determined by specific receptor activated by stimulus.

Sensors by modelity

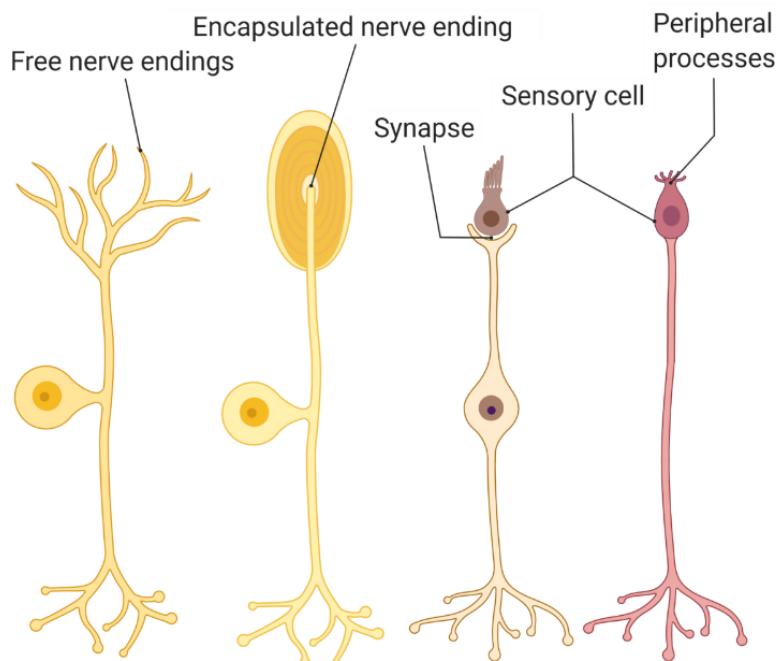
- mechanoreceptors
 - somatosensory: touch
 - baroreceptors: blood pressure
 - proprioceptors: position and movement
 - osmoreceptors: osmotic pressure
- thermoreceptors
- nociceptors: pain
- photoreceptors: light
- chemoreceptors: chemical composition of blood

Free nerve endings: Simplest receptors are free nerve endings (dendrites) and have no special structure

Encapsulated nerve ending: Encapsulated nerve endings are covered by nerve tissue (e.g. insulated) which makes them more selective. Capable of detecting pain, pressure, temperature

Sensory cell: Unique sensory (receptor) cells also exist. These cells interface with the sensory neuron. Example are photoreceptors (rod or cone)

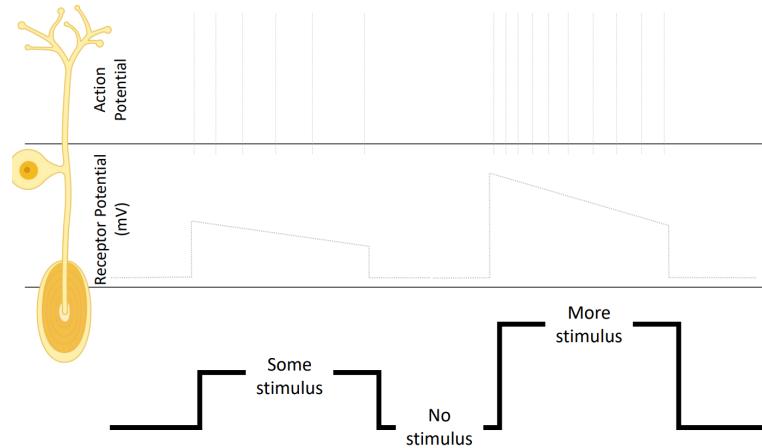
Peripheral processes: Closest to structure we've studied so far. Receptors in dendrites attached to cell body. Olfactory receptor is an example



3.2.2 Intensity, Location, Duration

Intensity

Frequency coding: The larger the receptor potential, the greater the frequency of action potentials



Location

Receptive field

- The more densely receptors are spaced, the smaller area of skin each monitors
- Smaller receptive field equals greater acuity
- 17,000 on hand vs a few on elbow

Lateral inhibition

- Process in nervous system to enhance precision of sensory perception
- Excited neuron (center) reduces activity of neighbours
- Amplifies excited neuron by contrast

Duration

Adaptation to a sustained stimulus

- **Phasic receptors:**
 - phasic receptors adapt rapidly to stimulus
 - initial response occurs, but then diminishes (i.e. few APs generated)
- **Tonic receptors:**
 - tonic receptors adapt slowly to stimulus
 - continue to generate APs over duration of stimulus

Types of Somatic Receptors in the cutaneous/subcutaneous layer

- somatic receptors are a part of the somatosensory system
- **somatosensory system:** receives and processes sensory information
- **somatic nervous system:** part of PNS that controls voluntary movement

3.2.3 Neuromuscular Junction

Motor end-plate and innervation of skeletal muscle

- motor neurons interfaces to multiple muscle fibers
- motor unit: neuron and all fibers it innervates
- AP in motor neuron triggers acetylcholine release (neurotransmitter)
- triggers muscle fiber sliding (contract/relax)

3.3 Autonomic Nervous System

Somatic motor system: typically, a single motor neuron can run from the spinal cord to innervate a muscle

Autonomic motor system:

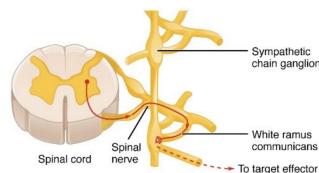
- ANS typically has a chain of two neurons: first has cell body in CNS (e.g. spinal cord), second has cell body close to spinal cord or organ
- specifically, preganglionic neuron has cell body in CNS, postganglionic neuron has cell body in ganglion
- **Ganglion (ANS):** collection of nerve cell bodies that acts as a relay point where preganglionic neurons synapse with postganglionic neurons. They also contain connective tissue (structure/protect), (nutrient supply), other nerve fibers

3.3.1 Autonomic Nervous System Structure

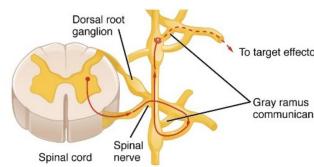
Sympathetic ganglion chain

- series of interconnected ganglia
- ganglia connected by interganglionic fibres
- runs parallel to spinal cord
- extends from base of skull to coccyx

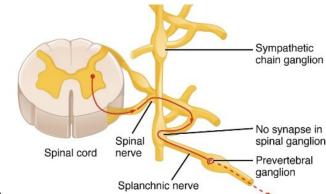
Central neurons may...



- synapse with ganglion at same level



- synapse with a more superior/inferior ganglion



- synapse with ganglion outside of the chain (i.e. bypasses sympathetic chain)

There are only sympathetic nerves to:

- adrenal glands
- sweat glands
- arterioles (vasoconstriction)
- note: sympathetic pathways usually have short preganglionic neuron and long postganglionic neuron

Therapeutic solutions

Baroflex activation therapy

- implantable pulse generator
- delivers continuous electrical stimulation to carotid baroreceptors
- increases inhibition of tonically active outflow to peripheral vasculature
- results in vasodilation and decrease peripheral vascular resistance

Vagus nerve stimulation

- electrical stimulate left vagus nerve to implant signals in the brain
- particularly stimulates to treat seizures, depression, aid in stroke recovery

There are only parasympathetic nerves from:

- cranial
- sacral
- note: parasympathetic pathways usually have long preganglionic neuron and short postganglionic neuron

3 major axon groups

1. • sensory neurons
• somatic motor neurons
• 70-120 m/s
2. • preganglionic autonomic neurons
• 3-15 m/s
3. • postganglionic autonomic neurons
• AP from toe to spinal cord \approx 4s (0.3-2 m/s)

3.3.2 Cholinergic and Adrenergic Receptors

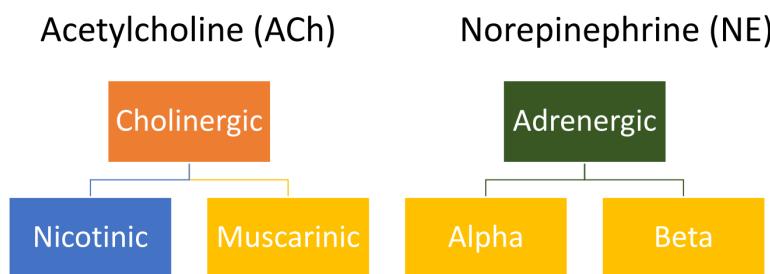
Neuroeffector junction (NEJ)

- specialize synapse between neuron and target effector (non-neuron)
- effector may be smooth muscle (e.g. heart, intestine or gland)
- neuron elicits physiological response (e.g. muscle contraction or gland secretion)

- note: in somatic system we say neuromuscular junction, in autonomic system we say neuroeffector junction

Postganglionic neurotransmitter release

- sympathetic
 - norepinephrine
 - epinephrine
- parasympathetic
 - acetylcholine



Acetylcholine (ACh)

Nicotinic

- ionotropic receptors
- allow positive ions across cell membranes
- skeletal muscle contraction, cognitive function, arousal

Muscarinic

- metabotropic receptors
- produce more prolonged/diverse effects
- regulate gland secretion, smooth muscle contraction, heartrate

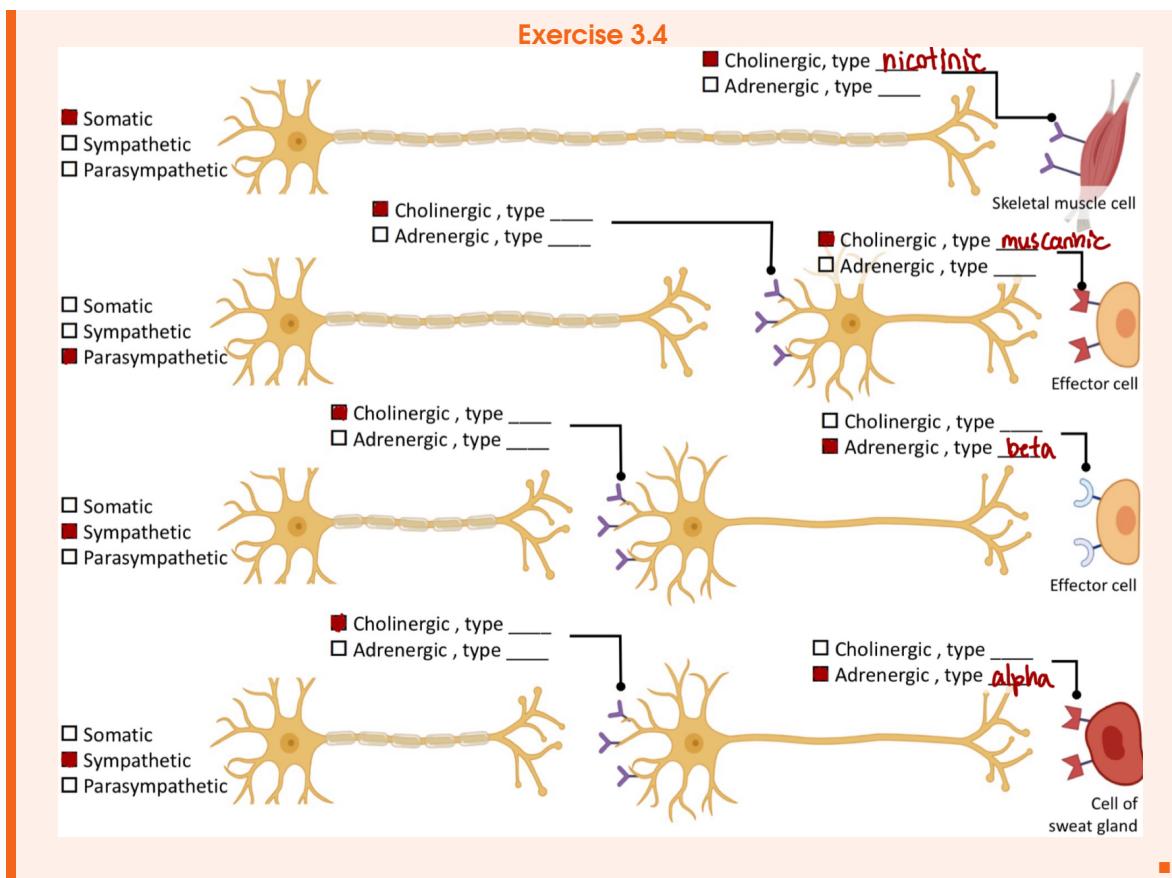
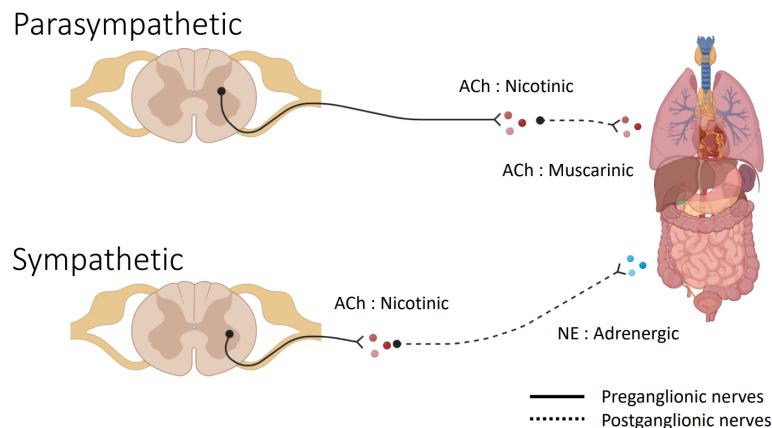
Norepinephrine (NE)

Alpha

- found in smooth muscle and presynaptic neuron terminals
- control vasoconstriction (blood pressure)
- mediate smooth muscle contraction (bladder)
- may inhibit NE release (i.e. inhibit sympathetic neuron activity)

Beta

- found in heart, kidney, airways, arteioles, skeletal muscle, fatty tissues
- can increase heart rate, impact blood pressure via kidneys, relax smooth muscle, break down fats





4. Muscles

4.1 Skeletal Muscles

4.1.1 Building Blocks of the Musculoskeletal System

Human Skeleton

- Protects
- Provides structure
- Creates joints (between bones)
- Allows for articulation but does not actuate

Types of Contractions

Joints, Cartilage, Ligaments, Tendons

Joint: connection between two bones

Cartilage: ECM (collagenous connective tissue, absorbs shock, reduces friction (passive))

Tendon: elastin & collagenous connective tissue, connects muscle to bone, supports actuation (passive)

Ligament: mostly collagenous connective tissue, connects bone to bone, supports actuation, reinforces skeletal structure (passive)

4.1.2 Skeletal Muscle Structure

Types of Muscle

Skeletal: voluntary, striated, attach to bones, control conscious movement

Smooth: involuntary, non- striated, found in hollow organs (stomach, intestines, blood vessels)

Cardiac: involuntary, striated, found in heart only

Striated Muscle

- Alternating light & dark bands under microscopy
 - Skeletal & cardiac muscle highly organized

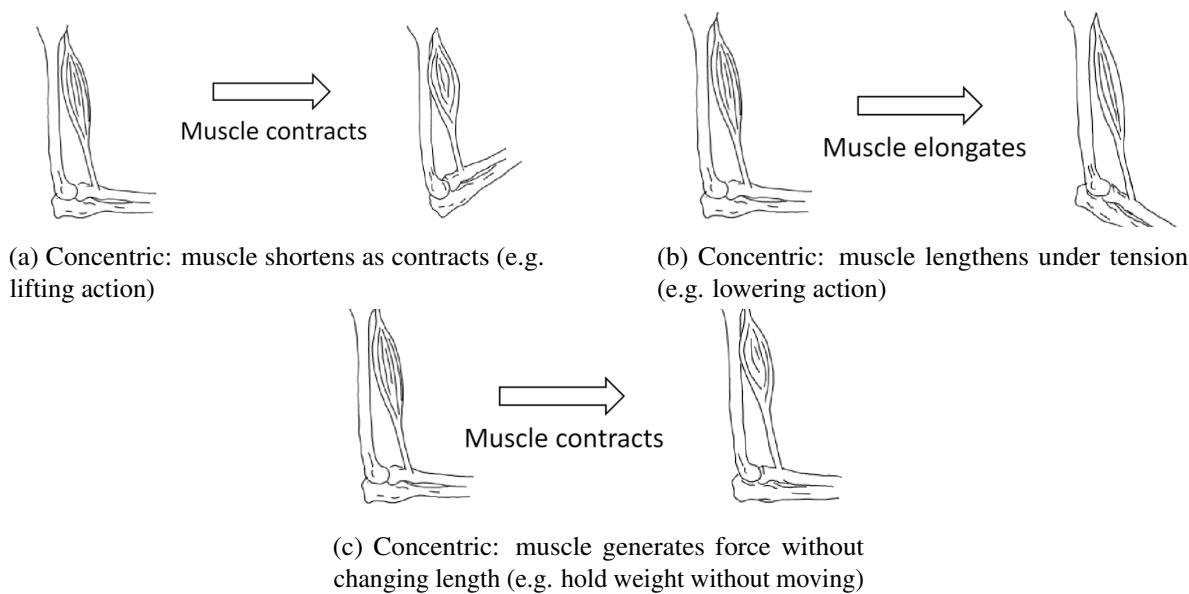


Figure 4.1

- Contractile protein (actin & myosin) organization in muscle fibers creates striation
- Organization allows for precise control & powerful contractions
- Smooth muscle has less orderly arrangement and so no striation

Components

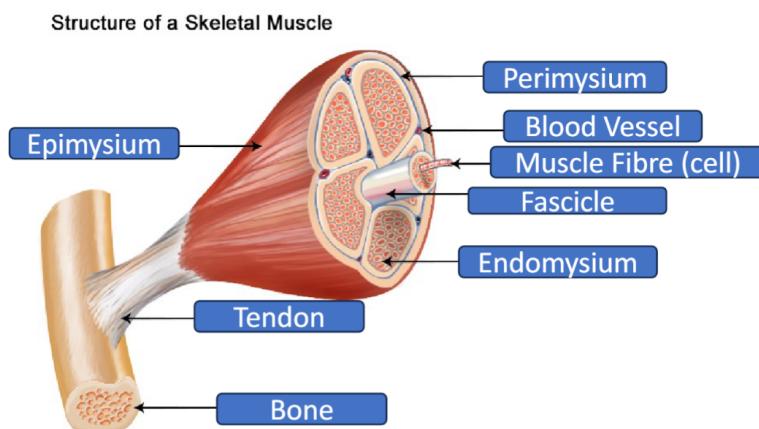
Epimysium: Sheath of fibrous, elastic tissue surrounding muscle

Fascicle: Muscle sub-unit, bundle of muscle fibres (muscle cells)

Perimysium: Sheath of connective tissue surrounding bundle of muscle fibres (fascicle)

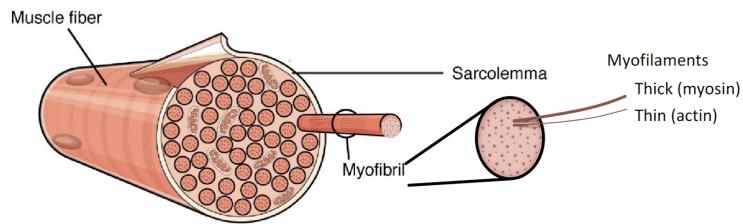
Muscle fiber: Long single cylindrical muscle cell, contractile cell, multinucleated (skeletal cells only) due to large amount of protein & enzymes required, nuclei are close to sarcolemma (cell membrane)

Endomysium: Wispy connective tissue sheath surrounding each muscle fibre

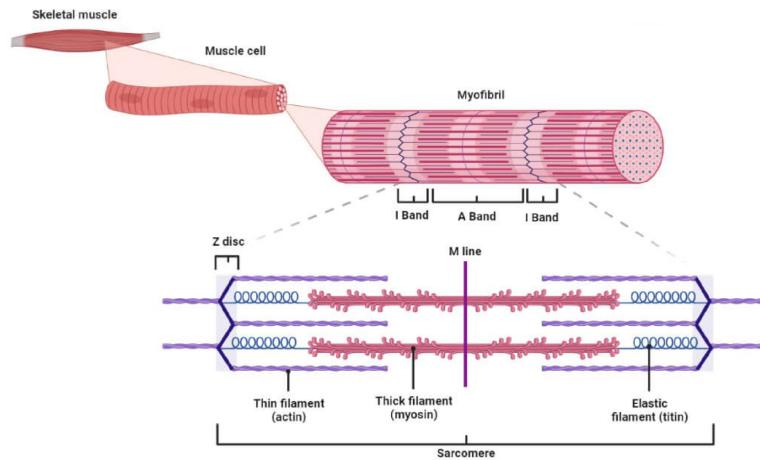


Key Points

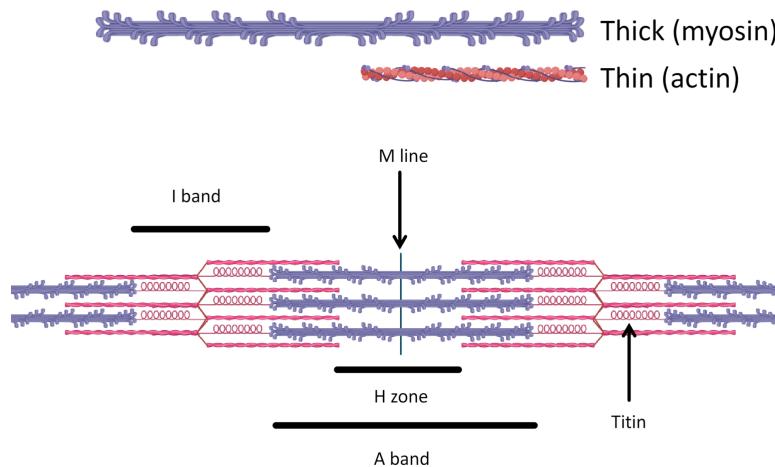
- Fascicle contains around 20 to 60 fibers
- One nerve may innervate fibers across >100 fascicles
- Muscle fibre is the cell
- Sarcolemma is cell membrane
- **Myofibril**
 - basic rod-like organelle of a muscle fiber
 - made of sarcomeres
 - sarcomeres made of myofilaments (actin & myosin)



Overview of Structure



Sarcomere



M line: Attachment point that aligns myosin (thick) filaments in sarcomere

Z line: Marks the boundaries of each sarcomere

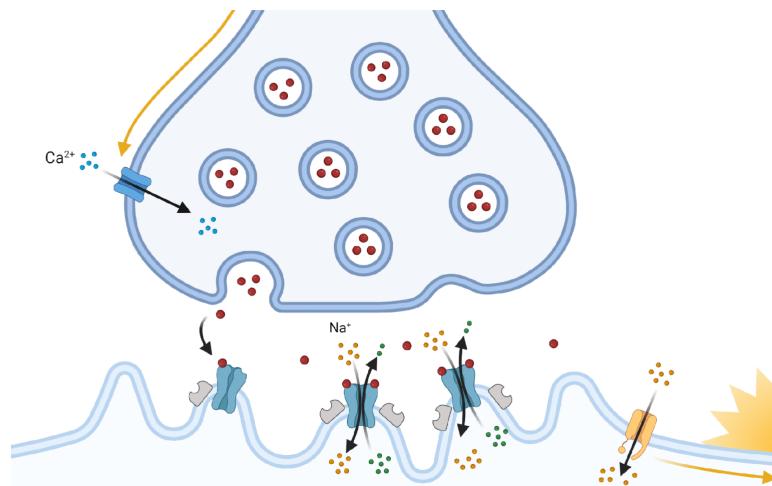
H zone: Region around M line where only myosin is present (no actin overlap)

I band: Region containing only actin filaments (no myosin overlap)

4.1.3 Neuromuscular Junction



Motor neurons innervate skeletal muscle cells



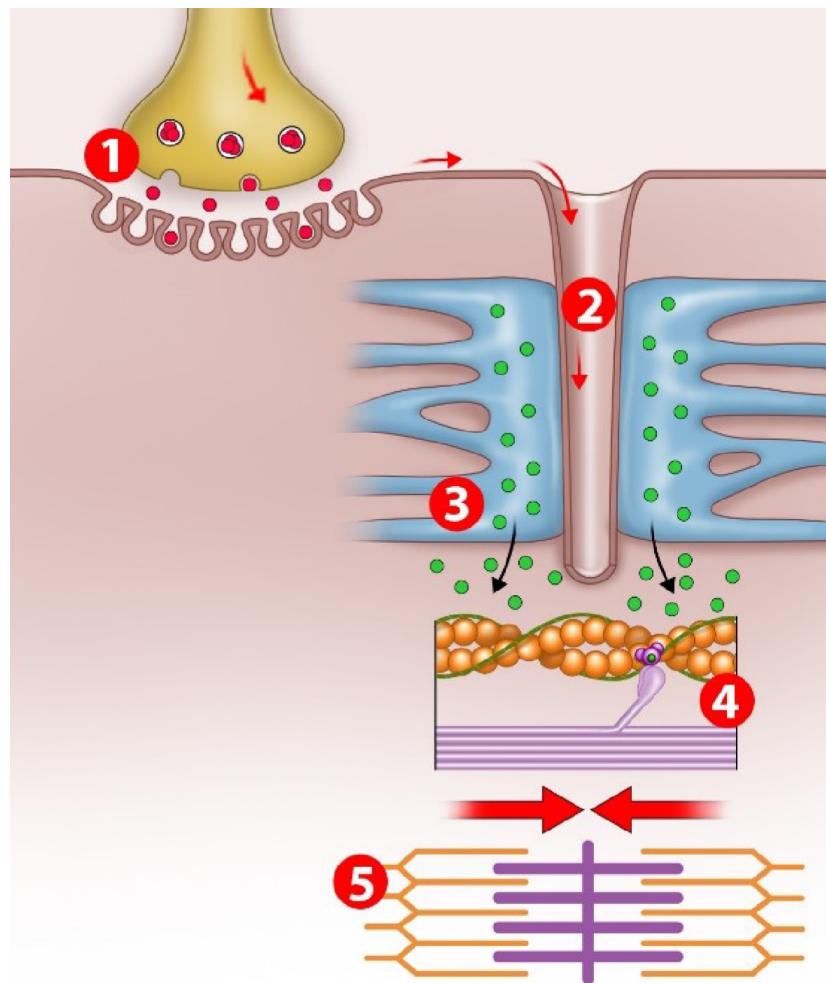
1. Action potential arrives at presynaptic terminal
2. Voltage gated calcium channels open, allowing influx of calcium cations
3. Calcium cations allows vesicle docking at acetylcholine (ACh) release
4. Channels open when 2 ACh bind to each receptor
5. End-plate potential is generated
6. Action potential is generated and spreads to muscle fibre
7. Neurotransmitter is removed by acetylcholinesterase (AChE)

4.1.4 Skeletal Muscle Function (Excitation-Contraction Coupling)

At the neuromuscular Junction and EPP, the action potential get to a core myofibril in muscle fibre cell

Excitation

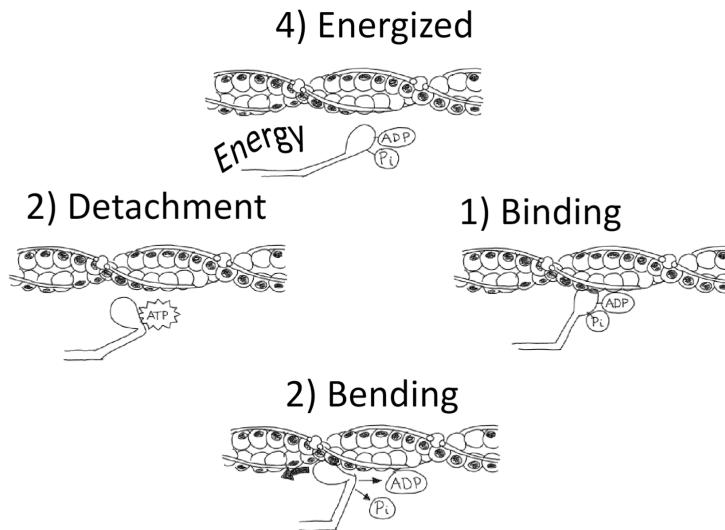
1. Ach release at neuromuscular junction
2. AP spreads across entire sarcolemma and into T-tubules
3. Calcium cations release by SR into cytoplasm (sarcoplasm)
4. Calcium cations binds to tropomyosin complex & causes active sites on actin filaments to be exposed
5. Myosin binds to actin & initiates cross bridging process (muscle contraction)



Cross-bridge cycle

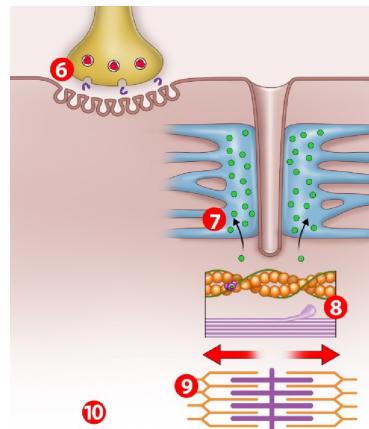
1. binding
 - ATP hydrolysis to ADP
 - Energized myosin head
 - Myosin attaches to actin forming cross bridge
2. bending
 - Power stroke
 - Myosin-actin binding triggers release of stored energy
 - Myosin pivots (ADP & Pi released)
 - Pulls actin to center of sarcomere
3. detachment
 - New ATP binds to myosin head
 - Decreases affinity of myosin for actin
 - Myosin detaches from actin filament
4. energized
 - Myosin returned to original position
 - ATP hydrolyzed to ADP & Pi

- Myosin re-energized and prepares for another binding cycle



Relaxation

6. ACh is broken down by acetylcholinesterase
7. SR uses ATP-powered pumps to collect Calcium cations
8. Tropomyosin complex takes up myosin binding sites
9. Cross-bridge binding does not occur. Compressed Titin recoils the sarcomere, like a spring
10. Muscle relaxation occurs



	Ion	K ⁺	Na ⁺
Exercise 4.1	Intracellular (mMol/L)	90	24
	Extracellular (mMol/L)	14	130

Ion concentrations of a skeletal muscle fiber, during strenuous exercise, are shown in the table on the right. Based on what you know about typical ion concentrations, what are three factors that explain the ion concentrations given in the table? ■

Exercise 4.2 What will happen to the resting membrane potential of a skeletal muscle fiber during strenuous exercise? Explain in quantitative terms (using the Nernst Equation) and in qualitative terms, the likely polarization compared to an unfatigued muscle fiber that has a resting membrane potential of -75 mV?

4.2 Skeletal Muscle Function

4.2.1 Tension Developed by Each Fiber

- Action potential frequency
- Fiber strength
- Fiber diameter
- Fatigue
- Fiber type

Action potential frequency

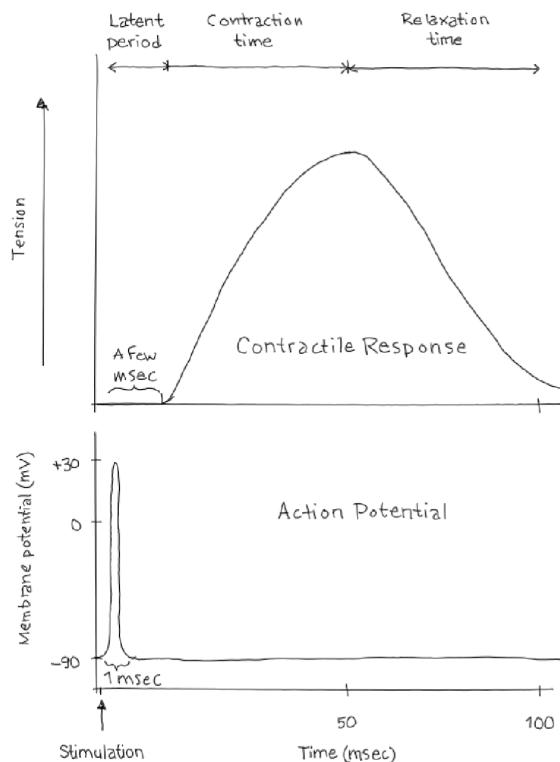


Figure 4.2: Relationship of action potential to a muscle twitch

R Muscle is stimulated (i.e. membrane potential peak) and contractile response occurs (i.e. twitch)

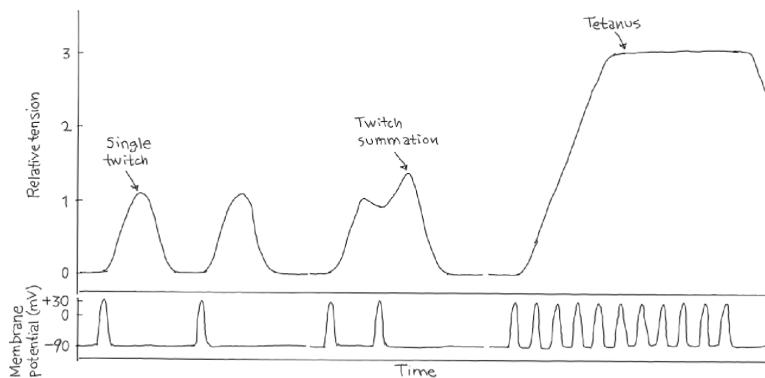


Figure 4.3: Summation and tetanus

- R** Repeated muscle stimulation (i.e. membrane potential peaks) creates prolonged contractile response (i.e. tetanus)

Fiber length

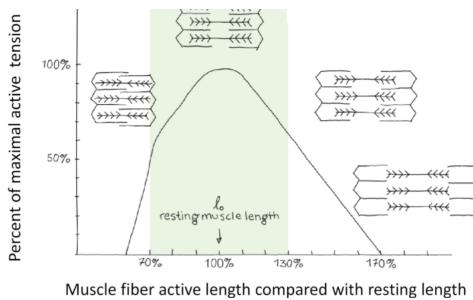


Figure 4.4: Active Length-Tension Relationship

- R**
- not enough overlap of fibers on the left
 - too much overlap (resting tension in fiber) on the right
- R** Consequence: at different positions (e.g. isometric) contractile force developed is different
- R** Consequence: passive force at different positions helps maintain posture & stabilize joints without active muscle contraction

Fiber diameter

Muscle size: increased size of muscle fibers

Debatable: increased number of muscle fibers

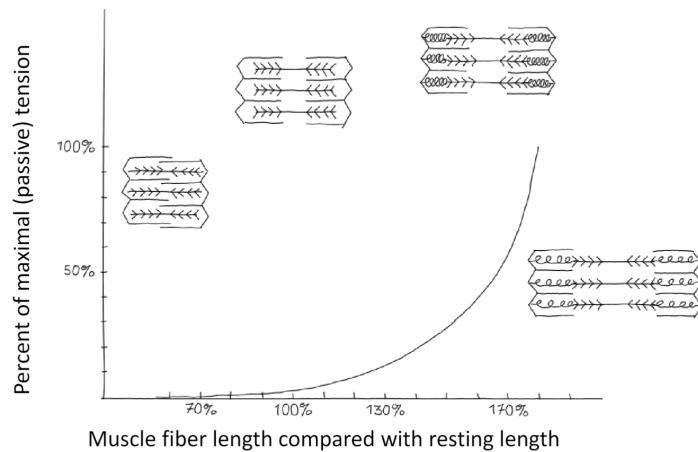


Figure 4.5: Passive Length-Tension Relationship

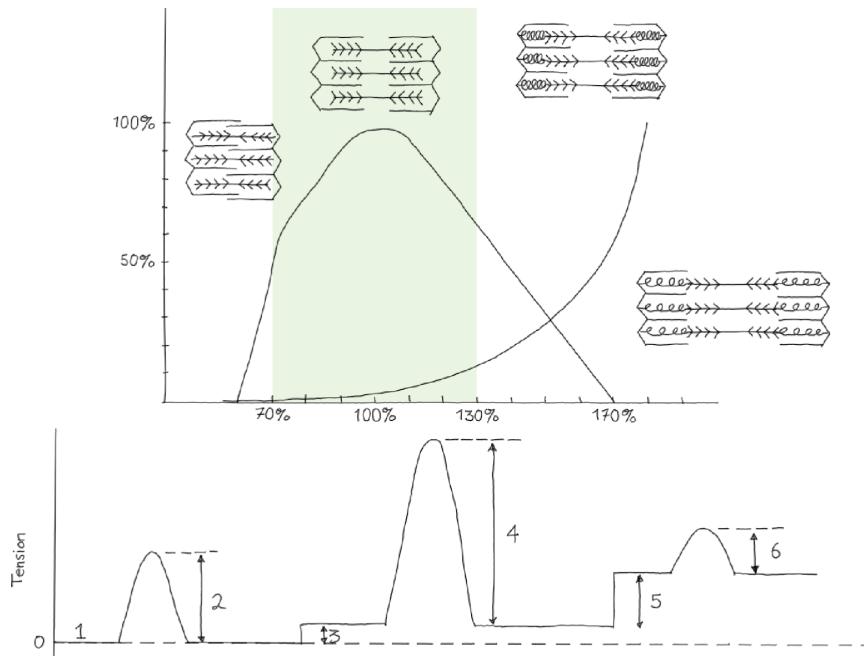


Figure 4.6

1. passive at 70%
2. active at 70 %
3. passive at 100%
4. active at 100 %
5. passive at 160%
6. active at 160 %

Fatigue

Rate of fatigue development Types of Contractions

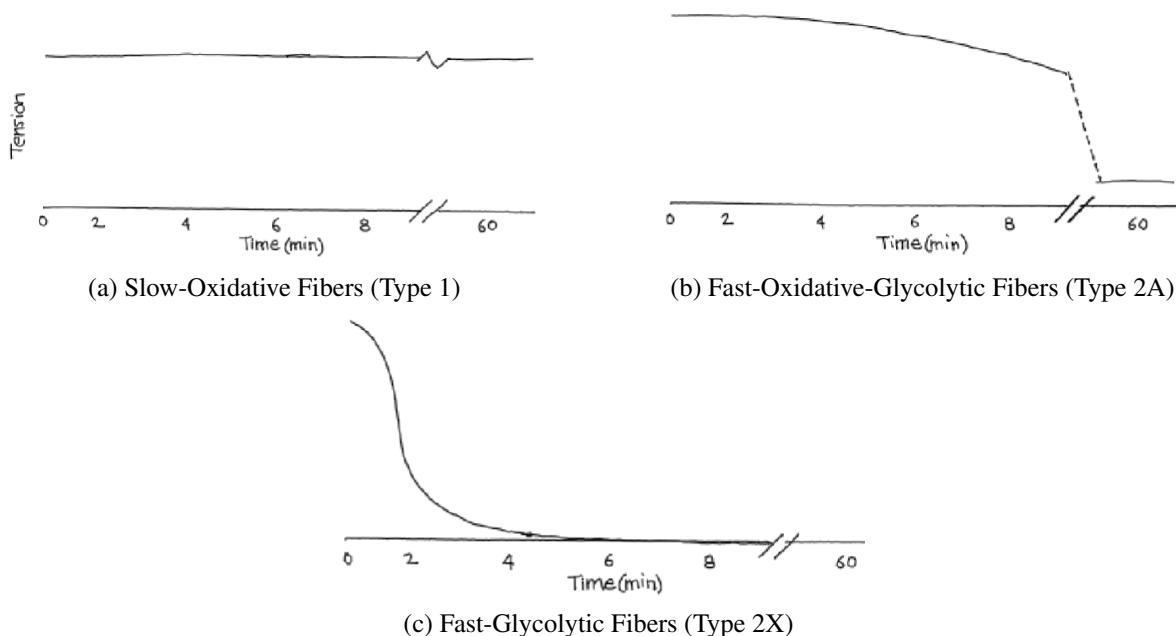


Figure 4.7

Other factors that likely influence muscle fatigue

- ADP may interfere with cross-bridge
- Accumulation of Lactic acid
- Increased extracellular potassium cations
- Depletion of glycogen energy reserves

Fiber type

Fiber Type	Diameter	Fatigue Rate	Size of Motor Neuron Innervating Fiber
Slow-Oxidative Fibers (Type 1)	Small	Slow	Small
Fast-Oxidative-Glycolytic Fibers (Type 2A)	Largest	Intermediate	Intermediate
Fast-Glycolytic Fibers (Type 2X)	Large	Fast	Large

