Student Project Works Q&A#1

Course Evaluation:

- Class participation and attendance (10%)
- Final exam (20%)
- Student project work and presentation (70%)

Project Work Overview

- **Project Work: Presentation of Historical Discoveries**

Activity: Each group selects a significant scientific discovery related to molecular and cellular physiology. The group must create a multimedia presentation that describes the historical context, the experiments conducted, the results obtained, and the significance of the discovery.

Objective: To strengthen the understanding of the historical and experimental foundations of the discipline and to improve students' presentation and scientific communication skills.

Project Work Overview

•Goals of the Project Work

The goal of the project work is for students to explore and present key historical discoveries that have shaped the field of molecular and cellular physiology. Each group will select a significant scientific breakthrough, analyze its historical context, the experimental methods used, the key findings, and its lasting impact on the field.

This project is designed to develop students' abilities in critical thinking, research, and scientific communication, while fostering a deep understanding of how foundational discoveries have influenced current knowledge. The final objective is to create a professional multimedia presentation that clearly conveys the significance of the chosen discovery and its relevance to modern scientific inquiry.

Project Work Overview

Guidelines and Deadlines #1

1. Group Formation:

Due Date: SPWQ&A#1

Students will form groups of 3-5 members.

Each group must submit their list of members and select a team leader responsible for communication with the instructor.

2. Topic Selection:

Due Date: SPWQ&A#2

Groups must choose a significant historical discovery in molecular and cellular physiology and submit their chosen topic for approval by the instructor. Ensure that no two groups are working on the same discovery.

Project Work Overview

Guidelines and Deadlines #2

3. Initial Research Outline:

Due Date: SPWQ&A#3

Groups must submit a brief outline (1-2 pages) that includes:

A summary of the chosen discovery.

The historical context and key experiments.

The scientists involved and the significance of the discovery.

Include a preliminary list of references.

4. Draft Presentation:

Due Date: SPWQ&A#4

Groups must submit a draft of their multimedia presentation (PowerPoint, video, etc.) for review. The draft should include:

An overview of the discovery.

Explanation of experimental methods and results.

Discussion of the long-term impact on molecular and cellular physiology.

Preliminary visuals and multimedia elements.

Project Work Overview

Guidelines and Deadlines #3

5. Final Presentation Submission:

Due Date: SPWQ&A#5

Groups must submit the final version of their multimedia presentation. It should include:

A clear and engaging narrative about the discovery.

High-quality visuals (images, diagrams, graphs).

A comprehensive analysis of the discovery's importance to the field.

Citations of all sources used.

Each group member must contribute equally to the final product.

In-Class Presentations:

Presentation Date: SPWQ&A#6

Each group will deliver a 15-20 minute presentation to the class, followed by a 5-minute Q&A session.

Presentations should be engaging, informative, and involve all group members.

Project Work Overview

Guidelines and Deadlines #4

7. Peer and Self-Evaluation:

Due Date: SPWQ&A#6

After the presentations, each student must complete a peer and self-evaluation form, assessing their own contribution and the contributions of their group members.

Project Work Overview

Grading Criteria:

Content (40%): Depth of understanding, historical accuracy, and clarity in presenting the discovery.

Presentation (30%): Quality of visuals, organization, and effectiveness in communication.

Research (20%): Use of credible sources and correct citations.

Teamwork (10%): Equal contribution from all group members as reflected in the peer evaluations.

Project Work Guidelines

Tips and tricks #1

1. Choose a Discovery that Inspires Your Group

•Select a topic that genuinely interests the group. When you're passionate about a subject, your research will be more thorough, and your presentation will be more engaging.

•Consider selecting discoveries that have ongoing relevance in modern research or connect to current advancements in the field.

2. Divide Tasks Early

•Break down the project into tasks early, such as research, visual creation, writing, and presentation practice. Assign roles based on each member's strengths, but ensure everyone contributes equally.

•Regularly check in with team members to ensure progress and collaboration.

Project Work Guidelines

Tips and tricks #2

3. Focus on Storytelling

- When presenting a historical discovery, think of it as telling a story. Include key moments such as the challenges scientists faced, how they solved them, and why the discovery was groundbreaking.
- Make it a narrative that flows logically from the historical context, through the experiments, to the lasting impact of the discovery.
- Use clear and concise language to convey your ideas effectively.

