Program Design
Choosing Reps, Sets, Loads, Tempo, & Rest Periods

2nd Edition
Program Design
Choosing Reps, Sets, Loads, Tempo and Rest Periods
2nd Edition

by
Paul Chek

A C.H.E.K Institute Publication
San Diego, CA
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PLEASE NOTE

*If you have taken this course as a live seminar and you wish to use it as a prerequisite for the C.H.E.K Institute’s Advanced Training Programs, then you will need to complete the exam. Please see page 96 for information on submitting the exam.

*If you purchased this course through the C.H.E.K Institute e-Learning Platform, you will need to log into your account and take the exam online.
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How to Complete this Course as CORRESPONDENCE COURSE ONLY

To maximize your learning potential, it is recommended that you complete the course in the following manner:

1. **Review the DVDs.** The first time through, just watch, listen and absorb the information.

2. At this point, you should **read the exam** thoroughly. The purpose is not only to pass the exam, but also to be proficient in applying the techniques. The exam questions will help direct your attention to important concepts and information.

3. **Read the manual.**

4. The second time through the DVDs, **follow along in the manual** and take notes! It is recommended that you stop the DVD – rewind and review – as often as necessary to clarify points that you may not understand.

5. **Perform all the assessments and exercises** you are capable of performing with good form. Repeat this process at least twice - not necessarily on the same day - and if possible, also practice them on a willing friend or family member.

6. Now that you have viewed the instructional DVDs twice and have read the exam, it's time to **take the exam.** Instructions for completing the exam are found on pages 96-97. The purpose of this correspondence course is not to trick you, but to make sure that you are proficient in the areas of knowledge presented. The exam is designed to direct your attention to the areas of importance. The exam is designed to be taken online; the exam in the back of this manual is for you to practice on and keep for reference.

7. If you cannot take the exam online for any reason, you may complete the exam in the manual and return the exam answer sheet and grading request sheet via mail, email or fax to:

   C.H.E.K Institute  
   Exam Grading  
   380 S. Melrose Dr, Ste 415  
   Vista, CA  92081  
   USA

   Fax: (+1) 760.477.2630  
   Email: educate@chekinstitute.com

   **Please note:** there is an additional fee for submitting your test to be graded by hand. Please see page 121 for details.
Course Objectives

1. Learn to effectively manipulate acute exercise variables to achieve the desired outcome!

2. Develop a working foundation so that you are capable of comprehending and applying the C.H.E.K Institute’s Advanced Program Design technology.

3. Complete the Program Design prerequisite for CHEK Exercise Coach Program!
Terminology

PLANES OF MOTION

Sagittal Plane: A vertical plane through the longitudinal axis of the trunk dividing the body into two portions. If it is through the anterior-posterior mid-axis and divides the body into right and left halves, it is called a median or mid sagittal plane.

Frontal Plane (Coronal Plane): A plane parallel with the long axis of the body and at right angles to the median sagittal plane.

Transverse Plane: Plane that divides the body into a top and bottom portion.

MOVEMENT TERMINOLOGY

1. Flexion: The act of bending or condition of being bent in contrast to extension.

2. Extension: The movement by which both ends of any part are pulled apart. A movement that brings the members of limb into or toward a straight condition. Opposite of flexion.

3. Adduction: Movement of a limb or eye toward median plane of body or, in case of digits, toward axial line of a limb.

4. Horizontal Adduction: Movement forward of the midfrontal plane, the action of which is in the horizontal plane.

5. Abduction: The lateral movement of the limbs away from median plane of body, or the lateral bending of the head or trunk.

6. Horizontal Abduction: Movement behind the midfrontal plane; the action of which is in the horizontal plane.

7. Pronation: A triplanar motion at the subtalar joint consisting of abduction, dorsiflexion, and eversion; Also, internal rotation of the forearm causing the radius to cross diagonally over the ulna and the palm to face posteriorly.