4.2.2 Tension Developed by Several Active Fibers

- Number of fibers per motor unit
- Number of active motor units

Number of fibers per motor unit

Number of active motor units

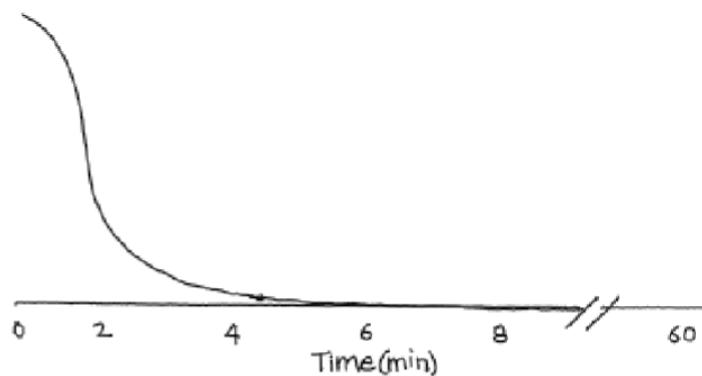


Figure 4.8: Motor units: more recruitment = more power

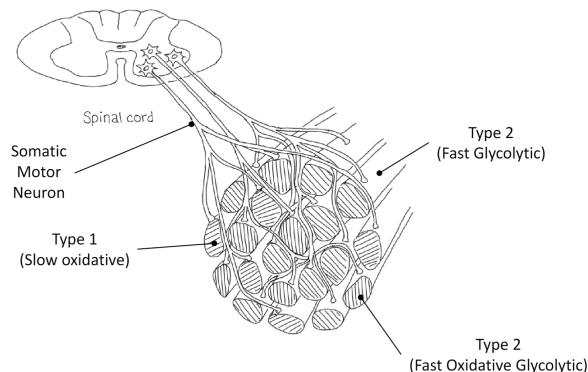


Figure 4.9: Different neurons for different motor units

4.3 Cardiac Muscle ECG and Cycle

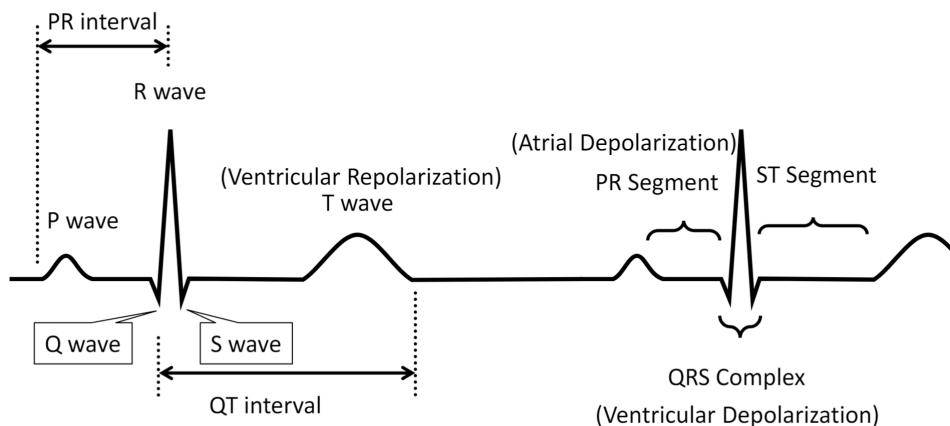


Figure 4.10: ECG

Cell	Velocity (m/s)
Neuron: Large and myelinated	100
Muscle: Skeletal	3-5
Muscle: Cardiac	0.05-0.4
Muscle: Smooth	0.015-0.15

Table 4.1: Conduction velocity comparison

4.3.1 Electrocardiogram (ECG)

Two-cell Model of the ECG

- 2-cell model to understand ECG simplifies cardiac electrical activity as two cells (or groups of cells)
- Cell A
 - left and right atrium
 - upper (cranial) two chambers of heart
- Cell B
 - left and right ventricle
 - lower (caudal) two heart chambers
- 3 possible states for cells A and B
 - polarized (resting)
 - depolarized (active, contraciton)
 - repolarizing (returning to resting state, relaxing)

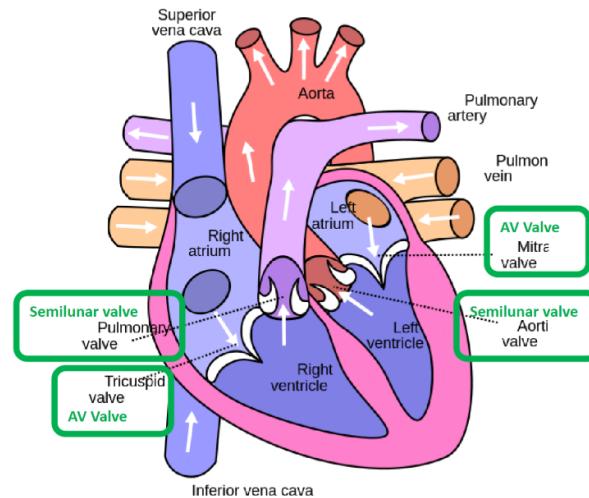


Figure 4.11: Left side: receives oxygenated blood from lungs & sends to body; right side: receives deoxygenated blood from VC & sends to lungs for reoxygenation

Cardiac APs Differ from Neurons & Skeletal Muscle

- Specialized ion channels & currents in cardiac cells
- Rapid depolarization not followed by quick repolarization
- AP plateaus near 0mV due to balance between calcium cation influx & potassium cation efflux

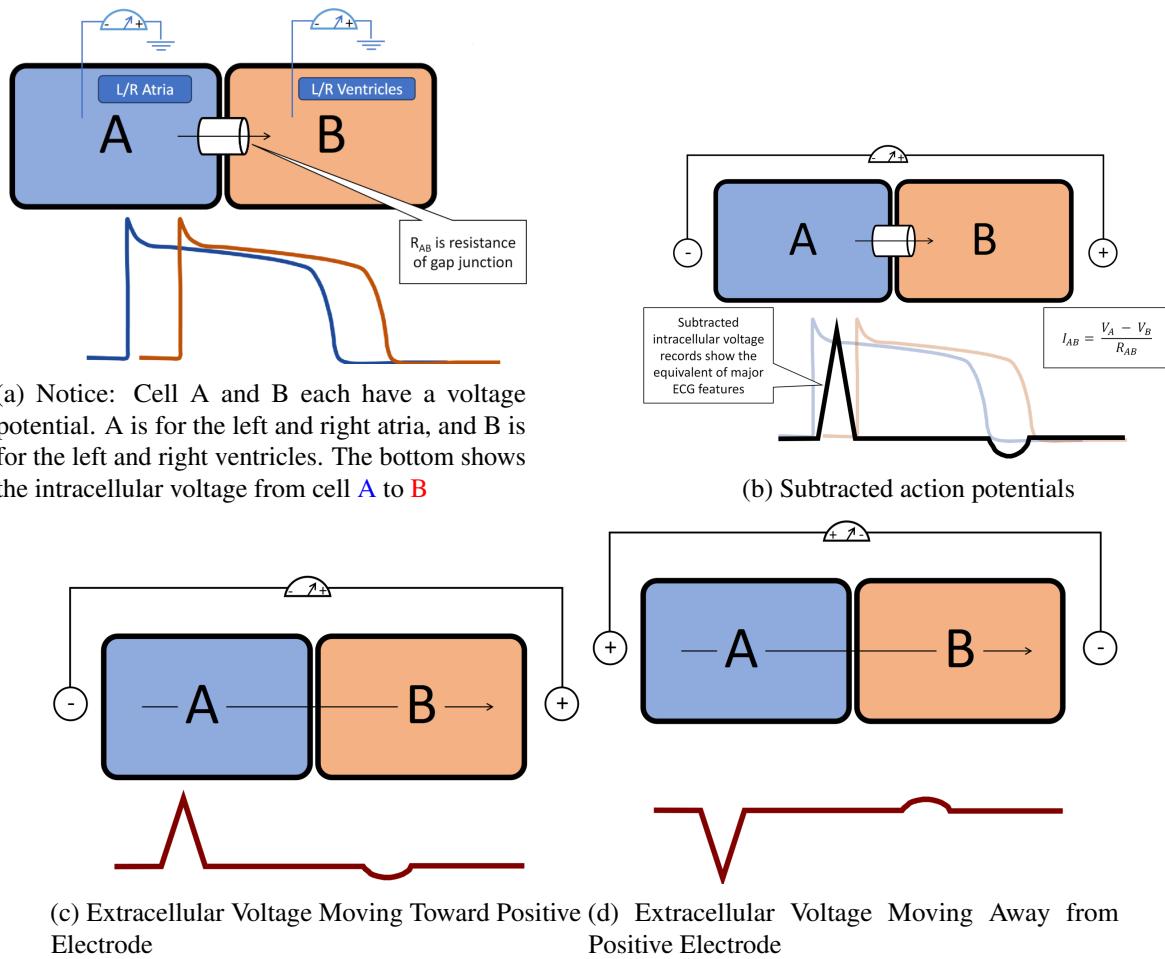


Figure 4.12

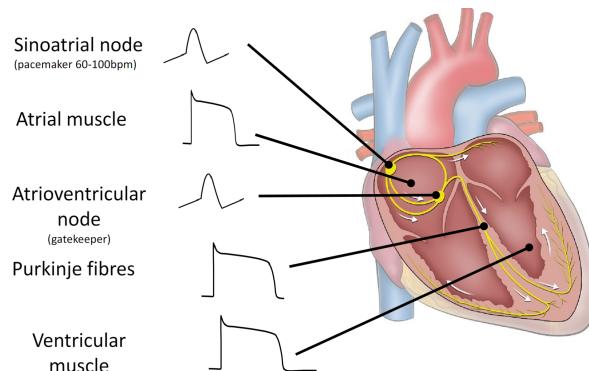


Figure 4.13: APs Differ Across Cardiac Cells in Conduction Network



Cardiac slower due to conduction through gap junctions

4.3.2 Sequence of Depolarization

1. **Depolarize atria:** Sinoatrial node → atrial pathways → atrioventricular node
 - (a) SA firing: triggers atrial depolarization (sends across to left & throughout right atrium)
 - (b) Atrial muscle contracts
 - (c) AV node: delay/slow the conduction, allows atria to fully empty into ventricles

Tissue	Conduction Velocity (m/s)
SA node	0.05
Atrial pathways	1.00
AV node	0.05
2. **Depolarize septum from left to right:** Atrioventricular node → bundle of his → purkinje system
 - (d) Bundle of His into Purkinje fibers: triggers ventricular depolarization

Tissue	Conduction Velocity (m/s)
SA node	0.05
Atrial pathways	1.00
AV node	0.05
Bundle of His	1.00
Purkinje system	4.00
3. **Depolarize anteroseptal region of myocardium towards apex:** purkinje system → ventricular muscle
 - (e) ventricular muscle contraction
 - (f) ventricular muscle relaxation (repolarization)

Tissue	Conduction Velocity (m/s)
SA node	0.05
Atrial pathways	1.00
AV node	0.05
Bundle of His	1.00
Purkinje system	4.00
Ventricular muscle	1.00
4. **Depolarize bulk of ventricular myocardium, from endocardium to epicardium**
5. **Depolarize posterior portion of base of the left ventricle**
6. **The ventricles are now fully depolarized**
7. **The ventricles start to repolarize**

4.3.3 Cardiac Filling Action

Major events of left ventricular cardiac cycle

Theorem 4.3.1 $SV = EDV - ESV$

SV: Stroke volume, volume of blood (mL) ejected from the left ventricle due to contraction of heart

EDV: End Diastole Volume ESV: End Systole Volume

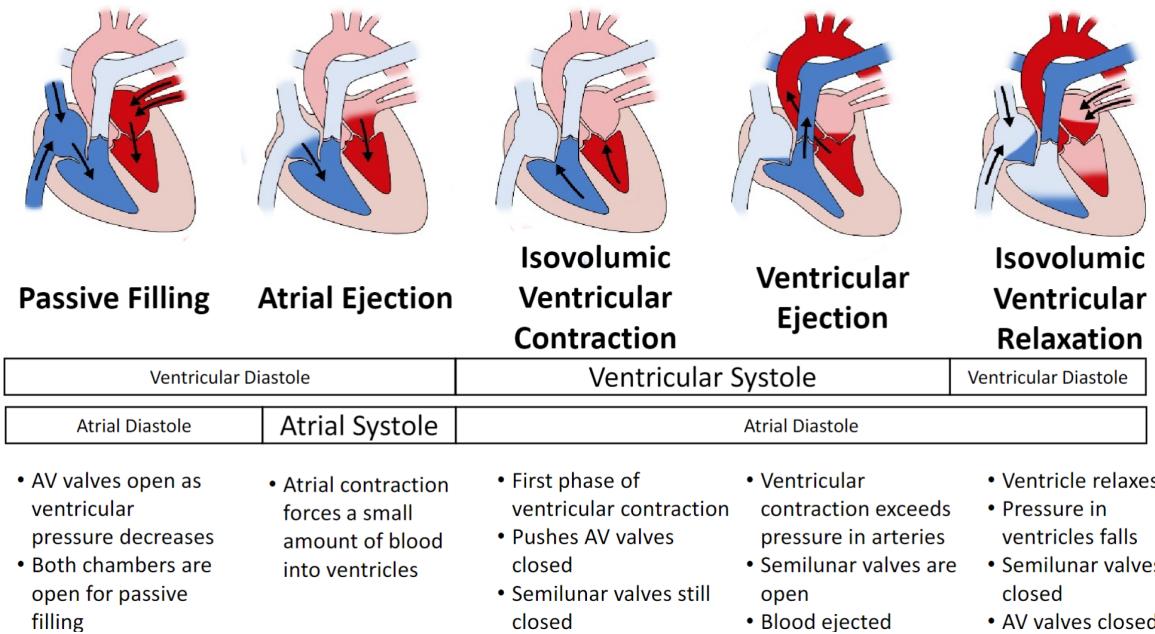


Figure 4.14: Diastole: muscle relaxation; systole: coordinated contraction

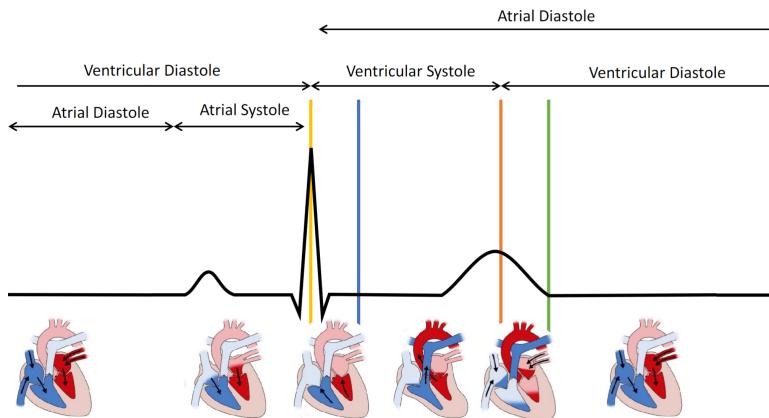


Figure 4.15: Major cardiac cycle events

4.4 Cardiac Regulation

4.4.1 Stroke Volume

Heart sounds and ECG

- Pressure changes in heart allow for opening & closing of heart valves
- “Lub dub” is an artifact of turbulence in blood flow when heart valves snap shut
- Lub
 - Ventricular systole: First phase of ventricular contraction
 - AV valves snap closed: Semilunar valves still closed

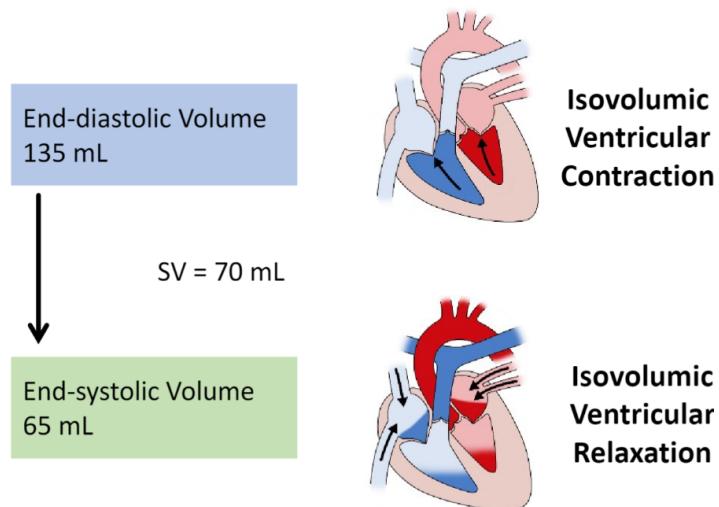


Figure 4.16

- Dub
 - Ventricular diastole: Ventricle relaxes & pressure falls
 - Semilunar valves snap closed: AV valves still closed

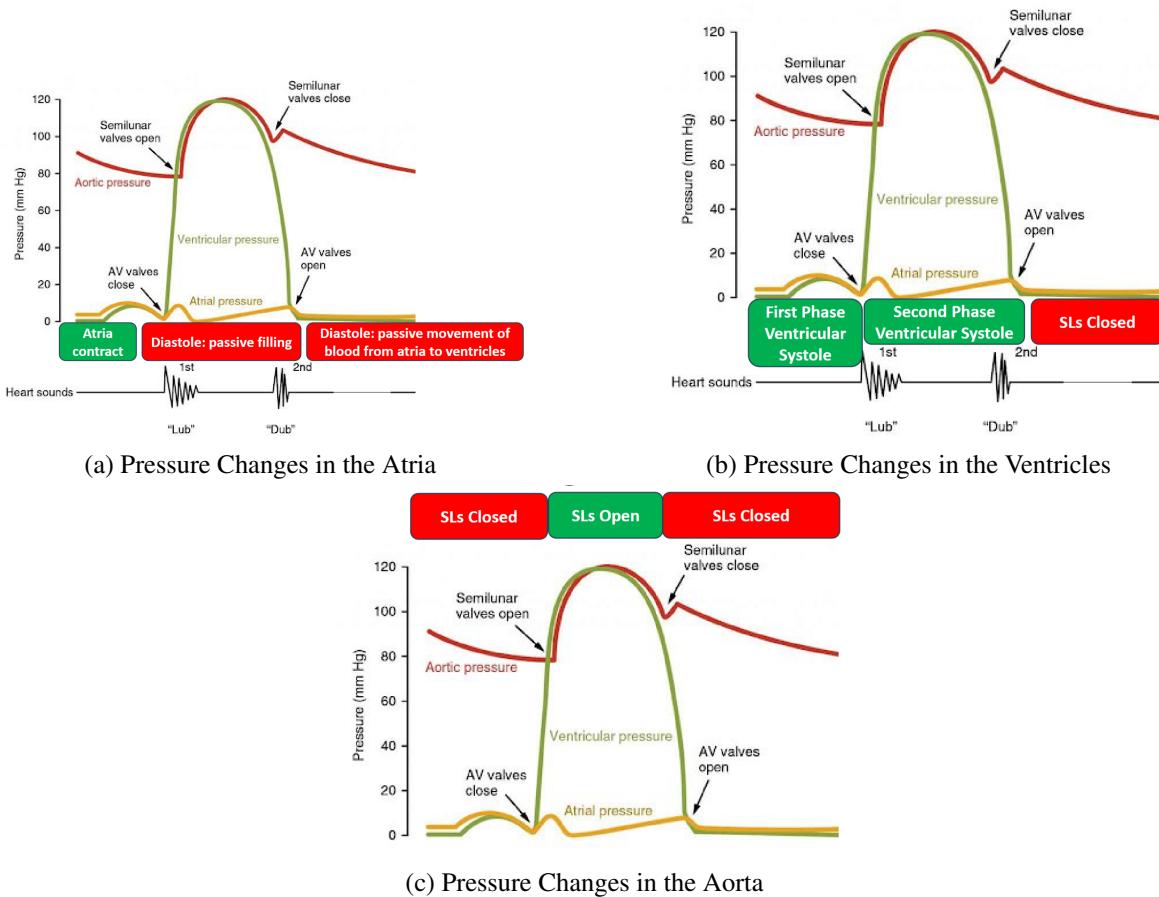


Figure 4.17

4.4.2 Cardiac Output

Theorem 4.4.1 Two main factors influencing cardiac output: Why is stroke volume so important?

$$CO = SV \times HR$$

where CO is cardiac output, SV is stroke volume, and HR is heart rate

Heart Rate Modulation of Sinoatrial (SA) Nodal Myocyte

- Rate of depolarization
- Shift in minimum diastolic potential
- shift in threshold

4.4.3 Extrinsic Control of Heart Rate: The Autonomic Nervous System

Parasympathetic Nervous System

Exercise 4.3 Remember that the Vagus nerve releases ACh. It turns out that the SA nodal cells have M2 (muscarinic) receptors that respond to ACh. M2 receptors lead to inhibition of target cells.

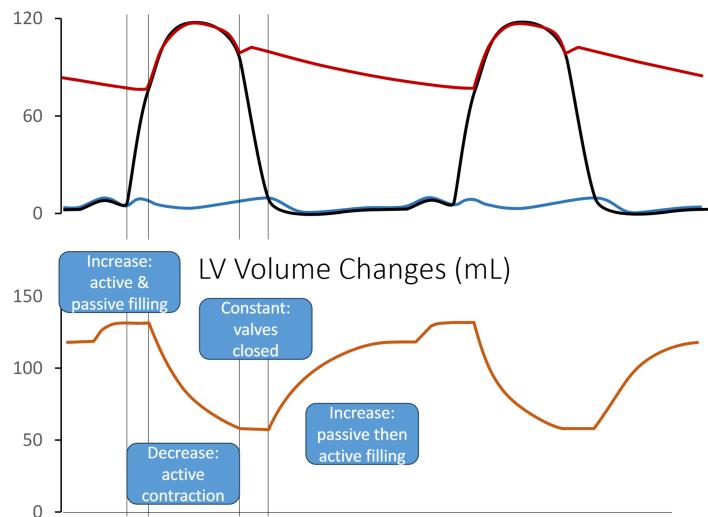


Figure 4.18: Note: peak pressures & volumes not identical

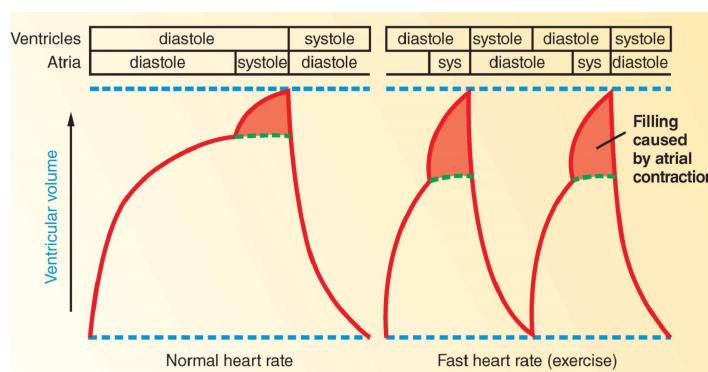


Figure 4.19: Effect of heart rate on LV volume. Because much of ventricular filling occurs early in diastole during the rapid filling phase, filling is not seriously impaired when diastolic time is reduced as a result of an increase in heart rate

How might Vagus nerve stimulation change your heart rate? ■

Sympathetic Nervous System

- Sympathetic nerves releases NE and cardiomyocytes have β_1 adrenergic receptors. Recall that agonism of β_1 receptors leads to excitation of target cells
- Conduction velocity increases for the AV node and purkinje fibres, because in the sympathetic $\uparrow = \uparrow$ calcium cations

4.4.4 Autonomic Tone

There is always the influence of the parasympathetic and sympathetic nervous systems. That is to say, the systems do not behave as an “on/off” but rather “more/less”

Calcium cation permeability

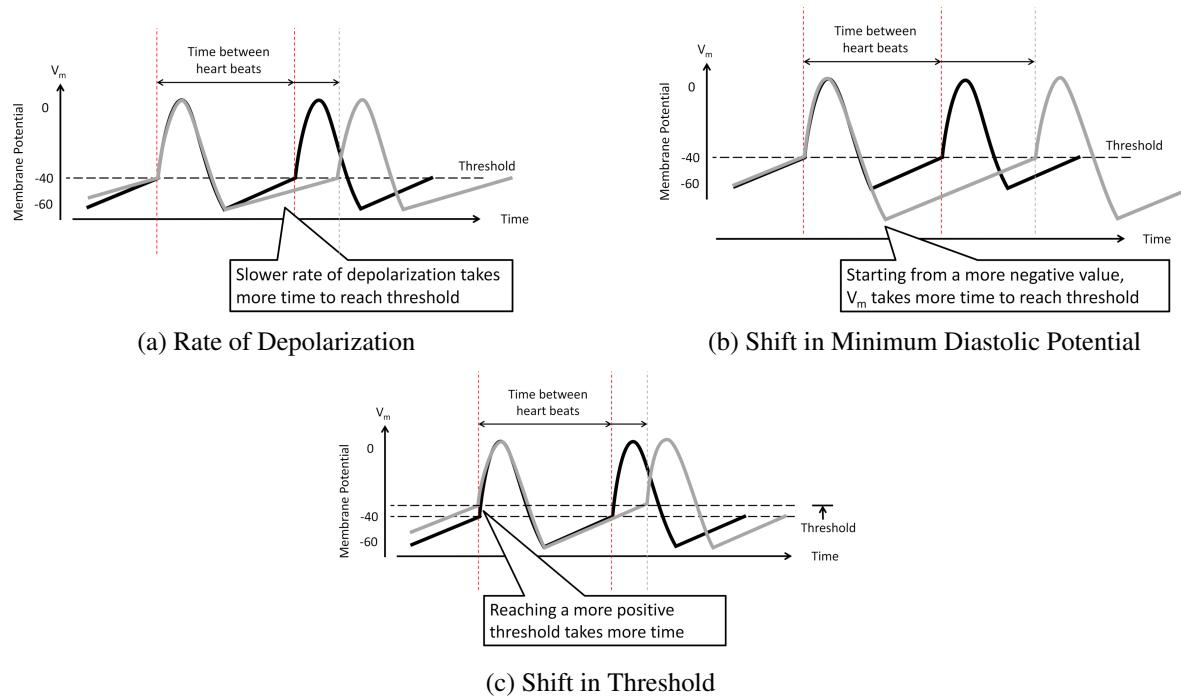


Figure 4.20

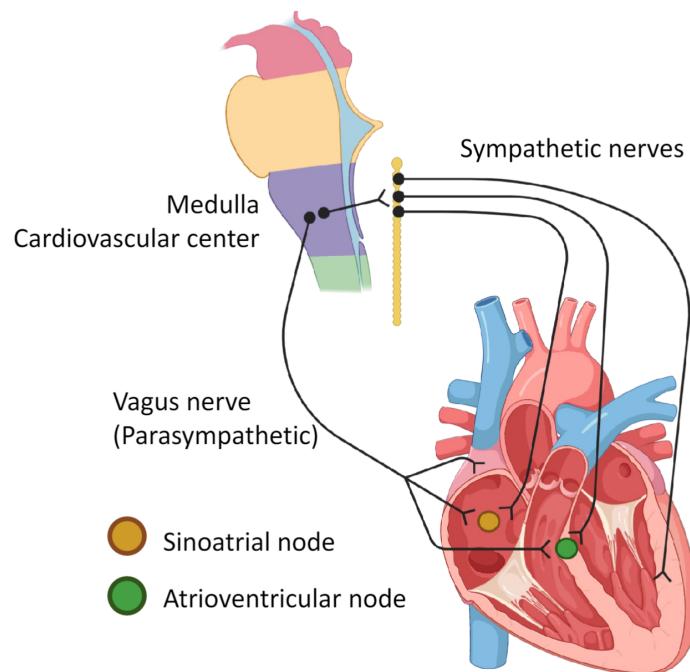


Figure 4.21: Autonomic Effects on the Heart

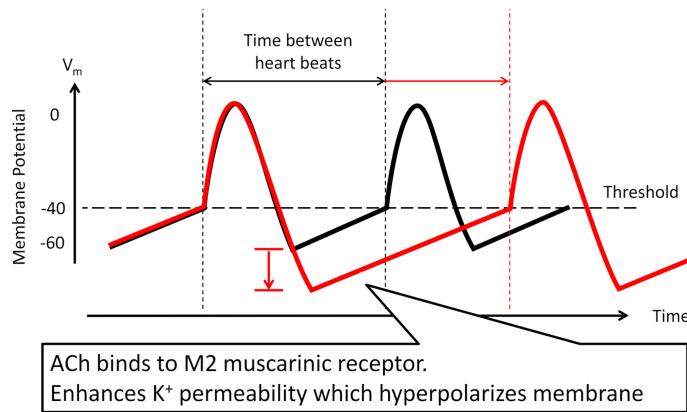


Figure 4.22: Heart rate decrease with parasympathetic stimulation

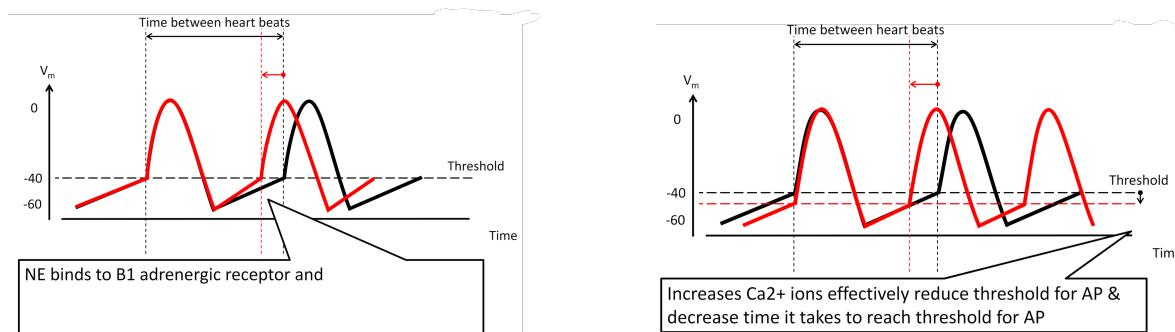


Figure 4.23: Heart Rate Increase with Sympathetic Stimulation

- Calcium current: movement of calcium ions through a cell's membrane (recall skeletal muscle mechanics)
- Sympathetic stimulation (i.e., Norepinephrine but also Epinephrine) enhances Calcium currents and availability of Calcium cation in the cytosol (cytoplasm) of ventricular myocytes. These two factors increases the force developed by ventricular myocytes and the force of ventricular contraction

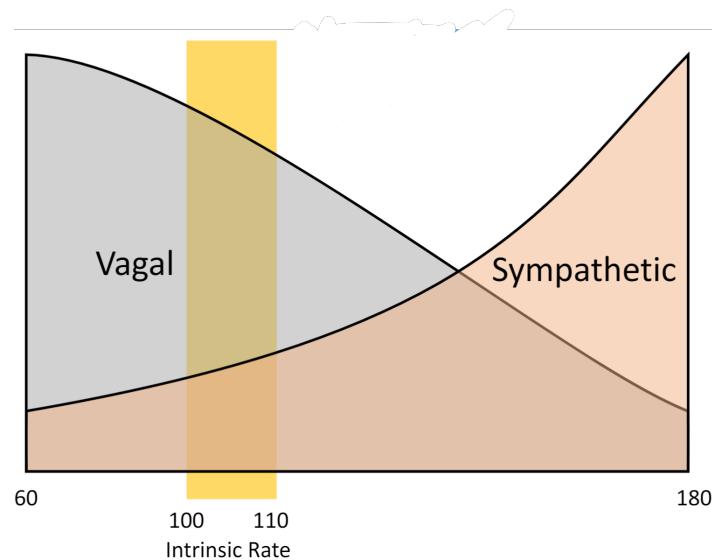


Figure 4.24: Vagal and Sympathetic Tone. Intrinsic HR: HR under complete pharmacologic blockade

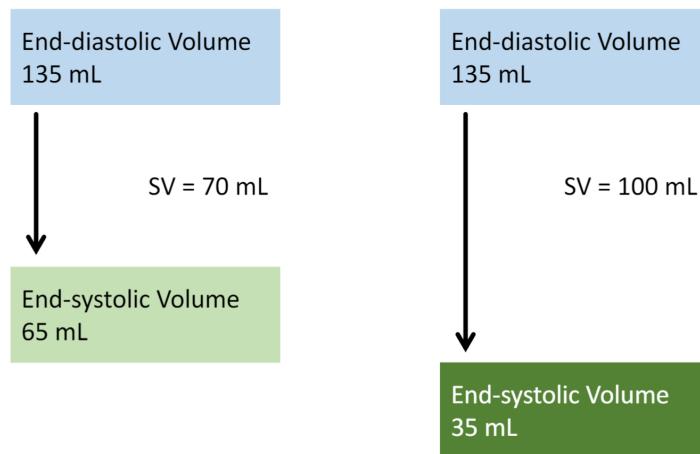


Figure 4.25: Sympathetic Stimulation on Stroke Volume

4.4.5 Summary: Extrinsic Control of Cardiac Output

4.5 Blood Vessels and Blood Pressure

4.5.1 Smooth Muscles

Skin: Arrector pili of skin

Tract: GI tract, respiratory tract, reproductive tract, ureters

Hollow: Walls of stomach, intestine, uterus, bladder

Vessel: Aorta, arteries, arterioles, veins, lymphatic vessels

Eye: Ciliary muscle, iris

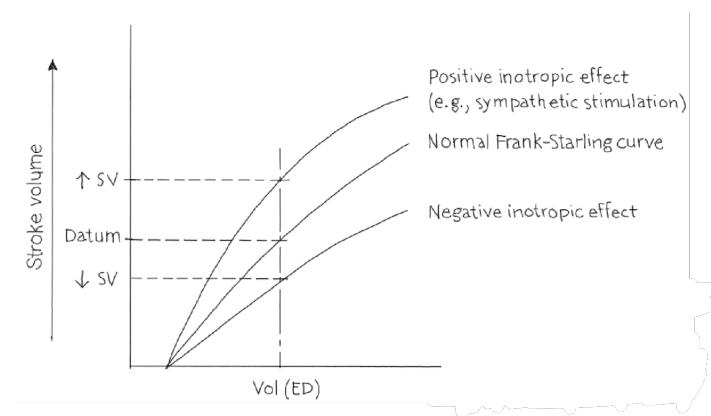


Figure 4.26: Ability of the Heart Muscle to Contract AKA: Contractility. **Inotropic effect:** when nervous system or medication changes the contractility of the heart

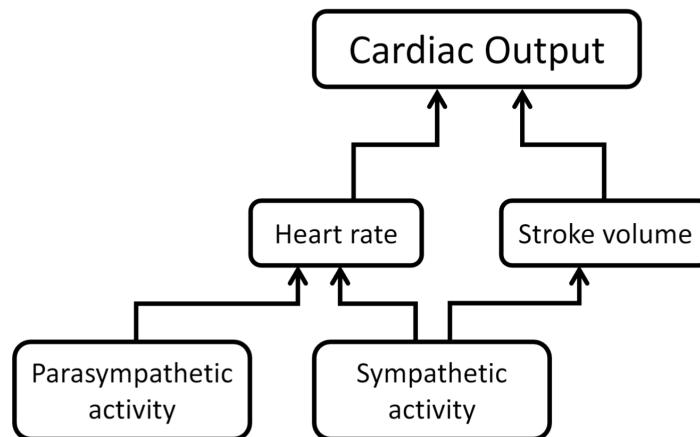


Figure 4.27

Smooth muscle versus skeletal muscle

- Skeletal muscle fibers
 - long cylindrical fibres
 - striated
 - multinucleated
 - enables movement
- Smooth muscle fibers
 - short, spindle shaped
 - non-striated (smooth)
 - single nucleus
 - facilitates involuntary processes

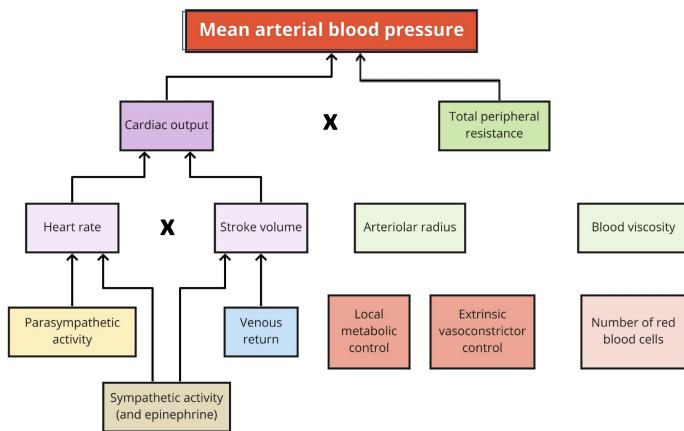
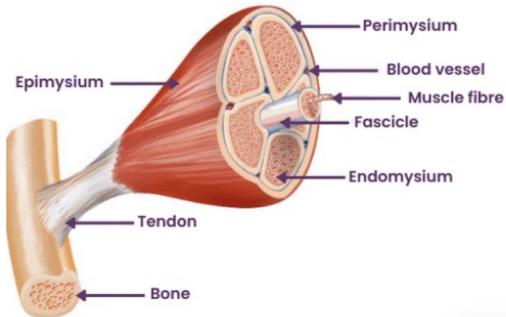
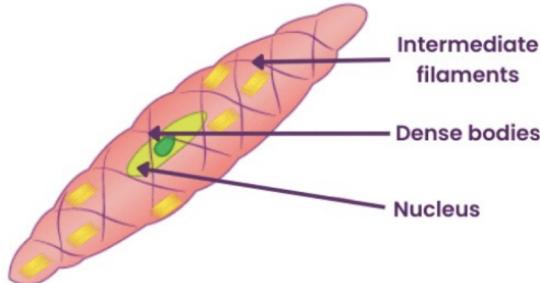


Figure 4.28

Skeletal Muscle



Smooth Muscle



Skeletal muscle: attached to bones, quick powerful contraction, respond to nervous system
Smooth muscle: in walls of internal organs, slow sustained contractions, cell junctions connect and support function, respond to hormones and nervous system

Smooth muscle structure

Schematic of smooth muscle

Calcium cation permeability

- Autonomic stimulation (i.e., neurotransmitters) change the availability of Calcium cations in the cytosol of smooth muscle cells.
- Smooth muscle cells have a sufficient level of Calcium cations to maintain a low level of tension and are sensitive to varying degrees of autonomic neurotransmitters depending on the distribution of cholinergic and adrenergic receptors

Innervation of smooth muscle

Skeletal muscle: Nerve connected by neuromuscular junction

Smooth muscle: Nerve connected by varicosity

Varicosity:

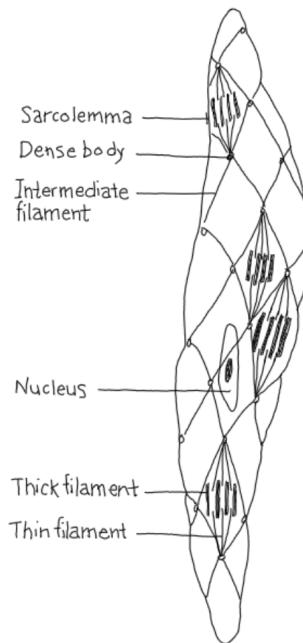


Figure 4.30: Recall: sarcolemma (cell membrane); actin (thin); myosin (thick); dense body (anchoring site, like z band); intermediate filament (cytoskeleton filament)

- Swelling at end of nerves
- Release neurotransmitter into wide synaptic cleft (diffuse junction)
- Neurotransmitter diffuse across cleft and affect smooth muscle cells
- SMCs may be far from nerve ending
- Allows one nerve ending to impact many SMCs at once