4. Use High-Quality Visuals

- Visuals make a huge difference! Include diagrams, graphs, and historical images related to the experiments and scientists. High-quality images can make complex concepts easier to understand and more engaging.
- Don’t overcrowd slides with text; use bullet points or short summaries, and explain details verbally.

Project Work Guidelines

Tips and tricks #3

5. Practice Your Presentation

- Rehearse your presentation several times.
- Make sure that each group member knows their part well and that the transitions between speakers are smooth.
- Time your presentation to ensure it fits within the 15-20 minute window, and prepare for the Q&A session by anticipating potential questions.

9. Context is Key

- When discussing the historical discovery, don’t just focus on the results. Provide the broader scientific and social context: Why was this discovery important at the time? How did it change the field of molecular and cellular physiology?
- Highlight how modern research builds on this historical breakthrough, linking past discoveries to current scientific understanding.

Project Work Guidelines

Tips and tricks #4

7. Pay Attention to Group Dynamics

Good teamwork is essential. Communicate openly and regularly with your group, and resolve any conflicts early on.

Make sure everyone has a voice and that all contributions are valued. This will result in a stronger, more unified presentation.

Project Work Guidelines

Possible Topics #1

Discovery of Ion Channel Structures

Description: The determination of ion channel structures using X-ray crystallography and cryo-electron microscopy (cryo-EM) has revolutionized our understanding of how channels function at the atomic level. The structure of the potassium channel (KcsA) solved by Roderick MacKinnon in 1998 was a landmark in understanding ion selectivity and gating mechanisms. Techniques: X-ray crystallography, cryo-EM, electrophysiology to understand structure-function relationships…. Relevance: This connects to lectures on ion channels and transporters and their role in synaptic transmission and action potentials.

Discovery of Alzheimer's Disease Mechanisms

Description: Alzheimer's disease was first described by Alois Alzheimer in 1906. Later discoveries focused on the role of beta-amyloid plaques and tau protein tangles in neurodegeneration. Techniques like PET imaging and molecular biology have furthered understanding of these pathological hallmarks. Techniques: Molecular biology, positron emission tomography (PET), immunohistochemistry…. Relevance: Related to neurodegenerative disease mechanisms and synaptic dysfunction covered in the course.

Project Work Guidelines

Possible Topics #2

Discovery of the Blood-Brain Barrier (BBB)

Description: The concept of the blood-brain barrier (BBB) was proposed by Paul Ehrlich in the late 19th century when he found that certain dyes injected into the bloodstream did not stain the brain. Further studies elucidated the role of endothelial cells and tight junctions in controlling the passage of substances into the brain. Techniques: Electron microscopy, molecular biology, in vivo tracers….Relevance: Connects to neuron-glia interaction and brain homeostasis

Discovery of Microglia Functions

Description: Microglia, first identified by Pío del Río-Hortega in the 1920s, were later recognized as the primary immune cells of the central nervous system. Modern research has revealed their roles in synaptic pruning, neuroinflammation, and their involvement in neurodegenerative diseases. Techniques: Immunohistochemistry, gene knockout models, live imaging in animal models… Relevance: This discovery is closely tied to lectures on microglia and their involvement in synaptic remodeling and CNS functions

Project Work Guidelines

Possible Topics #3

Discovery of Astrocytes' Functions

Description: Historically thought to play only a supportive role, astrocytes were later shown to be active participants in synaptic signaling, forming the "tripartite synapse." They regulate neurotransmitter levels, maintain the extracellular ion balance, and influence synaptic plasticity. Techniques: Microscopy, Calcium imaging, electrophysiology, molecular biology… Relevance: This discovery relates to neuron-glia interactions and astrocyte functions covered in the course

Discovery of Parkinson's Disease Mechanisms

Description: James Parkinson first described the disease in 1817, but it wasn't until the mid-20th century that researchers discovered the loss of dopaminergic neurons in the substantia nigra as the underlying cause. The development of L-DOPA as a treatment marked a major breakthrough….Techniques: Histology, neuroimaging, pharmacology.
Relevance: Directly linked to the lecture on the dopaminergic system and neurodegenerative diseases

Project Work Guidelines

Possible Topics #4

Discovery of the Effects of Drugs of Addiction

Description: Research in the late 20th century, particularly by scientists like Eric Nestler, revealed how drugs such as cocaine and opioids hijack the brain's reward circuits, leading to addiction. These drugs modify synaptic plasticity in pathways involving dopamine. Techniques: Electrophysiology, imaging techniques, behavioral studies in animal models… Relevance: Connects to lectures on synaptic transmission and plasticity, as well as the dopaminergic system

