

Bemidji Area Schools

Grades 9-12 Exercise Science Outcomes

Strand	Substrand	Standard "Understand that ..."	Benchmark "The student will ..."	Activity	
1. The Nature of Science and Engineering	1. The Practice of Science	1. Science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	9.1.1.1.2 Understand that scientists conduct investigations for a variety of reasons, including: to discover new aspects of the natural world, to explain observed phenomena, to test the conclusions of prior investigations, or to test the predictions of current theories.	Muscles and mitochondria activity Exercise In a Pill? "Marathon Mouse"	
			9.1.1.1.3 Explain how the traditions and norms of science define the bounds of professional scientific practice and reveal instances of scientific error or misconduct. <i>For example:</i> The use of peer review, publications and presentations.	VO ₂ max tests (predictions and tests) "Bigger, Stronger, Faster"	
			9.1.1.1.4 Explain how societal and scientific ethics impact research practices. <i>For example:</i> Research involving human subjects may be conducted only with the informed consent of the subjects.	"Bigger, Stronger, Faster" Supplements PowerPoint activity Cardiac activities	
			9.1.1.1.6 Describe how changes in scientific knowledge generally occur in incremental steps that include and build on earlier knowledge.	Heart rate and blood pressure activities (all seven of them) Body composition activities (all three) Nutrition and supplements (all five activities) VO ₂ max testing (all five activities)	
	2. Scientific inquiry uses multiple interrelated processes to pose and investigate questions about the natural world.			9.1.1.2.1 Formulate a testable hypothesis, design and conduct an experiment to test the hypothesis, analyze the data, consider alternative explanations, and draw conclusions supported by evidence from the investigation.	Muscles and mitochondria activities Exercise In a Pill activity
				9.1.1.2.2 Evaluate the explanations proposed by others by examining and comparing evidence, identifying faulty reasoning, pointing out statements that go beyond the scientifically acceptable evidence, and suggesting alternative scientific explanations.	Any prediction labs (VO ₂ max, body composition, lung volume, blood pressure)
				9.1.1.2.4 Use primary sources or scientific writings to identify and explain how different types of questions and their associated methodologies are used by scientists for investigations in different disciplines..	Medical/scientific journals from ACSM (VO ₂ max, ATP production, exercise and mitochondria)

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1. The Nature of Science and Engineering	2. The Practice of Engineering	1. Engineering is a way of addressing human needs by applying science concepts and mathematical techniques to develop new products, tools, processes and systems.	9.1.2.1.1 Understand that engineering designs and products are often continually checked and critiqued for alternatives, risks, costs and benefits, so that subsequent designs are refined and improved. <i>For example:</i> If the price of an essential raw material changes, the product design may need to be changed.	VO ₂ max testing: how the test can be altered/tailored to be sports specific (fine-tuned to the athlete's sport)
		3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	1. Natural and designed systems are made up of components that act within a system and interact with other systems.	9.1.3.1.1 Describe a system, including specifications of boundaries and subsystems, relationships to other systems, and identification of inputs and expected outputs. <i>For example:</i> A power plant or ecosystem.
	9.1.3.1.2 Identify properties of a system that are different from those of its parts but appear because of the interaction of those parts.			Muscular system (muscle structure and function, muscles and mitochondria lab)
	9.1.3.1.3 Describe how positive and/or negative feedback occur in systems. <i>For example:</i> The greenhouse effect			Within exercise, changes within systems (heartrate, blood pressure, waste production, Kreb's Cycle)
	2. Men and women throughout the history of all cultures, including Minnesota American Indian tribes and communities, have been involved in engineering design and scientific inquiry.		9.1.3.2.2 Analyze possible careers in science and engineering in terms of education requirements, working practices and rewards.	Careers in exercise science → graduate studies and possibilities (discussion and PowerPoints)
			4. Science, technology, engineering, and mathematics rely on each other to enhance knowledge and understanding.	9.1.3.4.1 Describe how technological problems and advances often create a demand for new scientific knowledge, improved mathematics, and new technologies.
	9.1.3.4.2 Determine and use appropriate safety procedures, tools, computers and measurement instruments in science and engineering contexts. <i>For example:</i> Consideration of chemical and biological hazards in the lab.			Consideration of chemical and biological hazards in the lab