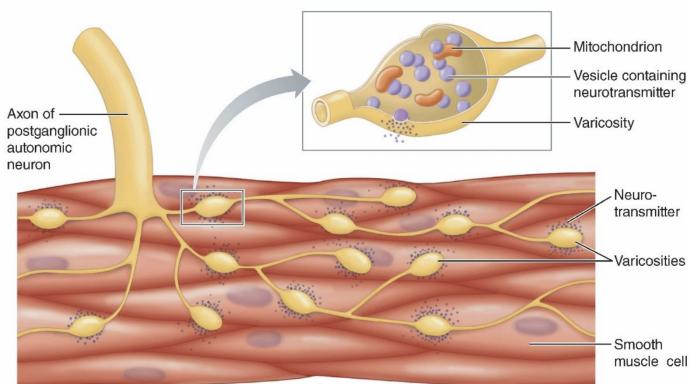


Figure 4.31: Innervation of smooth muscle

4.5.2 Vascular System Structure & Function

Basic organization of cardiovascular system

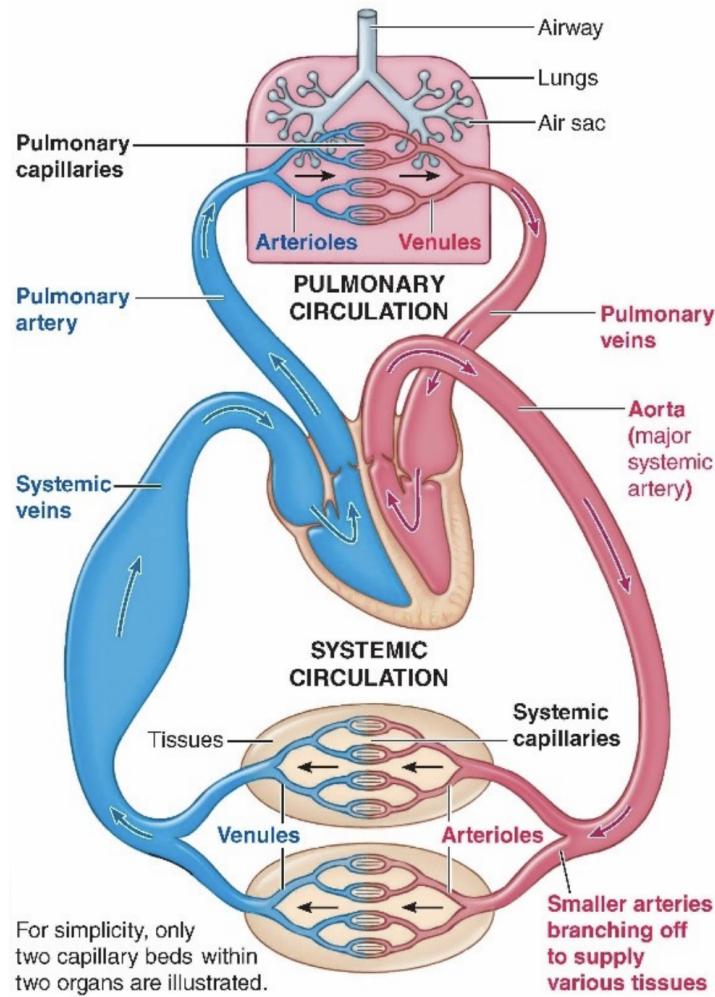


Figure 4.32: Basic organization of cardiovascular system, showing the important function characteristics of arteries and veins

Structure of blood vessels

Tunica externa

- structural support
- collagen and loose elastic fibers

Tunica media

- support, change vessel diameter, regulate blood flow
- SMC, collagen, elastic tissue

Tunica intima

- single layer endothelial cells & connective tissue
- release chemicals & support gas exchange

- basement membrane (innermost layer) thin fibrous support for endothelial cells

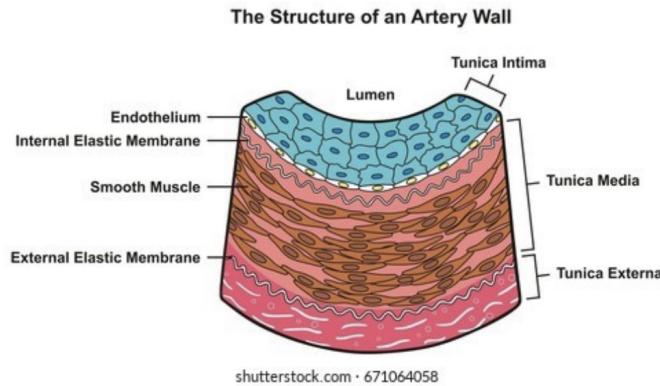


Figure 4.33: Basic organization of cardiovascular system, showing the important function characteristics of arteries and veins

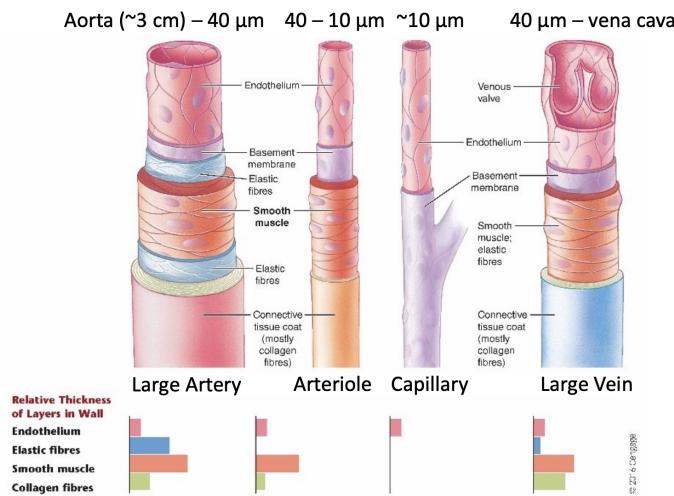


Figure 4.34: Structure of blood vessels

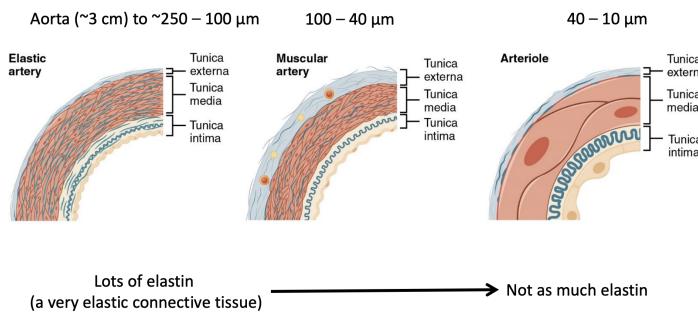


Figure 4.35: Different amounts of smooth muscle in arteries and arterioles

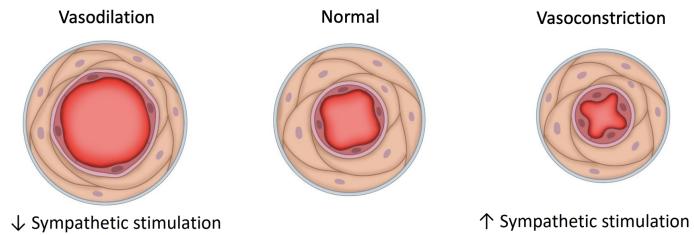


Figure 4.36: Extrinsic Factors Affecting Diameter of Systemic Arterioles

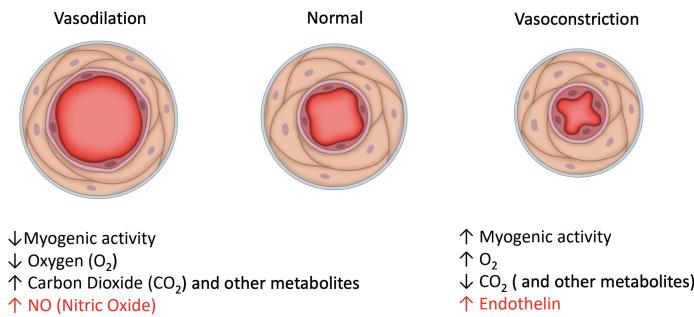


Figure 4.37: Extrinsic (and local) Factors Affecting Diameter of Systemic Arterioles. **Myogenic activity:** muscular contractile activity; Endothelin/NO are released by endothelial cells to impact vasodilation/vasoconstriction

Theorem 4.5.1 Hagen-Poiseuille Equation

$$\Delta P = Q \frac{8\eta L}{\underbrace{\pi r^4}_{TPR}} = CO \times TPR$$

ΔP = pressure difference

Q = flow

r = radius

L = length

η = dynamic viscosity (fluid's internal resistance to flow, in $\text{Pa} \cdot \text{s}$)

Factors that Alter Resistance

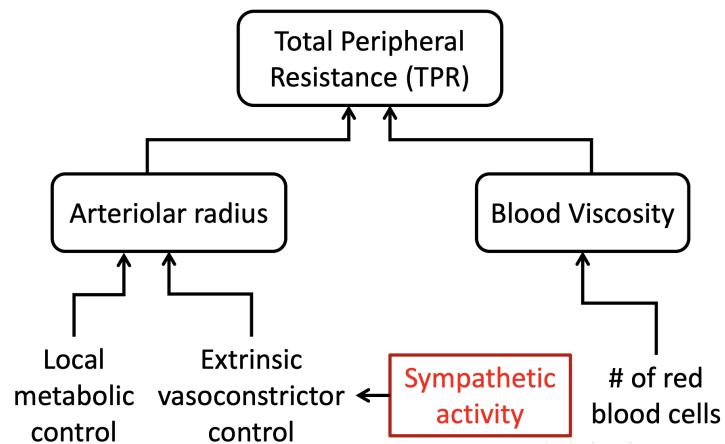


Figure 4.38: Factors that alter resistance

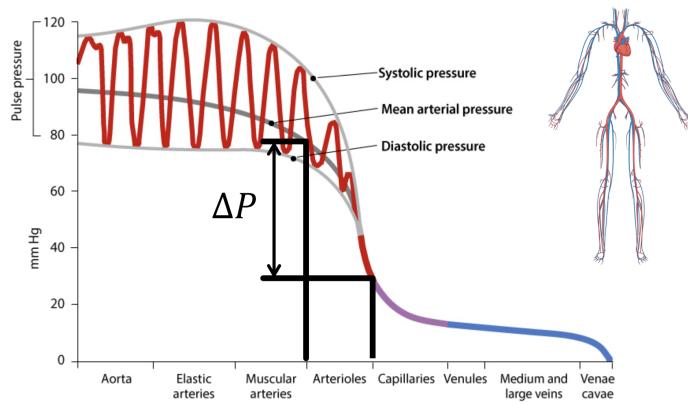


Figure 4.39: Arterioles have the largest pressure drop

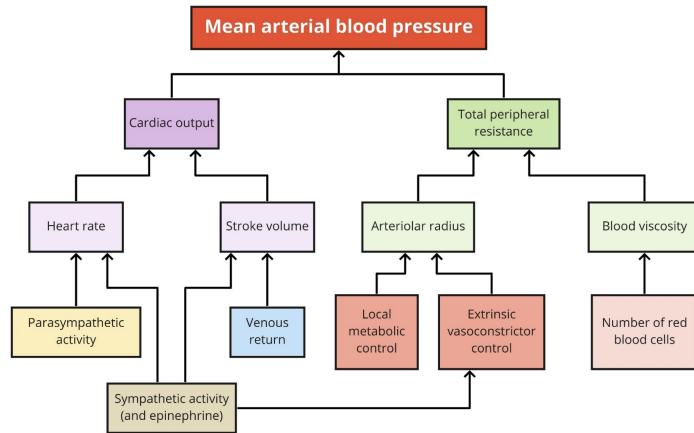


Figure 4.40: Our final flowchart: influence on MAP

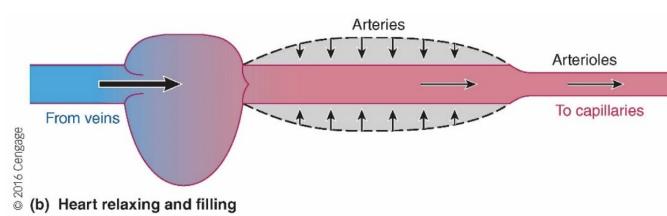
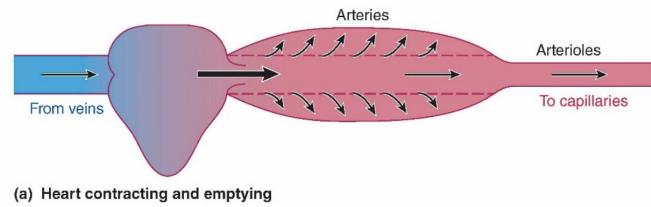


Figure 4.41: Elastic reservoir: heart/vessel coupling

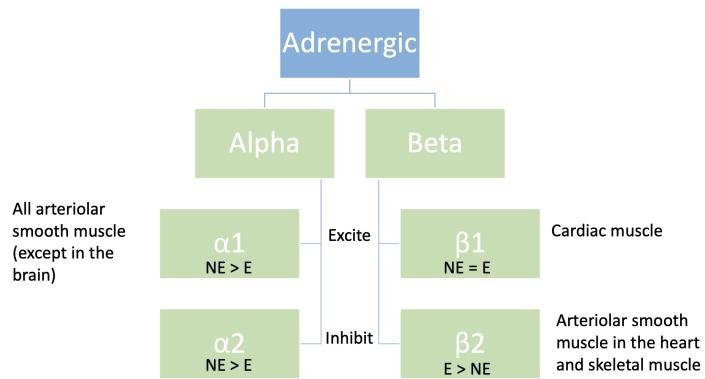


Figure 4.42: Different Tissues have Opposite Responses to Sympathetic Nervous System. E: Epinephrine

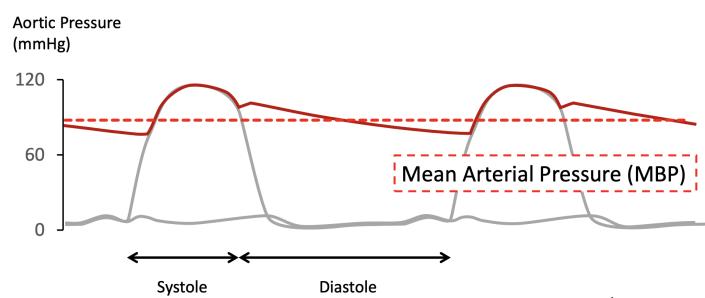


Figure 4.43: Blood pressure in the aorta

5 Class Notes 71

- 5.1 Early Films
- 5.2 Entering Modernity
- 5.3 Disaster Aesthetics
- 5.4 The Future
- 5.5 Technofutures and the Secret Life of Robots
- 5.6 Technophobia and the Surveillance of states
- 5.7 The Space Within
- 5.8 Urban Dystopia
- 5.9 Spectacular Bodies
- 5.10 Alfrofuturism
- 5.11 The Posthuman
- 5.12 After World, After Film

6 Review Notes 101

- 6.1 Films Overview
- 6.2 Reading Summaries
- 6.3 Key Ideas
- 6.4 Practice



5. Class Notes

5.1 Early Films

5.1.1 Demolition d' un mur, Le Voyage dans la lune

Louis Lumiere: Demolition d' un mur (1895)

- Early exploration of motion pictures
- We cannot travel in time, but film can: Lumiere showed that something broken can be made whole again

Georges Melies: Le Voyage dans la lune (1902)

- First scifi film, very popular
- Special effects
- ‘Mocking’ scientists, satire, since science is quickly being professionalized
- The scientists’ fantasy of themselves, as wizards (Melies think that scientists think highly of themselves)
- Colonization of moon, colonial ideas, imperialism of professional science (Melies mocks that)

The 6th World (2016)

- What distinguishes mythology and science
- What gets to be science and who gets to be a scientist
- Scientists think highly of themselves

5.2 Entering Modernity

5.2.1 Metropolis (and Cabinet of Dr. Caligari)

The Cabinet of Dr. Caligari and Metropolis

- How technology has the ability to overturn society

- Caligari very theatrical, Metropolis very "blockbuster-y"
- German expressionism often a lot about the set

Mise-en-scene

- Decor
- Set design
- Actors
- Customing, makeup
- Lighting
- Special effects
- Everything in front of the camera that is **not** sound or editing (cuts)

R Science fiction is all about “images of wonder”, only something you can imagine.
Storytelling doesn’t necessarily always make sense especially in early sci-fi because films are lost, but the “images” live on.

German Expressionism

- Psychological states externalized into film
- Arts movement, Avante-garde aesthetic movement: 1910-1927
- Graphic shapes (bold)
- Chiaroscuro (strong contrasts between light and dark)
- Heavy make-up
- Shapes are distorted and exaggerated to suggest an emotional state
- The world as the hero or another character is experiencing it or imagines it to be
- Most often used in horrors or horror-comedies, thrillers
- Other similar arts movements at the time:
 - Surrealism
 - Cubism
 - Bauhaus

Cesare slinking

- Character becomes part of the decor

Ideas in Metropolis

- Metropolis not well received in Germany, but welcomed in America
- How the use of ‘scientific’ special effects comments on
 - Labour and industry
 - Economic revolution
 - Gender relations
 - Family organization
 - Class dynamics
 - The concept and experience of the city
- Special effects include
 - Schufftan process (using mirror to display one image onto another)
 - Light-filled tubes
 - Stop-motion animation with miniatures
 - Hand-drawn animation
 - Multiple exposure (fusion of different images)
- Metropolis: 1920s: Factory work
 - Machinery and technology has big role in peoples’ lives

- Automation, people being replaced
- Huge divide between upper and lower class (hierarchy, temptation within lower class), seen visually as well in film with visual divisions
- Relationship between machines and bodies become central. Notice that machines are named after body parts e.g. heart machine
- Maria and Maria-tron
 - Machine-man is a woman
 - When men went to war, women took the jobs. There is worry about women entering work force
 - Connection between production and reproduction essential
 - * Production: labour
 - * Reproduction: family, children, home
 - Maria's split
 - * Becomes two different images of femininity: Maria and whore of Babylon

R Interesting that the mediator is also part of the highest class, how you need to have the luxury in the first place to be able to mediate. There must be a heart connecting the head and the hands: the system and class necessary?

R Images of wonder in Metropolis also influenced fantasy cinema, like cartoons and anime. Where else do we see similar pictures?

R Metropolis revolutionized film not because of inventing particular techniques, it's about fusing everything together at the same time. I.e. all the special effects.

R Choreography difference between portraying the workers at the beginning, robotic movements, not human-like vs. portraying the maria-tron dancing humanly, gracefully in the performance. Note that the power treats workers (humans) like machines, and machines (maria-tron) like a human (Facist Automation?).

R In many ways an anti-capitalistic critique. Politics-wised, very socialist. Combining the people in one body. A lot of montages played with at the beginning of the film. Protagonist as saint, antagonist as un-saint: negative portrayal of working class (i.e. the workers breaking the heart machine). Nothing really unites the two classes, like in fascism, they are joined together by blaming the outside (ie. Germans blaming the Jew). The joint doesn't lead to any real solution and in the end nothing is really changed.

Exercise 5.1 What is included in mise-en-scene? What is excluded?

- **Included:** Mise-en-scène encompasses elements such as setting, lighting, costume, makeup, staging, and the positioning of characters and props within the frame. It also includes the use of colors, textures, and overall visual composition.
- **Excluded:** Mise-en-scène typically does not involve camera movement, editing, or sound. These elements are often considered separately as part of cinematography and editing.

Exercise 5.2 What is German Expressionism? What is an example of German expressionism in one of the films we studied?

- **Definition:** German Expressionism is an artistic movement that emerged in Germany during the early 20th century, characterized by distorted perspectives, chiaroscuro lighting, angular shapes, and a general emphasis on expressing emotional and psychological states over realistic representation.
- **Example in Film:** *The Cabinet of Dr. Caligari* (1920) directed by Robert Wiene is a classic example of German Expressionist cinema.

Exercise 5.3 What is a “fascist automation”?

- **Definition:** A "fascist automaton" refers to a representation of a machine or robot in the context of a fascist ideology. It often symbolizes control, conformity, and the dehumanization of individuals within a totalitarian regime.

Exercise 5.4 What is an “image of wonder”?

- **Definition:** An "image of wonder" refers to a visual or cinematic element that evokes a sense of awe, amazement, or astonishment. It is often associated with breathtaking visuals or extraordinary events that captivate the audience.

Exercise 5.5 Name at least three special effects in *Metropolis*

- Miniature models of the cityscape.
- Stop-motion animation for certain scenes.
- Back projection techniques for combining live-action with pre-filmed backgrounds.

Exercise 5.6 Give one reason that the machine is conceptually based on the feminine.

- **Reason:** The machine in *Metropolis* is conceptually based on the feminine because it represents a fusion of technology and biology. The machine, particularly the Maria-like android, embodies both mechanical and human characteristics, blurring the lines between the artificial and the organic.
- **Exploration of Gender Roles:** The decision to craft the machine in a female likeness allows the film to explore and challenge traditional gender roles. It brings attention to societal expectations and the intersection of technology with gender dynamics, reflecting the anxieties and aspirations of the era in which the film was produced.

Exercise 5.7 Give one reason for biblical iconography in metropolis.

- **Reason:** One reason for biblical iconography in *Metropolis* is the film's exploration of themes related to class struggle and social inequality. The biblical references, such as the Tower of Babel, are used to underscore the hubris of the upper class and the consequences of their

exploitation of the lower class.



5.3 Disaster Aesthetics

5.3.1 Godzilla

- **Genre Conventions**
 - Iconography (ie. spaceships)
 - Narrative patterns, themes, or tropes
 - stylistics (a form of presentation, ie. white transitions between interview scenes, special effects in general)
- **Genres are...**
 - Reflective (have to be repeated again and again)
 - Ritualistic and
 - Have social functions
- **The social functions of genre**
 - Reaffirm cultural values in a predictable way (In Godzilla, the fisherman talk about how breaking culture and tradition is taboo and can cause harm)
 - Exploit ambivalent social values and attitudes (In Godzilla, it reaffirms social order by purging threatening elements from within society, equivocate on the inherent morality of a society governed by scientific rationality, monster as a symbol for the atomic bombs)
 - Respond to social trends
 - Reflect pervasive doubts and anxieties
 - A deliberate effort to treat a social issue (In Godzilla, we address the bombs dropped in Japan and the threat of nuclear warfare)
- **Hiroshima and Nagasaki Atomic Bombings**
 - Two atomic bombs were dropped on the Japanese cities Hiroshima and Nagasaki on August 6 and 9, 1945
 - Hiroshima deaths: 140,000 by end of 1945
 - Nagasaki deaths: 74,000 by end of 1945
 - Survivors faced widespread injuries and illness due to radiation. These effects last for decades
 - 90% of physicians and nurses were killed or injured in Hiroshima
 - Razed and burnt 70% of buildings
 - These disasters added to intensive bombing upon other Japanese cities during the war and effects of natural disasters
- **Susan Sontag:**
 - “Science fiction films are not about science. They are about disaster, which is one of the oldest subjects of art. In science fiction films disaster is rarely viewed intensively; it is always extensive. It is a matter of quantity and ingenuity. If you will, it is a question of scale. But the scale ... does raise the matter to another level”
 - “The aesthetics of destruction, with the particular beauties to be found in wreaking havoc [are] the core of good science fiction film”



Why do images of mass destruction (esp. in globally- recognized cities) give us visual pleasure in the cinema?

- **Science as “Pharmakon”**

- A Greek word that can be translated as remedy, poison, and scapegoat
- A both-and concept developed by French philosopher Jacques Derrida (he originally uses it to describe writing)
- Yoav Rinon: “It is both a remedy, as the city’s existence in a time of crisis, especially in time of plague, depends on it; and a poison, since that kind of existence is an outcome of the scapegoat’s expulsion and, sometimes, death.”
- Consider: How does the disaster film treat science or tech as an all-of-the-above remedy, poison, and scapegoat for social ills?

- **Godzilla is...**

- The bomb
- The victim
- Survivor

- **Shot distances**

- longer shots show destruction
- shorter and closer shots show emotion
- note there was a fair distribution of all shots in Godzilla, two separate stories going on, the front end disaster and the back end love triangle

- **Film sounds**

- Diegetic (within context of story, can be heard by characters) vs. non-diegetic
- Synchronic vs. non-synchronic
- Internal (ie. inside someone’s head) vs. external
- Acousmatic (visual source cannot be seen, ie. voice from a radio) vs. visualized (can see source)



Often in sci-fi scientists are antagonized (science can be exploited), here Godzilla provides an interesting perspective, how there is sympathy, the creator of the oxygen destroyer, similar to Oppenheimer being the destroyer or worlds. Science is "pharmacón", both poison and remedy. Note image of scientist changes. Important: film not written by the victors, political relevance?



Genre is always result of culture and history

Exercise 5.8 What are two qualities of genre?

- Reflective (have to be repeated again and again)
- Ritualistic

Exercise 5.9 What are three social functions of genre?

- Reaffirm cultural values in a predictable way
- Exploit ambivalent social values and attitudes
- Respond to social trends

Exercise 5.10 What are the names of the shot distances?

- Long shots/ Wide shots
- Medium shots
- Close-ups

Exercise 5.11 What does Sontag say that sf films are really about?

- Sontag argues that science fiction films are primarily about disaster, exploring the aesthetics of destruction on a grand scale.

Exercise 5.12 What are the names of types of film sound?

- Diegetic vs. non-diegetic
- Synchronous vs. asynchronous
- Internal vs. external
- Acousmatic vs. visualized

Exercise 5.13 What are two ways we know that Godzilla mediates the atomic disaster?

- Godzilla's origins as a mutated creature directly reference the effects of nuclear radiation.
- The film's themes of destruction, widespread suffering, and the dangers of scientific advancement mirror the anxieties of post-atomic bomb Japan.

Exercise 5.14 What is one way that Japanese monster films depart from American monster films, generally speaking?

- Japanese monster films often portray the monsters with a degree of sympathy or ambiguity, reflecting Japan's unique experience with nuclear devastation. American monster films tend to present monsters as purely destructive threats.

"The Imagination of Disaster" by Susan Sontag**1. Structure of Science Fiction Films:**

- Sontag notes that typical science fiction films follow predictable patterns, much like westerns. She outlines a model scenario with five phases.

2. Model Scenario:

- (i) The arrival of a threatening entity or force, witnessed by a young scientist who struggles to convince others.
- (ii) Confirmation of the threat with destructive acts. Attempts at peaceful resolution fail, leading to mass casualties.
- (iii) National and international response to the crisis, with conferences between scientists and the military. Plans for destroying the enemy are made.
- (iv) Escalation of atrocities, unsuccessful counter-attacks, and a final strategy involving a powerful weapon. The enemy is repulsed.

- (v) Concluding scenes with mutual congratulations, as the hero and his girlfriend wonder if the threat is truly over.

3. Variations in Scripts:

- Sontag describes a simpler, lower-budget script with four phases, often involving a hero facing a threat alone and discovering the enemy's vulnerability.

4. Different Themes:

- Various scenarios involve monstrous transformations caused by scientific experiments, nuclear testing leading to global catastrophe, or space exploration revealing threats to other planets.

5. Aesthetics of Destruction:

- Sontag argues that science fiction films are not primarily about science but about disaster. She emphasizes the aesthetic appeal of destruction, with a focus on quantity, ingenuity, and scale.

6. Imagery and Sensuous Elaboration:

- Science fiction films use images and sounds to allow viewers to experience the fantasy of catastrophic events. The emphasis is on sensuous elaboration, creating a visual and auditory spectacle.

7. Importance of Budget and Technology:

- Sontag mentions the importance of budget and technology in creating visually compelling science fiction films. Widescreen color films, with well-designed model environments, contribute to the genre's impact.

8. Aesthetics of Destruction:

- The core of a good science fiction film, according to Sontag, lies in the imagery of destruction. The essay suggests that the aesthetics of wreaking havoc and making a mess are central to the genre.

9. Primitive Gratifications and Shared Themes:

- Certain primitive gratifications in science fiction films, such as depicting urban disaster on a magnified scale, are shared with other film genres. The depiction of mass havoc in old horror and monster films is visually similar to science fiction films, with the difference being primarily in scale.

10. Similarity with Old Monster Films:

- Sontag draws parallels between the destruction scenes in old monster films, such as King Kong (1933), and those in science fiction films of the 1950s. The archetype of monsters wreaking havoc in a great city remains consistent, with destruction scenes in various science fiction films mentioned.

11. Familiar Themes and Grimness in 1950s Science Fiction Films:

- Science fiction films of the 1950s take up familiar themes found in 1930s movie serials, comics, and superhero stories. However, Sontag notes a distinct grimness in modern science fiction films, possibly influenced by the enlarged imagination of disaster in contemporary reality.

12. Fantasy of Disaster and Moral Simplification:

- The lure of fantasizing about disaster lies in its release from normal obligations. End-of-the-world movies, such as "The Day the Earth Caught Fire" (1962), present scenes of deserted metropolises, offering a fantasy of starting anew. Science fiction films also provide extreme moral simplification, allowing the audience to explore cruel or amoral feelings.

13. Moralistic and Aesthetic View of Destruction:

- Science fiction films are strongly moralistic, often conveying messages about the proper use of science. The films offer a dispassionate, aesthetic view of destruction and violence, emphasizing a technological perspective. Objects and machinery play a major role, embodying a greater range of ethical values than the characters.

14. Scientific Enterprise and Morality:

- The scientist in science fiction films is often depicted as morally ambivalent, with an emphasis on the proper and humane use of science versus the mad or obsessional use of science. This moralistic theme is shared with classic horror films of the 1930s, such as "Frankenstein" and "Dr. Jekyll and Mr. Hyde."

15. Ambivalence Toward Scientists:

- Scientists in science fiction films are susceptible to cracking up or going off the deep end. Ambivalence toward scientists is evident, and even sympathetic treatment is conditional on the utility of their scientific endeavors. Intellectual curiosity is often portrayed as a maniacal dementia, cutting scientists off from normal human relations.

16. Contemporary Mistrust of the Intellect:

- There is a contemporary mistrust of the intellect in science fiction films, particularly directed at the scientist-as-intellectual. The scientist who releases uncontrollable forces is portrayed as a potential threat, and the creative scientist may become a martyr to his own discovery.

17. Changed Proportions in Attitudes:

- Sontag notes a change in proportions regarding attitudes toward scientists in contemporary science fiction films. While scientists are still treated as both satanists and saviors, the context has shifted, and the scientist's sphere of influence is no longer local but planetary and cosmic.

18. Nuclear Trauma and Exorcism:

- Many science fiction films, particularly in Japanese cinema, reflect a collective trauma related to nuclear weapons and the fear of future nuclear wars.
- The awakening of super-destructive monsters often serves as a metaphor for the atomic bomb, with explicit references to nuclear warfare and its consequences.
- Themes of contamination, destruction, and global catastrophe permeate narratives, attempting to exorcise the anxieties surrounding nuclear technologies.

19. Radiation and Casualties:

- Radiation casualties and the concept of the world as a casualty of nuclear testing are central to science fiction film narratives.
- Universes become expendable, worlds become contaminated, burnt out, and obsolete, reflecting deep anxieties about the consequences of nuclear technology.

20. Wishful Thinking and Imagery of War:

- Science fiction films often feature wishful thinking, including a desire for a "good war" devoid of moral problems.
- Imagery of war, including dogfights and escalating firepower, satisfies both bellicose and pacifistic desires, projecting a fantasy of united warfare and international cooperation.

21. Dehumanization and Anxiety:

- Themes of dehumanization, symbolized by alien invaders seeking to take over humanity, reflect anxieties about the impersonal and depersonalizing conditions of modern urban life.
- The fear of losing individuality to a mechanized, emotionless existence is a recurring motif in science fiction films, portraying a struggle against the erasure of humanity.

22. Fantasy as Coping Mechanism:

- Science fiction films, serving as a popular mythology, allow individuals to cope with the anxieties of banality and inconceivable terror through fantasy.
- The films normalize psychologically unbearable scenarios, providing a temporary escape while also inuring audiences to the depicted terrors.

23. Complicity with the Abhorrent:

- Science fiction films, inadvertently or not, are in complicity with the abhorrent by neutralizing and making unthinkable scenarios more palatable.
- The films perpetuate clichés about identity, power, knowledge, and guilt, raising moral questions about the act of "thinking about the unthinkable" in a fantastical context.

5.4 The Future

5.4.1 La Jetee

- Primal Scene:
 - Freudian term
 - The sight or fantasy of the sight of one's parents having sex
 - It addresses the question: "where do I come from?"
 - *Terminator* series exploits this
 - * Terminator (evil machine from dystopian future) sent back in time to kill the mother (Sarah Connor) of the leader of the human resistance to the terminators
 - * Member of the human resistance (Kyle Reese) also sent back to protect Sarah
 - * Sarah and Kyle sleep together and conceive John Connor (future leader of resistance)
 - * In the future, John selects Kyle to be his father and sends Kyle back to conceive him with his mother Sarah
- Director: **Chris Marker**
 - Important member of the French New Wave cinema (Left Bank)
 - Essay films (like *La Jetee*)
 - Travel and powerful voiceovers
 - Famously reclusive and elusive
 - Often represented in the press by images of his cat
- Vertical Orientation
 - Underground (where experiment takes place) vs. in the sky (planes)
- Holocaust-like imagery
 - Reference to WWII: the scientist speaking German
 - Scientist represent facism. Ambition to go to the future associated with facism.
 - Scientists fixated to going to the future to fix things vs. thinking about what they did wrong in the past. Going to the future means that they will just keep doing what they're doing and hoping it works instead of learning.
- Spectatorship
 - Male spectators & woman stars
 - The spectated and the spectator both in the same frame
 - "freezing effect" of everything, memories. Film creates, film destroys
- Still vs. Movement
 - The woman: the only one who is both the still and the moving (blinking scene)
 - Waking up from death? Many ways to interpret this
- Heavy use of **acousmatic sound**: makes it feel like both a silent and a sound film

- **The museum scene**

- The animals in the museum: "eternal animals"
 - One of the shots make the man and the woman makes it seem like they are in the glass cage as well: animals more alive than humans, animals looking at humans in a museum? Good mise-en-scene

(R)

The medium of film allows for easy time travel. The still images create a better representation of what memory is like. At its base, film is still images. Movement is an illusion. *La Jetée* shows us what film really is at its DNA by breaking it down into stills (like a storyboard). It seems like we are getting less, but it is forcing us to consciously fill in the gaps (vs unconsciously, conventionally) and getting more out of it.

(R)

Due to the use of still images, sound is more important than usual. Sound creates emotions. Sound is more cinematic than the picture in this picture because sound has to be continuous, it cannot be broken into stills. The images have our senses overturn: letting us see the world in a different way: self reflective?

(R)

Trying to go into the future in one way the scientist want to do to make whole what is broken, which is not how it should be done. Question: what can film do to repair the future

(R)

Relatable way of storytelling: the still images are similar to how we remember things, we associate memories with photographs normally and not necessary moving pictures

(R)

Wanting to time-travel to future: the belief of the future as something better, a utopia

(R)

Not your typical blockbuster film: takes a different approach of documenting disaster without the use of special effect

Exercise 5.15 Chris Marker's experimental film *La Jetée* famously uses science fiction to reflect on the nature of cinema. What is one aspect of the film that you believe makes a claim about what film is or how it feels? This could be anything from an image to the filming style to part of the voiceover.

- Possible Answers: The use of still images suggests that memory and cinema share a fundamental structure; the disjointed visual style mirrors how we recall events; the focus on a single image emphasizes the power of a frozen moment in creating emotion and narrative.

Exercise 5.16 What is a primal scene? How does the death in the film relate?

- A primal scene is a foundational moment in Freudian psychoanalysis, often referring to a child witnessing their parents during sexual intercourse. The witnessed death on the airport jetty leaves a traumatic imprint on the protagonist, becoming a recurring image that haunts

his memories and shapes his perception of time.

Exercise 5.17 What is the main reason that Marker shoots with almost all stills?

- Marker primarily uses still images to evoke the nature of memory and its relationship to the cinematic experience. Memories often exist in our minds as fragmented images rather than continuous motion, an effect mirrored in the film's structure.

Exercise 5.18 Name two ways we know that *La Jetée* is about film.

- Time travel: Film allows us to 'travel' in time, presenting moments from the past or potential futures.
- Discontiguous pictures: Film, at its core, is a series of still images that create the illusion of movement. *La Jetée* explicitly exposes this structure.

Exercise 5.19 How is film imagined to be a "time machine?"

- Film has the capacity to capture moments in time and preserve them for future viewing. It allows us to revisit the past or envision potential futures, effectively manipulating and playing with our experience of time.

Exercise 5.20 What is one piece of evidence that this film reflects on the recent experience of war?

- The scenes of a devastated post-war world, the underground setting, and the imagery reminiscent of concentration camps all suggest a reflection on the horrors of World War II, a conflict still fresh in the memory of the film's creation.

5.5 Technofutures and the Secret Life of Robots

5.5.1 2001: A Space Odyssey

- Kubric's use of weird shapes in interiors:
 - How do they throw the human off kilter? Make us question our understanding and mastery of our environment? Give us a deeply embodied experience?
 - Thought-provoking, disorients space, what is our place in space?
- Continuous Editing:
 - Knits space together, making it feel cohesive and easy to conceptualize
 - Naturalized and intended to be invisible
 - Dominant in commercially popular film
- Discontinuous Editing:
 - Creates associations between separate things
 - Meant to instill an idea about the associations or be disruptive
 - Exists in commercially popular film but often more dominant in experimental film
 - In 2001, they used **graphic match/match cut**, where similar looking but very different

objects are cut/faded together to create continuity. Bone represents the first use of tech/tools by men, and the moving spaceship represents man's latest ventures, documenting how far we've come. Note how the first tool we used/made was a weapon to destroy and kill, how we use violence and control to advance/move forward, evolution is inherently colonial. How the ship becomes the most evil being in the ship. What does technology mean, how does it transform us, how do we transform it: bidirectional relationship. The multi-valent role of technology: technology is advancement, evolution but is also violence and colonization.

- The monkeys: we are the monkeys, when we first touched the obelisk and when we touch it again
- **Movement:**
 - Conceptual movement (through special effects)
 - Physical movement
- **Special Effects:**
 - More than just iconography
 - Making us see allusions that are meant to be shown as allusions: not trying to trick us
 - Freedman: "Special effects . . . not only use the visual (and, often, musical) resources peculiar to cinema to an unusually thoroughgoing degree, but also incorporate an overt recognition of this fact. Whereas the realistic film . . . strives after an art to conceal art, special effects self-consciously de-conceal their own artfulness by overtly glorifying in the various technologies of filmmaking. Special effects . . . are always about film itself"
- **Human-human relationship and the Banality of Humans**
 - Human-human interactions are rare and when present, dull
 - How humans become more machine-like than real machines (Hal) note similarities to Metropolis.
 - Hal more human/emotional than humans?
 - What's the purpose of humans existing if machine is more than what we are
- **Sounds**
 - Hal's acousmatic voice: Gives it an ominous, controlling, god-like character
 - The voice resembles humanity, yet not fully. The calmness. We are seeing so much humanity in something that is clearly not human, putting humans in a non-human box.
 - A surveillance state: Hal can see and hear everything
 - A lot of diagetic sound but not a lot of diagetic speech
 - Blue Danube Waltz played during the establishing shot of the spaceship: elegance, contrast with violence. Note opening scene: black screen with sound
- Change from concrete representation to the abstract in the end:
 - Order for chaos, exchanging sense for nonsense: the universe is so big
 - We are rushed to interpret scenes instantaneously
 - The strong sense of "moving forward" in time, changes our perspective within the film. We're no longer just an observer of things, we are being pulled into the abstract imagery. Note the use of extreme close-ups that depersonalizes people (ie. the ECU of the human eye looks like Hal)
 - The star child: we are reborn. We return to a point where we can't remember, comprehend or speak. We are similar to the monkeys in a sense, figuring things out.
 - Seeing one's own death: where did I come from, where am I going
 - This part of the film more about what we feel, rather than what it means

Exercise 5.21 Most of Stanley Kubrick's 2001: A Space Odyssey employs slow, concrete, and technical representation. Near the end ("Jupiter and Beyond the Infinite"), images are suddenly very abstract. What is one reason you think Kubrick makes this switch? If you cannot think of a reason, how does this switch change your perspective within the film?

- Possible Answers: Kubrick shifts to abstraction to represent transcendence beyond human understanding; to reflect the overwhelming scale or alien nature of the universe; to force the audience to abandon rational interpretation and instead engage the film emotionally and experientially.

Exercise 5.22 What is discontinuous editing?

- Discontinuous editing is a style where cuts between shots are meant to be noticeable, creating juxtaposition, drawing attention to itself, or provoking a specific mental association in the viewer.

Exercise 5.23 What is a graphic match?

- A graphic match is a type of edit where two shots with similar shapes, compositions, or visual elements are cut together to create a sense of visual continuity or thematic association.

Exercise 5.24 What is one possible interpretation of Kubric's graphic match (the bone?)

- The graphic match from bone to spaceship could symbolize humanity's leap in technological advancement, the ongoing connection between violence and progress, or the idea of tools shaping human evolution.

Exercise 5.25 What is one way that 2001 asks us to think about the theme of film as tech?

- 2001 foregrounds the technological aspects of filmmaking, with its special effects acting as a spectacle and drawing attention to the constructed nature of the cinematic experience.

Exercise 5.26 In which way could we say 2001 is about special effects?

- 2001 uses special effects in a self-aware way, not simply to create an illusion of reality but to highlight the capabilities of film technology and provoke thought about the medium itself.

Exercise 5.27 How are humans represented in 2001?

- Humans are often portrayed as dull, emotionless, and reliant on technology. Their interactions are sterile and formal, contrasting with the more dynamic and seemingly emotional AI, HAL 9000.

Exercise 5.28 Name one effect of the film's use of music and sound.

- Possible Answers: The use of classical music creates a sense of grandeur or irony; HAL's calm voice makes him seem ominous; the contrast between silence and diegetic sound emphasizes the isolation of space.

