

Exercise Science
 HPERDS
 Calvin College

American College of Sports Medicine KNOWLEDGE/SKILLS/ABILITIES (KSA)
 for both ACSM (Exercise Leader [EL] and Health/Fitness Instructor [HFI]) Certifications

These are EDUCATIONAL OUTCOMES expected of ALL Ex. Sci. students by the end of the 4th year

	KSA	KSA Number
	Functional Anatomy and Biomechanics	
EL		
1	Describe the basic structures of bone, skeletal muscle and connective tissue	1
2	Describe the basic anatomy of the heart, cardiovascular system, and respiratory system.	2
3	Identify the major bones and muscles and their actions. Major muscle include the trapezius, pectoralis major, latissimus dorsi, biceps, triceps, abdominal, erector spinae, gluteus maximus, quadriceps, hamstrings, and gastrocnemius.	3
4	Define: supination, pronation, flexion, extension, adduction, abduction, hyperextension, rotation, and circumduction.	4
5	List and describe the types of joints in the body.	5
6	Identify the interrelationships among center of gravity, base of support, balance, and stability.	6
7	Describe the following abnormal curvature of the spine: lordosis, scoliosis, kyphosis.	7
8	Describe low back pain syndrome and describe exercises used to prevent this problem.	8
9	Describe the biomechanical effects and potential risks of using hand/ankle weights.	9
10	Describe and demonstrate exercises designed to enhance muscular strength and/or endurance of specific major muscle groups.	10
11	Describe and demonstrate exercises for enhancing musculoskeletal flexibility.	11
HFI		
12	Describe the structure and nature of movement in the major joints of the body.	12
13	Describe the factors that determine range of motion in the major joints of the body.	13
14	Describe the biomechanical principles that underlie performance of the following activities: walking, jogging, running, swimming, cycling, weight lifting, and carrying or moving objects.	14
15	Locate the common sites for measurement of skinfold thickness, skeletal diameter, girth measurements for estimation of body composition; the anatomic landmarks for palpation of peripheral pulses; locate the brachial artery and correctly place the BP cuff and stethoscope in position of BP measurement.	15
	Exercise Physiology	
EL		
1	Define aerobic and anaerobic metabolism.	18
2	Identify the role of aerobic, anaerobic and ATP-PC systems in the performance of various physical activities.	19
3	Define the following terms: ischemia, angina pectoris, tachycardia, bradycardia, myocardial infarction, cardiac output, stroke volume, lactic acid, oxygen consumption, hyperventilation, systolic blood pressure, diastolic blood pressure.	20
4	Describe the role of carbohydrates, fats, proteins as fuels for aerobic and anaerobic metabolism.	21
5	Demonstrate an understanding of the components of fitness: cardiorespiratory fitness, muscular strength, muscular endurance, flexibility, body composition.	22
6	Define the major components of motor fitness: agility, speed, balance, coordination, power.	23
7	Describe the normal, cardiorespiratory responses to static and dynamic exercise in terms of heart rate, blood pressure, and oxygen consumption.	24
8	Describe how heart rate, blood pressure, and oxygen consumption responses change with adaptation to chronic exercise training and how men and women may differ in response.	25

