Science of Fitness – Training Guide (05)

by Karen L. Lancour
National Institute Instructor

This event encompasses the **anatomy** of the **skeletal, muscular, cardiovascular, and respiratory systems including aspects of physical activities and fitness.**

Facts and Concepts

Skeletal System

- Bones of the axial and appendicular skeleton.
- Types of joints and ranges of motion.

Muscular System

- Location of major skeletal muscles. (see SO national website for list – http://www.soinc.org)
- Origin and insertion of skeletal muscles and which bone is moved.

Cardiovascular System

- Basic anatomy of the heart and circulatory system, including heart chambers, valves, and major vessels associated with the heart including the coronary vessels.
- Measurement of the pulse rate, including anatomical sites.
- Recognizing physical signs associated with atherosclerosis and their causes and effects.
- Flow of blood through the heart and body.
- Calculations
  - Math skills involve simple multiplication and division using known formulas.
  - Relevant formulas include Systolic and Diastolic Pressure, Mean Arterial Pressure, Stroke Volume, and Cardiac Output.
  - Measurement of blood pressure (systolic, diastolic, and Mean Arterial Pressure), breathing and heart rates

Respiratory System

- Basic anatomy of the respiratory system—nose to lungs.
- Effects of smoking -- carbon monoxide, nicotine, and lung disease.

Nutrition

- Nutritional analysis of food, food pyramid, fuel sources during brief and prolonged exercise.
- Interaction of exercise and nutrition in long-term weight management.

Relevant Formulas – Science of Fitness (B)

Stroke volume (SV) = milliliters of blood pumped per beat

Heart rate (HR) = number of beats per minute

Cardiac output (CO) = heart rate times stroke volume

$$CO = HR \times SV$$

Pulse pressure (PP) = the difference between systolic pressure (SP) and diastolic pressure (DP)

$$PP = SP - DP$$

Mean Arterial Pressure (MAP) (2 equations):

Formula 1: MAP = diastolic pressure + 1/3 pulse pressure

Formula 2: MAP = 2/3 diastolic pressure + 1/3 systolic pressure

The F.I.T.T. Principle

Frequency – number of times per week that you are exercising.

Intensity – how strenuous is the exercise or how much effort is required.

Time – how many minutes per session does the exercise require.

Type or Mode of exercise – kind of exercise as aerobic or strength training.

Tips for Preparing Event Resources

- The most effective resources are the ones produced by the students.
- The process of producing the resources is a major learning tool.
- Since the events are timed, organization of materials is essential for the most effective use of the materials during the competition.
- A three ring binder is a good tool for housing and organizing resource material.
- Prepare and organize materials by major topic divisions within the competition.
- Organize materials on each page to maximize available space.
- Reduce the size of pictures where possible to get more information on a page.
- Cut and paste items to organize materials more effectively on a page.
- Write notes in margins or with pictures.
- Color code information to help your locate or emphasize key items.
- Put pages in sheet protectors – two per protector to save space.
- Use taps to separate sections.
- Label tabs so items can be located with ease.
- Practice for the competition using your resources.
- Practice with sample questions and use your resources to answer them.
- Use a timer when attempting to locate information and answer questions.
- Modify the information as you use it to make it more efficient.

Note: Be sure to verify all resource information with a second source. Textbooks do contain errors and there are many errors present on internet resources.

Science of Fitness – Sample Problems (05)

What is the origin and insertion of the biceps brachii muscle. What bone does it attach to. If this muscle contracts, how will the bone move?

Name the 4 chamber of the heart and the openings which allow blood to enter or leave each chamber?

How does the respiratory system stop food from passing into the trachea?

Draw a nutritional pyramid. How many portions include carbohydrates?

How does the body adapt to exercise acutely (in the short-run) compared to chronically (in the long-run) [e.g., effects on cardiac output, systolic vs. diastolic blood pressure, minute ventilation, and blood flow to various tissues]?

If systolic pressure is 122 and diastolic pressure is 84, what are the pulse pressure and the Mean Arterial Pressure?

Mrs. Jones has a heart rate of 85, a systolic pressure of 140 and diastolic pressure of 60, and an end diastolic volume of 110 and end systolic volume of 40. What is her cardiac output?

Name three major cellular and biochemical effects nicotine has on the efficiency of breathing and gas delivery to the muscles of the body.

What are the measurable components of physical fitness and body composition and what are methods for assessing them?

Why is the percent of VO2 (maximum oxygen uptake) included in the definition of vigorous physical activity?

How is exercise prescribed (the F.I.T.T principle: frequency, intensity, time and type of activity)?

Science of Fitness Resources (05)

The Skeletal System - Anatomy
http://www.howe.k12.ok.us/~jimaskew/anatomy10.htm#one

The Skeletal Muscle System – Anatomy
http://www.howe.k12.ok.us/~jimaskew/anatomy11.htm

Cardiovascular System – Anatomy and Physiology
http://www.biology.eku.edu/RITCHISO/301notes5.htm

Respiratory System – Anatomy
http://www.howe.k12.ok.us/~jimaskew/anatomy23.htm#one

Respiratory System – Anatomy and Physiology
http://www.biology.eku.edu/RITCHISO/301notes6.htm

Master muscle list with origin, insertion, function & pictures
http://www.lumen.luc.edu/lumen/MedEd/GrossAnatomy/dissector/mml/index.htm

FITT Principle
http://www.healthgoods.com/Education/Fitness_Information/Fitness_Short_Course/fitt_principle.htm

The CDC Science of Fitness website at http://www.cdc.gov/nccdphp/dnpa/science_olympiad/index.htm
http://web.uccs.edu/scioly/
The CDC Division of Nutrition and Physical Activity website (http://www.cdc.gov/nccdphp/dnpa/index.htm) will have updates, sample questions and problems.

Also refer to the Surgeon General's Report on Physical Activity and Health at
http://www.cdc.gov/nccdphp/sgr/sgr.htm.
EXcellence in Curriculum Integration through Teaching Epidemiology (EXCITE) at
http://www.cdc.gov/excite
EXcellence in Curriculum Integration through Teaching Epidemiology (EXCITE)—Science Olympiad at
http://www.cdc.gov/excite/olympiad.htm
Division of Nutrition and Physical Activity at http://www.cdc.gov/nccdphp/dnpa
Adult and Community Health at http://www.cdc.gov/nccdphp/dach
Tobacco Information and Prevention Source (TIPS) at http://www.cdc.gov/tobacco/

Government Resources
Health finder at http://www.healthfinder.gov
President's Council on Fitness and Health
http://www.fitness.gov

Non-Governmental Resources
American College of Sports Medicine at http://www.acsm.org
American Heart Association at http://www.americanheart.org
Norman J. Arnold School of Public Health at http://www.sph.sc.edu/
Science Olympiad Inc. at http://www.SOinc.org
University of Colorado at Colorado Springs at http://web.uccs.edu/scioly/