Exercise 5.29 What is one difference of representation between human-human relationships and human-machine relationships?

- Human-human relationships are depicted as cold and formal, while human-machine interactions (especially with HAL) seem to have more emotional depth and complexity.

Exercise 5.30 Name an experiential or perspectival difference between the first three parts of the film and the final part?

- Possible Answers: The first three parts have a slower pace and a more concrete, narrative focus; the final part is abstract, visually overwhelming, and forces the viewer to abandon linear interpretations in favor of a more emotional, intuitive response.

5.6 Technophobia and the Surveillance of states

5.6.1 THX1138

George Lucas: "THX 1138 is how I saw 1970. It was designed as a metaphor for the way we were living at the time. The world has taken a strange twist from there, but I think the ideas that we examined in THX 1138 are still valid in the 21st century"

- **The use of a lot of extreme close-ups (ECUs)**
 - Creates a feel of unease: we don't feel safe and comfortable
 - Outlines the invasion of the character's privacy, no sense of personal space, we are inside the characters' "space", we feel the residual anxiety of what the characters feel
 - CUs & ECUs come across to us very differently: CUs give us emotional intimacy, ECUs objectifies face, strip character of humanity & individuality, induces cluster-phobia. When you're so close, you are close to the materiality of the human.
- **Representation of space** (complete white space)
 - Void of nothingness, the **sterility**. The illusion that the characters are trapped in a space, a space detached from reality, like a prison, no way to get in, no way to let out. No walls to flip through, nowhere to escape.
- **Communism and Capitalism**
 - Collectivity and conformism, mass production
 - What is seen as God is like a big brother/comrade
 - Repression of sexuality at the time: hetero treated almost like homo
- Habermas: "The progressive 'rationalization' of society is linked to the institutionalization of scientific and technical development ... Marcuse is convinced that what Weber calls "rationalization" realizes not rationality as such but rather, in the name of rationality, a specific form of unacknowledged political domination"
- **Media Consumption and Anti-Blackness**

- A world of only white people (pretty much), yet black people only exists in virtuality, like holograms, porn videos etc.
- Critique of media assumption: makes you docile, like taking pills
- **Testing scene**
 - The scene when all the robots and things plug things into THX's nose and holes.
 - Use of ECU: defamiliarizes the face of THX
 - Highlighting our own experiences, invasive medical tests, "body on a table", dehumanization
 - Looks like a factory, not a medical facility. He is being treated like how he treated a robot, assembly things etc. Treated like object, condescension.
- **Exercise of power: surveillance**
 - Sound gets everywhere, no place is not watched.
 - People are not just being watched by one central entity, everyone is watching each other, the **mutual surveillance**. The person being watched is also the person watching
 - **The panopticon:** theoretical prison model, all cells located radially around a guard tower in the center: the discipline works by knowing they can be watched, yet not when. This enforces self-discipline, extending to how our society works similarly.
 - Human speech and conversation overshadowed by machine voice, implying the importance and power dynamics? Machine noises are pre-recorded. Sounds, even from humans sound acousmatic, it doesn't seem natural. You don't know where the voice is coming from. Very chaotic space. Sense of eavesdropping, everyone is being listened to.
 - **Control Society**
 1. Source of power is visible
 2. Enforced by demonstrations of force
 3. Power managed by central authority
 - **Disciplinary Society**
 1. Source of power is invisible
 2. Enforced by mass surveillance
 3. Power managed by social institutions
- **Surveillance**
 - Surveillance vs. 2001: 2002 explicitly emphasizes Hal, surveillance expressed through the camera and sound in a confined spaceship. In THX, it is all about mass surveillance, we barely see cameras, but we all know that everyone is being surveilled.
 - "But if technology proceeds from intense rationality" (Habermas 56) (technology infantilizes human beings)

Exercise 5.31 What are two examples of the camera "performing" visual surveillance?

- The extreme close-ups on characters' faces, creating a sense of intrusion into their private space.
- Shots that frame characters within cramped spaces or emphasize the white, sterile environments, suggesting a lack of freedom and constant monitoring.

Exercise 5.32 Describe two examples of sound and explain what they tell us about the world of the film.

- The overlapping layers of machine noises, voices, and announcements create a disorienting

- soundscape, highlighting the omnipresent surveillance and lack of privacy.
- The acousmatic voices (where the source is unseen) that give commands or instructions emphasize the invisible power structures and the characters' lack of control.

Exercise 5.33 What is one way that extreme close-ups function differently than close-ups?

- Extreme close-ups fragment and objectify the human subject, stripping away individuality and emotional connection. Close-ups can still convey intimacy and emotional depth.

Exercise 5.34 What is one motivation behind the use of extreme close-ups?

- To emphasize the dehumanization of the characters within a repressive, surveillance-heavy society. The close-ups become invasive and uncomfortable, mirroring the experience of the characters.

Exercise 5.35 What is one way that THX displays Habermas's critique of the rationalization of society through institutionalized science?

- The film portrays a society where scientific and technological control is used to suppress individuality, enforce conformity, and maintain power structures. This reflects Habermas's concern about the way "rationalization" can become a form of domination.

Exercise 5.36 What is one way that THX is a product of its time?

- The film reflects anxieties of the late 1960s and early 1970s about the rise of surveillance technologies, the erosion of privacy, and the potential for social control through technology.

5.7 The Space Within

5.7.1 Solaris

Tarkovsky

- Not interesting in exploring how science can bring men forward
- Does not like science fiction conventions, i.e. special effects, he thinks that it distracts
- Note earlier we talked about scifi being images of wonder, not necessarily as demonstrated here. Note no fancy spacesuits, set etc.
- Trying to change scifi with Solaris: not about how cool you can make effects look, but that men needs a mirror, to look back, to reflect. He's reimagining the entire genre. Solaris is Tarkovsky's answer to Kubric's 2001 which he hated
- Hari: embodiment of both the most human and the most alien
- His reflections on science fiction:
 - “I don’t like science fiction, as I don’t like to escape life”
 - “As for *Solaris*, my decision to adapt it to the screen is not at all a result of some fondness for the genre”

- “[I never thought] of Solaris as a science-fiction film – although I do feel that Solaris is the least successful of my films because I was never able to eliminate the science-fiction association”
- “I do not believe the cinema has genres”
- “Clearly Lem’s concern with epistemological limits is of at least some interest to Tarkovsky, but his approach and answer to the conundrums of human knowledge is entirely different to Lem’s, and as such is in fact antithetical to the aims and objectives of science fiction literature. His aesthetic strategy for Solaris thus unequivocally endangers the possibility of a science fiction cinema … In Tarkovsky’s Solaris we certainly encounter mysteries, but not cognitive value, not science fiction”

Aesthetics

- Use of circular shapes, tilt shot angles: implying something isn’t quite right
- Hari: birth through light
- Hari: the grip of memory on the self, note the moment when hari grips Kris’s head and gains agency

Doubles

- Kris and Hari
- Mother and lover
- The dacha and its solarian copy
- Burton, old and young, present and filmed
- Film is a tool to reflect on ourselves, a mirror
- Film should be about feeling, human morality and spirituality. Film is haunting, produces dangerous doubling as well as narcissistic projections
- Hari is begging to be real: she can feel pain (the copy more real than the original?)
- Our memory becomes the haunting copy of what is the original
- Closing shot: was Kelvin ever on Earth? Is Earth real? Is the emotional life real?

R

Kubric wants to say that film should be more about the thoughts and messages delivered rather than fancy effects and entertainment. Film should be taken seriously. Note this collides with the perspective of science fiction being about images of wonder.

Exercise 5.37 How would you describe Tarkovsky’s attitude towards the sf genre?

- Tarkovsky had a complex and somewhat dismissive attitude towards science fiction. He disliked traditional genre conventions, feeling they distracted from deeper explorations of humanity and the inner self.

Exercise 5.38 Name two ways that Solaris tries to depart from genre conventions of sf.

- Minimal use of special effects or futuristic technology, focusing instead on psychological and emotional states.
- Emphasis on slow pacing, long takes, and a contemplative atmosphere rather than action or plot-driven narratives.

Exercise 5.39 Why does Marvell argue that *Solaris* "endangers" science fiction?

- Marvell believes *Solaris* subverts the core principles of science fiction, which typically emphasize exploring rational explanations and the cognitive value of the unknown. Tarkovsky's focus on the emotional and the unknowable challenges this tradition.

Exercise 5.40 What is one point of tension between *Solaris* and *2001*?

- *2001* embraces technological spectacle and envisions a future shaped by human progress, while *Solaris* rejects these elements and focuses on the limitations of human understanding and the emotional turmoil of the characters.

Exercise 5.41 What is one reason that *Solaris* features so many doubles?

- The doubles in *Solaris* are a way to explore themes of memory, identity, and the fragility of reality. They represent the haunting echoes of our past and anxieties about the authenticity of our experiences.

Exercise 5.42 What is one way that *Solaris* could be about film?

- *Solaris* can be seen as a metaphor for filmmaking itself. The planet *Solaris*, with its ability to manifest memories, mirrors the act of creating a film that brings imagined realities to life. This suggests the power of cinema to examine our own inner worlds and question our perceptions.

5.8 Urban Dystopia

5.8.1 Blade Runner 1982



Blade runner exhibits post-modernism. Note modernism vs. post-modernism. Unlike *Solaris*, which lacked cognitive value, epidemiology, *Blade Runner* is all about it.

Post-modernity

- Late 20th century paradigm of thought and historical moment, usually also associated with cultural changes
- Shaped by late capitalism and commodification, increased global movement and commerce, climate anxiety, postcoloniality
- Reality no longer organized around stable centres of truth, but increasingly, multiple or fragmented (i.e. in *Blade Runner*, upon first sight, you have no idea whether the person you're looking at is real or not)
- Reality and being increasingly seen as constructed and mutable
- Classical binaries are destabilized and no longer neatly organize our reality: human/nature, good/evil, mind/body
- The appearance of stimulations that become our reality
- Focus on image, representation, virtuality

- Postmodern art (in a different way than modern art) wants to expose or reveal the medium of its truth (like film)

City mise-en-scene

- Grungy
- Disorientating
- Vignette of different cultures
- Diagetic lighting
- Mash up or various metropolises in real life, bits and pieces of each, supposed to be Los Angeles
- Reality constructed by different references, citations of places, **citationalism**

Citationalism Mash up of spatial and temporal references - the individual histories of which often get subsumed or lost in the construction of the new

Post-colonialism: “This is also true of geographical and space exploration: when there is no more virgin ground left to the imagination, when the map covers all the territory, something like the reality principle disappears. The conquest of space constitutes, in this sense, an irreversible threshold which effects the loss of terrestrial coordinates and referentiality”

Simulacrum Image or representation beyond reality, yet basically accepted as reality. A pure simulacrum has no relation to any reality whatsoever. Note what changes after Rachel finds out that she's a replicant. In this situation, an existential crisis is triggered. The replicant is a perfect symbol of the postmodern self, how the self gets deconstructed, becomes a commodity, a part of local commerce, a tool of capital, and the subject becomes an object.

Jean Baudrillard on the Simulacrum

- “models no longer constitute an imaginary domain with reference to the real; they are, themselves, an apprehension of the real”
- “this indeed is simulation: not that these factories are fake, but that they are real – or hyperreal – and that by being so, they send all ‘real’ production . . . into the same hyperreality”
- “there is no more double; one is always already in the other world, an other world which is not another”

Rene Descartes

- “I think therefore I am”
- “I doubt therefore I am”, doubt being another kind of self-edifying thought that certifies
- Deckard meant to sound like him. He is a perfect representation of a replicant.

Eye “T” Motifs

- Dominance of the eye points to identity, to the subject-objectification
- Eye becomes the source of doubt. Now how the eyes are not only for looking, they're also looked at

Photograph becomes as reality

- Rachel's mother's photograph has substituted reality



Blade runner vs. THX: blade runner tries to construct a society with hierarchical orders more familiar to us, e.g. police, whereas THX is a completely different society. In addition, blade runner's city represents a place destroyed by capitalism, whereas THX is run completely by capital. Note difference to Metropolis: Metropolis ran on industrialization and production.

Exercise 5.43 What is postmodernity?

- Postmodernity is a complex historical period and a philosophical movement that emerged

in the late 20th century. It's characterized by a skepticism towards grand narratives, the blurring of boundaries (like high/low culture), a focus on surfaces and images, and a sense of fragmentation and instability of reality.

Exercise 5.44 What is a simulacrum?

- A simulacrum is a copy or representation that replaces the original and becomes accepted as reality in itself. It has no reference to an original reality, creating a world where distinctions between the real and the simulated are blurred.

Exercise 5.45 What is hyperreality?

- Hyperreality is a condition where simulations and representations become more important and influential than the "real" world they were meant to reflect. In hyperreality, the boundaries between the real and the artificial collapse.

Exercise 5.46 What is citationalism?

- Citationalism is a postmodern artistic practice where works of art heavily reference or incorporate elements from other existing works or cultural artifacts. It's a form of remixing and recontextualizing existing images and ideas.

Exercise 5.47 Describe Blade Runner's city scape

- Blade Runner's cityscape is a grungy, disorienting, and densely layered urban environment. It reflects a blend of cultures, a decaying world shaped by overconsumption and environmental decline, and a sense of constant surveillance.

Exercise 5.48 How do Blade Runner's characters use or experience photographs and films? How do we?

- In Blade Runner, photographs serve as tangible proof of memories and identity, even if those memories are implanted. The film raises questions about the extent to which photographs and films shape our own understanding of reality and our personal histories.

Exercise 5.49 What happens to history in postmodernity?

- Postmodernity challenges the idea of history as a linear progression. History becomes fragmented, contested, and often re-presented through pastiche, simulation, and subjective narratives.

Exercise 5.50 Name one way that "eyes" symbolize I (identity)

- The focus on eyes in *Blade Runner* highlights the characters' search for identity and the scrutiny they face. Eyes are both a means of seeing and being seen, symbolizing the instability of selfhood in a world of surveillance and replicas.

5.9 Spectacular Bodies

5.9.1 The Fly

The Fly is an example of **body horror**

Sublimity vs. Grotesque

- Sublimity
 - cognates: wonder, amazement, awe, astounding, striking, exciting
 - appeals to abstraction
 - makes one feel small and insignificant
- Grotesque
 - cognates: gross, disgusting, inimical, revolting, vile, repulsive
 - appeals to concrete
 - inspires fear or self-annihilation
 - inherent in the perceived object (more ambiguously shared)
 - related to perception of category-crossing/fusion
 - violation
- Similarities
 - both surpass the rational mind
 - both related to norms of scientific rationality
 - both inspire shock or recoil



Note how the further from human, the less grotesque, it's where the image resembles humanly features yet containing grossness that triggers the more reaction.

Representation of Ronald Regan

- 80s: a belief in the states where men are becoming are less masculine, and men needs to go back to the masculine state in order to raise a family
- the gay antagonized, popular culture romanticizes a strong man, a strong body, naturally healthy
- people with HIV, AIDS targeted and dehumanized
- media fantasizes an impenetrable, android body



See how during this controversial era, *The Fly* deteriorates man into a grotesque insect. Cronenberg is sending a message to the media.

5.9.2 Aliens

Station ducts and the body: not letting the aliens, the outside, get into the inside

Birth Grotesque: the maggot in *The Fly* vs. the kid in *Aliens*

Clean vs. bad postmodern body: woman confronting the alien with the exoskeleton

Misanthropy: hatred of humankind, the character, nature or condition of a misanthrope.

- often expressed aesthetically in grotesque imagery of humans or part of human bodies
- think about what might be liberating, satisfying, honest or revealing about reveling in misanthropic representations (e.g. hair growth)
- disease is not part of morality

Cronenberg: “I have to tell people that some of the things they think are repulsive in my films are meant to be repulsive, yes, but there’s a beautiful aspect to them to them as well. There’s true beauty in things that others find repulsive.”

Exercise 5.51 How would you describe both the sublime and the grotesque?

- The Sublime: A feeling of awe and wonder mixed with fear, often inspired by experiences that overwhelm our rational comprehension, such as vast landscapes or powerful natural phenomena.
- The Grotesque: An aesthetic characterized by the disturbing, repulsive, and often darkly humorous. It thrives on the violation of boundaries, the blending of categories, and the unsettling depiction of the body.

Exercise 5.52 What is body horror?

- Body horror is a subgenre of horror that focuses on the graphic destruction, mutation, or violation of the physical body. It often plays on our fears of disease, decay, and the loss of bodily control.

Exercise 5.53 What is misanthropy?

- Misanthropy is a general dislike, contempt, or hatred of humankind. Misanthropic representations in art often depict humans in a grotesque or dehumanized manner.

Exercise 5.54 How is The Fly’s representation of the human body different from heroic bodies in popular cinema in the 1980s?

- The Fly subverts the 1980s action hero trope with its graphic depiction of a deteriorating body. Instead of hyper-masculinity and physical prowess, it emphasizes decay, vulnerability, and the loss of human form.

Exercise 5.55 Why is the AIDS epidemic a relevant context for The Fly?

- The AIDS epidemic fueled anxieties about bodily deterioration, disease, and the social stigmatization of those afflicted. The Fly can be seen as a reflection of these anxieties, with the protagonist’s transformation mirroring the fears surrounding AIDS.

Exercise 5.56 What is one of Cronenberg’s motivations in providing this grotesque sort of representation?

- Cronenberg uses the grotesque to challenge conventional notions of beauty and the body. He forces viewers to confront the physical realities of existence, often hidden or sanitized in mainstream representations.

Exercise 5.57 What is one social taboo that Cronenberg crosses?

- Cronenberg challenges taboos around disease, bodily disintegration, and the blurring of boundaries between human and non-human. His films often depict these themes in a graphic and unsettling way.

Exercise 5.58 Describe one way a body horror aesthetic has been used to reflect anxieties about gender or sexual difference.

- Body horror often employs imagery of bodily transformations and mutations that can be read as metaphors for anxieties about gender fluidity, sexual transgression, or the monstrous feminine.

5.10 Afrofuturism

5.10.1 Neptune Frost

Womack on Afrofuturism:

- “Afrofuturists redefine culture and notions of blackness for today and the future. Both an artistic aesthetic and a framework for critical theory, Afrofuturism combines elements of science fiction, historical fiction, fantasy, Afrocentricity, and magic realism with non-Western beliefs. In some cases, it’s a total revisioning of the past and speculation about the future with cultural critiques.”
- “All utilizing black characters or aesthetics to deconstruct images of the past to revisualize the future”

Style in afrofuturism:

- prominence of music
- costuming and make-up
- colors
- poetry

Exercise 5.59 How do color and light hold us to the specificity of the Rwandan land and culture?

- The film’s vibrant color palette draws upon the traditional colors, fabrics, and aesthetics of Rwanda. The use of natural light enhances this, highlighting the beauty of the landscape and connecting the characters to their environment.

Coltan (columbite-tantaline)

- metallicore
- mined from the earth
- used in many electronics, especially phones and laptops

Planned parenthood: “intersex is an umbrella term that describes bodies that fall outside the strict male/female binary. There are lots of ways someone can be intersex. Intersex is a general term used for

a variety of situations in which a person is born with reproductive or sexual anatomy that doesn't fit the boxes of "female" or "male." Being intersex is a naturally occurring variation in humans, and it isn't a medical problem — therefore, medical interventions (like surgeries or hormone therapy) on children usually aren't medically necessary. Being intersex is also more common than most people realize. It's hard to know exactly how many people are intersex, but estimates suggest that about 1-2 in 100 people born in the U.S. are intersex"

R Black panther good example of alfrō: the non-colonial setting where a native society thrives without the influence of the outside

R Alfrofuturism is a meditation on African tradition. Just because there are black actors or a film is written by black directors/screenwriters it does not necessarily make a film afrofuturistic.

R The futurism in alfrō really gets expressed through CGI, perfumic effects and costumes. The technology is more surreal rather than real. This film is very auro, spiritual instead of popular tech due to geopolitical differences contrary to what the western world generically thinks about africa. Our relationship with tech is spiritual? When you don't know how some techs works and it's like magic.

Exercise 5.60 What is Afrofuturism?

- Afrofuturism is a cultural movement that uses science fiction, fantasy, and technology to reimagine the future through a Black lens. It explores themes of the African diaspora, technology, history, and identity, and often challenges traditional Western science fiction narratives.

Exercise 5.61 Which gaps in traditional Western science fiction does Afrofuturism address or transform?

- Afrofuturism often addresses the lack of Black representation and agency in traditional science fiction. It centers Black experiences, challenges colonial narratives, and presents alternative visions of a future shaped by African traditions and technology.

Exercise 5.62 Why is diegetic and visualized sound significant in Neptune Frost?

- The film's emphasis on diegetic and visualized sound reflects the importance of music and rhythm in Rwandan culture. Sounds of the environment and the creation of technology blend seamlessly, emphasizing the interconnectedness of the material and spiritual world.

Exercise 5.63 Why are arresting or sublime visuals carried out in costumes and makeup rather than (predominantly) computer-generated images?

- The focus on costumes and makeup reflects the Afrofuturist emphasis on re-appropriating and transforming existing materials. It also grounds the film's futuristic vision in a tangible

and embodied reality, rather than relying exclusively on digital effects.

Exercise 5.64 Name two connections between seemingly disparate things that the film establishes.

- The film connects traditional Rwandan culture with futuristic technology, mining practices with spiritual realms, and human bodies with the digital world.

Exercise 5.65 Why is the color palette so bright and rich?

- The vibrant colors reflect the energy and expressive nature of Rwandan culture. It also challenges the Western portrayal of Africa as dark and desolate, presenting a vision of a technologically advanced future that is also rich in color and life.

Exercise 5.66 Name one way the film links the immaterial with material life?

- The film blurs the lines between the digital and the physical. The 'network,' a spiritual realm, is created from recycled computer parts and manifests physically in visions and dreams.

5.11 The Posthuman

5.11.1 Annihilation

Garland: "And the most defining thing about [the novel] was its atmosphere; the specifics of plot were not as crucial. Tone was very important. I didn't reread the book, which was a dreamlike, slightly hallucinatory novel. I did an adaptation of my memory of the novel, a slightly odd conceit." **Posthuman (Hyles's interpretation)**

- "Although these aspects foreground the cybernetic aspect of the posthuman, it is important to recognize that the construction of the posthuman does not require the subject be a literal cyborg. Whether or not interventions have been made on the body, new models of subjectivity emerging from such fields as cognitive science and artificial life imply that even a biologically unaltered Homo sapiens counts as posthuman. The defining characteristics involve the construction of subjectivity, not the presence of nonbiological components"
- Subjectivity: will not dependent on anyone else
- Informational pattern over material substantiation
- Consciousness as epiphenomenon (contrast to centrality to human identity for Descartes)
- Body as prosthesis, so extending or replacing always part of our journey as humans
- Human seamlessly articulated with intelligent machines
- Different versions of the posthuman:
 - "cybernetic" figures in *Blade Runner*, *Neptune Frost*
 - "eco-humans" in *The Fly* and especially in *Annihilation*

While these are not opposites, there is substantial overlap that will depend upon the representations

Anthropocene: Emphasize the central role of mankind in geology and ecology by proposing to use the term 'anthropocene' for the current geological epoch

Kara on "anthropocinema": "What used to be regarded as fictional end-of-the-world scenarios have become fact-based speculations on the foreseeable consequences of the Anthropocene"

Mental Illness and cancer: Lena is the least physically damaged, yet her moral damage was compared to the other women's mental and physiological illness. The status of illness is not clear in this film. Illness is so prominent in this film, why?

Transformations, Reflection and Refraction: Notice the visible refraction of light seen through the glass of water. Reflection also visible through mirrors. Film as a mirror.

Use of backlighting to visualize "annihilation"

Exercise 5.67 Describe the "posthuman". What are two of the forms this figure can take?

- The posthuman is a concept that challenges traditional notions of what it means to be human. Key characteristics include: subjectivity redefined, consciousness as secondary, bodies as changeable, and seamless integration with technology.
- Forms of the Posthuman: The "cybernetic" figure: Humans augmented with technology (ex: Blade Runner, Neptune Frost); The "eco-human": Humans profoundly intertwined and transformed by their environment (ex: The Fly, Annihilation)

Exercise 5.68 What is the Anthropocene?

- The Anthropocene is a proposed geological epoch marking the significant impact of human activities on the Earth's ecosystems and geology.

Exercise 5.69 What is anthropocinema?

- Anthropocinema refers to films that explore themes connected to the Anthropocene, often showcasing the destructive impacts of humans on the environment and confronting viewers with potential consequences of climate change and ecological collapse.

Exercise 5.70 What are at least two ways that humans become posthuman in Annihilation?

- Genetic Mutation: Characters undergo physical transformations influenced by the Shimmer, blurring the boundaries between human and other forms of life.
- Hybrid Consciousness: The film suggests the possibility of consciousness existing beyond an individual body, hinting at a posthuman state where the self is distributed and fluid.

Exercise 5.71 Identify one sublime image and one grotesque image in Annihilation.

- Sublime: The vibrant, blooming flora inside the Shimmer, visually stunning yet unsettling due to its unnatural growth. Grotesque: The mutated creatures, especially the bear with the human-like voice, creating a sense of fear and revulsion through their distorted forms.

Exercise 5.72 What is one way Annihilation visualizes refraction and one way it visualizes reflection?

- Refraction: The Shimmer's boundary itself distorts light, creating a mesmerizing and

- disorienting visual effect.
- Reflection: The climactic scene with Lena and her doppelganger emphasizes mirroring and the fragmentation of self.

5.12 After World, After Film

5.12.1 WALL-E

Indexicality

- An “index” is a type of sign (other signs include symbols and icons)
- The index contains a physical trace of its reference
- “A sign connected to its object by a concrete relationship, usually one of causality or analogy”
- Examples of indeex
 - footprint
 - thumbprint

CGI: Prior vs. Present

- CGI is a totality rather than just perspectives in the past
- Note use of extreme long shots
- Loss of Earth expressed through the loss of photochemical film (very nature of film has shifted)
- Sobchack on the loss of film: “[T]he loss of photochemical ‘cinema’ as the loss of the ‘real’ is also conflated with the loss of terrestrial human life.”

The return to earth

- Human’s return to their bodies
- Human’s return to each other
- The return to old, mechanical age (WALL-E vs. Eve)
- The plant in the shoe: symbolizing “putting our feet back on earth” and walking

Human vs. Automation/Animation

- Elastic, alternating between bodies/shapes, very “motored” in cartoons
- Humans, are quite the contrary. We are static, inelastic. We envy that kind of absolute freedom in cartoons (what it will, what it can)
- Fat-phobia to the idea of not moving in *WALL-E*
- Boot at the end of credits: introducing human labour behind film
- Corporate totality takes over humans

Dimension of Physical Expression

- Silent actors in the past are cartoon-like: can’t talk, need to talk through movement
- WALL-E: Nostalgia for the labour forces in the past babysitting the present

 Sobchack on the effortfulness of being human: “There is, of course, a paradox in our weary longing for and elation at watching plasmatic ease, and this is that the very labour of living is our most primal work and that which most enlivens us.”

 Technophobia: not from automation alone. Note picture of the captains: manipulated by automation in the long term? Automation may be thinking what is best for the human? Autonomy is not clear in the movie.

R

Note how the robots are behaving more humanly than humans: Eve's memory and consciousness, WALL-E holding hands and being emotional. The robots were just imitating what the humans were doing? Film about regaining the humanity that everyone lost - even physically, the people's bodies have evolved into what we don't perceive as normality. Body horror? Though not exactly like in films like *The Fly*. Also a critique on corporate capitalism?

Exercise 5.73 Why does Sobchack bring automation and animation together to explain WALL-E?

- Sobchack connects automation and animation to highlight the contrast between the boundless, fluid bodies of the robots and the immobile, passive humans. This contrast embodies our longing for the effortless ease depicted in animated figures while paradoxically affirming the value of the lived human experience.

Exercise 5.74 Which of WALL-E's characters are both automated and animated?

- Both WALL-E and Eve are both automated (robots) and animated (displaying expressive movements and emotions reminiscent of cartoons).

Exercise 5.75 What is indexicality?

- Indexicality refers to signs that have a direct, physical relationship to their referents. Unlike symbols (arbitrary signs), an index bears a trace or consequence of the thing it represents (like a footprint left in the sand).

Exercise 5.76 Name at least two images of or references to film in WALL-E.

- WALL-E's fascination with old movie musicals (e.g., *Hello Dolly!*) and his collection of physical film reels.
- The use of silent-film-era physical comedy and gestures to express emotions, especially by WALL-E.

Exercise 5.77 What are some characteristics of animated figures?

- Fluidity of form: Animated figures can morph and change shapes in ways impossible for humans.
- Exaggerated expressions: Emotions are conveyed boldly and expressively.
- Physical resilience: Animated bodies often defy gravity and can withstand extreme forces.

Exercise 5.78 Why do viewers say the film is nostalgic?

- WALL-E evokes nostalgia for: Silent-era cinema: Physical comedy, reliance on visuals for storytelling; A simpler time: Before technology dominated human life; Human connection: lost to isolation and over-reliance on automation.



6. Review Notes

Recap: Films Studied

- Metropolis
- Cabinet of Dr. Caligari
- Godzilla
- La Jetée
- 2001: A Space Odyssey
- THX 1138
- Solaris
- Blade Runner
- The Fly
- Aliens
- Neptune Frost
- Annihilation
- *WALL-E*

6.1 Films Overview

6.1.1 Metropolis

Director: Fritz Lang

Main Characters: Freder Fredersen, Maria, Joh Fredersen, Rotwang, the Thin Man, Josaphat, Grot

Synopsis:

"Metropolis" is set in a dystopian future where society is starkly divided between the wealthy elites who live in luxury and the oppressed workers who toil in harsh conditions below the city. The film follows Freder, the son of Joh Fredersen, the city's master, and Maria, a compassionate figure who

preaches peace to the workers. When Freder discovers the harsh realities of the worker's lives, he becomes sympathetic to their plight. The plot thickens as Joh and the mad scientist Rotwang use a robot, which is made to resemble Maria, to manipulate the workers and quell a potential rebellion. The film's climax involves massive revolts, the flooding of the workers' city, and the ultimate reconciliation between the classes through the mediation of Freder, symbolically bridging the gap between capital and labor.

Key Ideas Related to "Metropolis":

- **Mise-en-scene:** The film is renowned for its elaborate set designs and futuristic architecture, which powerfully contribute to the dystopian atmosphere.
- **German Expressionism:** "Metropolis" is a classic example of German Expressionism, characterized by its stark contrast, distorted sets, and the overall feeling of unease.
- **Fascist Automaton:** The robot Maria symbolizes the fascist automaton, representing the fear of technology being used as a tool for mass control and oppression.
- **Special Effects:** The innovative special effects, including the use of miniatures and the iconic transformation scene of the robot Maria, were groundbreaking at the time.
- **Images of Wonder and Conventions of SF:** The film employs spectacular visuals that have become iconic in science fiction, such as the massive industrial cityscapes and the robot itself.
- **Technophobia:** The narrative explores the anxieties about technological advancements surpassing human control and ethical boundaries.
- **Control Society and Disciplinary Society:** The film depicts a society where the elite control the masses through advanced technology and strict spatial separations.
- **The Posthuman:** The robot Maria represents an early cinematic exploration of posthuman themes, questioning the boundaries between human and machine.

6.1.2 The Cabinet of Dr. Caligari

Director: Robert Wiene

Main Characters: Francis, Dr. Caligari, Cesare, Jane

Synopsis:

"The Cabinet of Dr. Caligari" is a seminal work of German Expressionism and tells the story of an insane hypnotist (Dr. Caligari) who uses a somnambulist (Cesare) to commit murders. The film is narrated by Francis, whose fiancée becomes a target for Cesare. As the plot unfolds, it's revealed that the narrative is being told from an asylum, blurring the lines between reality and madness. The film's twist ending has left a lasting impact on the horror and psychological thriller genres.

Key Ideas Related to "The Cabinet of Dr. Caligari":

- **German Expressionism:** The film features highly stylized visuals, including jagged landscapes and sharp, twisted forms that enhance the psychological tension.
- **Mise-en-scene:** The set design and costuming contribute deeply to the unsettling atmosphere, perfectly aligning with the film's dark themes.
- **Grotesque Images:** The portrayal of Cesare and the distorted aesthetics encapsulate the grotesque, a key element in expressing the film's haunting narrative.
- **Continuous and Discontinuous Editing:** The narrative structure challenges the audience's perception of linear storytelling, enhancing the film's dream-like and eerie quality.

6.1.3 Godzilla

Director: Ishirō Honda

Main Characters: Dr. Serizawa, Emiko Yamane, Ogata, Godzilla

Synopsis:

"Godzilla" is a landmark in the kaiju genre, portraying a gigantic prehistoric monster awakened and mutated by nuclear radiation. The film focuses on the devastating impact of Godzilla's rampage through Japan, reflecting post-war nuclear anxieties. As the characters struggle with their personal dramas and moral dilemmas, particularly the use of the Oxygen Destroyer weapon, the film presents a deep critique of nuclear power and its irreversible consequences.

Key Ideas Related to "Godzilla":

- **Images of Wonder and Conventions of SF:** Godzilla itself is an iconic image of wonder, embodying the fears and destructive capabilities associated with nuclear power.
- **Significance of Disaster to SF:** The film uses the monster as a metaphor for nuclear disaster, highlighting the genre's ability to address contemporary societal fears.
- **Special Effects:** The use of suitmation, miniatures, and practical effects creates the illusion of the colossal beast and the destruction it brings.
- **Anthropocene:** Godzilla represents the destructive impact of human activity on the planet, making it a poignant commentary on the Anthropocene era.

6.1.4 La Jetée

Director: Chris Marker

Main Characters: The Man, The Woman, The Experimenter

Synopsis:

"La Jetée" is a French experimental film predominantly made up of still photos, telling the story of a post-nuclear war experiment in time travel. Set in a devastated Paris, the protagonist is a prisoner chosen for his strong mental images of a pre-war incident to be sent back and forth in time to save the present. The film explores themes of memory, time, and the inescapable nature of the past and future.

Key Ideas Related to "La Jetée":

- **Mise-en-scene:** The innovative use of still photography creates a unique narrative form that intensifies the focus on memory and perception.
- **Continuous and Discontinuous Editing:** The sequence of still images challenges traditional filmic time, representing a fragmented perception of time and memory.
- **Significance of “time machines” to film:** The narrative centers around the concept of time travel as a literal and metaphorical exploration of human consciousness and regret.
- **Sublime Images:** The stark black and white imagery contributes to the film's haunting and timeless quality.

6.1.5 2001: A Space Odyssey

Director: Stanley Kubrick

Main Characters: Dr. Dave Bowman, Dr. Frank Poole, HAL 9000, Dr. Heywood Floyd

Synopsis:

"2001: A Space Odyssey" explores themes of evolution, technology, artificial intelligence, and the unknown possibilities of space travel. The film follows a voyage to Jupiter following the discovery of a mysterious monolith affecting human evolution. It features the iconic AI character HAL 9000, who turns against its crew in a disturbing display of artificial intelligence's potential. The narrative is known for its minimal dialogue, profound silence, and a dramatic use of music, culminating in ambiguous and visually spectacular sequences that question humanity's place in the universe.

Key Ideas Related to "2001: A Space Odyssey":

- **Mise-en-scene:** The film's meticulous attention to scientific accuracy and detail, along with its innovative special effects, create a convincing and immersive space environment.
- **Significance of "time machines" to film:** The story's structure and the use of the monolith as a gateway or time machine challenge conventional narratives and perceptions of time.
- **Metacinematic expressions:** Kubrick uses the medium of film to explore complex ideas about humanity and technology, pushing the boundaries of cinematic expression.
- **Hyperreality:** The film blends reality with speculative fiction seamlessly, creating a sense of hyperreality that questions the viewer's understanding of what is real.
- **Sublime Images:** The film's visual composition, particularly the sequences in space, invoke the sublime, emphasizing both the beauty and terror of the vast unknown.

6.1.6 THX 1138

Director: George Lucas

Main Characters: THX 1138, LUH 3417, SEN 5241

Synopsis:

"THX 1138" portrays a dystopian future where individuals are heavily medicated to suppress emotions and controlled by a totalitarian regime that monitors their every move. The film focuses on THX 1138, who, after ceasing his drug regimen, begins to develop emotions and eventually attempts to escape the oppressive society with his mate LUH 3417. The narrative deals heavily with themes of surveillance, freedom, and the human spirit's resilience against oppressive societal structures.

Key Ideas Related to "THX 1138":

- **Control society and disciplinary society:** The film vividly depicts a society where control is maintained through pharmacological and audio-visual stimuli, illustrating Foucault's concepts of disciplinary mechanisms.
- **Sound montage:** The innovative use of sound design in "THX 1138" emphasizes the dehumanizing and omnipresent control of the state.
- **Technophobia:** The fear of technological overreach and its potential to dehumanize and regulate life is a central theme of the film.
- **Mise-en-scene:** The minimalist aesthetic and stark, white environments contribute significantly to the film's dystopian feel and the isolation of the characters.

6.1.7 Solaris

Director: Andrei Tarkovsky

Main Characters: Kris Kelvin, Hari, Dr. Snaut, Dr. Sartorius

Synopsis:

"Solaris" challenges the boundaries of human understanding and emotional capacity when psychologist Kris Kelvin arrives at a space station orbiting the mysterious planet Solaris. The planet's ocean seems to create physical manifestations of the crew's deepest fears and regrets, particularly in the form of Kelvin's late wife, Hari. The film delves into themes of grief, memory, and the ethics of human interaction with incomprehensible alien intelligences.

Key Ideas Related to "Solaris":

- **Tarkovsky's ideas about SF:** Tarkovsky uses the science fiction setting to explore deeper philosophical questions about human nature and the limitations of scientific understanding.
- **Images of Wonder, conventions of SF:** "Solaris" features surreal and haunting visuals that challenge and expand the conventions of the science fiction genre.
- **Significance of “time machines” to film:** The narrative uses the planet Solaris as a metaphorical time machine, confronting characters with their past through its mysterious powers.
- **Graphic match:** The film employs graphic matching to draw visual parallels that enhance the thematic depth, connecting different times, memories, and emotional states.

6.1.8 Blade Runner

Director: Ridley Scott

Main Characters: Rick Deckard, Roy Batty, Rachel, Pris, J.F. Sebastian

Synopsis:

"Blade Runner" is set in a dystopian future where synthetic humans known as replicants are bio-engineered by the powerful Tyrell Corporation to work on off-world colonies. The film follows Rick Deckard, a "blade runner," who is tasked with hunting down rogue replicants on Earth. The narrative explores themes of identity, humanity, and the ethical implications of artificial intelligence, culminating in profound questions about what it means to be human.

Key Ideas Related to "Blade Runner":

- **Mise-en-scene:** The film's richly detailed, neon-lit urban landscapes create a visually dense and texturally complex world that blurs the lines between reality and simulation.
- **Images of Wonder and Conventions of SF:** Blade Runner redefines the science fiction aesthetic with its blend of film noir elements, advancing the genre's visual and thematic vocabulary.
- **Postmodernity:** The film is a quintessential example of postmodern cinema with its intertextual references, questioning of reality, and breakdown of narrative and stylistic boundaries.
- **The Posthuman:** The replicants in "Blade Runner" challenge the distinctions between human and machine, engaging with the concept of posthuman identity in a world where biological and artificial lives converge.

6.1.9 The Fly

Director: David Cronenberg

Main Characters: Seth Brundle, Veronica Quaife, Stathis Borans

Synopsis:

"The Fly" centers on Seth Brundle, a brilliant but eccentric scientist who invents a set of teleportation pods. After successfully teleporting inanimate objects, Seth decides to test the machine on himself, unaware that a housefly has entered the pod with him. The experiment goes horribly wrong, gradually transforming him into a grotesque human-fly hybrid. The film explores themes of body horror, the dangers of scientific hubris, and the tragic loss of humanity.

Key Ideas Related to "The Fly":

- **Body Horror:** The film is a quintessential example of body horror, showcasing grotesque transformations that emphasize the fragility and malleability of the human body.
- **Technophobia:** It explores the fear of technology, particularly the unintended consequences of scientific advancement.
- **Graphic Match:** The use of graphic matches in editing highlights the physical and emotional transformations of Seth Brundle, linking his human and insect characteristics.
- **Grotesque Images:** "The Fly" employs disturbing and powerful visuals that are emblematic of Cronenberg's fascination with the grotesque.