9	List the physiological adaptations associated with strength training in men and women.	26
10	Define and describe the relationship of METs and kilocalories to physical activity.	27
11	Identify the common sites for pulse and palpation and describe how heart rate is determined by pulse palpation. List precautions in the application of these techniques.	28
12	Identify the physiological principles related to warm-up and cool-down.	29
13	List the effects of temperature, humidity, altitude, and pollution on the physiological response to exercise.	30
14	Identify the physical and physiological signs of over-exercising, over-training, overuse.	31
15	Describe the common theories of muscle fatigue and delayed onset muscle soreness (DOMS).	32
HFI		
16	Describe the primary anaerobic energy systems and their role during exercise.	33
17	Describe the basic properties of cardiac muscle and the normal pathways of conduction in the heart.	34
18	Calculate the energy cost in METs and kilocalories for given exercise intensities in stepping exercise, bicycle ergometry, and during horizontal and graded walking and running.	35
19	Identify approximate MET equivalents for various sport, recreational and work tasks.	36
20	Discuss the physiological basis of the major components of physical fitness: flexibility, cardiovascular fitness, muscular strength, muscular endurance, and body composition.	37
21	Explain the differences in the cardiorespiratory responses to static exercise compared with dynamic exercise, including possible hazards of static exercise.	38
22	Explain how the principle of specificity relates to the components of fitness.	39
23	Define and describe the implications of ventilatory anaerobic threshold (“anaerobic threshold”) as it relates to physical conditioning programs and cardiovascular assessment.	40
24	Explain the concept of detraining or reversibility of conditioning and its implications in fitness programs.	41
25	Discuss the physical and psychological signs of over-training and provide recommendations to deal with these problems.	42
26	Describe the structure of the skeletal muscle fiber and the basic mechanism of contraction.	43
27	Describe the functional characteristics of fast and slow twitch fibers.	44
28	Explain contraction of muscle in terms of the sliding filament theory.	45
29	Explain twitch, summation, and tetanus in terms of muscle contraction.	46
30	Discuss the physiological principles involved in promoting gains in muscular strength and endurance.	47
31	Demonstrate an understanding of the relationship between number of repetitions, intensity, number of sets, and rest with regard to strength training.	48
32	Describe how each of the following differ from the normal condition: dyspnea, hypoxia, hypoventilation, orthostatic hypotension, premature atrial contractions, and premature ventricular contractions.	49
33	Describe blood pressure responses associated with exercise and changes in body position.	50
34	Define hypotension and hypertension and explain why blood pressure should be monitored during exercise testing.	51
35	List the physiological adaptations to the muscular system, metabolism, and the cardiorespiratory system that occur at rest, during submaximal and maximal exercise following chronic anaerobic and aerobic training.	52
36	Describe the response of the following variables to steady state submaximal exercise and maximal exercise: heart rate, stroke volume, cardiac output, pulmonary ventilation, tidal volume, respiratory rate, arteriovenous oxygen difference.	53
37	Describe the physiologic and metabolic responses to exercise associated with chronic disease (e.g., heart disease, hypertension, diabetes mellitus, and pulmonary disease).	54
HFD		
38	Discuss the physiological and biochemical characteristics of fast and slow twitch muscle fibers.	55
Human Development and Aging		
EL		
1	Describe the changes that occur in maturation from childhood to older adulthood for the following areas: skeletal muscle, bone structure, reaction and movement time, coordination, tolerance to hot	59

	and cold environments, maximal oxygen consumption, strength, flexibility, body composition, resting and maximal heart rate, resting and maximal blood pressure.	
2	List the benefits and risks associated with exercise training in pre- and post-pubescent youth.	60
3	Identify benefits and precautions associated with resistance and endurance training in the older adult.	61
4	Describe special leadership techniques which might be used for children, adolescents, and older participants.	62
HFI		
5	Demonstrate and understand the effect of the aging process on the structure and function of the human organism at rest, during exercise, and during recovery.	63
6	Characterize the differences in the development of an exercise prescription for children, adolescents, and older participants.	64
7	Describe the unique adaptations to exercise training in children, adolescents, and older participants with regard to strength, functional capacity, and motor skills.	65
8	Describe common orthopedic and cardiovascular considerations of older participants and what modifications in exercise prescription are indicated.	66
Pathophysiology/Risk Factors		
EL		
1	Identify risk factors for coronary artery disease (CAD) and designate those that may be favorably modified by regular and appropriate physical activity habits.	69
2	Define the following terms: total cholesterol, high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), total cholesterol/high density lipoprotein cholesterol ratio anemia, and hypertension.	70
3	Be familiar with the plasma cholesterol levels for various ages as recommended by the National Cholesterol Education Program.	71
4	Identify the following cardiovascular risk factors or conditions that may require consultation with medical or allied health professionals prior to participation in physical activity or prior to a major increase in physical activity intensities and habits; inappropriate resting, exercise, and recovery HR's and BP's; new discomfort or changes in the pattern of discomfort in the chest area, neck, shoulder or arm with exercise or at rest; heart murmurs; myocardial infarction; fainting or dizzy spells, claudication, ischemia, cigarette or other tobacco use, lipoprotein profile.	72
5	Identify the following respiratory risk factors that may require consultation with medical professionals prior to participation in physical activity or prior to major increases in physical activities or habits; extreme breathlessness after mild exertion or during sleep, asthma, exercise-induced asthma, bronchitis, emphysema.	73
6	Identify the following metabolic risk factors that may require consultation with medical professionals prior to participation in physical activity or prior to major increases in physical activity intensities and habits: body weight more than 20% above optimal, thyroid disease, diabetes or glucose intolerance, McArdle's syndrome, hypoglycemia.	74
7	Identify the following musculoskeletal risk factors that may require consultation with medical professionals prior to activity or prior to major increases in physical activity intensities and habits: osteoarthritis, rheumatoid arthritis, acute or chronic back pain, prosthesis-artificial joints.	75
8	Demonstrate an understanding of muscle atrophy and the loss of strength and endurance with disuse/sedentary behavior.	76
9	Define shin splints, sprains, strains, tennis elbow, bursitis, stress fracture, tendonitis, contusions, osteoporosis, arthritis, overweight, chondromalacia, blisters, skin irritations, and low back discomfort.	77
HFI		
10	Demonstrate an understanding of the pathophysiology of atherosclerosis and how this process is influenced by physical activity.	78
12	Identify the effects of the following substances on exercise response: antihistamines, tranquilizers, alcohol, diet pills, cold tablets, caffeine, and nicotine.	80
Human Behavior/Psychology		
EL		
1	List several techniques to deal with disruptive individuals in group programs (e.g., non-complier,	90