Discovery of the Mechanisms of Psychedelics

Description: Early studies on psychedelics, such as LSD, revealed their impact on serotonin receptors, particularly the 5-HT2A receptor, leading to altered states of consciousness. Recent research focuses on their potential in treating psychiatric disorders by promoting synaptic plasticity. Techniques: Receptor binding studies, functional MRI, clinical trials. Relevance: Related to the discussion of neurotransmission, synaptic plasticity, and potential therapeutic approaches in neurological and psychiatric conditions

Project Work Guidelines

Possible Topics #5

Discovery of the Action Potential

Description: The action potential was first described by Hodgkin and Huxley in the early 1950s. They elucidated how changes in the permeability of sodium and potassium ions across the neuronal membrane generate an electrical signal. This breakthrough laid the foundation for understanding electrical signaling in neurons. Techniques: Voltage clamp technique, electrophysiology, mathematical modeling. ..Relevance: Directly relates to the mechanisms of ion channels and synaptic transmission covered in the course.

Discovery of Neuroplasticity

Description: The concept of neuroplasticity was first proposed by Donald Hebb in 1949, suggesting that neuronal connections strengthen with repeated activation. Later, experimental evidence showed that synaptic plasticity underlies learning and memory, particularly through mechanisms like long-term potentiation (LTP). Techniques: Electrophysiology, in vivo imaging, behavioral studies. ...Relevance: Tied to discussions of synaptic plasticity and learning mechanisms in the course.

Project Work Guidelines

Possible Topics #6

Discovery of Tripartite Synapses

Description: The concept of the tripartite synapse emerged in the 1990s when researchers discovered that astrocytes actively participate in synaptic transmission by regulating neurotransmitter levels and modulating synaptic strength. This challenged the previous view of astrocytes as mere support cells. Techniques: Calcium imaging, electrophysiology, immunohistochemistry…Relevance: Links to neuron-glia interactions and astrocyte functions discussed in the course.

Discovery of Calcium's Role in Synaptic Transmission

Description: Calcium’s critical role in neurotransmitter release at the synapse was discovered in the 1950s by Bernard Katz and colleagues. They demonstrated that calcium influx triggers the fusion of synaptic vesicles with the presynaptic membrane, releasing neurotransmitters into the synaptic cleft. Techniques: Electrophysiology, calcium imaging, patch-clamp technique…Relevance: Fundamental for understanding the molecular mechanisms of synaptic transmission.

Project Work Guidelines

Possible Topics #7

Discovery of the Gut-Brain Axis

Description: The concept of the gut-brain axis emerged from research in the early 2000s, revealing how the microbiota in the gut communicate with the brain and influence mood, cognition, and behavior. This opened new avenues for understanding the role of the microbiome in neurological health. Techniques: Microbiome sequencing, functional MRI, behavioral analysis… Relevance: Related to neuro-hormonal communication and the influence of peripheral systems on brain function.

Discovery of Nerve Growth Factor (NGF)

Description: Rita Levi-Montalcini discovered Nerve Growth Factor (NGF) in the 1950s. NGF is a protein critical for the growth, maintenance, and survival of certain neurons. This discovery was pivotal in understanding how neurons develop and regenerate.

Techniques: Bioassays, immunohistochemistry, molecular biology.

Relevance: Tied to the mechanisms of neuronal growth, regeneration, and survival discussed in the course.

Project Work Guidelines

Possible Topics #8

Discovery of Genetic Mutations Underlying Epilepsy

Description: The discovery of genetic mutations causing epilepsy, particularly in ion channels, began in the 1990s. These mutations affect neuronal excitability and can lead to seizures, revolutionizing the understanding of channelopathies and genetic contributions to neurological disorders. Techniques: Genetic sequencing, electrophysiology, animal models… Relevance: Relates directly to the study of channelopathies and the molecular basis of epilepsy covered in the course.

Discovery of Chloride Equilibrium in Neurons

Description: The role of chloride ions in maintaining neuronal equilibrium and modulating inhibitory neurotransmission was elucidated in the 20th century. Research revealed that chloride transporters regulate the concentration of chloride ions in neurons, which is critical for GABAergic inhibition.

Techniques: Electrophysiology, patch-clamp recordings, ion imaging.

Relevance: Fundamental for understanding synaptic inhibition and neuronal excitability, key topics in the course.