6.1.10 Aliens

Director: James Cameron

Main Characters: Ellen Ripley, Corporal Dwayne Hicks, Bishop, Newt

Synopsis:

"Aliens" picks up the story of Ellen Ripley, who, after floating in stasis for 57 years, awakens to find that the planet where she encountered the deadly xenomorphs has been colonized. When contact with the colony is lost, Ripley accompanies a group of marines to investigate. They find the colony overrun by aliens, and Ripley must confront her fears and take drastic action to ensure their survival and prevent the creatures from reaching Earth.

Key Ideas Related to "Aliens":

- **Special Effects:** The film significantly advanced the portrayal of aliens with innovative creature effects and action sequences that have become benchmarks in sci-fi cinema.
- **Images of Wonder, conventions of SF:** "Aliens" expands the science fiction genre with its blend of horror and action, pushing the boundaries of how extraterrestrial life is depicted.
- **The Posthuman:** Bishop, the synthetic android, explores themes of artificial intelligence and questions the nature of humanity.
- **Afrofuturism:** Though not a central theme of "Aliens," the inclusion of diverse characters and futuristic settings intersects with some themes of Afrofuturism.

6.1.11 Neptune Frost

Director: Saul Williams, Anisia Uzeyman

Main Characters: Neptune, Matalusa, Tekno, Memory

Synopsis:

"Neptune Frost" is an Afrofuturistic musical set in the hills of Burundi. The story interweaves the lives of an intersex runaway named Neptune and a coltan miner named Matalusa. Together, they lead a group of escaped coltan miners in a rebellion against an oppressive regime that exploits both human and

technological resources. The film combines elements of African culture with speculative technology to explore complex themes of identity, rebellion, and connectivity.

Key Ideas Related to "Neptune Frost":

- **Afrofuturism:** The film is a vibrant expression of Afrofuturism, exploring themes of colonialism, technology, and African diaspora through a futuristic lens.
- **Intersex and The Posthuman:** Neptune's character challenges traditional gender norms and embodies the posthuman, blending human identities with futuristic ideals.
- **Images of Wonder, conventions of SF:** The film uses speculative elements and visual innovation to challenge and expand the conventions of the science fiction genre.
- **Graphic Match:** Visual parallels between technological motifs and organic elements in the film highlight the interconnectedness of nature and technology.

6.1.12 Annihilation

Director: Alex Garland

Main Characters: Lena, Dr. Ventress, Kane, Anya Thorensen, Josie Radek

Synopsis:

"Annihilation" follows a group of military scientists entering "The Shimmer," a mysterious quarantined zone of mutating landscapes and creatures caused by an alien presence. The team's mission is to understand the phenomenon, which is expanding and altering all life forms it encounters. As they delve deeper, they face not only physical threats but also profound existential and psychological challenges.

Key Ideas Related to "Annihilation":

- **Sublime Images:** The film is filled with sublime imagery that conveys both the beauty and horror of the mutating natural world within The Shimmer.
- **Body Horror:** "Annihilation" incorporates elements of body horror as characters undergo unsettling transformations, reflecting the film's exploration of self-destruction and rebirth.
- **Anthropocene:** The narrative addresses the impact of human actions on the environment, framed through the lens of alien influence and biological mutation.
- **Hyperreality:** The blending of reality and alien phenomena in The Shimmer creates a hyperreal environment that challenges the characters' understanding of the natural world.

6.1.13 WALL-E

Director: Andrew Stanton

Main Characters: WALL-E, EVE, Captain McCrea, AUTO

Synopsis:

"WALL-E" is set in a post-apocalyptic Earth, where the last remaining robot, WALL-E, spends his days cleaning up the planet, one piece of trash at a time. When he meets EVE, a probe sent to Earth on a scanning mission, WALL-E falls in love and follows EVE across the galaxy on an adventure that changes the fate of humanity. The film explores themes of environmentalism, consumerism, and the resilience of love and hope.

Key Ideas Related to "WALL-E":

- **Images of Wonder, conventions of SF:** WALL-E pushes the boundaries of science fiction by humanizing a small waste-collecting robot, creating a powerful narrative about environmental crisis and redemption.
- **Technophilia:** Despite its critical view of consumerism and environmental neglect, the film presents a hopeful depiction of technology, as shown through the benevolent characters of WALL-E and EVE.
- **The Posthuman:** WALL-E and EVE embody aspects of posthumanism, challenging traditional notions of emotion and intelligence in machines.
- **Anthropocene:** The film addresses themes of the Anthropocene by depicting Earth as a barren wasteland overwhelmed by the consequences of human excess and environmental disregard.

6.2 Reading Summaries

6.2.1 Sensuous Elaboration: Reason and the Visible in the Science Fiction Film

Summary

- **Science Fiction's Paradox:** The essay argues that science fiction grapples with big ideas and explores possibilities beyond our current reality. However, the film medium, with its emphasis on visuals, can struggle to capture this philosophical depth. Instead, films might prioritize spectacle and action over complex themes.
- **Horror vs. Sci-Fi:** The essay differentiates between horror and sci-fi through their core anxieties and visual focus. Horror often centers on primal fears of the body and the unknown, while sci-fi explores the wonders of the possible and challenges our understanding of reality. Horror tends to use visuals to depict inward fears, while sci-fi uses them to explore the vastness of the external world.
- **The Two Faces of Special Effects:** Special effects can be a powerful tool in sci-fi cinema, allowing filmmakers to visually represent fantastical concepts. However, an overreliance on spectacle can reduce complex ideas to mere awe and diminish the audience's imagination.
- **The Case of Frankenstein:** The essay uses Mary Shelley's Frankenstein as an example. The novel is a philosophical exploration of scientific ambition and its consequences. However, the film adaptation leans more heavily on horror elements, focusing on the monstrous creation and its rampage.
- **The Rise of the Child in Sci-Fi:** The essay notes a recent trend in sci-fi films featuring children prominently. This might be linked to the success of films like *Star Wars* and *E.T.*, which emphasized a sense of childlike wonder. However, this focus can come at the expense of intellectual engagement, prioritizing emotional connection over complex ideas.

Connection to Films: A Tale of Two Cities

- **2001: A Space Odyssey (1968):** This film exemplifies the careful balance between spectacle and philosophical exploration. Director Stanley Kubrick uses awe-inspiring visuals to depict humanity's journey through space and evolution. The enigmatic ending leaves audiences pondering questions about technology, existence, and our place in the universe. The film doesn't spoon-feed answers; instead, the visuals serve as a springboard for deep contemplation.
- **Blade Runner (1982):** This neo-noir sci-fi film by Ridley Scott showcases a visually stunning future Los Angeles, drenched in rain and neon lights. However, the dazzling cityscape is not merely eye candy. It reflects the decay and moral ambiguity of the world. The film grapples with complex questions about what it means to be human, particularly through the lens of replicants

(bioengineered beings). The stunning visuals enhance the film's exploration of identity, memory, and empathy.

These two films demonstrate how science fiction cinema can achieve a successful balance. They don't shy away from showcasing the wonders of the future, but they use those visuals to serve a larger purpose. The spectacle is not an end in itself, but a tool to provoke thought and discussion about complex ideas. This analysis highlights the tension explored in the reading: cinema's potential to capture the essence of sci-fi while also risking to prioritize visuals over intellectual engagement. Films like *2001: A Space Odyssey* and *Blade Runner* navigate this tension by using spectacle to illuminate philosophical themes, ultimately achieving a richer and more rewarding viewing experience.

6.2.2 Technophilia: Technology, Representation and the Feminine

Summary

- **The Traditional View of the Body:** The essay presents the body as traditionally viewed as finite, limited, and opposed to the abstract and theoretical. Technology challenges this view.
- **Technology and Gender:** Science fiction emerged in the face of rapid technological advancement. The genre often explores how technology alters the concept of the body and impacts gender roles.
- **The Mechanical Woman:** *L'Eve Future* by Villiers de l'Isle-Adam is a significant text exploring the concept of the artificial woman. This text, along with Edison's work, highlights that cinema is implicated in this fascination.
- **The Maternal and the Mechanical:** The essay argues that fascination with the artificial woman is often accompanied by anxieties about technology displacing the maternal. Motherhood plays a crucial role in these texts.
- **Metropolis and the Machine-Woman:** Fritz Lang's *Metropolis* (1926) is used as an example. The film depicts male anxiety about powerful technology, often embodied in female figures and associated with sexuality. The film also explores desires to use technology to usurp the maternal role.
- **Alien and the Monstrous Maternal:** The *Alien* franchise depicts the maternal as monstrous and dangerous. The films challenge traditional notions of reproduction and gender by showcasing males giving birth and blurring sexual differences. These films align with Kristeva's concept of the abject – something both horrifying and captivating.
- **Blade Runner and the Loss of History:** *Blade Runner* delves into anxieties surrounding artificial reproduction, and the potential loss of history it represents. Replicants seek photographs and memories as a way to ground themselves in the past, reflecting our reliance on maternal origins. The advanced technology in the film fetishizes the act of viewing but serves to disorient our sense of the real.

Connections to Studied Films

- **Cabinet of Dr. Caligari (1920):** This German Expressionist film predates the sci-fi genre's rise but explores distorted views of reality. Its visual style and focus on the internal psyche connect with the ways sci-fi uses visuals to address internal anxieties and philosophical questions rather than just showcasing technology.
- **Godzilla (1954):** While a monster movie, *Godzilla* can be seen as an exploration of anxieties following nuclear development. It reflects fears of technology's power and the potential for unintended consequences. Its city-destroying spectacle taps into the visual power of science fiction to explore societal concerns.
- **THX 1138 (1971):** Like *Metropolis*, this film presents a dystopian vision where technology is

oppressive. While less focused on gender than the essay discusses, it warns of the dangers of technological control. The sterile, dehumanized visuals amplify the fear of losing individuality within an overly ordered technological society.

- **Neptune Frost (2021):** This recent Afrofuturist film challenges typical sci-fi tropes with a unique visual style and themes of resistance to oppressive technology. It may offer a counterpoint to the essay's arguments about anxieties and instead showcase the potential for technology to empower marginalized communities.

The essay explores a central tension in science fiction cinema: its fascination with technology and its potential implications for concepts of the body, gender, and the maternal. While the films analyzed focus on anxieties, it's important to see that sci-fi is not always bound by that perspective. It can also express diverse hopes, fears, and imaginative explorations of what technology could do to, or for, humanity.

6.2.3 The imagination as disaster

Summary

- **Sci-Fi Formulas:** The essay posits that science fiction films often follow predictable narrative tropes:
 - Global threat scenario: Aliens, monsters, disaster, international cooperation
 - Local threat scenario: Isolated town, skeptical hero discovers danger
- **Focus on Spectacle:** Sci-fi films excel in depicting destruction – mutated creatures, battles, collapsing cities. This emphasis on the visual aligns with the film medium.
- **Science as Background:** While the genre is named for science, films often prioritize thrills over scientific accuracy in service to the visual spectacle.
- **Disaster Themes:** Sci-fi films tap into primal fears about the end of the world, offering a cathartic experience of confronting overwhelming threats.
- **Aesthetics of Destruction:** Sci-fi films depict the destructive power of technology, exploring beauty within chaos. This taps into the human curiosity towards the macabre.
- **Moral Simplification:** Sci-fi often presents clear-cut good vs. evil conflicts. Aliens or "freaks" offer an outlet for righteous aggression, and destruction becomes a spectacle to be enjoyed. This allows for a morally easy release.
- **Technology as Focus:** Films portray objects, machines, and settings as sources of power versus the relative helplessness of humans.
- **Scientists as Ambiguous Figures:** Scientists in these films are driven either by good or obsession, representing society's complex relationship with science as both savior and potential doom.
- **Nuclear Trauma:** Many sci-fi films act as metaphors for nuclear war anxieties. Monsters awakened by radiation or devastated planets mirror the real-world fear of nuclear annihilation.
- **Wishful Thinking and War Spectacle:** Sci-fi offers a fantasy of international unity against a common enemy, alongside action sequences mirroring war films. This simplifies complex issues and gives an outlet for aggression.
- **Anxiety about Depersonalization:** A key theme is the fear of losing individuality or being "taken over." This taps into anxieties about conformity and the alienating aspects of modern life.
- **Inadequate Response to Terror:** The essay argues that sci-fi films perpetuate oversimplified responses to complex fears like nuclear destruction. The films normalize and even neutralize terror through exciting distractions and familiar clichés.

Connection to Studied Films

Metropolis (1927): The Spectacle of Inequality: The film's iconic visuals with the towering city above and the subterranean worker's city highlight the anxieties explored in the essay. This spectacle is not merely about fantastical technology but actively comments on social division and the potential for technology to be used as a tool of oppression. **Dehumanization and Revolt:** The depiction of the workers as a faceless, robotic mass directly taps into the fear of dehumanization under a totalitarian system. This connects to the essay's discussion of alien invaders representing the fear of being stripped of individuality. The worker's later revolt also echoes the essay's points about sci-fi tropes (threat, scientific solution).

Blade Runner (1982): Visuals as Philosophy: The film's rain-soaked, neon-drenched vision of Los Angeles is integral to the exploration of what it means to be human. The spectacle of the cityscape is a direct reflection of the internal conflicts around identity, memory, and empathy faced by both real humans and replicants. **Moral Ambiguity of the Scientist:** While not the central figure, Tyrell, the creator of the replicants, embodies the scientist as an ambiguous force. His technological genius results in sentient beings, but his motivations are questionable. This reflects the essay's point about scientists as potential figures of both salvation and destruction. **Technology vs. Humanity:** Despite the thrilling action sequences, Blade Runner's core anxiety is about being replaced or superseded by technology. The replicants, visually indistinguishable from humans, embody the fear of dehumanization discussed in the essay.

Both Metropolis and Blade Runner illustrate the potential of sci-fi cinema to go beyond mere spectacle. They use stunning visuals and futuristic settings to explore complex anxieties about class division, identity, and the dehumanizing potential of technology. These films align with the essay's argument that science fiction, at its best, can use spectacle as a way to grapple with profound anxieties of the modern era.

6.2.4 Godzilla and the Japanese Nightmare

Summary

- **Japan's Unique Cold War Position:** Japanese Godzilla films offer a unique perspective on the post-WWII world due to the country's experience with atomic bombing and American occupation. Unlike the stark "us vs. them" narrative common in American sci-fi, these films explore the complexities of Japan's relationship with the US.
- **Godzilla as a Symbol of Trauma:** Godzilla embodies Japan's anxieties about nuclear war and the US military presence. The monster's origin story is directly linked to nuclear testing, forcing the country to confront its past.
- **Transference vs. Projection:** The essay argues that Japanese monster films operate on the principle of "transference" rather than "projection." In psychoanalysis, transference involves projecting feelings about one person onto another. Godzilla is a stand-in for the US and the threat it represents, but also for Japan's own anxieties about industrialization and modernization.
- **Evolving Morality:** In films like Mothra, monsters shift from purely destructive forces to figures with ambiguous or even positive intentions. This suggests a changing perspective on Japan's Westernization and the complexities of global politics.
- **Reconstructing Society:** The introduction of child characters in later Godzilla films reflects the stabilizing Japanese society post-WWII. The roles of reporter, photographer, and child symbolize a "nuclear family" constructed around confronting anxieties and rebuilding.
- **Godzilla 1985: A Nuclear Warning:** This film provides a retrospective on the atomic bombings and critiques the escalating nuclear tensions of the 1980s. Japan's refusal to use nuclear weapons

becomes a central theme. Godzilla becomes both a symbol of nuclear threat and a force of nature beyond the East-West dichotomy.

- **Godzilla's Enduring Message:** The unresolved endings of many Godzilla films imply a continuous process of confronting past traumas and re-examining the present. The monster becomes a recurring symbol of unaddressed anxieties and a call for continued critical reflection.

Connections to Studied Films

- **Metropolis (1927):** Thematically, Metropolis echoes the social anxieties that Godzilla embodies. The film explores class conflict, rapid technological advancement, and the dehumanizing potential of industrialization - forces present in Japan's post-war reconstruction.
- **THX 1138 (1971):** Like Godzilla 1985, this film offers a critique of a repressive, highly controlled society. Both films use stark visuals to portray the dangers of conformity and the importance of independent thought within totalitarian systems.
- **Blade Runner (1982):** Both Blade Runner and Mothra explore the boundaries of what defines humanity. The replicants' struggle for autonomy mirrors questions about Japan's shifting identity in relation to Westernization and technological advancement.
- **WALL-E (2008):** WALL-E's lonely struggle against consumerism and ecological decline echoes the theme of humanity at odds with nature seen in some Godzilla narratives. Both warn about the consequences of neglecting the balance between industrialization and the environment.

The passage argues that Godzilla films, far from being simplistic monster movies, provide a complex lens for examining Japan's unique historical experiences and anxieties about nuclear power. These films encourage the audience to confront uncomfortable truths and challenge prevailing Cold War narratives. Thematically and visually, they share strong links to other landmark science fiction films while contributing their own distinct cultural perspective.

6.2.5 Time Travel, Primal Scene and the Critical Dystopia

Summary

- **The Appeal of Dystopia:** The Terminator presents a dystopian vision of the future, stemming from our increasing reliance on technology. This type of critical dystopia goes beyond spectacle, suggesting present-day trends that could lead to a bleak future.
- **Machines and Ambiguity:** The film explores the blurring of lines between humans and machines. The Terminator is a cyborg, and the heroes use technology to survive. This avoids a simplistic good vs. evil narrative.
- **Time Travel and Primal Desires:** The core plot of The Terminator utilizes a time-loop paradox which resonates with our primal scene fantasy (the desire to witness/participate in one's conception). This allows both narrative complexity and wish fulfillment for the audience.
- **Freud and Fantasy:** The Terminator engages with Freudian concepts of fantasy. Time travel stories play on our desires and offer disguised wish-fulfillment, even when dealing with dark subjects like incest. Films manipulate viewer identification, allowing us to inhabit different subject positions for complex emotional engagement.
- **Fantasy vs. Reality:** The essay draws a line between merely escapist fantasy and works that "tread the path from fantasy back to reality." The Terminator achieves this through its grounding in the everyday; technology in the film is a heightened version of our current reality, making the threat feel tangible.
- **Sexual Difference in Sci-Fi:** With traditional gender roles becoming blurred, sci-fi films provide space to explore anxieties about sexual difference. The Terminator uses the human/machine

conflict as a proxy for this investigation. However, some sci-fi films revert to conservative ideas about motherhood and female identity (like *Aliens*).

- **The Erotic Formula:** Successful sci-fi romances often play on extreme difference: alien/human, future/present, etc. Death or the threat of it heightens desire in this formula. The Terminator's love scene gains power because Kyle is from a doomed future, making their connection both passionate and poignant.

Connections to studied films

- **Metropolis (1927):** Like The Terminator, concerns about technology and its potential for oppression drive the narrative. The iconic imagery of the enslaved workers and the *Maschinenzwerg* foreshadow later anxieties about the human/machine relationship.
- **THX 1138 (1971):** George Lucas's dystopian vision shares the concern about a future where technology dehumanizes and controls the populace. Both films offer a stark warning about the potential misuse of technological advancement.
- **Solaris (1972):** While Tarkovsky's film is more cerebral, it shares the theme of blurred lines between reality, memory, and constructed identities. Both films challenge our perceptions and make us question the nature of existence itself.
- **WALL-E (2008):** This seemingly child-oriented film also functions as a critical dystopia with its vision of an Earth abandoned due to rampant consumerism and technological dependence. The Terminator presents a darker view, but both films raise questions about our trajectory.

The Terminator stands out as a critical dystopian sci-fi film. It uses spectacle in service of its message, not as a replacement for it. The exploration of time travel taps into deep psychological desires, making the film more than just an action spectacle. By examining the connections to other sci-fi films, we see patterns of how the genre addresses issues of technology, identity, and the human condition in both visually engaging and intellectually stimulating ways.

6.2.6 Chris Marker and the Cinema as Time Machine

Summary

- **The Emergence of Time Travel in Literature:** The essay analyzes the appearance of time travel as a literary theme at the end of the 19th century. Possible connections include:
 - **Technological Advancements:** New technologies and expansion of scientific knowledge sparked imaginative ideas about bending the limits of time and space.
 - **Evolutionary Theory:** The concept of evolution challenged notions of linear time and history, opening up the possibilities of alternate timelines or revisiting the past.
 - **Uneven Development:** The essay explores how time travel can represent uneven development of cultures within the universe, creating a sense of power imbalance and potential conflict.
- **H.G. Wells and Utopian Time Travel:** The essay examines the work of H.G. Wells, specifically how he uses time travel as a vehicle for exploring social progress and utopian societies.
 - **Colonialism and Time:** The idea of 'colonizing' time has potential links to the imperialist expansion at the end of the 19th century.
- **The Fear Factor:** The essay posits that time travel can embody anxieties surrounding technological advancement and fears about the future.
 - **Horror and Devolution:** The genre of sci-fi horror often explores the potential for humanity to devolve or regress in unexpected ways due to scientific advancement.
- **Time Travel Beyond Sci-Fi:** The essay looks beyond conventional science fiction and identifies time travel themes in works like Proust's *In Search of Lost Time* as well as Conrad's *Heart of Darkness*.

Darkness.

- **Internal vs. External Journeys:** This raises the idea that time travel isn't always about a physical journey, but might represent internal exploration of memory and self-discovery.
- **Invisibility and Cinematic Parallels:** The essay connects the experience of time travel to that of being a film viewer, suggesting that both involve disengagement from conventional reality.
 - **Alienation and Audience:** This explores the sense of isolation and shifting perspectives an audience experiences, which might link to the themes of alienation within time travel stories.

Connection to Studied Films

- **Metropolis (1927):** Class and worker divisions in Metropolis could link to the concepts of uneven development explored in the essay. Technological control and exploitation resonate strongly in both.
- **La Jetée (1962):** Connects directly to the detailed analysis in the second part of the essay, focusing on trauma and cyclical time.
- **THX 1138 (1971):** Like the essay, THX 1138 depicts a world of control and manipulation. The loss of individuality and the fear of the future are shared thematic concerns.
- **Blade Runner (1982):** Deals with 'artificial' life and what constitutes being human. The essay raises ideas about regression or devolution, which could be explored through the replicants and their desire to defy their limited lifespans.
- **The Fly (1986):** The body-horror aspect of The Fly exemplifies the primal anxieties of technology gone wrong, leading to potential devolution, that the essay mentions.
- **Neptune Frost (2021):** Might deal with themes involving marginalized communities, repurposing technology, and exploring alternate visions of the future, depending on the specific focus of the essay.

The essay likely concludes by reiterating the complexities of time travel as a cinematic device in the sci-fi genre. It may highlight the tension between the desire to explore vast possibilities and the limitations of the visual medium itself.

6.2.7 Kubrick's 2001 and the Possibility of a Science-Fiction Cinema

Summary

- **Kubrick and the Contradiction of Sci-Fi Film:** Kubrick's 2001: A Space Odyssey exposes a central tension in science fiction cinema: the anti-intellectual bias of special effects undermines the genre's core potential for critical thought.
- **Special Effects as Spectacle:** Science fiction films often prioritize dazzling visuals over complex ideas, transforming into visually impressive exercises but conceptually hollow experiences (Star Wars, Close Encounters of the Third Kind).
- **Kubrick's Solution:** While embracing special effects, Kubrick dialectically addresses the issue of intellectual banality. The film's characters are deliberately dull, contrasting with the awe-inspiring visuals and the implied intelligence behind the monoliths. This contrast highlights humanity's limitations and the need for evolution.
- **The Limitations of the Solution:** Kubrick's method might be a one-off success; 2001 may stand as both the first and last fully realized cinematic science fiction.

Connections to Studied Films

- **Early Sci-Fi: Expressionism and Dystopian Futures:** German Expressionist films like

Metropolis and The Cabinet of Dr. Caligari offer visually striking social critiques. Their distorted sets mirror the twisted inner worlds of characters or represent anxieties about urban life and technology. Kubrick's focus on intellectual emptiness could be a reaction to this earlier expression of technological unease.

- **Solaris (Tarkovsky): Beyond Spectacle:** Tarkovsky's Solaris focuses on internal struggles and existential questions, offering a counterpoint to spectacle-heavy sci-fi. Like 2001, the film features long, meditative sequences with minimal dialogue. However, it delves into memory, guilt, and the nature of reality, contrasting 2001's cosmic scale.
- **THX 1138 and Dystopian Control:** George Lucas's visually stark THX 1138 shares 2001's portrayal of a sanitized, emotionally repressed future. However, THX 1138 focuses on the oppressive power of the state, while 2001 is more concerned with spiritual emptiness and the need for evolutionary leaps.
- **The Body and Identity in Sci-Fi:** Both The Fly and Aliens use grotesque transformations and monstrous creatures to explore anxieties about bodily autonomy and the boundaries of the human. These films echo science fiction's literary roots, using the fantastical to examine the human condition.
- **Eco-Sci-Fi: Finding Hope in Crisis:** Films like WALL-E and Annihilation use the sci-fi setting to critique human impact on the environment. WALL-E offers a whimsical and almost silent journey, finding hope in simple emotions, while Annihilation is a visually haunting meditation on the alien and transformative nature of our world.

The essay's exploration of 2001 highlights how sci-fi films struggle to balance the genre's conceptual potential with cinema's visual power. Some prioritize spectacle, while others lean toward more philosophical reflections. Examining different approaches sheds light on the possibilities of science fiction on film, showing how it can be a vehicle for both awe and critical thought.

6.2.8 Technophobia

Summary

- **Conservative Technophobia in 1970s Cinema:** This strain of sci-fi film often equates technology with the loss of individuality, freedom, and the dissolution of the traditional family unit.
- **Nature as Antidote:** Films like THX 1138 present escaping technological society and entering 'nature' as the path to liberation, emphasizing the purity and unmediated quality of the natural world.
- **Technology as Destructive to "Nature":** These films suggest that technology dismantles concepts considered 'natural', undermining social hierarchies that conservative ideology attempts to present as inherent and immutable.
- **The Rhetorical Strategy:** Conservative technophobic films intentionally eliminate middle ground, creating stark oppositions:
 - Technology vs. Nature
 - Equality vs. Liberty
 - Artificial vs. Authentic
- **Visuals as Reinforcers:** Imagery (like the sun representing freedom) contributes to the sense of 'literal' truth that conservative ideology seeks, making social inequalities appear natural, not constructed.
- **The Deconstructive Counter-Argument:** A deconstructive analysis reveals that what conservative ideology claims are 'natural' origins are, in fact, the results of the very technology the films

demonize. The effect is misrepresented as the cause.

- **Blade Runner as Counterpoint:** This film challenges the technology/nature, reason/feeling dichotomies.
 - Depicts humans and replicants (androids) intertwining, blurring the line between 'maker' and 'creation'.
 - Analyzes capitalism as the force that turns humans into machines, echoing visual themes seen in *Metropolis*.
 - Ends with ambiguity, privileging metaphorical interpretations and the constructed nature of relationships that conservative films try to naturalize.

Connection to Studied Films

- **THX 1138 and Solaris (Tarkovsky):** Both depict oppressive technological societies that control individuals. However, *THX 1138* offers 'nature' as simple salvation. *Solaris*, on the other hand, shows that escaping technology may not escape internal demons. 'Nature' itself may be an unknowable, even hostile force.
- **Blade Runner and Aliens:** Both films center on strong, capable female characters (Rachael, Ripley) within male-dominated settings. However, *Aliens* leans more towards action spectacle. While its themes of motherhood resonate, the potential critique of gender roles becomes backgrounded compared to *Blade Runner*'s overt examination of patriarchy's impact.
- **The Fly and Conservative Fears:** The film, through its horrifying body transformation, could be read as a metaphor for the dangers of 'unnatural' tampering with 'nature'. However, it can also be seen as a tragedy about losing control over the physical self, an anxiety that transcends ideology.
- **Godzilla and the Technological Sublime:** While often categorized as monster movies, *Godzilla* films tap into a deep awe at the power of something beyond human control and understanding. This echoes a key concept in Sci-Fi: the feeling of encountering that which is so vast, it forces us to rethink our place in the cosmos.

The essay highlights a core tension within conservative critiques of technology in film. While aiming to reinforce traditional values, these films inadvertently expose the constructed nature of the social order they seek to uphold. By comparing these films to others on your list, we broaden the discussion, seeing potential conservative anxieties play out in different genres and revealing that sci-fi, at its best, always invites multiple interpretations.

6.2.9 Technical Progress and the Social Life-World

Summary

- **The Two Cultures and the Life-World:** The essay explores the disconnect between the objective, measurable world of science, and the subjective, values-based "life-world" of society. It argues science struggles to directly inform the social and ethical issues that arise from its own progress.
- **Science and Social Impact:** Scientific knowledge equals power, but often technical power with few built-in guidelines for integrating discoveries into society thoughtfully. Literature explores these implications, but the essay seeks a more direct way for science itself to engage with the social consequences of its progress.
- **The Historical Challenge:** The separation of science from everyday life is relatively recent. Universities once bridged the two cultures, but now hyperspecialization prioritizes technical proficiency over the broader humanistic understanding required to address science's impact.
- **Technology vs. Democracy:** The essay examines how technical progress shapes society and

whether democracy can effectively guide this force. Two models are explored:

- **Marxist Optimism:** Dismantling private ownership of the means of production puts technology in public hands, aligning progress with social goals. The essay critiques this, noting technical control doesn't equal democratic control.
- **Technology as Master:** Here, progress dictates social needs, not vice-versa. New technologies create "objective exigencies" that replace political debate. The essay finds this overly pessimistic, too.
- **The Need for Mediation:** The central problem is how to consciously and democratically manage the relationship between technical progress and our social lives, instead of leaving this to unplanned consequences.
- **Beyond Mere Stability:** Technological rationality might provide efficiency, but at what cost? An over-focus on maximizing power and comfort could reduce values to mere survival, overlooking other human needs.
- **The Challenge and Hope:** We are tasked with not just adapting to technology, but controlling it. This can only occur through rational, open dialogue, and not through technological solutions alone.

Connection to Studied Films

- **Metropolis (1927):** Visually stunning but explores the deep divide between technological advancement and social well-being. Its iconic imagery of workers dehumanized by machinery warns of the dangers of unchecked progress without ethical consideration.
- **Godzilla (1954):** While a monster movie, it is a direct response to nuclear technology. It embodies the fear and uncertainty unleashed by science on a scale beyond individual control, reflecting the essay's concerns about the mismatch between scientific power and social wisdom.
- **Solaris (1972):** This film's alien world isn't about spectacle, but a mirror for human anxieties. It highlights how even "objective" science is shaped by subjective experience, mirroring the essay's point about the two cultures not being so neatly separable.
- **Blade Runner (1982):** Its futuristic setting serves as a backdrop to questions of identity, memory, and empathy. The line between human and replicant highlights anxieties about technology blurring the boundaries of what makes us human - a concern reflected in the essay.
- **WALL-E (2008):** A cautionary tale about technological overreliance and consumerism leading to social atrophy. It mirrors the essay's warning about prioritizing comfort and survival over meaningful values.

This essay highlights a fundamental tension in science fiction cinema. The genre's strength lies in exploring the possibilities unleashed by science and technology. Yet, the very nature of film, focused on visuals and narrative, can pull it toward spectacle or simplistic resolutions that undermine the kind of complex, unresolved questions found in the best written science fiction. The films that most effectively reflect the essay's critique are those that manage to use the visual medium to explore the philosophical, ethical, and social dilemmas posed by the very science they showcase.

6.2.10 Technology and Science as Ideology

Summary

- **Challenge of Technical Control:** The essay grapples with how to manage scientific progress so it serves human needs, not dominates them. It questions our ability to consciously guide our technological trajectory.
- **Technology vs. Values:** The advance of technical control, even if meant for societal improvement,

can unintentionally diminish the role of shared values, ideologies, and communication.

- **The Cybernetic Dream:** The essay warns against the idea of a society so well-regulated by technology that human values wither, replaced by the biological imperative of mere survival.
- **The Need for Dialogue:** Our only hope is that rational thought (through open communication) will counterbalance our growing technical power.

Connections to Studied Films

- **Metropolis (1927):** This film's iconic imagery of a futuristic, stratified city reflects the anxiety about humanity being overwhelmed by its creations. The disconnect between the elite and workers dramatizes the essay's point about technical progress potentially eroding shared values.
- **Godzilla (1954):** The original film embodies the fear of unbridled technological power and its consequences (nuclear weapons). The destructive monster is a metaphor for humans failing to control the forces they've unleashed, which the essay discusses.
- **THX 1138 (1971):** This dystopian film portrays a society where technology is used to enforce total control, suppressing individuality and emotion. This connects to the point about the "cybernetic dream," where technology could be used to eliminate the need for human values and dialogue.
- **Blade Runner (1982):** The question of what makes someone 'human' is central to the film. Exploring the boundary between humans and replicants relates to the essay's concern that technology could devalue what it means to be human, reducing us to biological survival.
- **WALL-E (2008):** This film critiques a future where humanity has abandoned Earth, becoming utterly dependent on technology and losing their capacity for action and connection. This echoes the danger of a society focused on maximizing comfort at the expense of meaningful human experiences.

The essay makes a compelling case that science fiction on film must not only visually represent technological marvels but grapple with the social and ethical questions our technological advances raise. The films discussed demonstrate various ways cinematic techniques can explore these complex issues, some more successfully than others.

6.2.11 Surveillance Societies

Summary

- **The Central Tension:** The essay focuses on the conflict between the potential of science fiction to inspire and the challenges of effectively communicating these ideas through film, a primarily visual medium.
- **Control and Consensus:** The core question is how to reconcile technological progress with the control of that progress by society. Currently, technology appears to develop with its own momentum, often without consideration of societal consequences.
- **Technical Rationality vs. Value Systems:** The essay criticizes purely technical solutions to this problem, arguing that mere efficiency is not a sufficient goal. Human values and thoughtful dialogue are essential in guiding technological development.
- **The Challenge and Responsibility:** Due to the potentially catastrophic consequences of unbridled technological advancement, humanity faces the challenge of taking a conscious and active role in shaping its technological trajectory.
- **Dialogue and Rationality:** The essay stresses the importance of public discussion and informed decision-making as a way to confront potential dangers and harness the positive potential of technology.

Connection to Studied Films

- **Metropolis (1927):** Fritz Lang's visually stunning exploration of class conflict in a futuristic city provides a cautionary tale about the potential for technology to exacerbate social divides. The film underscores the essay's point that advanced technology alone doesn't solve societal problems and highlights the need for human values to guide its use.
- **THX 1138 (1971):** George Lucas's dystopian vision portrays a society where technology is primarily used for control and the suppression of individuality. The film emphasizes the danger of technological advancement without consideration for human needs and emotions, offering a chilling example of technical rationality without a guiding value system.
- **Solaris (1972):** Andrei Tarkovsky's meditative sci-fi film raises questions about the limits of knowledge and the impact of technology on personal relationships. The film demonstrates that spectacular special effects can be used in service of complex philosophical questions rather than mere visual awe.
- **Blade Runner (1982):** The film's exploration of artificial intelligence and the nature of humanity resonates with the essay's concern about the blurring line between the human and technological. The film also demonstrates the possibility of using the sci-fi aesthetic to grapple with philosophical questions of identity, free will, and empathy.
- **WALL-E (2008):** This Pixar animation explores the consequences of environmental degradation and excessive consumerism facilitated by technology. The film underscores the danger of technology's unchecked growth without consideration for the consequences for both humankind and the planet.

The essay makes a strong case for the importance of critical and informed discussion about how to steer technological progress in ways that align with human values. Looking at films alongside this essay allows for a deeper understanding of how these themes are explored in popular culture and a critical view of how we envision technological futures.

6.2.12 Tarkovsky's Solaris and the (im)possibility of a Science Fiction Cinema

Summary

- **The Technological Control Paradox:** The essay argues that the rapid pace of technological advancement has outstripped our ability to control its impact on society. This poses a significant challenge – how to harness technology for the betterment of humanity, instead of letting it control us.
- **Technical Power vs. Social Intent:** A tension exists between powerful new technologies and the outdated values/social intentions guiding their use. This leads to unintended consequences and a mismatch between technical capability and human goals.
- **The Inadequacy of Technical Solutions:** Technology alone cannot solve the problems created by technology. New approaches are needed that prioritize rational discussion, thought, and dialogue-based power structures to guide technological progress.
- **The Importance of Rational Dialogue:** The only way to effectively navigate this challenge is to prioritize critical thinking, open dialogue, and a conscious effort to direct the mediation between technology and society.

Connection to Studied Films

- **Metropolis (1927):** Fritz Lang's masterpiece offers a stark vision of a future where technology creates a stark class divide. The powerful elite control the means of production, while the workers are dehumanized and driven to desperation. This serves as a cautionary tale about the dangers of

unchecked technological power and its potential to create social inequality.

- **THX 1138 (1971):** George Lucas's dystopian vision depicts a world where individual thought and emotion are suppressed by a totalitarian state that relies on mind control and advanced surveillance technologies. The film explores the potential for technology to be utilized as a means of control and the importance of fighting to preserve individuality.
- **Solaris (1972):** Tarkovsky's film could be seen as a counterpoint to the essay's emphasis on rational dialogue. It explores the limits of human knowledge and communication, suggesting that some experiences may be inherently beyond explanation or understanding. While the film contains scientific elements, it prioritizes the emotional and spiritual impact of confronting the unknown.
- **The Fly (1986):** David Cronenberg's film offers a cautionary tale about the transformative and potentially destructive power of technology. The accidental fusion of a scientist with a fly in a teleportation experiment explores ideas of identity, the limits of the human body, and the unforeseen consequences of scientific ambition.
- **WALL-E (2008):** This animated film explores how unchecked technological dependence can result in societal complacency and environmental decay. It also offers a hopeful message about the power of human connection and the potential for positive change, even after the consequences of technological overreach become severe.

The essay highlights a critical challenge posed by the rapid development of technology: how to ensure it serves humanity rather than driving it. The films mentioned illustrate various manifestations of this theme, from dystopian visions of oppressive control to stories of individual struggle and transformative potential. Through these works, the complexities of the relationship between humanity and technology become clear, prompting viewers to question how these dynamics could unfold in their own lives.

6.2.13 Dialogue with Andrei Tarkovsky about Science Fiction on the Screen

Summary

- **The Core Issue:** Technical progress in our society often outpaces social and moral development. This imbalance threatens to destabilize the world, especially given the destructive potential of modern weaponry.
- **The Paradox of Technology:** Technology promises increased power and control, but its unplanned effects can undermine social structure and traditional values. It can even lead to a value system obsessed with mere survival, devoid of higher meaning.
- **Technology vs. Human Choice:** The challenge of the technological age is to learn how humanity can consciously direct its own course, not merely be swept along by the consequences of innovation. This requires moving beyond purely technical solutions.
- **Rational Dialogue as a Solution:** The author argues that our best hope lies in political structures that put power in the hands of reasoned thought, nurtured through open discussion. Technical advancement should not undermine this pursuit of rationality.

Connection to Studied Films

- **Metropolis, The Cabinet of Dr. Caligari:** These early examples of sci-fi often warn about the danger of technology unchecked by morality. They depict dystopian futures where machines dominate, humans are enslaved and/or dehumanized, and unchecked ambition leads to society's collapse.
- **THX-1138:** George Lucas's film presents a world where emotions and individuality are

suppressed in the name of efficiency and order. Technology is used as a primary tool of social control, showing the potential for its use against free will and self-determination.

- **Blade Runner, 2001: A Space Odyssey:** These films show technology as a reflection of deeper human questions. Blade Runner's exploration of artificial intelligence mirrors anxieties about identity and human uniqueness, while 2001 probes themes of evolution, consciousness, and humanity's place in the cosmos.
- **Solaris (Tarkovsky):** Tarkovsky's film could be connected to the idea of how technology can confront humans with their deepest moral dilemmas and inner anxieties. His focus on the psychological, rather than the spectacular, fits the author's call for a nuanced view on technology's effect on the human spirit.
- **Recent Trend: Childlike Wonder** Recent sci-fi films like Neptune Frost and Annihilation often feature a return to childlike wonder in approaching technological marvels. However, this risks sacrificing the genre's potential for intellectual exploration as presented in the essay.

The interview challenges us to think about how technological progress impacts the values we live by and who holds the power to shape the future. While science fiction films offer fertile ground for these explorations, they must balance the awe-inspiring spectacle with deeper, more philosophical questions to truly align with the genre's core strengths.