8. Supination: A triplanar motion at the subtalar joint consisting of dorsiflexion, adduction and inversion, looks like inversion; Also external rotation of the forearm (radioulnar joint) that causes the palm to face anteriorly.

9. Circumduction: The active or passive circular motion of a joint. A combination of flexion, abduction, extension and adduction movements that is usually performed by the hip, thumb, wrist, shoulder, metatarsophalangeal and metacarpophalangeal.
Types of Strength

1. Concentric Strength/Contraction: The muscle develops tension and shortens, causing movement to occur\(^2\).

2. Eccentric Strength/Contraction: The muscle lengthens while producing tension, thus braking, slowing or controlling the speed of movement\(^2\).

3. Isometric Strength/Contraction: The muscle develops tension without producing any external movement\(^2\).

4. Dynamic Strength/Contraction: A more accurate description of the term “isotonic.” Dynamic contractions are those occurring in the presence of varying levels of muscle tension and joint speed. Dynamic contraction is used interchangeably with the European term “auxotonic.”\(^1\) pg. 47.

5. Isotonic: Constant Tone, such as when slowly lowering a heavy load; isokinetic machines produce constant loading. It should be noted that isokinetic or “isotonic” loads are rare in functional environments.

6. Limit Strength: The ability to exceed ordinary levels of absolute strength. A person under hypnosis or perceived life-threatening stress may display this type of strength\(^8\).

7. Maximal Strength: The peak force or torque that the neuromuscular system is capable of producing in a single maximal voluntary contraction, irrespective of the time element\(^2\).
   a. Absolute Strength/Endurance: The maximum amount of force your muscles can produce irrespective of body weight and time of force development. Absolute strength is important for sports in which extra body weight helps performance. Many of the field events in track and most positions in football require high levels of absolute strength\(^8\),\(^2\).
   b. Relative Strength/Endurance: The most force your muscles can produce in relation to your body weight\(^8\).

8. Optimal Strength: The amount of strength needed for maximum performance, in that additional strength will not improve performance\(^8\).

9. Strength Endurance: The ability to produce muscular contractions over an extended period. For example, a distance runner or rower would benefit most from this type of strength\(^8\).
   a. Intensive Endurance: >50% Intensity. For example, a competitive wrestler would benefit from this type of strength.
   b. Extensive Endurance: <50% Intensity. A 2500 meter rower, cross country runner, park ranger, or distance swimmer would benefit from this type of strength.
10. **Speed - Strength:**

   a. **Starting Strength:** The ability of a muscle to generate maximum force at the beginning of a movement.

   b. **Explosive Strength:** The ability of the muscle to continue increasing the force developed from starting strength.

   c. **Reactive Strength:** The ability of the muscle to switch from eccentric (negative) to concentric (positive) work.

**Intra-muscular coordination:** The capacity to recruit motor units within a muscle is referred to as intra-muscle coordination.

- Beginner athletes can generally recruit about 60% of their available motor units (poor intra-muscle coordination).
- Advanced athletes can recruit up to 85% of available motor units in a trained muscle.

---

**Figure 1. Maximal Strength Qualities**

- **Limit Strength**
- **Competitive Maximum** (Fmax or CFmax)
- **Training Maximum** (1RM or TFmax)


Figure 1. Maximal Strength Qualities
Classification of Muscle Actions

1. **Agonists**: Muscles acting as prime movers.

2. **Antagonists**: Muscles acting in direct opposition to prime movers.

3. **Stabilizers**: Muscles stabilizing or supporting a body segment while other muscles carry out a movement. For example, during the first 30° of shoulder abduction, the trapezius muscles, rhomboids, and serratus anterior stabilize (fixate) the scapula, providing a working foundation from which the deltoids and supraspinatus can initiate abduction.