	comedian, chronic complainer, and the over-exerciser).	
2	Define the psychological principles which are critical to health behavior change (i.e., behavior modification, reinforcement, goal-setting, social support and peer pressure).	91
3	Describe the personal communication skills necessary to develop rapport in order to motivate individuals to begin exercise, enhance adherence, and return to exercise.	92
4	Identify several techniques that can be used in an exercise program to facilitate skill development in muscular relaxation.	93
5	List specific techniques to enhance motivation: posters, recognition, bulletin boards, games, competitions, etc.	94
HRI		
6	Describe the specific strategies (e.g., operant conditioning) aimed at encouraging the initiation, adherence, and return to participation in an exercise program or any other healthy lifestyle behaviors.	95
7	Describe effective counseling communication skills in order to bring about behavioral change.	96
8	Describe how each of the following terms may impact the successful management of an exercise program; anxiety, depression, fear, denial, rejection, rationalization, aggression, anger, hostility, empathy, arousal, euphoria, and relaxation.	97
9	Discuss the potential manifestation of test anxiety (i.e., performance, appraisal, threat) during exercise testing and how it may disrupt accurate physiological responses to testing.	98
10	Describe the differential effects of exercise and progressive relaxation as stress management techniques for modifying anxiety, depression, anger, and for generating relaxation.	99
11	Discuss the behavioral change strategies that are appropriate or inappropriate for modifying body composition.	100
Health Appraisal and Fitness Testing		
EL		
1	Describe and demonstrate the use of health history appraisal to obtain information on past and present medical history, orthopedic limitations, prescribed medications, activity patterns, nutritional habits, stress and anxiety levels, family history of heart disease, smoking history, and use of alcohol and illicit drugs and know when to recommend medical clearance.	103
2	Describe the use of informed consent forms and medical clearances prior to exercise participation.	104
3	Demonstrate the ability to conduct group field assessment, such as Copper 12-minute test, step test, strength, muscular endurance, and flexibility assessment.	105
4	State the rationale for determining body composition.	106
5	Describe the types of tests for cardiorespiratory fitness, evaluation of strength and flexibility, and techniques used to determine body composition, and the purposes for which each may be used (i.e., base-line, comparison, motivation, etc.).	107
6	Describe the difference between maximal and submaximal cardiorespiratory exercise tests.	108
7	Demonstrate the ability to measure pulse rate accurately both at rest and during exercise.	109
8	Demonstrate the ability to measure blood pressure accurately at rest.	110
HFI		
9	Demonstrate or identify appropriate techniques for health appraisal and use of fitness evaluations.	111
10	State the purpose and demonstrate basic principles of exercise testing.	112
11	Describe the categories of participants who should receive medical clearance prior to administration of an exercise test or participation in an exercise program.	113
12	Identify relative and absolute contraindications to exercise testing or participation.	114
13	Demonstrate the ability to obtain appropriate medical history, informed consent, and other pertinent information prior to exercise testing.	115
14	Discuss the limitations of informed consent and medical clearances prior to exercise testing.	116
15	Demonstrate the ability to instruct participants in the use of equipment and test procedures.	117
16	Demonstrate the ability to assess muscular strength, muscular endurance, and flexibility.	118
17	Demonstrate various techniques of assessing body composition and discuss the advantages/disadvantages and limitations of the various techniques.	119
18	Discuss and demonstrate various submaximal and maximal cardiorespiratory fitness tests using various modes of exercise and interpret and critique the information obtained from the various tests.	120
19	Discuss modification of protocols and procedures for cardiorespiratory fitness tests in children,	121