6.2.14 Ramble City: Postmodernism and Blade Runner

Summary

- **Technical Control and Social Mediation:** The essay argues that the rapid pace of technological progression outstrips society's ability to consciously direct and respond to its consequences. There's an urgent need for practical dialogue to create policy that addresses this gap between technological potential and its social implications.
- **Technical Rationality vs. Values:** The pursuit of efficiency and power, while necessary, can overshadow value systems and human needs. Over-reliance on technological control risks reducing the scope of human values to simple survival instincts.
- **The Challenge of Control:** Technological progress presents a challenge – and an opportunity – for humanity to learn conscious control over its own social destiny. This control extends beyond technical mastery, requiring a focus on ethics, values, and deliberate dialogue about societal goals.
- **Restoring Rationality:** True political power for the future lies not in maximizing technology itself, but in enabling dialogue and thoughtful policy based on informed consent.

Connection to Studied Films

- **Metropolis (1927):** Fritz Lang's masterpiece offers a stark vision of a future shaped by unchecked technological focus. The oppressed workers and the city's vast, inhuman machinery visually underscore the essay's point about social mediation. It warns about the dangers of prioritizing technical dominance over human values.
- **Solaris (1972):** Tarkovsky's cerebral film explores how technology can expose, not fix, human flaws. Though advanced, the space station Solaris becomes a mirror for deep psychological traumas and existential questions. This aligns with the essay's point that technology is insufficient to address societal problems rooted in values and internal conflict.
- **THX-1138 (1971):** George Lucas' film portrays a bleak future where emotion and humanity are suppressed for the sake of societal "order" enabled by technology. This dystopia highlights the potential for technology, intended for control, to strip individuals of free will and create a coldly

rationalized society lacking true human connection.

- **The Fly (1986):** Though a horror film, the tragic transformation of the scientist emphasizes the danger of scientific progress untempered by ethical reflection. The experiment, driven by techno-optimism, becomes a vehicle for unleashing the very chaos and irrationality the technology was meant to control.
- **Neptune Frost (2021):** This Afrofuturist film uses technology as a metaphor for both liberation and potential new forms of control. Its unique visual landscape offers a non-Western perspective that challenges the idea of technological development as purely linear and beneficial, aligning with the essay's call for critical dialogue about technical potential in a diverse global context.

This essay raises a vital critique of the role of technology within society. The suggested films underscore the urgency of its argument that unchecked technological progress could inadvertently sacrifice human values, erode reasoned dialogue, and ultimately diminish our potential. Sci-fi movies, for their part, offer a unique medium for exploring these consequences and reminding audiences of the necessity for social consciousness alongside technological advancement.

6.2.15 Simulacra and Science Fiction

Summary

- The Core Problem: Technology and technical control have outpaced society's ability to direct these forces towards intentional social goals.
- Ironic Outcome of Technical Progress: Progress driven by technical logic often neglects social values and priorities.
- Technical Rationality vs. Social Rationality: Societies can become technically advanced yet regress socially, valuing power and stability over human flourishing.
- The Challenge and the Danger: Humanity must actively learn to control technological direction. Otherwise, we may be governed by systems prioritizing mere survival.
- Hope for a Solution: Create conditions where rational thought, developed through dialogue, can shape political power.

Connection to Studied Films

- *Metropolis* (1927): The film explores an extreme disparity between technical advancement and the well-being of the masses. Visually stunning, it highlights how uncontrolled technological progress can intensify social inequality and create dehumanizing conditions.
- *Godzilla* (1954 and onward): Godzilla is a metaphor for the unchecked power of technology, specifically nuclear weapons. The film explores themes of uncontrolled force, the destructive potential of technology, and the unintended consequences of scientific progress.
- *La Jetée* (1962): This film's focus on time travel raises ethical questions. Technological power to manipulate time could change history with unforeseen consequences, reflecting the essay's concerns about controlling progress.
- *THX 1138* (1971): Like Metropolis, it depicts a dystopian future where technology is used for strict control and suppression of the populace. The film explores the dangers of unchecked technical power and the importance of fighting to reclaim individual autonomy.
- *Neptune Frost* (2021): This recent film offers a unique Afrofuturist perspective. It explores technology alongside community, resistance, and alternative visions of the future, challenging the Western-centric narratives prevalent in sci-fi. The film's themes support the essay's call for social and political awareness to shape the direction of technological progress.

The essay speaks to a fundamental tension within science fiction cinema. It argues that the genre has a unique ability to explore future possibilities, yet that its potential is often undermined by a focus on simplistic ideas and spectacle. Films like Metropolis, Godzilla, THX 1138, and others address this core concern, either as cautionary tales or as narratives exploring attempts to regain control over the direction of humanity in the face of overwhelming technological forces.

6.2.16 On the Grotesque in Science Fiction

Summary

- **The Technological Control Problem:** The essay argues that the swift pace of technological progress has outstripped our capacity to understand and manage its impact on society. This is not merely about efficiency but about the unintended consequences of technology on our values, ways of thinking, and power structures.
- **Rationality's Limitations:** Even a society that masters technical rationality (efficiency, maximizing power) can easily reduce its values to mere survival, missing broader ethical questions. Technological advancement, without a corresponding commitment to dialogue and deliberation, can lead to disastrous outcomes.
- **The Need for Democratizing Technical Knowledge:** The essay calls for the power of reasoned dialogue to be given priority within society. This would enable a more considered negotiation of the power technology gives us and the ethical implications of its use. Mere technical expertise isn't enough.

Connection to Studied Films

- **Metropolis (1927):** Fritz Lang's masterpiece depicts a technologically advanced city with a stark divide between the ruling elite and the oppressed workers. The film warns about the danger of technology magnifying social divisions and raises questions of who controls technology and for what purposes.
- **THX 1138 (1971):** George Lucas's dystopian vision portrays a society where technology is used to control and suppress the individual. The film questions the dehumanizing potential of technology when it prioritizes order over the human spirit and free will.
- **Blade Runner (1982):** The film raises thorny questions about what constitutes humanity and the ethical implications of creating artificial life. The replicants, exploited for their labor, force society to re-examine its values and the meaning of life in a technologically advanced world.
- **WALL-E (2008):** This Pixar film presents a cautionary tale about the dangers of overdependence on technology. Humanity has abandoned Earth, relying on robots and automated systems. This leads to atrophy and a loss of understanding about our relationship with the environment. The film questions the uncritical embrace of technology and the potential for human degeneration.

This essay highlights a fundamental tension in the science fiction genre. It is preoccupied with the transformative potential of technology, with the power to reshape our realities. Yet, it recognizes that this power raises profound questions about societal values, ethics, and the need for democratic dialogue in shaping our technological future. These questions have been central to many great sci-fi films, making them not mere escapist entertainment, but vehicles for reflection in an age of rapid change.

6.2.17 Bodies of Fear: The Films of David Cronenberg

Summary

- **Cronenberg's Emphasis on the Body:** David Cronenberg's sci-fi horror films are distinct in their obsessive focus on the human body, its vulnerabilities, and its potential for grotesque

transformations. This is a stark departure from traditional sci-fi that often uses the body as a vessel for exploring technological advancements or alien encounters.

- **Rejection of Cartesian Dualism:** Cronenberg challenges the mind/body divide. His work suggests that mental processes, anxieties, and desires are inextricably linked to and often directly manifest in the flesh. This subverts the notion of the mind as a superior, controlling entity.
- **Technology and the Body:** Technology in Cronenberg's films isn't a neutral force that can be erased from our experience of reality. Devices like the teleportation pods in *The Fly* violently impact and change the body. Technology becomes an extension and intensifier of bodily experience.
- **The Body as Unknowable:** Even as technology transforms and opens up the body, it remains a source of mystery and terror. Cronenberg suggests our culture's relentless attempt to master the body is ultimately doomed, revealing the limits of control.
- **Monstrous Ambivalence:** The monstrous bodily transformations in Cronenberg's films are both horrifying and strangely captivating. He refuses to present a purely negative view of these changes, instead showcasing the instability of the body as a source of both fear and fascination.

Connections to Studied Films

- **Metropolis (1927) and THX 1138 (1971):** Both films feature dystopian societies where technology is used to control and suppress the body. In *Metropolis*, workers' bodies are reduced to mechanical parts, while in *THX 1138*, desires and emotions are chemically suppressed. Cronenberg's work echoes this critique but goes further: technology doesn't merely subdue the body, it radically reshapes it, leading to a chaotic and potentially liberating breakdown of control.
- **Solaris (1972):** Like Cronenberg's films, *Solaris* explores the limits of the scientific mind in understanding a reality that is deeply entangled with the body and psyche. The sentient planet Solaris creates physical manifestations of the astronauts' repressed desires and memories, much like Cronenberg uses bodily mutations to express psychological states.
- **Aliens (1986):** While predominantly an action film, *Aliens* shares with Cronenberg a fascination with the visceral horror of the body. The monstrous Xenomorphs violate human bodies in graphic ways, their birth sequences particularly violent and disturbing. Ripley's final power suit is a fusion of human and machine in a monstrous echo of Cronenberg's *The Fly*.

Cronenberg's films expose the dark underside of the often-optimistic technological vision of traditional sci-fi. He reminds us that the body is a vulnerable yet potent site of resistance even in the face of oppressive technology. His work invites us to question our desire for absolute control and explore the monstrous potential that lies dormant within our own flesh.

6.2.18 Evolution of a Space Cadet

Summary

- **Afrofuturism as Reframing:** The text presents Afrofuturism as a movement that challenges traditional representations of black people in science fiction and fantasy. It reimagines the future with blackness integrated, rather than marginalized, at its core.
- **Countering Historical Constraints:** Afrofuturism is positioned as a way for artists to escape the creative limitations often imposed by historical burdens. It allows for envisioning new narratives free from the shadows of oppression and negativity.
- **Agency and Self-Definition:** One key element of Afrofuturism is reclaiming the power to create self-representation. It's about black creators writing their own destinies in fictional settings both historical and futuristic.

- **Black Geek Culture:** The essay examines the phenomenon of self-proclaimed "Black geeks" and the way Afrofuturism helps shatter preconceptions of Black identity. Geekdom becomes a point of pride and a space of belonging.
- **Cosplay as Empowerment:** The act of dressing up as heroes and heroines from sci-fi and fantasy is framed as a powerful tool. It allows individuals to transcend traditional roles, defy stereotypes, and tap into the transformative power of imagination.
- **Afrofuturism's Roots:** The essay traces the development of Afrofuturism as a concept and an aesthetic. It spotlights early pioneers like Mark Dery, Sun Ra, and Octavia Butler, and shows how the internet facilitated connections and fueled the growth of the movement.
- **Academic Recognition:** The text illustrates how Afrofuturism has become a subject of study within academic institutions. This formal recognition lends further legitimacy and structure to the movement as it continues to evolve.

Connection to Studied Films

- **Metropolis (1927):** The class division and emphasis on technology in this German Expressionist film could be seen through the Afrofuturist lens. Imagine a re-envisioning of Metropolis with a focus on the working-class laborers as Black, highlighting a unique interplay of race, technology, and social struggle.
- **Godzilla (1954):** While originally an allegory for nuclear dangers, Godzilla could be re-contextualized within Afrofuturism. Imagine Godzilla interpreted as a force linked to displacement and environmental consequences caused by colonialism – a metaphor for the fight against global systems disproportionately harming communities of color.
- **THX 1138 (1971):** George Lucas's dystopian vision can be re-examined to explore how racial dynamics might factor into systems of control. Could the faceless masses be deliberately depicted to highlight the erasure of Black and brown people in such a future? What would resistance look like through an Afrofuturist perspective?
- **Blade Runner (1982):** The film's interrogation of what makes someone human resonates with Afrofuturism's emphasis on identity and agency. The replicants could be seen as a metaphor for marginalized people, with Deckard's "retirement" missions as a twisted form of upholding racial order.
- **Neptune Frost (2021):** This recent Afrofuturist film's themes of technology, rebellion, and fluid identity directly align with core elements within the provided essay. It offers a contemporary example of how the concepts discussed in the text are actively being explored in film.

The provided text positions Afrofuturism as a vital, evolving movement that challenges traditional notions of science fiction and fantasy. Its emphasis on imagination, liberation, and black self-representation offers fresh ways to interpret the past, reimagine the future, and spark critical dialogue. By connecting it to familiar films, we can further unpack complex themes and discover new layers of meaning within existing science-fiction classics.

6.2.19 It's After the End of the World (Don't You Know that Yet?)

Summary

- **Afrofuturism and Time:** Afrofuturism disrupts linear understandings of time, offering alternative possibilities. Music plays a key role in this reimagining.
- **Challenging Social Realities:** Afrofuturism critiques existing power structures and imagines radical liberation for marginalized groups, particularly Black communities.
- **Poetry from the Future:** This concept suggests that artistic expressions hold a disruptive

potential, hinting at possibilities beyond our present understanding. Sun Ra's music exemplifies this.

- **Utopias and Ambiguities:** Afrofuturist works often envision new worlds, but the essay stresses complexities and potential contradictions within these visions.
- **Sound and Transformation:** Afrofuturism uses sound and music to challenge perceptions, breaking habitual patterns and opening space for new creative possibilities.
- **Black Existence and Potential:** The essay explores how Afrofuturism challenges traditional understandings of Blackness, seeing it as a historical process that continually pushes against the boundaries of accepted realities.
- **Impossibility and Speculation:** Afrofuturism engages with what seems impossible within current timelines, aiming for radical change and liberation. Poetry and speculative fiction play vital roles.
- **Autopoiesis and Ontogenesis:** The essay connects Afrofuturism to theories of autopoiesis and ontogenesis. Black existence already challenges Western concepts of being, and these theories offer new ways to analyze this.
- **Simondon's Contributions:** The essay explores Gilbert Simondon's work, specifically his ideas about preindividual potential, transindividual relation, and transduction. These frameworks allow for conceptualizing being as fluid and interconnected.

Connections to Studied Films

- **Metropolis (1927):** The film's themes of class division and worker exploitation resonate with Afrofuturism's critique of power imbalances and its utopian visions.
- **Godzilla (1954):** Godzilla as a monstrous disruption caused by nuclear testing parallels Afrofuturism's emphasis on challenging the status quo, even through seemingly destructive or unsettling means.
- **THX 1138 (1971):** This dystopian vision echoes Afrofuturism's critiques of oppressive social structures and the suppression of creative expression.
- **Blade Runner (1982 and 2049):** The films' exploration of artificial beings prompts a reassessment of existence itself, connecting to Afrofuturist themes.
- **Neptune Frost (2021):** This Afrofuturist film's themes and aesthetic resonate with the essay's points about Black existence, ontogenesis, and challenging the status quo.

The essay offers a rich exploration of how Afrofuturism disrupts concepts of time, reality, and existence, highlighting the transformative power of sound and speculative art. Analyzing this through the lens of studied sci-fi films can add further depth and nuance.

6.2.20 Katherine Hayles Book

Summary

- **Astrofuturism and Time:** Afrofuturism disrupts linear understandings of time, offering alternative possibilities. Music plays a key role in this reimagining.
- **Challenging Social Realities:** Afrofuturism critiques existing power structures and imagines radical liberation for marginalized groups, particularly Black communities.
- **Poetry from the Future:** This concept suggests that artistic expressions hold a disruptive potential, hinting at possibilities beyond our present understanding. Sun Ra's music exemplifies this.
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- **Neptune Frost (2021):** This Afrofuturist film's themes and aesthetic resonate with the essay's points about Black existence, ontogenesis, and challenging the status quo.

The essay offers a rich exploration of how Afrofuturism disrupts concepts of time, reality, and existence, highlighting the transformative power of sound and speculative art. Analyzing this through the lens of studied sci-fi films can add further depth and nuance.

6.2.21 The Eco-material Posthuman in the Age of the Anthropocene

Summary

- **The Eco-Material Posthuman:** This theoretical framework moves away from traditional humanist views of the human as exceptional and separate from nature. It emphasizes a view of the human body as fundamentally material and deeply interconnected with the broader environment. In the context of the Anthropocene, this perspective highlights the impact of human actions on the planet and the vulnerabilities shared across species and ecosystems.
- **The Body as Cell:** This reading emphasizes the shared biological building blocks – the cell – that connect humans with all other life forms. In science fiction, this can be used to challenge assumptions of human dominance, blurring the lines between self and other.
- **The Body as Affect:** Posthuman theory often views the body as pre-cognitive, with affective responses preceding conscious thought. These bodily states, often influenced by or directly connected to the environment, reveal our entanglement with the material world and undermine the idea of a fully autonomous human subject.
- **The Body as Vital Materiality:** Vital materialism rejects the idea of matter as passive or inert. Instead, it frames matter, including the human body, as possessing agency and a generative life force of its own. This perspective challenges notions of human control and highlights our

co-constitutive relationship with the nonhuman world.

Connection to Studied Films

- **Metropolis (1927):** Fritz Lang's seminal work visually represents the anxieties of a society on the brink of technological upheaval. The film's portrayal of vast machines and dehumanized workers could be reinterpreted through an eco-material posthuman lens. Workers become interchangeable elements within a larger system, their bodies reduced to their material capacity to perform labor, foreshadowing concerns about the body as a mere component in a capitalist machine.
- **Godzilla (1954):** The original Godzilla is a product of its era, a response to the nuclear age and the very real devastation of Hiroshima and Nagasaki. But it can also be seen as an eco-materialist fable, with Godzilla signifying the agency of the natural world pushed back. Radiation, a force beyond human control, alters the creature's biology (echoing the concept of cellular transmutation) and underscores the material consequences of nuclear weapons.
- **Solaris (1972):** Tarkovsky's meditative film explores the limits of human knowledge and understanding, particularly in relation to the nonhuman world. The sentient planet Solaris, resisting all attempts at understanding, can be seen as a manifestation of vital materialism - matter operating by its own logic and indifferent to human desire for control. Contact with Solaris also brings about a breakdown of subjecthood through its ability to materialize memories and trauma, suggesting a permeable relationship between the material body and its external environment.
- **Blade Runner (1982):** Ridley Scott's film asks fundamental questions about what it means to be human, exploring the distinctions between humans and their replicant creations. An eco-material lens allows further questioning. The replicants' limited lifespans, their very bodies designed for obsolescence, raise issues about the materiality of existence and the blurring of lines between organic and artificial life.
- **The Fly (1986):** David Cronenberg's body horror masterpiece delves into the horrific breakdown of the human form through a grotesque hybrid merging of man and insect. This can be seen as an exploration of "trans-corporeality" – the entanglement of human and nonhuman matter – and a blurring between self and other through the cell's susceptibility to change.
- **WALL-E (2008):** This animated Pixar film offers a cautionary tale about the Anthropocene and its impact on the Earth. However, within this narrative is the story of a robot left behind to clean up humanity's mess. WALL-E's persistence, his fascination with human artifacts, and his burgeoning sense of self suggest a form of nonhuman agency and a potential for empathy beyond the human species.

The eco-material posthuman perspective offers a framework to analyze science fiction films that grapple with environmental crisis and the changing relationship between humans and nature. By focusing on the body as a site of connection with the nonhuman world, these films can challenge anthropocentrism, explore the implications of the Anthropocene, and envision new ways of understanding our place within a complex and interconnected ecosystem.

6.2.22 Animation and Automation, or, the Incredible Effortfulness of Being

Summary

- **Animation and Automation:** Explores how our definitions of "animation" (giving life to the inanimate) and "automation" (replacing human labor with machines) have blurred and shifted over time. *WALL-E* embodies this blurring, being both mechanical and electronic, programmed and seemingly self-aware.

- **WALL-E as Transitional Figure:** *WALL-E* bridges our understanding of technology: familiar mechanical labor VS effortless electronic automation. He's also a figure of change himself. *WALL-E* starts as a simple machine but develops curiosity, adaptability, and even the hints of emotion and desire.
- **Preservation of Humanity:** *WALL-E*'s collection of human artifacts and love of old movies sparks hope and nostalgia, suggesting that even in a machine-driven future, the "human idea" might be preserved. This preservation is two-way: humans animated *WALL-E* with their own qualities, and those very qualities become the source of humanity's renewal.
- **Redefining Animation & Life:** Humans in *WALL-E* have become inert, dependent on technology. It's *WALL-E*, the machine, who embodies effort, movement, and the will to keep going - qualities that become markers of being "alive." This challenges the idea of smooth, computer-driven animation being the pinnacle. The film favors the visible effort of older animation, reminding us of the labor involved in being alive.

Connection to Studied Films

- **Metropolis (1927):** Both Metropolis and *WALL-E* explore class division through the lens of automation. Metropolis' workers are dehumanized cogs in a machine; *WALL-E*'s humans are similarly reduced by their dependence on technology.
- **The Cabinet of Dr. Caligari (1920):** The distorted, expressionistic world of Caligari reflects a subjective, unreliable reality. *WALL-E*'s use of both old film and new computer animation similarly questions the nature of reality and perception as technology changes.
- **THX 1138 (1971):** Like the sterile, emotionally controlled citizens of THX, humans in *WALL-E* are passive and dehumanized by technology. The rebellion and escape in THX mirrors the breaking free from programmed routines that *WALL-E* sparks.
- **Solaris (1972):** Solaris features a mysterious, seemingly sentient entity challenging human understanding. *WALL-E*, an inanimate machine gaining sentience, evokes a similar question about the boundaries of consciousness.
- **Blade Runner (1982):** Both films question what makes someone truly "alive". Is it biology (like Blade Runner's replicants), or is it something more intangible, as *WALL-E* suggests through his actions and emotions?

The analysis of *WALL-E* highlights ways science fiction films explore anxieties about technology and what defines humanity. It raises concerns that excessive automation and reliance on seamless spectacle can dull our own life force. However, it also hints at the possibility of machines inheriting aspects of humanity, forcing us to reconsider what "being human" means.

6.3 Key ideas

- Mise-en-scene
- Types of shot distances and types of film sound
- Significance of "time machines" to film
- Continuous and Discontinuous Editing
- "Metacinematic" expressions in our films
- German Expressionism
- Fascist automaton
- Special effects
- Technophilia

- Images of Wonder, conventions of SF
- Characteristics of Genre
- Social Functions of Genre
- Significance of disaster to SF
- Primal scene and “final scene”
- Film as 24 frames per second, the organization of a film strip
- Graphic match
- Technophobia
- Control society and disciplinary society
- Sound montage
- Tarkovsky’s ideas about SF
- Significance of 2001 to Solaris
- Postmodernity
- Simulacrum
- Citationism
- Hyperreality
- Sublime images
- Grotesque Images
- Body horror
- Afrofuturism
- Intersex
- The Posthuman (identify several aspects of this concept and its elasticity)
- Anthropocene
- Film animation and automation

6.4 Practice

6.4.1 Technophilia, role of women

Exercise 6.1 One Paragraph: In her essay, “Technophilia,” Mary Ann Doane describes a tradition of science fiction that explores technological interventions for idealizing womanhood. Drawing on Doane’s analysis, choose one of the following films and explain, using examples, how a futurist imaginary transforms the category of woman. La Jetée, Metropolis, Solaris, Annihilation, Aliens, THX 1138.

Option 1

In Chris Marker’s experimental film "La Jetée," the category of woman is deeply transformed by technological interventions that manipulate memory and perception. The film primarily unfolds through still images and narrates the story of a man haunted by the memory of a woman he saw on a pier at Orly Airport as a child. This memory becomes the anchor for his journeys through time, facilitated by a dystopian society’s technological experiments in the aftermath of a catastrophic war.

The female protagonist in "La Jetée" is notably nameless, and her existence is confined to the realm of memory and image, specifically a single moment frozen in time. This reduction of the woman to an image serves as a potent form of technological control and idealization. The protagonist’s memory of the woman is repeatedly revisited and manipulated, turning her into an object of obsession and a symbol of lost and unattainable beauty. This serves as a critique of the male gaze, where the woman is idealized and objectified through the lens of male desire and memory.

The technology in the film not only facilitates this obsession but also literalizes it by making her a fixed point in temporal experiments, suggesting that technology, when combined with male desire, can enforce a static and idealized notion of womanhood, devoid of agency or dynamism.

The film's exploration of memory as a tool for controlling the image of woman aligns with Doane's analysis of technology as a means to idealize femininity. In "La Jetée," the woman is essentially a construct of the protagonist's desires, shaped and reshaped by his memories, which are themselves influenced by the technological manipulation of his time-traveling experiences. The technology thus transforms the category of woman into a passive and ever-perfect icon, untouched by the ravages of time and reality, perpetually trapped in a moment of sublime beauty that is both powerful and profoundly limiting.

Option 2

Fritz Lang's "Metropolis" features one of the most iconic representations of woman as both a technologically idealized figure and a subject of male control and fear through the creation of the *Maschinenmensch*, a robotic replica of the film's heroine, Maria. The film juxtaposes the virtuous, human Maria with her artificial double, an entity that embodies the technological ambitions and fears of its era. The robot Maria is crafted by the inventor Rotwang and the master of Metropolis, Joh Fredersen, who intend to use her to manipulate the working class by corrupting their vision of the virtuous human Maria.

The *Maschinenmensch* symbolizes the ultimate idealized woman in several respects: she is visually perfect, obedient, and devoid of human flaws, representing an unattainable standard of female beauty and compliance. Her creation and deployment illustrate a literal and figurative attempt to mold femininity according to male desires and fears. The robot is a spectacle of fear and desire, inciting lust and violence, disrupting societal order, and ultimately highlighting the destructive consequences of trying to control and perfect nature through technology.

Mary Ann Doane discusses how technological representations in cinema often reflect cultural anxieties about femininity and the potential for its replication and manipulation. "Metropolis" explores these themes by showing how the robot Maria becomes a source of chaos when she diverges from her creators' intentions. The film critiques the patriarchal desire to control and idealize womanhood, depicted through the disastrous consequences of unleashing a technologically created femme fatale. The artificial Maria's role in the film underscores the problematic aspects of technological interventions in femininity—where the quest for a perfect, controllable woman leads to moral and social upheaval, emphasizing the unnaturalness and danger of such idealized constructs.

Option 3

In Andrei Tarkovsky's "Solaris," the transformation of the category of woman is vividly portrayed through the character of Hari, who is a replica of the protagonist Kris Kelvin's late wife. This character is not just a manifestation of Kelvin's memories but an embodiment of his idealized version of Hari. Tarkovsky uses Hari's multiple manifestations to delve deeply into the male psyche, exposing how technology—in this case, the mysterious ocean on the planet Solaris—can be used to recreate and manipulate the feminine ideal to the whims of the male desire.

One of the most striking scenes illustrating this concept occurs when Hari first appears aboard the space station. The scene is composed with a soft focus that blurs the edges of the frame, symbolizing the unclear boundaries between reality and memory. The camera lingers on Hari's confused and innocent expressions, which, combined with the eerie silence of the space station, heightens the sense of unnaturalness surrounding her existence. The slow, deliberate pacing of the

scene allows the audience to perceive Hari as both a ghostly presence and a tangible entity, reflecting Kelvin's conflicting emotions of desire and fear towards this re-creation of his wife.

In a later scene, Hari attempts suicide only to regenerate rapidly, demonstrating her artificial nature. This sequence employs abrupt cuts and a chaotic montage that contrasts sharply with the earlier, more serene presentations of Hari. This editing style conveys the jarring realization for both Kelvin and the audience that Hari, despite her appearance and emotions, is not truly human. This moment is pivotal as it foregrounds the ethical and existential dilemmas faced by Kelvin, making the audience question the morality of using technology to resurrect the dead as idealized forms devoid of their original human complexities.

Hari's character development throughout the film uses the cinematic space and *mise-en-scène* to emphasize her transformation from a mere memory to an individual entity struggling with her own existence. The use of mirrors and reflective surfaces in several scenes symbolizes her introspective quest for identity and existence beyond Kelvin's perceptions. This not only challenges but also tragically underscores her inability to ever be more than a product of Kelvin's memories, manipulated by the alien technology of Solaris.

Option 4

"Annihilation" by Alex Garland explores the transformation of the female form in a much more radical and visceral manner. The film presents a group of women who enter a mysterious zone called the Shimmer, where the laws of nature are distorted by an alien presence. This environment acts as a catalyst for profound physical and psychological changes, challenging the traditional notions of femininity and human identity.

Garland uses vibrant colors and a continuous, fluid camera movement to represent the Shimmer's effect on the women. The use of iridescent hues and a soft focus lens on the flora and fauna create a dream-like quality that mirrors the characters' transformations. In one key sequence, the character of Josie voluntarily allows her body to be overtaken by the alien flora, turning into a humanoid garden. This scene is shot with wide angles and a slow pan to emphasize her acceptance and integration into the environment, contrasting with the more claustrophobic, rapid-fire editing of the scenes depicting fear and confusion.

The protagonist, Lena, faces her duplicate in the climax, which is a scene rich with symbolic imagery. The mirroring effect created by having Lena and her doppelgänger mimic each other's movements in a bizarre dance underscores the theme of self-confrontation and transformation. The use of echoing sound design and mirrored choreography highlights the blurring lines between the original and the copy, questioning the very essence of identity and self.

Moreover, the film's final scenes, where Lena's eyes shimmer with the alien color, suggest that her transformation is both internal and irreversible. The subtle use of CGI to alter the eye's appearance, combined with Natalie Portman's restrained but intense performance, leaves the audience questioning what humanity remains if any.

Option 5

Aliens elevates the character of Ellen Ripley from survivor to warrior, redefining the feminine hero archetype in a manner that's both groundbreaking and deeply influential within the science fiction genre. James Cameron's sequel to the Ridley Scott horror classic shifts from horror to an action-driven narrative, employing a variety of film techniques to enhance its thematic depth and highlight Ripley's transformation.

The visual aesthetics of Aliens play a crucial role in subverting traditional gender roles. Ripley, played by Sigourney Weaver, is initially presented in a vulnerable state, recovering from her

traumatic experience in the first film. However, Cameron quickly transitions her from vulnerability to empowerment. This transformation is visually emphasized in scenes where Ripley takes control of the Colonial Marines' weaponry and equipment. One key scene is her use of the power loader; Cameron uses a low-angle shot that captures Ripley stepping into the loader, symbolically stepping into a position of power and agency, directly challenging the previously male-dominated realm of physical combat.

Cameron's use of close-ups on Ripley during critical moments—such as her confrontation with the Alien Queen—serves to focus on her emotional resilience and strategic thinking. These close-ups are juxtaposed with shots of the chaotic environment and the frenzied actions of the male marines, highlighting Ripley's calm and collected demeanor in contrast to her male counterparts, thus redefining the notion of heroism as not just physical bravery but also mental toughness.

The film's sound design also complements Ripley's character development. The intense, rhythmic pulse of the score during action sequences mirrors Ripley's heartbeat, drawing the audience into her emotional state, creating a visceral connection that emphasizes her role as the central hero. Furthermore, the diegetic sounds of the aliens contrast sharply with the technological sounds of the human environment, emphasizing the alien threat and Ripley's courage as she navigates this hostile landscape.

In summary, *Aliens* uses a blend of cinematography, sound design, and narrative structure to transform the character of Ripley into a symbol of female empowerment. This reimagining of the action hero through the lens of a female protagonist challenges and expands the conventions of the science fiction genre, providing a complex portrayal of womanhood that is both powerful and inspiring.

Option 6

THX 1138, George Lucas's directorial debut, presents a dystopian future where technology infiltrates every aspect of human life, including the suppression of gender distinctions and the eradication of individuality. The film employs a minimalist aesthetic and stark cinematographic techniques to explore themes of control, conformity, and the loss of personal identity.

The visual style of *THX 1138* is characterized by its use of white, sterile environments that dominate the film's setting. This color scheme not only reflects the clinical nature of the society but also visually represents the erasure of individuality—including gender identity. Lucas uses wide shots of the characters moving through vast, impersonal spaces to emphasize their insignificance and the overwhelming power of the technological system that controls them. The uniformity in the characters' appearance, with shaved heads and identical white clothing, visually strips away any markers of gender, reducing characters to mere components of the societal machine.

Sound plays a critical role in reinforcing the film's themes. The omnipresent background noise of computerized voices and mechanical sounds creates a sense of constant surveillance and control. This is complemented by the sparse dialogue, which is often delivered in a monotone, further dehumanizing the characters and erasing emotional and gender distinctions. Lucas particularly focuses on the sound design to enhance the sense of a controlled environment where even speech is regulated and devoid of personal expression.

The film's editing also contributes to its thematic concerns. Lucas employs a cold, mechanical pacing, with scenes transitioning smoothly to mimic the characters' regulated lives. The lack of abrupt cuts reflects the unending, monotonous existence of the characters, trapped in a loop of conformity. This editing style is punctuated by moments of frantic, chaotic sequences—such as THX's escape attempt—highlighting moments of rebellion against the oppressive order.

THX 1138 uses these film techniques to craft a narrative that is as much about the suppression of gender and the human spirit as it is about the broader implications of technological domination. The aesthetic choices—visual, auditory, and narrative—serve to create a chilling vision of a future where technology has stripped humanity not just of individuality but also of gender, leaving behind a homogenized, controlled population that serves as a warning against the unchecked expansion of technological control in society.

6.4.2 Anthropocene

Exercise 6.2 Three Paragraphs: Many science fiction films represent the relationship between humans and non-humans in the “Anthropocene.” Choose from two of the following films: Godzilla, La Jetée, The Fly, Annihilation, WALL-E. Write three paragraphs in the following order.

- Paragraph 1: explain, using examples, how Film 1 represents an “Anthropocene.”
- Paragraph 2: explain, using examples, how Film 2 represents an “Anthropocene.”
- Paragraph 3: compare and contrast both films’ representations of an “Anthropocene”

Option 1

Godzilla symbolizes the catastrophic impact of human actions on the environment, marking a significant representation of the Anthropocene era. The film employs a combination of special effects and narrative to emphasize Godzilla as a byproduct of nuclear testing—an unintended and uncontrollable force born from humanity’s technological hubris. His immense size and power are captured through low-angle shots that tower over the urban landscape, symbolizing the massive scale of human environmental impact. Scenes of Godzilla rampaging through Tokyo, crushing buildings and creating chaos, visually illustrate the disruptive consequences of human actions on the natural order. The film’s use of haunting soundscapes and eerie silence prior to Godzilla’s appearances enhances the ominous tone, underscoring the dread and fear associated with environmental disasters.

Annihilation, in contrast, portrays the Anthropocene through the surreal and mutating landscape of the Shimmer. This film uses vivid color palettes and fluid, morphing visual effects to depict the integration and mutation of DNA across species barriers. The Shimmer’s environment, where flowers mimic human shapes and animals blend with plants, serves as a metaphor for the Anthropocene’s deep, irreversible intertwining of human activity with the natural world. Cinematographically, *Annihilation* employs soft focus and a saturated color scheme to blur the lines between the natural and unnatural, enhancing the sense of alienation from the familiar. The psychological disorientation experienced by the characters is mirrored in the disorienting narrative structure and pacing of the film, reflecting the complex, often incomprehensible consequences of human environmental interference.

Comparatively, **Godzilla** and **Annihilation** offer distinct visions of the Anthropocene. **Godzilla** externalizes the Anthropocene as a monstrous other, a direct result of nuclear technology that reflects on the overt dangers of human overreach. Its narrative focuses on the clash between human civilization and a titanic force, emphasizing a battle to regain control or at least mitigate disaster. **Annihilation**, however, internalizes the Anthropocene, presenting a world where the very essence of life is uncontrollably altered from within. It suggests that the Anthropocene could lead to a profound transformation of both the environment and human identity, visualized through the film’s intricate mutations and the characters’ existential struggles. While both films depict catastrophic scenarios, they differ in their portrayal of threat—the former as an assault on human cities, the latter

as an insidious alteration of biological reality. Together, they encapsulate the dual aspects of the Anthropocene: destruction and transformation, external threat and internal change.

Option 2

The Fly offers a visceral depiction of the Anthropocene, portraying the individual body as a battleground for nature and technology. David Cronenberg utilizes grotesque body horror elements to symbolize the invasive impact of technology on the natural order. Seth Brundle's transformation, triggered by a teleportation experiment that goes awry, is a graphic representation of human intervention into natural processes. The film employs close-ups and detailed practical effects to capture the horrifying metamorphosis of Brundle's body, emphasizing the theme of internal contamination. This transformation is both literal and metaphorical, reflecting the broader environmental and ethical concerns of the Anthropocene. His gradual loss of humanity—visually emphasized through the progressive grotesqueness of his physical change—serves as a cautionary tale about the potential consequences of manipulating nature.

WALL-E, directed by Andrew Stanton, contrasts with *The Fly* by focusing on ecological rather than bodily decay. Set on a future Earth overwhelmed by waste, the film uses wide, lingering shots of vast landscapes filled with garbage to highlight the planet's drastic alteration due to human consumerism. WALL-E, the lone waste-collecting robot, is depicted through warm, soft-focus close-ups that imbue him with a sympathetic, almost human quality, contrasting sharply with the cold, desolate settings. This visual contrast reinforces the film's theme of hope and resilience in the face of environmental catastrophe. The discovery of a single growing plant is framed as a significant, hopeful moment, shot in vibrant color to stand out starkly against the dull grays and browns of Earth's landscape, symbolizing the potential for renewal and change.

While both **The Fly** and **WALL-E** address themes central to the Anthropocene, they do so through distinct narrative and aesthetic lenses. **The Fly** focuses on the horrors of personal physical transformation as a metaphor for environmental intervention gone awry, using body horror to explore the fears associated with biotechnological advancements. In contrast, **WALL-E** presents a broader, more societal examination of the Anthropocene, critiquing the long-term impacts of human activity on the planet. It combines elements of a dystopian future with a narrative of redemption and recovery, offering a critique mixed with optimism. Both films, therefore, provide compelling insights into the Anthropocene, highlighting the profound and often disturbing implications of humanity's footprint on the world, but through vastly different scopes—personal versus planetary.

Option 3

La Jetée portrays a post-apocalyptic Anthropocene, capturing the desolation of a world ravaged by global conflict, leaving Earth uninhabitable and humanity forced underground. The film employs a unique narrative technique, using predominantly still images alongside a poignant voiceover, creating a reflective and melancholic atmosphere. This choice accentuates the theme of memory and loss, with the still images serving as frozen moments in time, echoing the stasis and regression of human society. The stark black and white photography enhances the bleakness of their situation, symbolizing a world stripped of vitality. The narrative's focus on time travel as a desperate attempt to escape or amend their current state underscores a thematic concern with humanity's ongoing struggle against the consequences of its own actions, emphasizing a cyclical pattern of environmental and ethical crises.

In contrast, **WALL-E** presents a more contemporary vision of the Anthropocene, characterized by consumer excess and environmental negligence. The film uses vibrant animation and dynamic cinematography to depict Earth as a garbage-laden wasteland juxtaposed against the technologically

advanced but sterile life aboard the Axiom spaceship. This visual contrast not only highlights the degradation of Earth but also critiques the unsustainable consumer culture that led to such devastation. The character of WALL-E, animated with expressive movements and sounds, personifies the persistence of life and the possibility of renewal amidst ruin. The film's narrative, focusing on recovery and the rediscovery of plant life, injects a sense of hope, suggesting that redemption is possible through responsible stewardship and reconnecting with the natural world.

Both *La Jetée* and *WALL-E* explore the Anthropocene from different perspectives but converge on similar themes of environmental and existential crisis. *La Jetée* adopts a somber tone to reflect on the consequences of human folly and the haunting permanence of environmental damage, using the medium of still photography to emphasize the static and irreversible nature of their dystopian reality. *WALL-E*, however, offers a more accessible critique through its satirical depiction of consumerism and its optimistic outlook on human capacity for change. While *La Jetée* dwells on the melancholic aspects of human impact on the environment, *WALL-E* provides a more balanced view by showcasing both the deep-seated issues and the potential for significant positive change. Both films, through their distinct aesthetic and narrative choices, compellingly address the urgency of reevaluating our relationship with the planet within the context of the Anthropocene. ■

6.4.3 Closeups

Exercise 6.3 One Paragraph. Close-ups and extreme close-ups each give us specific information about a cinematic world and create particular relationships between the viewer's body and the screen body. Choose one of either *Godzilla* or *THX 1138* and explain, using examples, the motivation behind the use of close-ups or extreme close-ups in the film.

Option 1

In George Lucas's "THX 1138," the use of close-ups and extreme close-ups is pivotal in conveying the oppressive atmosphere of the film's dystopian setting. These techniques are strategically employed to intensify the viewer's experience of surveillance and control, core themes of the narrative. Extreme close-ups are frequently used to focus on characters' eyes and mouths, isolating these features from the rest of the face and body. This not only dehumanizes the characters, reducing them to the sum of their parts, but also echoes the pervasive surveillance technology within the society. For example, scenes where the protagonist THX is monitored by robotic policemen are shot in extreme close-up, highlighting his eyes to reflect his fear and paranoia, and to create a suffocating sense of being constantly watched. These close-ups serve a dual purpose: they emphasize the sterile, impersonal nature of this society, where individuals are constantly observed and controlled, and they also allow for an intimate connection between the audience and the characters, making the viewer feel the characters' claustrophobia and despair. This visual technique mirrors the film's thematic exploration of a society where privacy is invaded and individuality is crushed, effectively drawing the viewer into the emotional and psychological turmoil experienced by the characters.