4. **Neutralizers**: Muscles counteracting the unwanted actions of other muscles by tending to produce opposite movements. For example, the anterior and posterior heads of the deltoids contract to neutralize each others actions of horizontal adduction/abduction and rotation during shoulder abduction in the frontal plane.

**Inter-muscular coordination**: The ability for agonists, antagonists, stabilizers, and neutralizers to work together in the execution of any given movement. With training, this “inter-muscle coordination” can be improved, which aids in performance.

For example, when a novice boxer throws a punch, the speed of the punch is reduced by excessive activity in the antagonists. (the body’s way of protecting joints from overload and injury). As the boxer becomes more skilled, with improved inter-muscular coordination, the activation of antagonists is both diminished and delayed, resulting in a faster, harder punch.
Training Terminology

1. **Station Training:** Performing one single exercise, generally followed by a rest period and then repeated for a predetermined number of sets.

2. **Circuit (Series) Training:** Performing a number of exercises in series, often with no rest or very short rest periods between each station (exercise). An extended (specific!) rest period is commonly given after completion of a circuit.

3. **Training Frequency:** The number of training sessions per week.

4. **Training Time:** The amount of time devoted to training. It may be calculated by set, exercise, session, day, week, month, or by any of the classic component measures of time in a periodization model.

5. **Training Volume:** Training volume may be measured by either total reps performed, or total pounds/kilograms lifted per unit of time, i.e., set, session, week, etc. It is important that total weight lifted be considered with total reps to appreciate the intensity/volume relationship.

6. **Training Load:** A measure of weight (pounds/kilograms) lifted per unit of time. Training load is an intricate factor in determining the affect and effect of training volume.

7. **Training Intensity:** A measure of degree of one’s applied strength relative to their current level of maximum strength. Training intensity is probably the most important component of strength training.

**NOTE:** The term “intensity” is frequently used erroneously in current exercise literature, especially in lay publications. Comments such as “high intensity aerobics,” or “high intensity circuit training” are misrepresentations of the term intensity. Poliquin states these workouts should be called “high density workouts.”
Table 1. Maximal number of repetitions as a function of resistance (adapted from 4, pg. 66)

<table>
<thead>
<tr>
<th>Resistance Level</th>
<th>100%</th>
<th>95%</th>
<th>90%</th>
<th>85%</th>
<th>80%</th>
<th>75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetition Maximum</td>
<td>1</td>
<td>1-3</td>
<td>5-6</td>
<td>7-8</td>
<td>Approx. 10-12</td>
<td>Approx. 2-16</td>
</tr>
</tbody>
</table>

**Athlete Classification**

**Training Age:** The training age of an athlete is determined by the number of years consistently performing a strength training program with progressively increasing loads; e.g., a 19-year-old athlete who has been successfully lifting weights for two years would have a training age of 2, not 19.

**Beginner:** <1 year of consistent strength training experience.

**Intermediate:** 1-2 years of consistent strength training experience.

**Advanced:** > 2 years of consistent strength training experience.

Referenced from: J. Hartmann, H. Tunnemann. 1995. *Fitness and Strength Training for All Sports (Theory - Methods - Programs)* (Figure 6. pg. 27). Sports Books, Toronto, Canada.
Energy Systems

When designing an exercise program, the energy system contribution to that athlete's given sport should be considered. For example, when designing a program for a 5,000 meter runner, much more emphasis would be put on rep/set/rest period combinations stressing the lactic acid energy system than would be done for a 100 meter sprinter, who is predominantly utilizing the ATP/PC energy system.

Figure 3. Energy metabolism (kJ/m) of human muscle during exercise as a function of time. (modified after Howard)

Referenced from: J. Hartmann, H. Tunnemann. 1995. *Fitness and Strength Training for All Sports (Theory - Methods - Programs)* (Figure 6, pg. 27). Sports Books, Toronto, Canada.
The respective energy system contributions for each sport are given in Table 2.

