

Topic 4: Movement Analysis

Content Area: **Science**

Course(s): **IB Sports, Exercise & Health Science**

Time Period: **2nd Marking Period**

Length: 5 weeks

Unit Overview

Neuromuscular Function: Students will be able to identify and describe the microscopic structures of a muscle cell in order to describe how it contracts. This will give them an understanding of the magnitude of energy and power required for full muscle contractions.

Joint & Movement Types: Students will be able to understand the different types of movements allowed by a variety of joint structures in order to describe the types of movements they produce. This will give them a deeper understanding that will allow them interpret movements needed for various sports and activities.

Foundations of Biomechanics: Students will be able to describe laws and principles of physics that apply to the human body in order to describe how the human body interacts physically with its surroundings. This will give them an understanding of how we can learn to control and improve our desired movements in sports and activities.

STAGE 1- DESIRED RESULTS

2020 New Jersey Student Learning Standards- Science

DCI: HS-LS1-2, HS-LS1-3, HS-LS1-6

CCC: Cause & Effect, Systems and System Models, Energy and Matter, Structure and Function, Stability and Change

S&EP: Asking questions/defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations, engaging in argument from evidence, obtaining, evaluating & communicating information

Essential Questions

How do we use physics to understand the movements created by the muscles and joints of the body?

Enduring Understanding

Students will not only understand the movements allowed by different types of joints and how muscles pull on the skeleton to create those movements, but they will be able to apply Newton's Laws of Motion and other concepts (angular velocity, Center of Mass, etc) to movements in sports.

Students will know...

Vocabulary: motor unit, dendrite, cell body (soma), nucleus, axon, motor end plate, synapse, acetylcholine, cholinesterase, sliding filament theory, myofibril, myofilament, sarcomere, actin, myosin, H zone, A band, Z line, tropomyosin, troponin, sarcoplasmic reticulum, ions, adenosine triphosphate (ATP), slow twitch fibers, fast twitch fibers, glycogen, glucose, flexion, extension, abduction, adduction, pronation, supination, elevation, depression, rotation, circumduction, dorsiflexion, plantarflexion, eversion, inversion, isotonic, isometric, isokinetic, concentric, eccentric, agonist, antagonist, reciprocal inhibition, delayed onset muscle soreness (DOMS), force, speed, velocity, displacement, acceleration, momentum, impulse, vector, scalar, center of mass, 1st class lever, 2nd class lever, 3rd class lever, fulcrum, lever, load, effort, Newton's Laws of Motion, angular momentum, moment of inertia, angular velocity, speed of release, height of release, angle of release, Bernoulli's Principle, projectile motion

Students will be able to...

- 4.1.1 label a diagram of a motor unit
- 4.1.2 explain the role of neurotransmitters in stimulating skeletal muscle contraction
- 4.1.3 explain how skeletal muscle contracts by the sliding filament theory
- 4.1.4 explain how slow and fast twitch fiber types differ in structure and function
- 4.2.1 outline the types of movement of synovial joints
- 4.2.2 outline the types of muscle contraction
- 4.2.3 explain the concept of reciprocal inhibition
- 4.2.4 analyze movements in relation to joint action and muscle contraction
- 4.2.5 explain Delayed Onset Muscle Soreness (DOMS) in relation to eccentric and concentric muscle contractions
- 4.3.1 define the terms: force, speed, velocity, displacement, acceleration, momentum, impulse
- 4.3.2 analyze velocity-time, distance-time, and force-time graphs of sporting actions
- 4.3.3 define the term Center of Mass
- 4.3.4 explain that a change in body position during sporting activities can change the position of the center of mass
- 4.3.5 distinguish between first-, second- and third-class levers
- 4.3.6 label anatomical representations of levers
- 4.3.7 define Newton's three laws of motion

- 4.3.8 explain how Newton's three laws of motion apply to sporting events
- 4.3.9 state the relationship between angular momentum, moment of inertia and angular velocity
- 4.3.10 explain the concept of angular momentum in relation to sporting activities
- 4.3.11 explain the factors that affect projectile motion at take-off and release
- 4.3.12 outline the Bernoulli principle with respect to projectile motion in sporting events