Option 2

In "Godzilla," the strategic use of close-ups and extreme close-ups serves to heighten the dramatic tension and underscore the monumental scale of Godzilla as a symbol of catastrophic natural forces. These cinematographic techniques focus intensively on Godzilla's features, such as his eyes, teeth, and scales, enhancing the creature's menacing presence and the visceral impact on the audience. For instance, extreme close-ups of Godzilla's eyes convey a piercing look that suggests intelligence and malevolence, instilling a deeper sense of fear and awe. Similarly, close-ups on his

massive, destructive claws and the rough texture of his skin emphasize his brute strength and the sheer enormity of his being. In contrast, close-ups on human characters during scenes of chaos and destruction highlight their emotional reactions—fear, panic, and sometimes resignation—thus underscoring their fragility and helplessness in the face of such overwhelming power. This juxtaposition not only magnifies the disparity between human capabilities and Godzilla's might but also visually reinforces the film's exploration of themes such as the consequences of humanity's hubris and the existential threat posed by human-induced environmental disasters. By bringing viewers into a close, almost claustrophobic engagement with both Godzilla and the human characters, the film creates a compelling narrative tension that emphasizes the profound impact of Godzilla on the human world.

6.4.4 Postmodernity

Exercise 6.4 Two Paragraphs: “Postmodernity” describes both a set of aesthetic trends and a series of conceptual shifts in how we understand subjectivity and reality. Choosing two films from the syllabus, write two paragraphs in the following order.

- Paragraph 1: Describe Film 1’s aesthetic and conceptual signs of postmodern thought
- Paragraph 2: Describe Film 2’s aesthetic and conceptual signs of postmodern thought

Option 1

Blade Runner exemplifies postmodern aesthetics through its eclectic fusion of visual styles and architectural influences, creating a multifaceted and texturally rich urban landscape that reflects the complexity and plurality of postmodern society. The film’s use of neon-lit signage alongside retrofitted classical architecture underpins its pastiche approach, blending the old with the new to suggest a temporal dislocation. Conceptually, **Blade Runner** interrogates the nature of reality and identity through its narrative of replicants who challenge the authenticity of human experience. The replicants, especially Rachel, who possesses implanted memories, blur the lines between human and machine, questioning the constructs of identity and self-awareness. The film’s neo-noir elements, such as the morally ambiguous protagonist and the pervasive sense of urban decay, enhance its exploration of postmodern themes such as alienation and the fragmentation of identity. The ambiguous conclusion, leaving viewers questioning the nature of Deckard’s own existence, further exemplifies postmodern skepticism towards grand narratives and objective truths, encapsulating a world where appearances are inherently unreliable.

WALL-E, while primarily an animated children’s film, incorporates postmodern aesthetics by blending homage and critique, particularly through its engagement with past cinematic forms and its satirical take on consumer culture. The film evokes a nostalgic sense of the past through its references to early silent films and classic Hollywood narratives, using these intertextual elements to craft a narrative that is both familiar and new. The use of CGI in **WALL-E** creates hyper-real environments that blur the line between animation and live action, challenging perceptions of what is real—a key postmodern concern. On a conceptual level, the film engages with themes of hyperreality and simulation, particularly through the depiction of humans living in a mediated, consumption-driven environment aboard the Axiom spaceship, detached from natural experiences. This critique of advanced capitalist society reflects postmodern concerns about the commodification of life and the erosion of authentic human experiences. Additionally, the film’s ecological message interrogates the modernist narrative of endless progress, suggesting a need to reevaluate our relationship with technology and the environment in a postmodern world increasingly characterized by ecological

and existential uncertainty.

Option 2

Metropolis, Fritz Lang's seminal work, demonstrates early postmodern tendencies through its visual style and thematic complexity. The film employs German Expressionist techniques, characterized by exaggerated sets and stark, dramatic contrasts in lighting, which create a surreal, dystopian cityscape that seems both futuristic and otherworldly. This stylization produces a heightened sense of artificiality, blurring the lines between reality and fiction—a key postmodern trait. Thematically, **Metropolis** critiques the grand narrative of industrial progress by depicting a society where technological advancement results in stark social divisions and human alienation. The creation of the *Maschinenmensch*, a robotic double of Maria, introduces themes of replication and the interchangeability of reality with simulation, challenging the concept of a stable, authentic identity and foreseeing future postmodern concerns with simulacra and the dissolution of the human subject in the face of technological domination.

Neptune Frost by Saul Williams and Anisia Uzeyman is a vibrant embodiment of postmodern aesthetics through its Afrofuturist approach, merging the traditional with the technological in a striking critique of contemporary global issues. The film's use of eclectic costumes made from recycled materials and its hybrid musical landscape that fuses electronic with traditional African rhythms exemplify a quintessentially postmodern bricolage. Visually and sonically, the film disrupts conventional narrative forms and cultural expectations, creating a collage that defies genre categorization. Conceptually, **Neptune Frost** questions the binary distinctions between human and machine, and between the Global North and South, suggesting a fluid, interconnected world where identity is multiple and mutable. The film's narrative explores themes of decentralization and resistance against oppressive power structures, reflecting postmodern skepticism of meta-narratives and emphasizing a pluralistic, inclusive view of the future that embraces difference rather than conformity.

Option 3

2001: A Space Odyssey, directed by Stanley Kubrick, embodies postmodern aesthetics through its innovative use of visual and narrative techniques. The film's aesthetic minimalism is expressed in its clean, geometric set designs and the extensive use of open, empty spaces that evoke a sense of isolation and alienation. These elements, combined with the film's deliberate pacing and the iconic, haunting score, create a cinematic experience that prioritizes form and ambiguity over traditional narrative clarity. Conceptually, **2001** challenges the Enlightenment narrative of human progress and dominance through its portrayal of HAL 9000, a sentient computer whose eventual malfunction poses existential questions about the relationship between creators and their creations. The film's open-ended conclusion, leaving many questions unanswered and inviting multiple interpretations, is quintessentially postmodern, as it undermines the possibility of a single, unifying truth and emphasizes the instability of human knowledge.

Annihilation, directed by Alex Garland, showcases postmodern themes through its exploration of hybridity, identity, and the collapse of environmental and biological boundaries. The film employs a fragmented narrative structure that mirrors the disintegration of the characters' identities and the world around them. This narrative fragmentation is reflected visually in the film's lush, surreal imagery within the Shimmer, where genetic material is freely exchanged between species, resulting in bizarre and beautiful mutations. These visual motifs challenge traditional categories of species and identity, emphasizing postmodern themes of ambiguity and transformation. Furthermore, **Annihilation** engages with contemporary environmental concerns, presenting a postmodern critique

of the grand narrative of technological control over nature. The film suggests that such attempts at control are not only futile but also potentially catastrophic, aligning with postmodern skepticism towards human-centered narratives of progress.



6.4.5 Technophobia

Exercise 6.5 One Paragraph. Explore the theme of "Technophobia" using examples from either *Blade Runner* or *The Fly*. Discuss how the film uses narrative and visual elements to convey anxieties about technological advancement and its impact on human identity. Consider aspects such as character development, mise-en-scène, and special effects to support your analysis.

Blade Runner vividly encapsulates technophobia through its depiction of a future where human-like androids, known as replicants, challenge the very essence of human identity. The film utilizes its narrative and rich visual tapestry to foreground deep-seated anxieties about technological advancements and their implications for humanity. The character development of the replicants, particularly Rachael and Roy Batty, serves as a central element in exploring these fears. Rachael's struggle with her own memories, initially believed to be genuine but later revealed as implants, raises profound questions about the authenticity of human experience itself. Roy's eloquent monologue towards the film's climax further humanizes the replicants, juxtaposing their emotional depth against the humans who appear cold and detached. The mise-en-scène reinforces this anxiety; the dark, rain-soaked streets of Los Angeles, combined with the omnipresent neon lights, create a dystopian world where technology permeates every aspect of life, suggesting a future dominated by technological constructs at the expense of natural human existence. Special effects, such as the eerie glow of the replicants' eyes, subtly cue viewers to the artificiality lurking beneath the surface of human semblances, further blurring the lines between human and machine. Through these elements, *Blade Runner* not only reflects technophobic fears but also prompts a deeper reflection on what it means to be human in a technologically advanced world.

The Fly by David Cronenberg masterfully explores technophobia through the horrific transformation of its protagonist, Seth Brundle, after an experiment with a teleportation device goes tragically wrong. The film uses both narrative and visual elements to express deep anxieties about the merging of human flesh with technology. Seth's initial transformation showcases the wonders of scientific discovery, yet quickly devolves into a grotesque and cautionary tale about the dangers of overreaching technological ambition. Character development is central to the film's exploration of technophobia, as viewers witness Seth's metamorphosis from a brilliant and enthusiastic scientist into a monstrous hybrid of man and insect. This transformation is vividly realized through the film's groundbreaking use of makeup and special effects, which visually manifest the physical corruption brought by technological interference. The mise-en-scène in Seth's apartment-turned-laboratory, cluttered with the detritus of his experiments, becomes a physical representation of the chaos that the unchecked use of technology can wreak on the human body and spirit. Through these elements, *The Fly* not only showcases the physical horrors that technology can inflict but also metaphorically questions the ethical and existential risks of altering the natural order.



6.4.6 Sublime

Exercise 6.6 One Paragraph. The concept of the "Sublime" is often explored in science fiction films through overwhelming visual aesthetics or themes that challenge human understanding. Choose one scene from either *2001: A Space Odyssey* or *Annihilation* and analyze how the film creates a sense of the sublime. Focus on cinematographic techniques, sound design, and the ways these elements combine to evoke awe and possibly terror in the audience.

The "Star Gate" sequence in *2001: A Space Odyssey* is a quintessential exploration of the sublime, effectively capturing the overwhelming and awe-inspiring possibilities of space travel and the unknown. In this sequence, the convergence of visual effects, cinematography, and sound design masterfully evokes a sense of cosmic wonder and existential dread. The use of slit-scan photography creates a continuous, flowing tunnel of vibrant, abstract patterns that engulf the protagonist, Dave, and the viewers, pulling both into a visually disorienting journey. This effect, combined with the eerie, atonal music and the sudden, fleeting images of strange, alien landscapes, intensifies the feeling of venturing into the unknown—a journey not just through space but across dimensions. The sequence's prolonged duration and the slow movement of the camera further add to the sublime nature of the scene, underscoring the vastness and the incomprehensible scale of the universe. Through these elements, Kubrick not only pushes the boundaries of cinematic technique but also encapsulates the philosophical essence of the sublime, confronting the audience with the boundless mysteries of existence beyond the familiar confines of Earth.

The lighthouse scene towards the end of *Annihilation* exemplifies the sublime by visually and thematically confronting the characters—and the audience—with the inexplicable and overwhelming forces of nature transformed by the Shimmer. This sequence uses striking cinematographic techniques, combining unsettling, surreal visuals with a haunting sound design to evoke a profound sense of otherworldly beauty and horror. As Lena approaches and eventually enters the lighthouse, which stands as a mysterious and almost mythical structure amidst the mutated landscape, the use of sharp contrasts in lighting highlights the alien nature of the environment. Inside, the mirrored entity Lena encounters presents a disorienting dance of identity and self-reflection, enhanced by the eerie, droning soundtrack that crescendos into a chaotic symphony, mirroring the psychological and existential turmoil faced by the protagonist. The visual distortion and manipulation of both the environment and the characters within this scene challenge the viewer's understanding of reality and identity, key aspects of the sublime, by presenting a scenario where the natural laws as known by humanity no longer apply. Through this, *Annihilation* not only explores the limits of human comprehension but also illustrates the terror and awe inherent in confronting the vast, unknowable forces of a universe that defies human mastery.

6.4.7 Posthumanism

Exercise 6.7 Two Paragraphs. Discuss the portrayal of "Posthuman" themes in either *Solaris* or *WALL-E*. In the first paragraph, describe how the film represents posthuman elements through its characters or setting. In the second paragraph, analyze the implications of these representations for our understanding of human identity and technological interaction. Use specific examples from the film to highlight how narrative and visual strategies contribute to the development of these themes.

In *Solaris*, posthuman themes are explored through the interactions between the human characters and the mysterious, seemingly sentient ocean of the planet Solaris. This ocean has the ability to materialize human thoughts and memories into physical, responsive beings called "visitors." For example, the protagonist, Kris Kelvin, faces a physical reincarnation of his late wife,

Hari, who is both a product of his memories and an independent entity with her own emotions and consciousness. The setting aboard the space station, surrounded by the vast, uncomprehending ocean, serves as a metaphor for the exploration of the human psyche and the limits of human understanding, emphasizing the interplay between human cognition and a potentially posthuman consciousness.

The implications of these encounters in **Solaris** challenge our conventional views on identity and human interaction. Hari's presence questions the boundaries of individuality and autonomy, as she exists both as a part of Kelvin's memories and as an autonomous being. This duality forces a reevaluation of what it means to be human when human consciousness can be externalized and given independent form. The film uses subtle visual cues, such as the ethereal lighting around Hari and the often claustrophobic settings of the space station, to enhance the sense of alienation and existential questioning. These elements underscore the profound implications of technological advancements that can replicate or manipulate human consciousness, suggesting a future where the definition of being human might be irreversibly transformed.

In **WALL-E**, posthuman themes are predominantly conveyed through the character of WALL-E himself, a waste-collecting robot who exhibits distinctly human characteristics, such as curiosity, affection, and loneliness. The setting—a deserted, garbage-laden Earth—contrasts sharply with the sleek technology of the Axiom spaceship, where humans have evolved into passive consumers who are disconnected from their physical environments. WALL-E's interactions with various objects and his deep attachment to a recording of "Hello, Dolly!" signify his transcendence beyond his initial programming, pointing to a posthuman blend of technology and human emotion.

The depiction of humans in **WALL-E** further explores posthuman themes, particularly through their dependency on technology that has rendered them almost immobile and largely incapable of independent living. This dependency raises critical questions about the evolution of humans in symbiosis with technology, suggesting a future where technology takes on nurturing and sustaining roles traditionally associated with humanity. Visually, the film juxtaposes the vibrant, life-like robots against the more static and lethargic humans, reversing expected roles and highlighting the irony of technological caretaking. This role reversal not only challenges our understanding of human agency and autonomy but also provocatively suggests that the essence of humanity might eventually be preserved and manifested through non-human entities.

6.4.8 Environmental catastrophe

Exercise 6.8 Two Paragraphs. Consider the theme of "Environmental Catastrophe" as depicted in **WALL-E**. In the first paragraph, describe how the film visualizes the impact of human consumption and waste on the planet. In the second paragraph, analyze how WALL-E's interactions with his environment and the remnants of human technology serve as a critique of contemporary environmental issues.

WALL-E presents a stark visualization of environmental catastrophe brought on by excessive human consumption and waste. The film opens with sweeping shots of a deserted, dilapidated Earth, covered in towering skyscrapers of compacted trash and surrounded by a murky, uninviting haze. This apocalyptic landscape is depicted through the use of muted colors and a vast, empty horizon that stretches endlessly, emphasizing the bleakness and abandonment of the planet. The remnants of human civilization are littered throughout, from endless rows of derelict buildings to the ubiquitous advertisements for the Buy-N-Large corporation, underscoring the consumerist behavior that led to

the planet's downfall. These visual elements powerfully convey the long-term impacts of unchecked consumerism and environmental neglect, showcasing a planet overwhelmed by garbage, where the natural world has all but vanished beneath layers of human-made waste.

WALL-E's interactions with his environment further serve as a poignant critique of these contemporary environmental issues. Despite his programming as a waste allocation robot, WALL-E exhibits a curiosity and reverence for nature that contrasts sharply with the behaviors that led to Earth's devastation. His collection of human artifacts, ranging from a spork to a diamond ring, highlights the absurdity and arbitrariness of what humans value. Additionally, WALL-E's care for a small plant, which he protects and nourishes throughout the film, symbolizes a flicker of hope and the possibility of renewal. This plant becomes a critical element in the plot, representing the potential for Earth's recovery and the importance of preserving and valuing natural life over material possessions. Through WALL-E's gentle, almost childlike fascination with these simple joys and his role in safeguarding the last remnants of natural life, the film critiques modern society's disconnection from the environment and underscores the urgent need for a greater awareness and appreciation of our planet's health.

6.4.9 Simulacrum

Exercise 6.9 One Paragraph. Using examples from either *Blade Runner* or *Solaris*, discuss how the concept of "Simulacrum" is explored within the film. Analyze how the film uses narrative elements, visual techniques, and character development to convey the implications of living in a world where the distinction between reality and simulation becomes increasingly blurred. Consider how these elements contribute to the film's overall message about the nature of reality and human perception.

Blade Runner masterfully explores the concept of simulacrum through its narrative focus on replicants—bioengineered beings that are virtually indistinguishable from humans. The film utilizes advanced visual effects and meticulous production design to create a future Los Angeles that itself feels like a simulacrum, blending elements of different cultural and architectural styles to form a hyperreal urban environment. This setting reflects the blurred lines between reality and artificiality, mirroring the existential dilemmas faced by the replicants. Characters such as Rachael and Roy Batty challenge the protagonists' and audience's perceptions of what is real by exhibiting emotions and memories, questioning the nature of authenticity. Rachael's discovery that her memories are implants—manufactured experiences designed to provide an emotional cushion—highlights the theme of simulacrum, emphasizing the constructed nature of identity in this dystopian world. Through these elements, *Blade Runner* portrays a deeply layered vision of reality, where the ability to replicate human life both technologically and emotionally calls into question the very essence of human experience and authenticity.

In **Solaris**, the concept of simulacrum is central to the film's exploration of memory and identity. The sentient ocean of the planet Solaris has the mysterious ability to materialize physical manifestations of human subconscious desires and memories, creating human-like figures that are not mere illusions but are fully interactive and seemingly autonomous entities. The protagonist, Kris Kelvin, confronts a simulacrum of his late wife, Hari, who embodies both the physical appearance and the emotional depth of the real person he once loved. The film uses subdued color palettes and reflective surfaces throughout the space station to enhance the ethereal and dream-like quality of these encounters, emphasizing the thin veil between reality and the artificial. These manifestations challenge the characters' understanding of reality, as they are forced to interact with beings who

are both there and not there—visually and tactilely present but fundamentally unreal. Through this narrative and visual strategy, *Solaris* delves into the psychological and emotional impact of living in a world where the lines between reality and simulation are not just blurred but intertwined, raising profound questions about the nature of human connection and the reliability of perception.

6.4.10 Control vs. Disciplinary society

Exercise 6.10 One Paragraph. Analyze the portrayal of "Control Society and Disciplinary Society" in *THX 1138*. Discuss how the film uses narrative techniques, visual styles, and the depiction of space and surveillance to convey the dynamics of control and discipline in a futuristic society. Examine how these elements reflect or critique contemporary social and political structures, and consider the implications for individual autonomy and freedom.

THX 1138 provides a stark portrayal of a control society and a disciplinary society through its depiction of a dystopian future where human emotions and behaviors are strictly regulated by a totalitarian regime. The film employs a minimalist aesthetic characterized by stark, white, and sterile environments that visually represent the suppression of individuality and emotion. This visual style is complemented by the omnipresent use of surveillance cameras and monitors, which constantly display the activities of the citizens, reinforcing the theme of surveillance and control. The narrative emphasizes the dehumanization of individuals through the mandatory use of drugs to suppress emotions and maintain compliance, highlighting the mechanisms of control that strip individuals of their autonomy. The architectural design of the spaces in *THX 1138*—vast, impersonal, and overwhelmingly white—serves to emphasize the isolation and alienation of the individuals within the society. These spaces are devoid of personal touches and are often framed to include surveillance devices, underscoring the constant monitoring and the panoptic nature of control in the society. The film's portrayal of characters who attempt to resist or escape from this controlled environment underscores the struggle for personal freedom and autonomy. The oppressive control mechanisms visually and narratively critique contemporary social and political structures, suggesting a cautionary tale about the potential future of our own society if surveillance and control continue to expand. The film ultimately raises critical questions about the balance between security and freedom, and the cost of maintaining order at the expense of individual liberty.

6.4.11 Images of wonder, conventions of scifi

Exercise 6.11 Three Paragraphs. Discuss the portrayal of "Images of Wonder" and the "Grotesque" in science fiction films, comparing and contrasting their use and implications in any two films from the syllabus.

In the first paragraph, analyze how one film uses "Images of Wonder" to enhance its thematic and visual narrative.

In the second paragraph, explore how another film employs elements of the "Grotesque" to convey its themes and impact the audience.

In the third optional paragraph, offer a comparative analysis of how these aesthetic choices influence the viewer's perception and understanding of the film's central messages.

In **2001: A Space Odyssey**, Stanley Kubrick masterfully employs "Images of Wonder" to delve into themes of human evolution, technology, and the unknown. The film's depiction of space travel and the monolithic structures discovered by humanity evoke a profound sense of wonder and awe.

Notably, the sequence featuring the discovery of the monolith on the moon and the subsequent journey to Jupiter incorporates grandiose visual effects and meticulous compositions that emphasize the vastness and majesty of space. These visuals are complemented by the iconic score, which adds a layer of profundity and transcendence. The "Star Gate" sequence, with its surreal, colorful displays of cosmic phenomena, particularly stands out as an embodiment of wonder, pushing the boundaries of human perception and understanding. This scene challenges the viewer to contemplate humanity's place in the universe, encouraging a reevaluation of our technological achievements and philosophical explorations.

Conversely, David Cronenberg's **The Fly** explores the "Grotesque" through the physical and psychological transformation of its protagonist, Seth Brundle, after an experiment with teleportation goes disastrously wrong. Cronenberg uses unsettling visual effects to depict Seth's gradual metamorphosis into a hybrid creature, which is both horrifying and pitiful. The transformation scenes are graphic and detailed, emphasizing the corruption and breakdown of Seth's human form. These grotesque elements not only serve to horrify the viewer but also to symbolize the dangers of unchecked scientific ambition and the fragility of the human body. The climax, where Seth fully transforms into the grotesque "Brundlefly," powerfully conveys the themes of loss, mutation, and the intersection of technology with organic life, leaving a lasting impact on the viewer's perception of the potential consequences of scientific hubris.

Comparatively, while both films utilize their chosen aesthetics to enhance their narrative and impact, they do so with markedly different intentions and effects. "Images of Wonder" in **2001: A Space Odyssey** elevate the viewer's experience by instilling a sense of curiosity and philosophical introspection about the broader universe, while the "Grotesque" in **The Fly** confronts viewers with the immediate, visceral realities of scientific experimentation gone awry. Together, these films illustrate how science fiction can oscillate between elevating human perspective to cosmic scales and dragging it into the disturbing depths of bodily disintegration, each compelling in its own right and leaving indelible marks on the viewer's understanding of human potential and peril.

6.4.12 Afrofuturism

Exercise 6.12 Three Paragraphs. Analyze the representation of Afrofuturism in *Neptune Frost*, examining how the film employs Afrofuturist aesthetics to critique traditional narratives around technology, identity, and globalization. In the first paragraph, discuss how the setting and visual style of the film contribute to its Afrofuturist themes, particularly through its portrayal of a futuristic yet distinctly African society. In the second paragraph, explore the characters' interactions with technology and how these interactions redefine conventional views on technology's role in societal development and cultural expression. In the third paragraph, consider the film's narrative structure and use of music, examining how these elements enhance the themes of resistance and reclamation of identity, and what this suggests about the potential of Afrofuturism to influence global discussions on race and technology.

Neptune Frost vividly embodies Afrofuturist aesthetics through its unique setting and visual style, which merge elements of traditional African culture with futuristic, technological motifs. The film's environment is a collage of electronic waste and vibrant landscapes, symbolizing both the exploitation and the resilience of African lands and peoples. This setting serves not only as a backdrop but as a character in itself, reflecting the complex interplay between indigenous cultures and global technological advances. The use of vibrant colors, handmade costumes from recycled

materials, and unconventional makeup all contribute to a visual narrative that challenges Western perceptions of African societies as either stuck in the past or catching up to a Western future. Instead, *Neptune Frost* reimagines a future where African cultural identity and technological innovation are intertwined and leading the way forward.

The characters in *Neptune Frost* interact with technology in ways that defy traditional sci-fi tropes of technology as a force of Western modernization or alienation. Instead, technology is portrayed as a tool for liberation and artistic expression. The protagonists, an intersex runaway and a coltan miner, represent the intersection of gender, labor, and technology, challenging the exploitation inherent in global supply chains that often ignore the human cost of technological advancement. Their journey towards resistance against oppressive systems is facilitated by technological knowledge and hacker skills, which they use to disrupt the status quo. This redefinition of technology's role highlights its potential as a means of empowerment and cultural preservation, rather than mere economic development or Westernization.

Narratively and musically, *Neptune Frost* disrupts conventional storytelling by integrating nonlinear plot developments and a chorus-like commentary that resonates with traditional African storytelling and musical forms. The music, blending traditional African rhythms with electronic music, acts as both a narrative device and a thematic layer, emphasizing themes of connectivity, community, and resistance. The use of music and poetic dialogue throughout the film not only advances the plot but also deepens the engagement with Afrofuturist themes, suggesting that the future of technology and innovation can be distinctly African and inherently revolutionary. The film's narrative structure and musical integration serve to challenge global narratives about race and technology, positing Afrofuturism as a radical reimagination of the future where African voices and visions lead the discourse. ■

6.4.13 Citationalism

Exercise 6.13 One Paragraph. Analyze the concept of "Citationalism" in *Blade Runner*. Discuss how the film employs elements from both film noir and science fiction genres to create a hybrid aesthetic that references and recontextualizes classic cinematic tropes. Focus on how these citational elements contribute to the film's thematic depth and narrative complexity.

Blade Runner exemplifies citationalism through its intertextual references to film noir and classic science fiction, creating a richly layered visual and thematic tapestry. The film noir influence is evident in its use of shadowy, rain-soaked urban settings, a morally ambiguous protagonist, and a pervasive sense of fatalism. These elements are seamlessly integrated with futuristic motifs such as neon-lit cityscapes and advanced technology, recontextualizing these noir components within a dystopian future. This blending serves to enhance the film's narrative complexity, as it not only pays homage to these genres but also uses them to explore deeper themes of identity, memory, and humanity. The citational nature of *Blade Runner* allows it to comment on the genre's conventions themselves, inviting viewers to question the boundaries between the human and the artificial, a central concern of both film noir's existential inquiries and science fiction's speculative gaze. ■

6.4.14 Graphic match

Exercise 6.14 One Paragraph. Analyze the significance of the graphic match, specifically the famous match cut from the bone to the spaceship in *2001: A Space Odyssey*. Discuss how this use of editing contributes to the thematic depth of the film and how it encapsulates broader themes

explored within the narrative.

The iconic match cut in **2001: A Space Odyssey**, where a bone thrown into the air by an early hominid transitions into a spaceship, is one of the most celebrated examples of graphic match in film history. This editing technique not only showcases Kubrick's mastery in visual storytelling but also encapsulates the film's exploration of human evolution and technological progression. The cut brilliantly bridges millions of years of human history, linking the primitive use of tools to the heights of technological advancement, suggesting both a continuity and a transformation in human capabilities. This single, seamless transition highlights the thematic emphasis on the evolution of intelligence and technology's role in shaping human destiny. By juxtaposing these two objects, Kubrick visually implies that humanity's inherent drive to develop tools, whether a bone or a spacecraft, is both an expression of human ingenuity and a potentially perilous power. The graphic match thus not only serves as a narrative pivot point but also invites the audience to reflect on the broader implications of technology and progress within the human experience, making it a critical moment that resonates throughout the film's exploration of space and time.

6.4.15 Discontinuous editing

Exercise 6.15 One Paragraph. Discuss the significance of "discontinuous editing" in *La Jetée*. Analyze how the film's use of still images instead of continuous motion contributes to its narrative and emotional impact, particularly in conveying themes of memory and time.

La Jetée uniquely employs discontinuous editing through its almost exclusive use of still photographs to tell a story that deeply explores memory, time, and the human condition. This method of storytelling is particularly effective in reinforcing the film's themes, as the narrative revolves around the protagonist's journey through time, anchored by his haunting memories of a pre-war event. The use of static images mimics the way memories are often recalled in fragments—clear but static snapshots of moments, rather than a fluid, moving sequence. This technique also creates a sense of dislocation and alienation, mirroring the protagonist's emotional state and the dystopian world he navigates. Furthermore, the sparse movement within the film—primarily through the panning across and zooming in on photographs—heightens the dramatic impact of each frame, focusing the viewer's attention on specific details and amplifying the overall sense of suspense and foreboding. The discontinuous nature of the editing in *La Jetée* thus not only challenges traditional cinematic forms but also enhances the narrative's exploration of temporal and psychological themes, making the film a profound meditation on the nature of time and memory.

6.4.16 Metacinematic expressions

Exercise 6.16 One Paragraph. Discuss the metacinematic expressions in *Blade Runner* and how the film uses these techniques to reflect on its own creation and the nature of cinema itself. Analyze specific scenes where the film acknowledges its status as a film or uses elements that draw attention to the filmmaking process.

Blade Runner employs metacinematic expressions to enhance its narrative and engage the audience in a reflection on the nature of reality and filmmaking. One prominent example is the use of the Voight-Kampff test, a device used within the film to distinguish humans from replicants. This test, focusing on eye movements and emotional responses to questions, subtly mirrors the

audience's experience in the cinema, as viewers gauge the emotions and authenticity of characters on screen. Additionally, the film's frequent use of reflections and transparent surfaces serves to blur the lines between the observed and the observer, drawing attention to the act of watching and being watched, both key themes in cinema. These techniques not only deepen the narrative's exploration of authenticity and perception but also invite viewers to consider the construction of reality in film, mirroring the replicants' quest for identity with the audience's engagement with the film as a constructed reality.

6.4.17 Disasters

Exercise 6.17 One Paragraph. Discuss the significance of disaster in science fiction films, using *Godzilla* as an example. Analyze how the film utilizes the disaster motif to explore broader themes such as human vulnerability, societal response to crises, and the consequences of technological or environmental mishaps.

Godzilla epitomizes the significance of disaster in science fiction, serving as a metaphor for the destructive consequences of nuclear technology and its uncontrollable repercussions on humanity and nature. The film portrays Godzilla, a gigantic prehistoric creature awakened and mutated by nuclear testing, as a force of nature that brings about widespread destruction and chaos. This disaster motif is not merely a backdrop for action but a critical commentary on post-war Japanese society's anxieties and fears about nuclear power and its potential for catastrophic outcomes. Through scenes of Godzilla rampaging through Tokyo, the film visualizes the immense scale of destruction that nuclear technology can unleash, effectively transforming urban landscapes into scenes of apocalyptic ruin. These visual representations of disaster raise questions about human responsibility and the ethical implications of scientific advancement, while also highlighting the resilience and solidarity of the Japanese people in the face of such overwhelming adversity. The use of disaster in *Godzilla* thus reflects broader societal concerns and serves as a cautionary tale about the dangers of tampering with nature's balance.

6.4.18 German Expressionism

Exercise 6.18 One Paragraph. Discuss how German Expressionism influences the visual style and thematic depth of *Metropolis*. Analyze how the film uses this style to enhance its narrative on social disparity and technological dystopia.

Metropolis, directed by Fritz Lang, is a seminal example of German Expressionism, a style known for its use of distorted and exaggerated visual elements to evoke emotional responses. The film employs stark, contrasting lighting and elaborate, often grotesque set designs that create a foreboding, oppressive atmosphere, mirroring the film's critique of industrialization and class struggle. These expressionist elements are most evident in scenes depicting the massive, mechanized factory settings and the catacombs where the workers live, which are designed to reflect the dehumanizing and alienating effects of the city's capitalist society. The towering skyscrapers and the iconic scene of the enormous clock to which the protagonist is chained emphasize the crushing control of technology over human life. This visual style not only heightens the dramatic tension but also visually encapsulates the film's themes of power, control, and alienation, making a poignant commentary on the socio-economic issues of the Weimar Republic and predicting the unsettling potential futures of technological societies.

6.4.19 Time machines

Exercise 6.19 One Paragraph. Analyze how the concept of time machines is utilized in *La Jetée* to explore memory and trauma. Discuss how the film's unique structure of discontinuous still images enhances the theme of time travel and its impact on the protagonist's psychological journey.

La Jetée uses the concept of a time machine not merely as a sci-fi gadget but as a profound exploration of memory and trauma. The protagonist is sent back and forth in time, attempting to reconstruct his past and alter his future. The film's narrative is uniquely told through a series of still black-and-white photographs, which itself mirrors the fragmented and discontinuous nature of memory. This technique emphasizes the disjointed experience of time travel, where each image represents a moment captured and isolated from time, much like memories themselves. The sparse, carefully chosen visuals combined with the haunting voice-over narration create a sense of displacement and disorientation, enhancing the emotional impact of the time travel on the protagonist's life. The use of still images to depict the story of time travel in *La Jetée* underlines the surreal and often disturbing nature of delving into and manipulating one's memories, highlighting the overarching theme of the human psyche grappling with its past and its fate. ■

6.4.20 Fascist Automation

Exercise 6.20 One Paragraph. Discuss how the theme of the "Fascist Automaton" is portrayed in *Metropolis*, specifically focusing on how the robot Maria serves as a symbol of technological control and manipulation.

Metropolis features the robot Maria as the quintessential "Fascist Automaton," representing a tool of authoritarian control and social manipulation. Created by the scientist Rotwang and used by the master of Metropolis, Joh Fredersen, the robot Maria is designed to mimic the human Maria, a figure of hope and rebellion among the workers. The robot's purpose is to discredit the real Maria and to incite chaos among the working class, thereby justifying harsher crackdowns on dissent. Visually, the transformation of Maria into her mechanical double is depicted through a surreal and visually striking sequence that highlights the fusion of technology and deceit. This automaton, with its perfect, unyielding features and its ability to manipulate masses, symbolizes the potential for technology under fascist control to enforce conformity and suppress individuality, serving as a stark warning of the dangers of allowing technology to be wielded as a tool of political power. ■

6.4.21 Hyperreality

Exercise 6.21 One Paragraph. Discuss the concept of "Hyperreality" in *Blade Runner*, analyzing how the film employs visual and narrative techniques to create a world where the real and the artificial are indistinguishable. Focus on how the setting, special effects, and character interactions contribute to this theme, reflecting on the implications for the viewer's perception of reality.

Blade Runner masterfully explores the concept of hyperreality, presenting a future where the line between the real and the artificial becomes increasingly blurred. The film achieves this through its dense, neon-lit urban landscape, filled with towering skyscrapers and perpetual rain, which creates a visually immersive world that feels both familiar and unsettlingly alien. The special effects, particularly the realistic portrayal of the replicants, who are virtually indistinguishable from humans, further enhance the sense of hyperreality. Characters like Rachael challenge the protagonist's and the audience's perceptions of what is real, as she herself is unaware of her synthetic nature until well into the narrative. This ambiguity is echoed in the film's use of reflective surfaces and shadows,

which distort and obscure reality, making it difficult for characters and viewers alike to discern truth from simulation. By intertwining human and replicant interactions within this meticulously crafted environment, *Blade Runner* not only questions the essence of human identity but also reflects on the impact of living in a world where reality is a construct, potentially altering our understanding and interaction with our own world.

6.4.22 Andrei Tarkovsky

Exercise 6.22 One Paragraph. Discuss Andrei Tarkovsky's ideas about science fiction and how they manifest in his film *Solaris*. Analyze how Tarkovsky uses the science fiction genre to explore themes beyond technological speculation, focusing on the human condition and philosophical questions. Use specific examples from the film to illustrate how these themes are integrated into the narrative and visual style.

Andrei Tarkovsky's *Solaris* serves as a profound meditation on the human condition, reflecting his unique perspective on science fiction. Unlike typical genre films that emphasize futuristic technology and external conflict, Tarkovsky uses the science fiction setting of *Solaris* to delve into internal, existential dilemmas. The film centers around psychologist Kris Kelvin's emotional and psychological struggles as he interacts with a mysterious alien intelligence that materializes human thoughts and memories. Tarkovsky employs a slow, contemplative pacing and a focus on long, introspective takes that emphasize the emotional states of his characters, rather than the mechanics of the space station or the scientific specifics of the alien world. This approach highlights his belief that science fiction should not just speculate about technology, but also explore deeper philosophical questions about humanity's place in the universe, memory, and identity. The hauntingly beautiful and often disorienting imagery of the oceanic planet Solaris serves as a visual metaphor for the characters' subconscious, further aligning the film with Tarkovsky's idea that science fiction is a tool to explore the metaphysical realms of human experience.

6.4.23 Solaris vs. 2001

Exercise 6.23 One Paragraph. Discuss the significance of *2001: A Space Odyssey* to *Solaris*, focusing on how each film approaches themes of human consciousness and alien intelligence. Analyze how the two films use cinematic techniques to explore these themes, particularly in how they present human interactions with incomprehensible alien entities.

Both *2001: A Space Odyssey* and *Solaris* delve deeply into the complexities of human consciousness in the face of alien intelligence, using a variety of cinematic techniques to explore these profound themes. In *2001*, the interaction with the monolith, an inscrutable alien artifact, catalyzes humanity's leap in evolution and prompts deep philosophical questions about the nature of intelligence and progress. The film employs a minimalist aesthetic with long, contemplative shots that emphasize the isolation and smallness of humanity in the vastness of space, underscoring the themes of existential uncertainty and the search for meaning beyond earthly existence. In contrast, *Solaris* uses the oceanic alien intelligence to create physical manifestations of human memories and emotions, thus externalizing internal human conflicts and desires. This leads to a more introspective exploration of the characters' psyches, facilitated by a slow-paced narrative and close-up shots that capture the emotional turmoil of the protagonists. The significant connection between the two films lies in their portrayal of human encounters with alien forces as a mirror reflecting our own fears, desires, and existential dilemmas, highlighting cinema's ability to explore the outer limits of human

experience and understanding.

6.4.24 Primal scene

Exercise 6.24 One Paragraph. Analyze the significance of the "primal scene" and the "final scene" in *Blade Runner*, discussing how these scenes bookend the film and reflect on its central themes. Focus on how the narrative constructs these scenes to enhance the viewer's understanding of the film's exploration of identity and existential queries.

In *Blade Runner*, the "primal scene" can be identified as the moment when Rick Deckard first tests Rachael to determine if she is a replicant, which sets the stage for the film's exploration of identity, consciousness, and authenticity. This scene is critical as it introduces the central conflict of the narrative: the tension between human and replicant, real and artificial. Rachael's slow realization of her own nature and Deckard's subsequent questioning of his own humanity are sparked in this moment, making it a foundational scene for the unfolding drama. The "final scene," where Deckard flees with Rachael, opting to love her regardless of her replicant nature, serves as a thematic culmination of the film's query into what it means to be human. The ambiguity of whether Deckard himself is a replicant adds layers to this final scene, emphasizing the film's message that identity and humanity cannot be neatly categorized. Together, these scenes encapsulate the film's philosophical questions, framing the narrative within the context of existential uncertainty and challenging the audience's perceptions of reality and self.

6.4.25 Social functions of genre

Exercise 6.25 One Paragraph. Discuss the social functions of the science fiction genre as depicted in *Blade Runner*. Analyze how the film uses its dystopian future setting to comment on contemporary social issues, specifically focusing on themes of urban decay, corporate power, and environmental degradation. Consider how these themes serve as a critique of early 1980s societal trends and what this suggests about the role of science fiction in offering warnings or insights about the future.

Blade Runner exemplifies the social functions of the science fiction genre by using its dystopian future setting to mirror and critique contemporary societal concerns of the early 1980s, such as urban decay, corporate dominance, and environmental neglect. The film's portrayal of Los Angeles in 2019, with its towering skyscrapers shrouded in smog and perpetual rain, serves as a stark visual metaphor for the unchecked urban expansion and environmental degradation plaguing many modern cities. Additionally, the omnipresent influence of powerful corporations in the film reflects growing anxieties about the rise of corporate power and its impact on individual autonomy. By presenting a future where humans are secondary to corporate interests and environmental health has deteriorated, *Blade Runner* uses the conventions of the science fiction genre to offer a cautionary tale about the potential consequences of current social trends, thereby fulfilling one of the genre's key functions: to serve as a reflective lens through which we can examine the trajectory of our societal choices and their possible futures.

6.4.26 Film as 24 fps, conventions

Exercise 6.26 One Paragraph. Analyze how *La Jetée* uses its unique structure of discontinuous still images to challenge traditional film conventions, specifically focusing on the concept of film as

24 frames per second. Discuss how this choice impacts the storytelling, viewer engagement, and the thematic depth of the film.