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1. The Nature of Science and Engineering	3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	4. Science, technology, engineering, and mathematics rely on each other to enhance knowledge and understanding.	9.1.3.4.3 Select and use appropriate numeric, symbolic, pictorial, or graphical representation to communicate scientific ideas, procedures and experimental results.	VO ₂ max estimates Body composition estimates
			9.1.3.4.4 Relate the reliability of data to consistency of results, identify sources of error, and suggest ways to improve the data collection and analysis. <i>For example:</i> Use statistical analysis or error analysis to make judgments about the validity of results	VO ₂ max labs Body composition labs Heart rate and blood pressure labs
4. Life Science	1. Structure and Function of Living Systems	1. Organisms use the interaction of cellular processes as well as tissues and organ systems to maintain homeostasis.	9.4.1.1.1 Explain how cell processes are influenced by internal and external factors, such as pH and temperature, and how cells and organisms respond to changes in their <u>environment to maintain homeostasis.</u>	ATP activity Energy Pathways article Muscular Ischemia PPT and lab
			9.4.1.1.2 Describe how the functions of individual organ systems are integrated to maintain homeostasis in an organism.	Mitochondria Functions and Training articles Power House of the Cell video clip
		2. Cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	9.4.1.2.1 Recognize that cells are composed primarily of a few elements (carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur), and describe the basic molecular structures and the primary functions of carbohydrates, lipids, proteins and nucleic acids.	ATP activity Energy Pathways article Supplements activities and articles.
			9.4.1.2.2 Recognize that the work of the cell is carried out primarily by proteins, most of which are enzymes, and that protein function depends on the amino acid sequence and the shape it takes as a consequence of the interactions between those amino acids.	Muscles and Mitochondria lessons
4. Life Science	1. Structure and Function of Living Systems	2. Cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	9.4.1.2.5 Compare and contrast passive transport (including osmosis and facilitated transport) with active transport such as endocytosis and exocytosis.	Muscles and muscle fibers activities

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	2. Interdependence Among Living Systems	2. Matter cycles and energy flows through different levels of organization of living systems and the physical environment, as chemical elements are combined in different ways.	9.4.2.2.2 Explain how matter and energy is transformed and transferred among organisms in an ecosystem, and how energy is dissipated as heat into the environment.	ATP actiities Energy Pathways article Muscles and mitochondria activities Lung volume activities
	4. Human Interactions with Living Systems	2. Personal and community health can be affected by the environment, body functions and human behavior.	9.4.4.2.4 Explain how environmental factors and personal decisions, such as water quality, air quality and smoking affect personal and community health.	Target heart rate and other heart rate activities Blood pressure labs Lung volume activities
			9.4.4.2.5 Recognize that a gene mutation in a cell can result in uncontrolled cell division called cancer, and how exposure of cells to certain chemicals and radiation increases mutations and thus increases the chance of cancer.	Muscles and mitochondria activities
1. The Nature of Science and Engineering	3. Interactions Among Science, Technology, Engineering, Mathematics, and Society	3. Developments in physics affect society and societal concerns affect the field of physics.	9P.1.3.3.1 Describe changes in society that have resulted from significant discoveries and advances in technology in physics. <i>For example:</i> Transistors, generators, radio/television, or microwave ovens.	VO ₂ max activities Heart rate activities Blood pressure activities Body composition labs, PowerPoint
		4. Physical and mathematical models are used to describe physical systems.	9P.1.3.4.1 Use significant figures and an understanding of accuracy and precision in scientific measurements to determine and express the uncertainty of a result.	Terms/conversion worksheet Body composition lab VO ₂ max tests Lung volume measurements