<table>
<thead>
<tr>
<th>Sport</th>
<th>Short Term System</th>
<th>Intermediate System</th>
<th>Long Term System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badminton</td>
<td>80</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Baseball</td>
<td>80</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Basketball</td>
<td>85</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Cricket</td>
<td>80</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Fencing</td>
<td>90</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Field hockey</td>
<td>60</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>American football</td>
<td>90</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Golf</td>
<td>95</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Gymnastics</td>
<td>90</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Ice hockey:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>forwards, defense</td>
<td>80</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>goalie</td>
<td>95</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Lacrosse:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>goalie, defense, attack</td>
<td>80</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>midfielders, man-down</td>
<td>60</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Rowing</td>
<td>20</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Rugby</td>
<td>90</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Skiing:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>slalom, jumping, downhil</td>
<td>80</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>cross-country</td>
<td>0</td>
<td>3</td>
<td>95</td>
</tr>
<tr>
<td>pleasure skiing</td>
<td>34</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Soccer:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>goalie, wings, strikers</td>
<td>80</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>half-backs or link players</td>
<td>60</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Squash</td>
<td>50</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Swimming and diving:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50m, diving</td>
<td>98</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>100m</td>
<td>80</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>200m</td>
<td>30</td>
<td>65</td>
<td>5</td>
</tr>
<tr>
<td>400m</td>
<td>20</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>1500m, 1 mile</td>
<td>10</td>
<td>20</td>
<td>70</td>
</tr>
<tr>
<td>Tennis</td>
<td>70</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Track and Field:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100m, 200m</td>
<td>95</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Field events</td>
<td>90</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>400m</td>
<td>80</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>800m</td>
<td>30</td>
<td>65</td>
<td>5</td>
</tr>
<tr>
<td>1500m, 1 mile</td>
<td>20</td>
<td>55</td>
<td>25</td>
</tr>
<tr>
<td>3000m</td>
<td>20</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>5000m</td>
<td>10</td>
<td>20</td>
<td>70</td>
</tr>
<tr>
<td>10 000m</td>
<td>5</td>
<td>15</td>
<td>80</td>
</tr>
<tr>
<td>Standard marathon</td>
<td>0</td>
<td>5</td>
<td>95</td>
</tr>
<tr>
<td>Volleyball</td>
<td>90</td>
<td>10</td>
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</tr>
<tr>
<td>Weight lifting</td>
<td>95</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Wrestling</td>
<td>90</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Contribution of short, intermediate and long term energy systems to common sports. This information is useful in determining acute exercise variables for program design.

The Science of Reps

FACTS ABOUT REP SELECTION

1. Repetitions completed is the single most important acute exercise variable\textsuperscript{15}.

2. Total Reps = Volume
   - Volume is a major factor when balancing a program to prevent injury and has a direct effect on both hypertrophy and strength development.
   - When 2 athletes of comparable strength are on the same basic program the athlete who has greater volume will always be stronger.

3. If you seek muscle mass, increased repetitions from the hypertrophy method (6-12 RM range) seem to produce the best results.
   - If maximal strength is also a concern you should restrict yourself to the 1-8 repetitions range\textsuperscript{1} (see Figure 4).

4. Because sets of 1-3 reps put great stress on the neuromuscular and endocrine systems, they are best used for short periods (1-3 weeks) and only by highly qualified athletes.
   - The endocrine system needs time to recuperate too, otherwise the athlete may experience adrenal depletion\textsuperscript{2}.
   - Bones, joints, and other connective tissues are also heavily stressed with “high intensity training” and may be injured with over exposure to intense loads (see Figure 5) for nervous system effect of high intensity training).