	adolescents, and older adults.	
20	Explain the purpose and procedures for monitoring clients prior to, during, and after cardiorespiratory fitness testing.	122
21	Demonstrate the ability to accurately measure heart rate, blood pressure, and rating perceived exertion at rest and during exercise according to established guidelines.	123
22	Demonstrate the ability to interpret results of fitness evaluations on apparently healthy individuals and those with stable disease.	124
23	Describe and demonstrate techniques for calibration of a cycle ergometer and a motor-driven treadmill.	125
24	Identify appropriate criteria for discontinuing a fitness evaluation and demonstrate proper procedures to be followed after discontinuing such a test.	126
	Emergency Procedures and Safety	
EL		
1	Demonstrate skills necessary to obtain basic life support and cardiopulmonary resuscitation certification.	130
2	Describe appropriate emergency procedures (i.e., telephone procedures, written emergency procedures, personnel responsibilities, etc.) in a variety of exercise settings.	131
3	Describe basic first aid procedures for exercise-related injuries such as: bleeding skin wounds, contusions, strains/sprains, fractures, dizziness, syncope, and metabolic abnormalities including hypo/hypertension, hypo/hyperglycemia, hypo/hyperthermia.	132
4	Demonstrate an understanding of the risks associated with exercise participation.	133
5	Describe the signs/symptoms or participants (including special populations) to defer, delay, or terminate the exercise session.	134
6	Demonstrate the basic [precautions taken in a weight room area to ensure participant safety (e.g., spotting, buddy system, control speed of movement, weights returned back to rack, safe passageways, check loose parts on equipment, etc.).	135
HFI		
7	Demonstrate knowledge of safety plans, emergency procedures, and first aid techniques needed during fitness evaluations, exercise testing, and exercise training.	136
8	Identify the components that create and maintain a safe environment.	137
9	Identify the content and discuss the use of informed consent and exercise waivers.	138
10	Discuss the instructor's responsibilities, limitations, and the legal implications of carrying out emergency procedures.	139
11	Describe potential musculoskeletal injuries (e.g., contusions, strains/sprains, fractures), cardiovascular/pulmonary complications (e.g., tachycardia, bradycardia, hypo/hypertension, tachypnea), and metabolic abnormalities (e.g., fainting/syncope, hype/hyperglycemia, hypo/hyperthermia).	140
12	Explain the initial management and first aid techniques associated with open wounds, musculoskeletal injuries, cardiovascular/pulmonary complications, and metabolic abnormalities.	141
13	Describe the components of an equipment maintenance/repair program and how it may be used to evaluate the condition of exercise equipment in order to reduce potential risk of injury.	142
	Exercise Programming	
EL		
1	State the recommended intensity, duration, frequency, and type of physical activity necessary for development of cardiorespiratory fitness in an apparently healthy population.	148
2	Differentiate between the dose of exercise required for various health benefits and the dose required for fitness development.	149
3	Describe the differences between improvement and maintenance exercise training programs.	150
4	Describe the principles of overload, specificity, and progression and how they relate to exercise programming.	151
5	Describe and demonstrate appropriate exercises used in warm-up and cool-down for: cardiorespiratory conditioning classes, weight training, and sport participation (racquet sports, volleyball, basketball, etc.).	152
6	Demonstrate an understanding of the components incorporated into an exercise session and their proper sequence (i.e., warm-up, aerobic stimulus phase, cool-down, muscular endurance, and	153