STAGE 2 - EVIDENCE OF LEARNING

Formative Assessment

- 3- Minute Pause
- A-B-C Summaries
- Analogy Prompt
- Choral Response
- Debriefing
- Exit Card / Ticket
- Hand Signals
- Idea Spinner
- Index Card Summaries
- Inside-Outside Circle Discussion (Fishbowl)
- Journal Entry
- Misconception Check
- Observation
- One Minute Essay
- One Word Summary
- Portfolio Check
- Questions & Answers
- Quiz
- Self-Assessment
- Student Conference
- Think-Pair-Share
- Web or Concept Map

Authentic Assessments

Draw/label – diagram of a motor unit and use it to explain the Sliding Filament Theory

Explain – the relationship between acetylcholine and cholinesterase in muscle contractions

Create – a stop motion video to identify the stages of the sliding filament theory, incorporating the structures, ions, neurotransmitters

Compare & Contrast – types of muscle fibers (I, IIa, IIx) using a T-chart

Create – dance video to model movements of joints and types of contractions

Investigation – using familiar exercises and movements, identify the roles of muscles in order to describe “reciprocal inhibition”

Describe – DOMS in a Flipgrid video to an athlete/patient

Investigation – using Dynamometer, generate force-time graph and interpret

Interpret – graphs so that you can predict what the movement looks like (velocity-time, distance-time, force-time)

Investigation – Center of Mass, try different positions/movements and explain why they did or did not work in relation to Center of Mass

Draw/label - 1st, 2nd & 3rd class levers; then identify & label anatomical examples of each type

Analyze – videos of examples of angular momentum in order to identify center of mass, moment of inertia and factors that affect angular momentum

Analyze – videos of examples of projectile motion in order to explain Bernoulli’s Principle and factors that affect projectile motion

Investigation – PhET “projectile motion” lab (ignoring drag)

Benchmark Assessments

4.1 Quiz

4.2 Quiz

4.3 Quiz

UNIT 4 TEST (comprised of Paper 1 & Paper 2 type questions)

STAGE 3- LEARNING PLAN

Instructional Map

Preview “I can” statements to identify learning objectives

Learn the fundamentals of skeletal and muscular anatomy and physiology

Learn the fundamentals of biomechanics

Apply biomechanics to the body and sports

Practice interpreting graphs and describing movements

Review “I can” statements to self-assess knowledge

Modification/Differentiation of Instruction

Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate

- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products

- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

504 Plans

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep
- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

Peer Tutoring

Repeated Drill and Practice

Cooperative Grouping

Teacher notes

Use of additional reference materials

Modification Strategies

- Cooperative Grouping
- Extended Time
- Frequent Breaks
- Highlighted Text
- Interactive Notebook

- Modified Test
- Oral Directions
- Peer Tutoring
- Preferential Seating
- Re-direct
- Repeated Drill and Practice
- Shortened Assignment
- Teacher Notes
- Tutorials
- Use of Additional Reference Materials
- Use of Audio Resources

Differentiation Strategies

High Preparation

- Alternative Assessments
- Choice Boards
- Games and Tournaments
- Group Investigations
- Guided Reading
- Independent Research / Project
- Interest Groups
- Learning Contracts
- Leveled Rubrics
- Literature Circles
- Multiple Intelligence Options
- Multiple Texts
- Personal Agendas
- Project Based Learning (PBL)
- Stations / Centers
- Think-Tac-Toe
- Tiered Activities / Assignments
- Varying Graphic Organizers

Low Preparation

- Choice of Book / Activity
- Cubing Activities
- Exploration by Interest (using interest inventories)
- Flexible Grouping
- Goal Setting With Student
- Homework Options
- Jigsaw
- Mini Workshops to Re-teach or Extend Skills
- Open-ended Activities
- Think-Pair-Share by Readiness, Interest, or Learning Style
- Use of Collaboration
- Use of Reading Buddies
- Varied Journal Prompts
- Varied Product Choice
- Varied Supplemental Materials
- Work Alone / Together

Horizontal Integration- Interdisciplinary Connections

See Appendix

Vertical Integration- Discipline Mapping

9th grade – Biology
10th grade – Chemistry
11th grade – Anatomy & Physiology
12th grade – Physics

Additional Materials

Sports, Exercise and Health Science by Oxford University Press (classroom set & PDF in Canvas)