5. The first year of training should be devoted to training with sets/intensities that do not exceed 8RM loads for adolescents and beginners. Fewer reps may be acceptable when using supervised slow tempo training because concentric-eccentric transition stress is minimized; reps can also drop below 8 when using body weight exercises, as long as form is ideal. As a general rule-of-thumb, it is wise to keep training intensities below 80% of (projected) 1RM to allow beginners time for work hardening: progressive adaptation of connective tissues to high stress levels. Adolescents and beginners have more to gain from developing improved body control, and strength gains via improved inter-muscular coordination, which takes place most effectively when good form can be maintained for higher rep volumes (for example, 16-30 reps per set). If an adolescent has not finished growing, using intensities of greater than 8 RM (less than 8 reps/set) without optimal motor system development typically leads to the development of faulty motor patterns. This puts aberrant stresses on the musculoskeletal system, which may disrupt optimal postural development, joint function, an motor patterning such that long term postural and movement faults are created. If an adolescent has been training under the guidance of a skilled coach, and has adequately mastered body weight training, and progressively developed through skillful application of resistance training, this guideline is less important. But this is a very rare situation, particularly in Western countries that lack a structured system of childhood athlete development, such as the Russian system has provided for children in the past.
6. FIBER COMPOSITION: Although not as accurate as a muscle biopsy, muscle fiber composition can be estimated by performing a max reps test using 75% of 1 RM. To perform this test, use the following steps:

a. Find your max for any given exercise, for example your best bench press is 400 lbs.

b. Calculate what 75% of that max weight is; i.e. 400 lbs. x .75 = 300 lbs.

c. After an adequate rest, use the 75% max load (300 lbs. as above) and do as many reps as you can using the same style (technique) as during the 1 RM test.

d. Take the number of reps performed (using Table 3) and find out what your approximate percentage slow twitch fiber composition is. If for example you do 8 reps you have approximately 30% slow twitch.

e. To train the slow twitch muscle fibers, take your % slow twitch and multiply it by whatever the max is for the exercise you performed the test on.

For example:
1 RM bench press = 400 lbs. x 75% = 300 lbs. @ an 8 rep test score = 30% slow twitch fiber composition. 400 x 0.30 = 120 lbs.

You now use 120 lbs as your bench press weight for training the slow twitch fibers.

7. Muscles with higher slow twitch fiber composition (e.g., soleus) respond best to fewer higher repetition sets. Fast twitch dominant muscles (e.g., gastroc) respond best to multiple sets of less reps and high intensity.

<table>
<thead>
<tr>
<th>Total Reps @75% 1RM</th>
<th>Approx. % Type 1 Fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>10%</td>
</tr>
<tr>
<td>6</td>
<td>10%</td>
</tr>
<tr>
<td>7</td>
<td>10%</td>
</tr>
<tr>
<td>8</td>
<td>30%</td>
</tr>
<tr>
<td>9</td>
<td>30%</td>
</tr>
<tr>
<td>10</td>
<td>30%</td>
</tr>
<tr>
<td>11</td>
<td>50%</td>
</tr>
<tr>
<td>12</td>
<td>50%</td>
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<td>90%</td>
</tr>
<tr>
<td>19</td>
<td>90%</td>
</tr>
<tr>
<td>20</td>
<td>90%</td>
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Table 3. Approximate % slow twitch @ reps max with 75% 1RM. With permission from J. Telle

![Figure 4. Repetition/Intensity Relationships with corresponding Strength Training Zones](image-url)
Figure 5. Training at a resistance requiring maximal effort results in very slow speeds and produces neural fatigue. Excessive exposure to this type of training is not optimal for developing maximal strength levels.


Figure 6. Repetition continuum versus training effect. (Poliquin & King 1991). Reproduced with permission from Charles Poliquin 1995.

Figure 7. Repetition/intensity relationships for five exercises

This diagram indicates the variance in repetitions to the same loading intensity among different muscle groups.
Reps and Skill Training

New motor skills are best learned by sets of 12-30 reps in most cases

- Never induce motor fatigue
- Never use high intensity to teach a new motor skill
- Always monitor for mental fatigue!