	flexibility).	
7	Define overload, specificity of exercise conditioning, use-disuse, progressive resistance, isotonic, isometric, isokinetic, concentric, eccentric, atrophy, hypertrophy, sets, repetitions, plyometrics, Valsalva maneuver.	154
8	Define RPE and describe the relationship to the physiological responses to exercise and its role in exercise programming.	155
9	Demonstrate an understanding of calculation of predicted maximal and training heart rate ranges.	156
10	Demonstrate various methods for monitoring exercise intensity such as heart rate and perceived exertion.	157
11	Describe the signs and symptoms of excessive effort that would indicate a change in intensity, duration, or frequency of exercise.	158
12	Describe and demonstrate appropriate modifications in exercise programs that may be recommended by a physician for the following: older adults, acute illness, controlled conditions such as exercise-induced asthma, allergies, hypertension, pregnancy and postpartum, obesity, and low back pain.	159
13	Demonstrate the ability to recognize proper technique and use of all exercise equipment (i.e., proper body mechanics, proper positioning on apparatus, appropriate settings, for cardiovascular and resistance training, proper monitoring techniques, safety considerations, etc.).	160
14	Describe the importance of flexibility and recommend proper exercises for improving range of motion of all major joints.	161
15	Demonstrate the ability to modify exercises in the group setting for apparently healthy persons of various fitness levels.	162
16	Describe and demonstrate exercises for the improvement and maintenance of muscular endurance and muscular strength.	163
17	Describe how the following weight training methods may be used in resistance programming: progressive resistance exercise, super sets, pyramiding, split routines, plyometrics, isokinetic, isotonic, isometric.	164
18	Identify various types of isometric, isotonic, and isokinetic equipment.	165
19	List advantages and disadvantages of various aerobic exercise equipment such as stair climbers, rowing machines, treadmills, bicycles, etc.	166
20	Describe the hypothetical concerns and potential risks that may be associated with the use of exercises, such as straight leg set-ups, double leg raises, full squats, hurdler's stretch, plough, forceful back hyperextension, and standing straight-leg, toe-touch.	167
21	Describe the differences between interval, continuous, and circuit training programs.	168
22	Demonstrate appropriate and effective group exercise management and teaching techniques.	169
23	Describe various locations a leader may take within a group to enhance visibility, participant interactions, and communication.	170
24	Demonstrate the ability to communicate effectively with exercise participant in the group and one-on-one setting.	171
25	Describe an exercise regimen for a water exercise class.	172
26	Describe partner resistance exercises that can be employed in a class setting.	173
27	Demonstrate a knowledge of techniques for accommodating various fitness levels within the same class.	174
28	Identify the differences between high impact and low impact exercise classes and which class is appropriate for various participants.	175
29	Identify the short-term and long-range advantages/benefits associated with fitness participation.	176
HFI		
30	Design, implement, and evaluate individualized and group exercise programs based on health history and physical fitness assessments.	177
31	Define exercise prescription guidelines for apparently healthy, high risk, and clients with controlled disease.	178
32	Demonstrate the use of the variables of mode, intensity, duration, frequency, and progression in designing cardiorespiratory and resistive training.	179
33	Design exercise programs to improve or maintain cardiorespiratory endurance.	180
34	Demonstrate the use of various methods for establishing and monitoring levels of exercise intensity	181