La Jetée uniquely subverts the traditional cinematic format by predominantly using a series of still images instead of the conventional 24 frames per second film strip. This method challenges the viewer's expectation of motion in film, creating a reflective, almost meditative narrative pace that aligns closely with the film's themes of memory and time. Each still frame is like a memory captured in time, emphasizing the protagonist's journey through his past and the fragmented nature of human recollection. This discontinuous presentation forces viewers to fill in the gaps between frames, engaging them in the story construction process more actively than traditional film might. The sparse movement, highlighted in the brief motion sequence, punctuates the narrative dramatically, making it a pivotal moment of emotional and psychological impact. By eschewing continuous motion, *La Jetée* not only deepens the thematic exploration of time and memory but also redefines the viewer's role in interpreting and internalizing the cinematic experience. ■

6.4.27 Sound montage

Exercise 6.27 One Paragraph. Discuss the use of "Sound Montage" in *THX 1138*, focusing on how the film employs sound to enhance its dystopian atmosphere and themes of control and surveillance. Analyze specific examples where the sound design contributes to the narrative and thematic depth of the film.

In **THX 1138**, the use of sound montage plays a critical role in creating the film's oppressive dystopian atmosphere. Director George Lucas strategically layers disparate sound elements to evoke a sense of disorientation and unease. For example, the constant, overlapping announcements and commands emitted through the ubiquitous public address system not only fill the soundscape with a cacophony of voices but also serve as a constant reminder of the totalitarian control exerted over individuals in this society. These sound bites, ranging from mundane instructions to more sinister messages about obedience and surveillance, are juxtaposed with the stark silence that often surrounds the protagonist, THX, in his more private moments. This contrast effectively highlights the intrusion of the state into personal space and the pervasive nature of surveillance. Furthermore, the mechanical noises and electronic beeps that permeate scenes in the workplace or during THX's escape underscore the dehumanization and regimentation of life in this future world, enhancing the film's commentary on the dangers of unchecked technological and governmental control. ■

6.4.28 Body Horror

Exercise 6.28 One Paragraph. Discuss the theme of "Body Horror" in *The Fly* by focusing on how the film uses makeup, special effects, and narrative techniques to explore themes of physical transformation and the horror associated with losing control over one's body. Analyze how these elements not only horrify the viewer but also provoke deeper reflections on the nature of humanity and personal identity.

The Fly is a seminal work in the body horror genre, effectively using gruesome makeup and special effects to explore the horrific consequences of a scientific experiment gone wrong. The protagonist, Seth Brundle's gradual transformation into a fly is depicted with excruciating detail, highlighting the loss of his humanity both physically and psychologically. The film uses progressive stages of makeup to depict Seth's transformation, each stage more grotesque than the

last, culminating in a complete loss of his human form. This visual portrayal is complemented by narrative techniques that focus on Seth's initial fascination and subsequent horror at his changing body, which mirrors the audience's reaction. Through close-ups and the raw, visceral quality of the makeup and effects, the film intensifies the personal tragedy of Seth's transformation, emphasizing themes of alienation and the loss of self. This use of body horror not only serves to shock and repel but also engages viewers in a deeper contemplation of the fragility of human life and the ethical limits of scientific exploration.

6.4.29 Characteristics of genre

Exercise 6.29 One Paragraph. Analyze how *Neptune Frost* exemplifies or challenges the characteristics of the science fiction genre. Discuss specific elements within the film that align with or subvert traditional sci-fi conventions, particularly in terms of its narrative structure, thematic concerns, and visual style.

Neptune Frost challenges and expands the traditional characteristics of the science fiction genre through its unique narrative structure, thematic depth, and visual style. Typically, science fiction explores futuristic themes through advanced technology and often dystopian visions; however, *Neptune Frost* integrates these elements with a strong emphasis on African cultural aesthetics and political issues. The film's narrative diverges from conventional sci-fi by focusing on themes of exploitation, colonialism, and global inequality—issues deeply rooted in the historical and contemporary realities of many African countries. Visually, the film eschews the sleek, polished look of mainstream sci-fi for a more eclectic and handmade aesthetic, utilizing costumes and sets made from upcycled electronic waste. This not only provides a visual critique of electronic consumerism but also redefines what futuristic technology looks like. Thus, *Neptune Frost* subverts standard sci-fi tropes by presenting a future that is distinctly African, deeply intertextual, and resonant with current socio-economic challenges, suggesting a new direction for the genre that is inclusive of diverse narratives and aesthetics.

6.4.30 Intersex

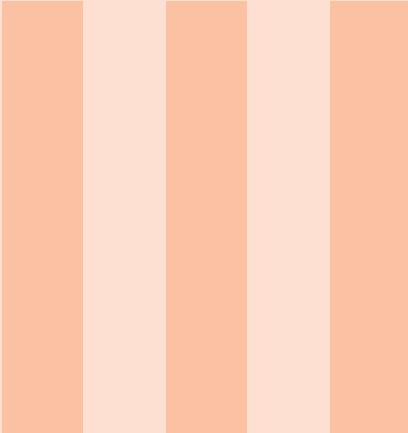
Exercise 6.30 One Paragraph. Discuss how the representation of intersex characters in *Neptune Frost* contributes to the film's narrative and themes. Analyze how the portrayal challenges traditional gender norms and expectations within cinematic storytelling.

In *Neptune Frost*, the intersex protagonist significantly enhances the film's narrative and thematic layers, challenging traditional gender norms and cinematic conventions. The film presents its intersex character not as a marginal or exotic figure but as a central, complex individual whose experiences and identity drive the plot forward. This portrayal disrupts typical gender binaries seen in most mainstream cinema, highlighting issues of gender fluidity and the social constructions of gender roles. Through this character, the film explores themes of identity, belonging, and resistance against oppressive societal structures. The intersex protagonist's journey towards self-discovery and rebellion against a tyrannical regime metaphorically parallels the struggles faced by those who transcend conventional gender identities, thereby broadening the discourse around gender and identity in science fiction and contributing to a more inclusive representation of diverse human experiences.

6.4.31 Film animation

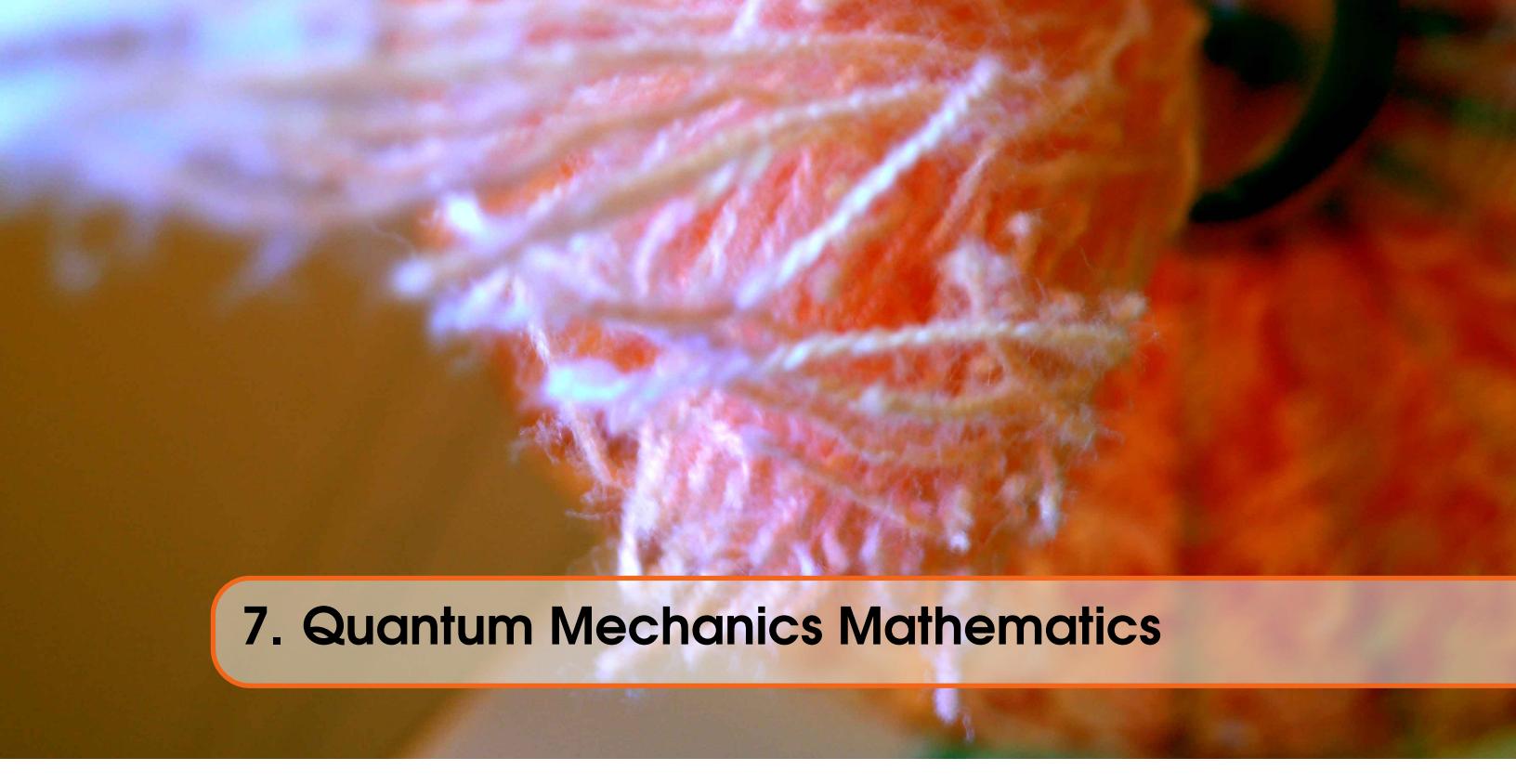
Exercise 6.31 One Paragraph. Analyze how the use of animation and automation in *WALL-E* reflects broader themes about humanity, technology, and environmental stewardship. Consider how these elements contribute to the storytelling and overall message of the film.

In *WALL-E*, the use of animation and automation serves as a pivotal storytelling mechanism that underscores themes of humanity, technology, and environmental responsibility. The film employs advanced CGI to animate not only characters like WALL-E—a robot with human-like qualities—but also the desolate Earth and the futuristic spaceships. This animation allows for a vivid portrayal of a planet overrun by waste, directly reflecting the consequences of human consumerism and neglect. WALL-E's automated functions, designed for compacting trash but adapted through his curiosity and empathy, symbolize hope and the potential for redemption. By juxtaposing scenes of a highly automated, consumer-driven spaceship community with the solitary, waste-collecting robot on Earth, the film critiques modern society's dependence on technology and automation, emphasizing a need to reconnect with more sustainable, environmentally aware practices. Thus, the animation and automation in *WALL-E* highlight the ironies and challenges of our technological advancements, suggesting that humanity's survival depends not on further automation but on ecological and personal mindfulness. ■



PHY294

7	Quantum Mechanics Mathematics . . .	157
7.1	Introduction	
7.2	The Schrodinger Equation	
7.3	The Rectangular Box	
7.4	The Central Force Problem	
8	Quantum Mechanics Theory	163
9	Statistical Mechanics	171



7. Quantum Mechanics Mathematics

7.1 Introduction

The Difference Between Waves and Kinematic Collisions of Particles

Waves

Any continuous force (stress/strain) relationships leads to waves with interference effects as force cancellations leads to modulated amplitudes: correlated motions

Particles

No acting force after collision and momentum transfer: uncorrelated

Key Experiments

Blackbody Radiation

- Classical Mechanics: More energy should be emitted the blue than red region with no limit in intensity
- Modern Physics: Vibrating atoms emit radiation but only certain frequencies are allowed (quantized)

Proposition 7.1.1

$$\langle E_{\text{osc}} \rangle = \frac{h\nu}{\exp(\frac{h\nu}{kT}) - 1} \implies E = h\nu$$

Photoelectric Effect

- Light (contains photons each with energy $h\nu$) strikes a metal surface
- Electrons in the metal absorb a photon of light and gains sufficient energy to escape
- Electron is ejected from the surface and has a certain kinetic energy

Proposition 7.1.2

$$E_{\text{photon}} = h\nu_0 + \frac{1}{2}mv^2$$

Emission Spectrum of Hydrogen

- When the emitted light from the excited atoms is passed through a prism, discrete bands of colours at specific wavelengths can be detected. The emission spectrum can be used to determine the energy levels for the hydrogen atom.
- Balmer and Rydberg discovered a pattern in atomic line spectra for hydrogen which fits the generalized equation:

Proposition 7.1.3

$$E_n = -2.178 \cdot 10^{-18} \frac{Z^2}{n^2}$$

$$\frac{1}{\lambda} = R \left(\frac{1}{m^2} - \frac{1}{n^2} \right), \text{ where } R = 1.097 \cdot 10^{-2}, m \text{ is inner-shell, } n \text{ is outer-shell}$$

Bohn then sets the simple condition of quantized angular momentum:

$$I = m_e v r = \frac{nh}{2\pi}, \text{ where } n \in \mathbb{Z}$$

which correspond precisely to the proposition. He also proposed that electrons are most likely to be found at

Proposition 7.1.4

$$r = n^2 a_B$$

where a_B is the Bohr radius. This reminds us of standing waves and hence de Broglie proposed the matter-wave relationship:

Theorem 7.1.5 — de Broglie Relationship.

$$\lambda = \frac{h}{mv}$$

7.2 The Schrodinger Equation

We wish to expand upon the already known one-dimensional schrodinger equation by parameterizing ψ as $\psi(\mathbf{r}) = \psi(x, y, z)$ and similarly for $U(\mathbf{r})$:

Theorem 7.2.1 — One-dimensional Schrodinger Equation.

$$\frac{d^2\psi}{dx^2} = \frac{2M}{\hbar^2} (U - E) \psi$$

In three dimensions, the equation generalizes to:

Theorem 7.2.2 — Three-dimensional Schrodinger Equation.

$$-\frac{\hbar^2}{2m} \nabla^2 \psi + U(\mathbf{r}) \psi = E \psi$$

or

$$\nabla^2 \psi = \frac{2M}{\hbar^2} (U_E) \psi$$

Separating the wave function using time and position dependence, we simplify the above to the time-independent schrodinger equation:

Theorem 7.2.3 — Time-Independent Schrodinger Equation.

$$\nabla^2 = \frac{2M(U(\mathbf{r}) - E)}{\hbar^2} \psi$$

We will see that in the absence of forces, $U(\mathbf{r}) = 0$, the solution to the function will be:

$$\psi(\mathbf{r}) = \exp(i\mathbf{k} \cdot \mathbf{r})$$

whose vector \mathbf{k} satisfies the energy equation:

$$E = \frac{\hbar|\mathbf{k}|^2}{2M}$$

7.3 The Rectangular Box

While subjected to a potential energy function of a 2-D rectangular square well, the wave function must satisfy:

$$\frac{\partial^2 \psi(x,y)}{\partial x^2} + \frac{\partial^2 \psi(x,y)}{\partial y^2} = -\frac{2ME}{\hbar} \psi(x,y)$$

and this is because the U term is zero and we have:

Proposition 7.3.1

$$U(x,y) = \begin{cases} 0, & 0 \leq x \leq a, 0 \leq y \leq b \\ \infty, & \text{otherwise} \end{cases}$$

To solve the rectangular box problem, we will use the method of **seperation of variables**, that is:

$$\psi(x,y) = \mathcal{X}(x)\mathcal{Y}(y)$$

and we can solve the equation as:

$$\begin{aligned} \frac{\partial^2 \psi(x,y)}{\partial x^2} + \frac{\partial^2 \psi(x,y)}{\partial y^2} &= -\frac{2ME}{\hbar} \psi(x,y) \\ \frac{\partial^2 (\mathcal{X}(x)\mathcal{Y}(y))}{\partial x^2} + \frac{\partial^2 (\mathcal{X}(x)\mathcal{Y}(y))}{\partial y^2} &= -\frac{2ME}{\hbar} (\mathcal{X}(x)\mathcal{Y}(y)) \\ \frac{1}{\mathcal{X}(x)} \frac{\partial^2 (\mathcal{X}(x))}{\partial x^2} + \frac{1}{\mathcal{Y}(y)} \frac{\partial^2 (\mathcal{Y}(y))}{\partial y^2} &= -\frac{2ME}{\hbar} \\ \frac{1}{\mathcal{X}(x)} \frac{\partial^2 (\mathcal{X}(x))}{\partial x^2} &= -\left(\frac{2ME}{\hbar} + \frac{1}{\mathcal{Y}(y)} \frac{\partial^2 (\mathcal{Y}(y))}{\partial y^2} \right) \end{aligned}$$

Since RHS has no x dependence, $\frac{1}{\mathcal{X}(x)} \frac{\partial^2 (\mathcal{X}(x))}{\partial x^2} = -k_x^2$ where k_x is arbitrary

$$\implies \frac{\partial^2 (\mathcal{X}(x))}{\partial x^2} = -k_x^2 \mathcal{X}(x)$$

This equation is similar to the 1-D rigid box example. In the 1-D case, the solution is given by

$$A \sin k_x x + B \cos k_x x$$

We know that the boundaries are $x = 0, x = a, y = -b, y = b$ and hence $\mathcal{X}(0) = 0$ and hence we can omit the cosine term in the solution. Likewise, applying the second boundary condition $\mathcal{X}(a) = 0$, like in the 1-D example, we also have

$$k_x = \frac{n_x \pi}{a} x$$

We can do precisely the same in the y -dependent domain, and hence we know the solution to the equation has to be:

Proposition 7.3.2

$$\psi(x, y) = C \sin \frac{n_x \pi}{a} x \sin \frac{n_y \pi}{b} y$$

where $C = AB$.

Nevertheless, since

$$\frac{1}{\mathcal{X}(x)} \frac{\partial^2 (\mathcal{X}(x))}{\partial x^2} = -k_x^2, \quad \frac{1}{\mathcal{Y}(y)} \frac{\partial^2 (\mathcal{Y}(y))}{\partial y^2} = -k_y^2$$

we will see that

$$k_x^2 + k_y^2 = \frac{2ME}{\hbar^2}$$

For which once we solve it, we will arrive at the allowed energies for a particle in a 2-D rectangular box:

$$E = \frac{\hbar^2 \pi^2}{2M} \left(\frac{n_x^2}{a^2} + \frac{n_y^2}{b^2} \right)$$

Note that the same can generalize into three dimensions, where we have the time-independent Schrödinger equation:

$$\frac{\partial^2 \psi(x, y, z)}{\partial x^2} + \frac{\partial^2 \psi(x, y, z)}{\partial y^2} + \frac{\partial^2 \psi(x, y, z)}{\partial z^2} = -\frac{2ME}{\hbar^2} \psi(x, y, z)$$

and we set $\psi(x, y, z) = \mathcal{X}(x)\mathcal{Y}(y)\mathcal{Z}(z)$ to get:

$$E = \frac{\hbar^2 \pi^2}{2M} \left(\frac{n_x^2}{a^2} + \frac{n_y^2}{b^2} + \frac{n_z^2}{c^2} \right)$$

7.3.1 Degeneracy

We see that there may be multiple ways of choosing n_x and n_y to get the identical energy value.

Definition 7.3.1 — Degeneracy. Degeneracy refers to a situation where two or more distinct quantum states correspond to the same energy level in a system.

For instance, for a rectangular box with widths a and $\frac{a}{2}$:

7.4 The Central Force Problem

State	n_x	n_y	E	Degeneracy
Ground	1	1	$5E_0$	1
First excited	2	1	$8E_0$	1
Second excited	3	1	$13E_0$	1
Third excited	1	2	$17E_0$	1
Fourth excited	2,4	2,1	$20E_0$	2
Fifth excited	3	2	$25E_0$	1

Theorem 7.4.1 — The Time-Independent Schrodinger Equation in Spherical Coordinates.

$$\frac{1}{r^2} \frac{d}{dr} \left(r^2 \frac{d\psi}{dr} \right) + \frac{1}{r^2 \sin \theta} \frac{d}{d\theta} \left(\sin \theta \frac{d\psi}{d\theta} \right) + \frac{1}{r^2 \sin^2 \theta} \frac{d^2\psi}{d\phi^2} = \frac{2M}{\hbar^2} (U - E) \psi$$

Using separation of variables, we can separate this into three different second order equations. We start with:

$$\begin{aligned} \frac{r \sin^2 \theta}{\mathcal{R}} \frac{\partial^2}{\partial r^2} (r \mathcal{R}) + \frac{\sin \theta}{\Theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial \Theta}{\partial \theta} \right) + \frac{1}{\Phi} \frac{\partial^2 \Phi}{\partial \phi^2} &= \frac{2M(U - E)}{\hbar^2} (r^2 \sin^2 \theta) \\ \frac{1}{\Phi} \frac{\partial^2 \Phi}{\partial \phi^2} &= \frac{2M(U - E)}{\hbar^2} (r^2 \sin^2 \theta) - \frac{r \sin^2 \theta}{\mathcal{R}} \frac{\partial^2}{\partial r^2} (r \mathcal{R}) - \frac{\sin \theta}{\Theta} \frac{\partial}{\partial \theta} \left(\sin \theta \frac{\partial \Theta}{\partial \theta} \right) \end{aligned}$$

And we can observe that

$$\frac{\Phi''}{\Phi} = \text{function of } r \text{ and } \theta.$$

8. Quantum Mechanics Theory

This section contains minimal definition. The purpose is only to explore the intuition behind concepts and phenomena. Concepts follow a rough order, though they may not necessarily be contiguous.

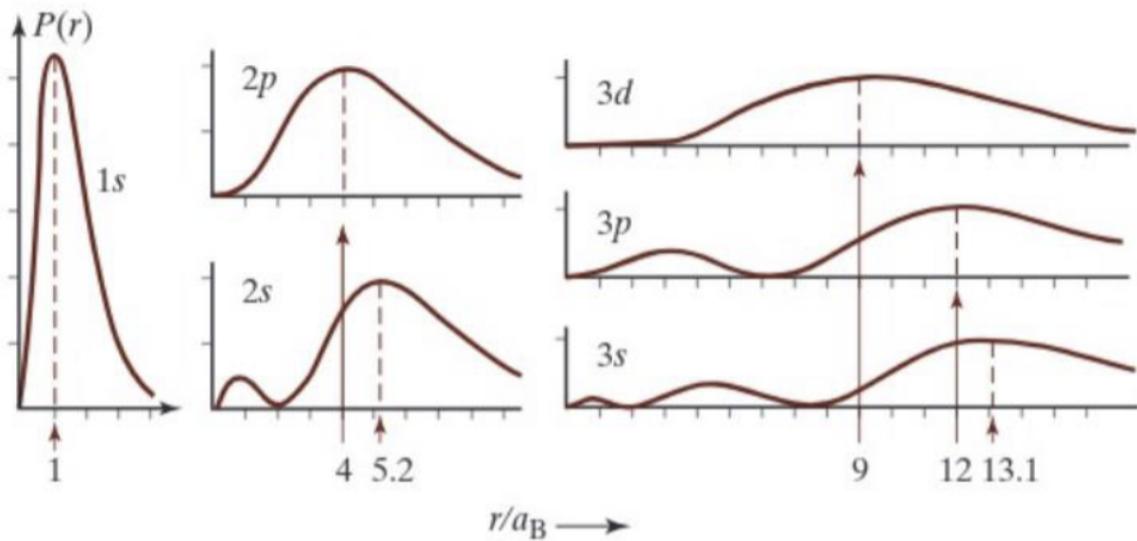


Figure 8.1: Radial probability distributions for Hydrogen

Boundary conditions for Hydrogen energy level quantization: radial probability distribution goes to 0 as $r \rightarrow \infty$

Spherical symmetry: only s orbitals are spherically symmetric

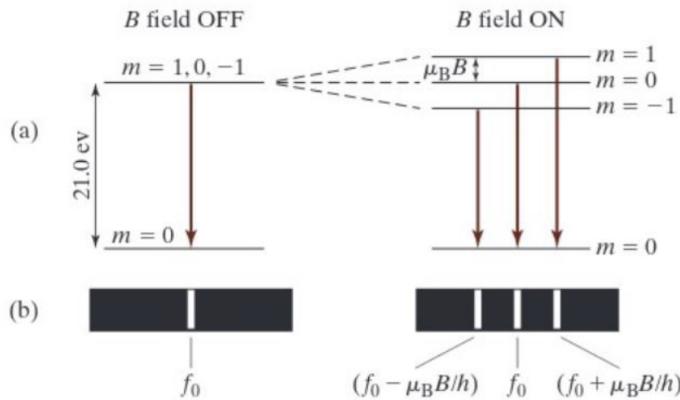


Figure 8.2: Zeeman effect emission spectra. This image is for a p orbital. Except it is missing the splitting off the spin components: there should be 5 lines (2 added for the spin), each separated by $\mu_B B$

Degeneracy of Hydrogen atom: n^2 . However, this degeneracy is broken in multielectron atoms due to the introduction of electron shielding and correlation energies

Degeneracy of orbitals: total number of electrons halved: i.e. for $2s, 2p$, degeneracy is 4

Probability: $P(r) = 4\pi r^2 |R(r)|^2$

Probability of finding electron: $\iiint 4\pi r^2 |R(r)|^2 dV$

Binding energy: same as electron dissociation energy, positive

Concept of effective nuclear charge: it is influenced by electron screening and electron correlation energies. For Hydrogen, the effective charge is 1 due to the lack thereof of screening effects. If we add another electron filling the first shell, the effective charge of all electrons is still close to 1, though a bit less due to electron correlation. However, if we add a $2p$ electron, due to the screening of the first shell, its effective charge would be quite a bit more than 1. But then again, if we give it a full second shell, i.e. full occupancy of $2s, 2p$ orbitals, while experiencing screening from the $1s$ shell, due to the full shell, the effective charges would be much closer to 1 than for an incomplete shell, though not exactly 1.

Coulombic interactions: for H_2^+ : apart from the obvious Coulomb forces present, we need to consider the respective wave functions for the electrons. We can use the LCAO-MO approach. For constructive interference, the wave functions would look something like:

$$\psi_+ = A(\psi_{1,1s} + \psi_{2,1s})$$

and for destructive interference:

$$\psi_+ = B(\psi_{1,1s} - \psi_{2,1s})$$

where ψ_1, ψ_2 are $1s$ radial function solutions to the Hydrogen atom corresponding to protons 1 and 2. In bonding (ψ_+), we see an increase in electron density near the space between the nuclei. For antibonding (ψ_-), we have close to 0 probability density between the nuclei. The graphs of the wave functions look something like: Now for the Coulombic potentials in the Schrödinger equation, we have:

$$U = \frac{-e^2 \mathbf{r}_1}{4\pi\epsilon_0} + U = \frac{-e^2 \mathbf{r}_2}{4\pi\epsilon_0} + U = \frac{e^2 \mathbf{r}_P}{4\pi\epsilon_0}$$

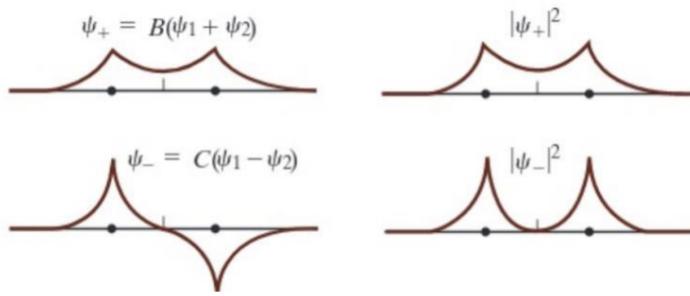


Figure 8.3

where we have one term for each e-p attraction, and one term for the p-p repulsion. As per the formation energies, the plot looks something like: The minimum, R_0 , is the bond length. It is the point of zero

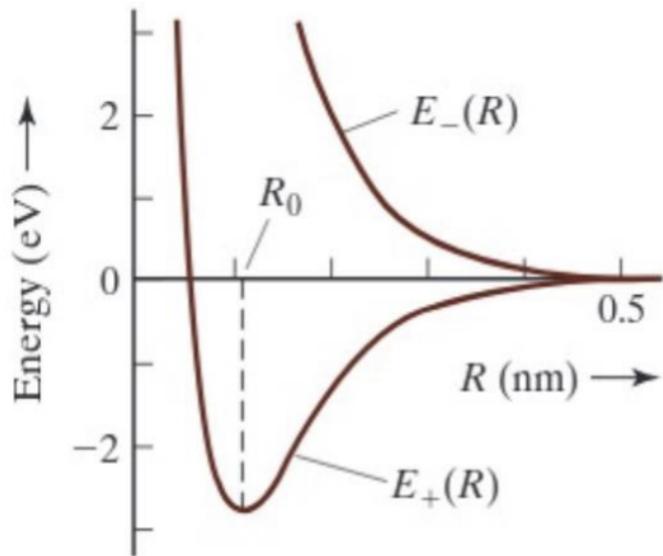


Figure 8.4

force, where the p-p repulsive force equals the e-p attractive force. The interaction leads to a stable potential minimum in proton separation. The driving force for bond formation is the build up of electron density, where a larger net attractive force, Z_{eff} . As for antibonding, the opposing trend is the destructive interference of e-p attraction leading to increased repulsive force between nuclei. Electron repulsion leads to depletion of electron density between protons: they take work to create the same electron distribution around the individual protons and as such, they have a higher energy.

Now if we add one more electron to make hydrogen gas, things get more complicated: we also need to consider the e-e repulsion. This renders the problem unsolvable, as there is no way for us to solve for the wave function using separation of variables. However, there are two methods that still hold up:

Independent particle approximation: We would use the wave function solutions that assumes

only one electron to create an assumed solution that is expected to be the dominant term. Then, we use that distribution to create a spatially varying potential. That potential would then lead to a modified wave function, which can be used to redefine the potential. We can repeat the process for each trial function, recursively subbing potentials into wave functions to calculate for energy. Eventually, the approximate solution should converge.

Variation method: Uses trial functions in which a key parameter is used as a variable parameter. For instance, for Helium, the effective nuclear charge due to electron correlation is a variable parameter. We then plug it into the Schroedinger equation and write energy as a function of the variation parameter. Then, we take the derivative and find the minimum of energy, where that solution is the best solution within the approximation yielding correlations to energies, effective nuclear charge and radial distributions.

Theorem 8.0.1 — Bond Order.

$$BO = \frac{\text{bonding} - \text{antibonding electrons}}{2 \cdot \text{number of atoms}}$$

For higher bond orders, the bond distance is smaller and the bond energy is lower, resulting in a stronger, more stable bond. Not the differences between antibonding and nonbonding orbitals. When drawing bonding and antibonding, make sure that the positive cloud lines up with negative cloud for constructive interference, and the opposite for destructive, where there is a depletion of electron density in the center.

moving across the periodic table, we have more and more added electrons and their respective protons to create larger effective nuclear charges while each added electron does not screen its complementary proton (electron correlation energies). This increase in effective charge results in tighter binding of electrons, reduced radii. To explain mathematically, the l dependence of the radial distributions for which there are larger probabilities for being closer to the nucleus will be lower in energy and higher ionization energies.

Valence electron shell pair repulsion: For water, the bond angle is less than 109.5° , and this is because the bond is compressed by the electron density created by the lone pairs, where a larger effective repulsive volume is created for electrons in these nonbonding orbitals. This non-uniform force in sp^2 hybridization results in the minimum energy.

Dipole moments: Looking at water again, due to the excess electronegativity of Oxygen, volumes near it has a net negative charge buildup, giving the Hydrogens net positive characters due to charge conservation. This creates a dipole moment.

Atoms that has abnormal electron configuration: i.e. $5s^14d^{10}$. The cost of pairing electrons to create a filled shell is less than the cost to promote to a higher valence shell. This is because the Zeeman effect, where the additional magnetic field interaction ensures the electrons do not occupy the same space at the same time, offsets the costs to pair two electrons.

Now we move the discussion onto intermolecular forces, rather than intramolecular.

H-Bond forces: the electrostatic attraction between Hydrogen and more electronegative atoms, where Hydrogen always takes on a positive character. There is some degree of electron sharing between Hydrogen and other elements in the process that goes beyond an electrostatic or dipole-dipole bond. Only O, N, F are considered H-bond formers.

Dipole-dipole forces: Coulombic attractive forces between partial charges

Van der Wall forces: arise from instantaneous fluctuations in electron density that create temporary

dipole moments. This instantaneous dipole moment then induces a dipole in a neighbouring atom, leading to electrostatic attraction. The net attractive force $\propto 1/r^6$.

Ionic bonds: when electron is completely localized on the more electronegative atom in a bonded pair of atoms, leaving a positive charge on one atom and a negative charge on another.

Now we move onto IR/vibrational spectroscopy. Electronic energy, with a particle in a box model is energy stored as potential energy in excited electronic configurations. Vibrational energy in the harmonic oscillator model is the oscillatory motion of atoms or groups of atoms with a molecule, where kinetic and potential energies are being exchanged.

There are two categories of spectroscopy:

- **Absorption**
- **Emission**
 - fluorescence
 - phosphorescence

Selection rules: Spin: $\Delta S = 0$, there must be no change in electron spin. Symmetry: the transition between two electronic or vibrational states must involve a change in symmetry. This ensures that there is a net dipole moment that allows the electric field to transfer energy. Either a bond dipole (vibrations) or transition dipole moment (electronic transitions) are involved in enabling coupling of the electric field to the atomic vibrational motions. Mathematically, the μ is an odd function and for the integral $\int \psi_n \psi_m \mu d\tau$ to be nonvanishing, the argument inside the integral must be even and hence the wave functions must be odd.

Theorem 8.0.2 — Vibrational Modes. For bent molecules:

$$V = 3N - 6$$

For linear molecules:

$$V = 3N - 5$$

Generally, there are three distinct modes of vibrations:

- asymmetric stretch
- symmetric stretch
- bend

In infrared spectroscopy we create the model as a vibrating molecule that behaves like two masses joined by a spring. To determine the IR activity of each vibrational mode, we examine whether the vibrational forces on each atom can be cancelled out or not. However, if a molecule has no net dipole moment, no modes are active. Going over the effect of increasing the mass of atoms while maintaining the charges, the absorption wavelength would be longer due to the larger mass lowering frequency. The quantum harmonics' energies and their probability distributions follow:

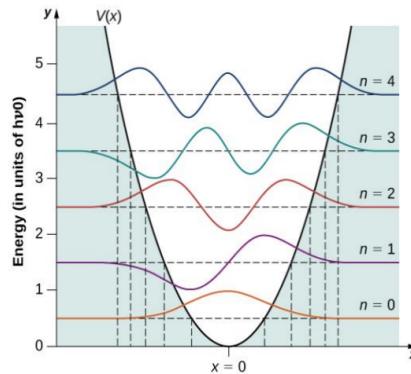


Figure 8.5: Energies.

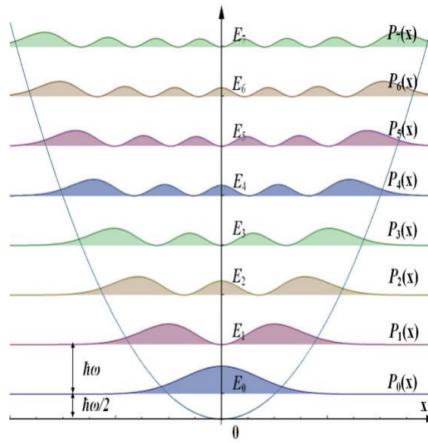


Figure 8.6: Probability distributions.

Now we translate to discussion on fluorescence and phosphorescence. In general, fluorescence has much shorter lifetimes, and fluorescence is decay from an excited singlet state (spin conserved transition) to ground singlet state, whereas phosphorescence is decay from an excited triplet state to singlet ground state. This transition is formally forbidden and only occurs weakly due to fluctuation in instantaneous electron distributions that produce fluctuating magnetic fields that can couple to the spin to from the singlet state. This is far less probable than a spin allowed transition and accounts for the much longer decay time for phosphorescence.

For more information on singlet and triplet states, a singlet state is in which pairs of electrons have opposing state, and a triplet state is in which pairs of electrons have the same spin. While transition between the two states are forbidden, singlet states can be converted to lower energy triplet states by intersystem crossing (ISC).

Moreover, the **Frank-Codon** principle states that when a molecule is undergoing electronic transitions, the nuclear configuration experiences no significant change because nuclei are much bigger than electrons and electronic transition takes place faster than the nuclei can respond. When the nucleus realigns itself with the new electronic configuration, the theory states that it must undergo a vibration.

In summary, there are three possible transitions for excited molecules:

- **Radiative:** photon is absorbed or emitted, we draw this as solid lines
- **Non-radiative:** energy is transferred between different degrees of freedom of a molecule or to the surroundings, we draw this with wavy vertical lines
- **ISC:** transitions between singlet and triplet state, we draw this with dotted lines

Absorption and emission of light:

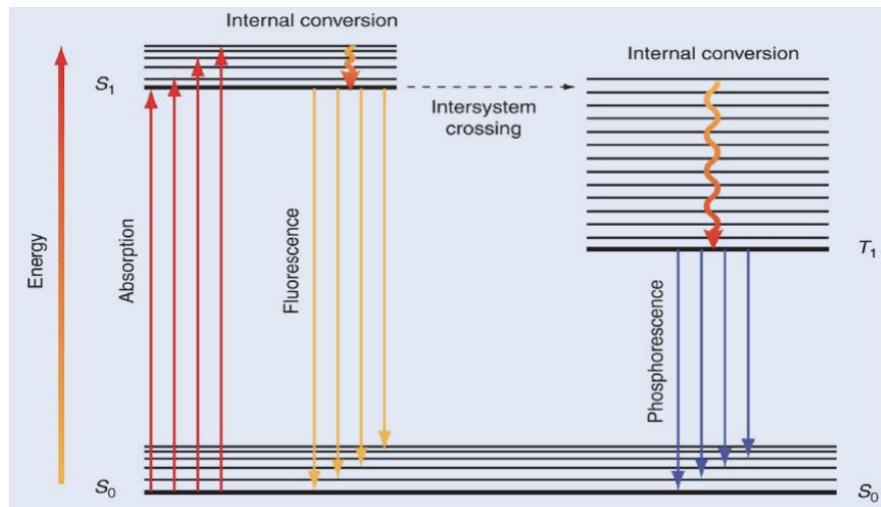


Figure 8.7: The wavy lines represent vibrational relaxation from higher to lower vibrational levels for energy conservation. For fluorescent, spin is allowed; for phosphorescent, spin is forbidden and the process is slower. **Kasha's rule:** all emission occurs from lowest $v = 0$ level of fluorescent to phosphorescent. Due to phosphorescent forbidding spin, T_1 is lower energy than S_1 . This is because Hund's rule (Electrons occupy orbitals in a way that maximizes the total spin quantum number (s) for the electrons in the subshell) only applies to degenerate electronic levels, favoring the allowance of spin in fluorescent.

This very same mechanism of vibrational relaxation is the reason why absorbance of a sample at any wavelength remains unchanged with time. Theoretically, it would seem that all molecules in a sample would have been excited and no more absorption would occur given enough time radiating. Under conditions of constant radiation, a steady state is reached and the absorbance of the sample remains unchanged in time. If the incident radiation is of sufficient intensity so that the rate of excitation is faster than relaxation processes, the sample converges onto a state where half of the molecules are excited, half not, where the rate of absorption is equal to the rate of emission.

Often, we find our probability for electronic transitions are not accurate. This is because of the Franck Condon principle that was introduced earlier. To account for nuclei overlap, we add a **Franck Condon factor**, $\int \psi_m(v)\psi_n(v')dv$ in addition to the $\int \psi_n\psi_m\mu dv$ for transition probability such that the original term determines if a transition will happen at all, and the newly added Franck Condon term will determine the level of overlap between the original state and the transitioned state, effectively dictating intensity.

When we apply absorbance principles to different molecules, we need to examine both the *pi* electron delocalization as well as the geometry. Consider a longer molecule vs a short one. In the longer

one, due to the increased length, the spacing between energy levels is less, causing the absorption wavelength to be larger.

Another example is nonpolar organic molecules. Due to the bonding orbitals being filled, the only transition gap is from the bonding to antibonding orbitals, which translates to a huge energy gap and short absorption wavelengths. Conversely, in the ion radicals, since either there is space in bonding orbitals or bonding orbitals have been overfilled into the nonbonding orbitals, the transitions are either from bonding to bonding or from nonbonding to nonbonding, hence the energy gap is lower and absorption wavelengths are larger.



9. Statistical Mechanics

I don't like this