Practice Program

1. Please write a program of three exercises for a male pairs figure skater that will improve relative strength; he is fully functional; TA = 13

2. Please write a program of three exercises for a mother of three children who has poor core control during stepping, bending and twisting, yet has a functional I.U.; there is motor activity; TA = 0

### Pairs Figure Skater

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NOTES
### Practice Program Answers

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<td>16-20</td>
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<td>Jefferson Squat + String</td>
<td>-2</td>
<td></td>
<td>16-20</td>
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The Science of Sets

1. There is an inverse relationship between sets and reps. As the number of reps increases, the number of sets decreases and vice versa.

2. In the first few weeks of training very little training volume (1-2 sets) will bring about ample amounts of performance improvement because adaptations are neural. It normally takes 6-8 weeks of training before three sets are needed for beginners.

3. Once initial strength fitness is achieved, a multiple presentation of the stimulus (3-6 sets) with specific rest periods between sets is superior to a single presentation of the stimulus. One must ensure that this increase is done progressively.

4. Muscles which are not usually subjected to high levels of training, such as the adductors and neck musculature, react well to few (1-3) sets.

5. Smaller muscle groups, such as the triceps, recover more quickly than large muscle groups, such as the quadriceps. The larger muscle groups need more extensive work loads to achieve optimal results. As an athlete improves their skill level and matures in training age, more sets will be needed to bring about super compensation and performance improvement.

6. In order to maintain the quality of training stimulus, no more than 30-36 sets per workout should be performed. Better results are achieved if the total amount of sets is kept under 20-25. It is also recommended that workouts be kept between 30-45 minutes for optimal hormonal response. There should be an inverse relationship between total time spent training and participating in the primary sport and time spent in the gym (total sets) (see Periodization Concepts).

7. The number of sets is the key loading norm in controlling over-training. If an athlete has not fully recovered from a workout, cut back on the amount of sets, never on the intensity if maximal strength development is the goal.

| Inverse Relationship Between Reps and Sets |
| Reps | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15+ |
| Sets | High | (5-12) | Low | (2-4) |

Figure 8. Rep/Set Relationship.
(Poliquin 1990) Reproduced by permission from Charles Poliquin 1995
8. Use a SET WINDOW (1–4) to prevent injury:
   - The low number being least likely to induce excess trauma
   - The high number representing optimal training volume for that given training program/phase/period.
     - Example: 1–4 sets for a beginner allows safety and adaptation.
     - Advanced applications vary.

9. High Intensity Training (H.I.T.) training most often works because it provides both active rest and periodization of training volume when cycled with other training methods!

10. Multiple presentations of an exercise stimulus are necessary to prevent adaptation as an exerciser becomes more conditioned
**Practice Program**

1. Please add sets to your previous program based on new knowledge of sets!

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## Practice Program Answers

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<td>6</td>
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The Science of Loads

Consider that load is directly related to the amount of tension placed on the working muscle, which is an essential component in both hypertrophy and strength development and in determining neurological demand.

TYPES OF LOADING

**Linear Progression:** Linear progression is the application of progressively increasing intensity. This system is not always optimal because as intensity escalates, volume must decrease, making it hard to maintain hypertrophy gains. There is also elevated risk of injury due to over training.

**Wave Loading:** Wave loading is accomplished by alternating sets of greater loads with sets of lesser loads to stimulate the nervous system. When the neural drive is increased to drive the larger (high threshold) fibers necessary to move maximal loads, a carry over effect results, making the next set with the previously challenging load seem relatively light to the body.

This results in improved performance (as evidenced by an increase in reps with a load found heavy in the last set prior to initiating the wave).

Figure 10
Loading pattern examples for the maximal weights methods. The loading patterns are particularly effective to train the synchronization of motor units and increasing the tolerance to elevated innervation frequencies.