	including heart rate, RPE, and METs.	
35	Design resistive exercise programs to increase or maintain muscular strength and/or endurance for the purpose of general fitness, hypertrophy, injury prevention, and sports conditioning.	182
36	Demonstrate the proper techniques for performing resistive exercises for all major muscle groups using calisthenics, free weights, resistive equipment, and machines.	183
37	Demonstrate an ability to establish appropriate resistance levels on circuit weight training equipment and various free weight exercises.	184
38	Design flexibility programs to improve or maintain range of motion at all major joints.	185
39	Demonstrate proper techniques for performing flexibility exercises for all major muscle groups.	186
40	Discuss the advantages and disadvantages of implementation of interval, continuous, and circuit training programs, and design programs for each.	187
41	Discuss the advantages and disadvantages of various commercial exercise equipment in developing cardiorespiratory fitness, muscular strength, and muscular endurance.	188
42	Describe special precautions and modifications of exercise programming for participation at altitude, different ambient temperatures, humidities, and environmental pollution.	189
43	Describe modifications in type, duration, frequency, progression, level of supervision, and monitoring techniques in exercise programs for patients of heart disease, diabetes mellitus, obesity, hypertension, musculoskeletal problems, pregnancy/postpartum, and exercise induced asthma.	190
44	Demonstrate an understanding for the components incorporated into an exercise session and their proper sequence (i.e., pre-exercise evaluation, warm-up, aerobic stimulus phase, cool-down, muscular endurance, and flexibility).	191
45	Describe the types of exercise programs available in the community and how these programs are appropriate for various populations.	192
46	Demonstrate an understanding of the importance of recording exercise sessions and performing periodic evaluations to assess changes in fitness status.	193
	Nutrition and Weight Management	
EL		
1	Define the following terms: obesity, overweight, percent fat, lean body mass, anorexia nervosa, bulimia, and body fat distribution.	194
2	Discuss the relationship between body composition and health.	195
3	Compare the effects of diet plus exercise, diet alone, and exercise alone as methods for modifying body composition.	196
4	Describe misconceptions about spot reductions and rapid weight loss programs.	197
5	Explain the concept of energy balance as it relates to weight control.	198
6	Identify the functions of fat and water soluble vitamins and contrast their potential risk of toxicity with over-supplementation.	199
7	Discuss the ramifications of the use of salt tablets, diet pills, protein powder, and other nutritional supplements.	200
8	Describe the importance of and procedures for maintaining normal hydration at times of heavy sweating, and describe appropriate beverages for fluid replacement during and after exercise.	201
9	Demonstrate familiarity with the USDA Food Pyramid and US Dietary Guidelines.	202
10	Demonstrate an understanding of the importance of calcium and iron in women's health.	203
11	Describe the effects of diet and exercise on the blood lipid profile.	204
12	Describe the myths and consequences associated with inappropriate weight loss methods: saunas, vibrating belts, body wraps, electric simulators, and sweat suits.	205
13	List the number of kilocalories in 1 gram of the following: fat, carbohydrate, protein, and alcohol. List the number of kilocalories in 1 pound of fat.	206
14	Describe appropriate weekly weight loss goals.	207
HFI		
15	List the six essential nutrients and describe their nutritional role.	208
16	Discuss the recommended distribution of calories from fat, carbohydrate, and protein.	209
17	Describe the health implications of variation in body fat distribution patterns and the significance of waist/hip ratio.	210
18	Discuss guidelines for caloric intake for an individual desiring to lose or gain weight.	211
19	Discuss common nutritional ergogenic aids, their purported mechanism of action and any risks an/or	212

	benefits (e.g., carbohydrates, protein/amino acids, vitamins, minerals, sodium bicarbonate, bee pollen, etc.).	
20	Describe nutritional factors related to the female athlete triad syndrome (i.e., eating disorders, menstrual cycle abnormalities, and osteoporosis).	213
21	Demonstrate familiarity with the NIH Consensus statement on health risks of obesity, Nutrition for Physical Fitness Position Paper of the American Dietetic Association (endorsed by ACSM), and the ACSM Position Stand on proper and improper weight loss programs.	214
Program and Administration/Management		
HFI		
1	Understand the health fitness instructor's supportive role in administration and program management within a health/fitness facility.	215
2	Demonstrate an ability to administer fitness-related programs within established budgetary guidelines.	216
3	Demonstrate an ability to develop marketing materials for the purpose of promoting fitness-related programs.	217
4	Describe various sales techniques for prospective program clients/participants.	218
5	Describe the documentation required when a client shows signs or symptoms during an exercise session and should be referred to a physician.	219
6	Demonstrate the ability to create and maintain records pertaining to participant exercise adherence, retention, and goal setting.	220
7	Demonstrate the ability to develop and administer educational programs (i.e., lectures, workshops, etc.) and educational materials (i.e., participant handouts).	221
8	Demonstrate an understanding of management of a fitness department (e.g., working with a budget, training exercise leaders, scheduling, running staff meetings, etc.).	222
9	Discuss the importance of tracking and evaluating member retention.	223