<table>
<thead>
<tr>
<th>MODE A: Wave-like loading I</th>
<th>MODE B: Wave-like loading II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(90%, 95%, 100%) 2-3</td>
<td>(85-88%, 90-92%, 94-97%) 2-3</td>
</tr>
<tr>
<td>3 2 1</td>
<td>3 2 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODE C: Bulgarian method</th>
</tr>
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<tbody>
<tr>
<td>85%, 90%, 95%, 100-103%, 90-92%, 100-103%, 90-92%, 102-105%, 85-88% 3</td>
</tr>
<tr>
<td>5 3 2 1 3 1 1 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODE D: Paler Method I</th>
<th>MODE E: Paler Method II</th>
</tr>
</thead>
<tbody>
<tr>
<td>85% 3, 90% 3</td>
<td>90% 3, 95% 3</td>
</tr>
<tr>
<td>5 3</td>
<td>3 2</td>
</tr>
</tbody>
</table>

*Note that all percentages are only guiding values since the relationship between the maximum and sub-maximum loads is influenced by training status, sex and muscle group. Only individuals with two years experience should use these training intensities.
Load Leaping: Load leaping is a term describing the wave like management of overall volume and intensity in an exercise program. This technique allows for maintenance of hypertrophy and concomitant development of neural drive, while reducing the risk of over training associated with linear progression. Load leaping is a management technique for achieving optimal results with volume and intensity dosages (see Periodization Concepts section).

Loading Techniques: There are numerous techniques of loading. A few examples are:

- Ascending Pyramid
- Descending Pyramid
- Double Pyramid
- Single Set System
- Multiple Set System
- Super Set System
- Drop Set System
- Circuit Programs
- Push Pull System, etc.

These systems are all successful methods of creating an overload. For an expanded explanation of various types of loading systems, I suggest reading the book titled: DESIGNING RESISTANCE TRAINING PROGRAMS by William J. Kraemer and Steven J. Fleck, Human Kinetics, published 1987.

Loads of 1-5 RM (85-100%) are used to develop maximal strength by primarily training the nervous system. The changes in the nervous system are:

- increased neural drive to muscle
- increased synchronization of motor units
- increased nerve impulse frequency
- increased activation of the contractile apparatus
- decreased inhibition by the protective mechanisms of the muscle (golgi tendon organ).
Benefits of Eccentric Training

1. Highly applicable to sports training. Some reasons are:
   - Improved ability to decelerate limbs and implements.
   - Improved ability to control landings from jumps of all types.
   - Important for injury prevention, especially overuse injuries.
   - Best method for overcoming strength training plateaus.

2. Eccentric loading generates more mechanical loading per motor unit. This results in up to 1.3 times more muscle tension than concentric training. The increased stimulus of eccentric training results in greater biological adaptations.

3. May produce hypertrophy faster than concentric contractions.

4. There is better overflow from eccentric to concentric strength than concentric to eccentric.

5. Can be used periodically to improve or maintain the neuromuscular system’s ability to generate fast force production.

   **NOTE:** A protocol commonly used by the Norwegians is to bench press two times per week, one with eccentric contractions only. For the first workout the athlete would perform 5 sets of 4-6 reps at 80-85% or their current maximum in the normal fashion; for the second workout the athlete would use 120% with eccentric only contractions.

6. Eccentric strength training should only be used for six weeks at a time. Each six-week period should be followed by a two-week break.

   **NOTE:** Care must be taken when using prolonged eccentrics. Athletes training for improved relative strength may experience hypertrophy (weight gain!).

7. Eccentric exercise is very beneficial in the rehabilitative setting. Eccentric weakness is often the etiology of overuse injuries in sports.
NOTES
Eccentric Loading (1,2,22)

SPECIAL PRECAUTIONS:
1. Athletes should only begin eccentric strength training after 1-2 years of solid strength training. (There are exceptions in rehabilitative situations)

2. As intensity increases, so does the need for skilled spotters.

3. Muscle soreness after eccentric training may be significant, and can last for several days. Supplementing anti-oxidants and post-workout nutrition may be helpful to aid in rebuilding tissue after eccentric workouts.

4. Eccentric training should not be used too close to athletic competitions because there may be decreased performance for 7-10 days.

5. Eccentric work is best done in sets of 1-6 repetitions since supra-maximal loads are used in this method. One should favor 4-6 repetitions per set when introducing eccentric work. (See Poliquin’s eccentric training progressions below)

Figure 12. Relationship between intensity and repetitions performed by male and females during eccentric external shoulder rotations.

Poliquin’s Suggested Progression for Eccentric Training:

LEVEL 1

For the athlete with less than the recommended 1-2 years of training experience. No training with eccentric loads is needed, just the simple lowering of loads under control should suffice.

LEVEL 2

Use 70% 1 RM to achieve concentric failure, and then do 2-3 forced repetitions with the same load. Repeat for 2-3 sets. As a variation you could perform only one forced rep, but try to stop the descending weights three times for a count of 4 seconds.

LEVEL 3

Use 70% max and go to concentric muscle failure, then do 2-3 forced repetitions with 15% more weight. Repeat for 2-3 sets.

LEVEL 4

Use 80% of maximal load, go to concentric muscle failure, and then do 2-3 forced repetitions with 20% more weight. Repeat 3-4 sets. As an alternative for levels 3 and 4, a training partner can manually apply resistance (pushing the bar down) for the eccentric portion instead of adding weight. These additional negative repetitions will exhaust eccentric strength levels after you achieve concentric muscular failure.

LEVEL 5

Use 110-120% of maximal load, do 4-6 reps for 4-6 sets, resting 4-5 minutes between sets. Take 8-10 seconds for each lowering.

LEVEL 6

Use 125-140% of maximal load, do 2-3 reps for 5-6 sets, resting 4-5 minutes between sets. Take 4-6 seconds for each lowering.
The Science of Tempo

Tempo is recorded as a number sequence that corresponds to the concentric and eccentric actions of the motion with the middle number commonly indicating a pause between muscle actions:

- Squat 311 = 3 eccentric – 1 pause – 1 concentric

1. There is a great deal of evidence that a high load is not the only pre-requisite for strength development: The duration of the stimulus is also of importance.
   - Tempo is the factor that controls the duration of the stimulus.

2. Strength is increased more rapidly if training includes various tempos of execution than if exercises are performed at one speed.
   - Slow speeds of movement (3-10 sec con/ecc) places increased time of tension on the muscular system. This is due to reduced momentum and substantially favors development of muscle size (hypertrophy) and strength.

3. When training at slow contraction speeds for maximal strength, no more than 60 seconds of work should be done for the following reasons:
   a. With sets lasting longer than 60 seconds the stress on the energy system becomes progressively more aerobic, not favoring optimal strength development.
   b. As a muscle fatigues, the capacity to develop muscle tension is lost and conditions for developing strength are no longer optimal.

4. For the first year of training, Eastern Block sources recommend training at moderate and slow tempos.

5. High intensity lifting with >80% 1 RM at a fast tempo is another way to achieve high levels of muscle tension. This recruits fast twitch muscle fibers.

6. When lifting loads quickly, maximal tensile loading of the muscle is only present during the acceleration phase of the lift unless the weight is lowered. When light loads are accelerated explosively, type II B muscle fibers are often recruited. It is during this initial phase that start strength is valuable and trainable (see Fig. 13).

7. Explosive strength training, such as vertical jumps, results in a small insignificant increase in maximal strength, but in a considerable shortening in the time of force production, therefore resulting in changes in the velocity end of the force-velocity curve. High resistance training (> 70% 1 RM) primarily produces changes in the force end of the force-velocity curve.
8. There is a positive correlation between strength and speed of movement at all loads\textsuperscript{16}.

9. The closer a given load is moved to maximum velocity, the greater the intensity and the greater the training effect on a neuromuscular basis\textsuperscript{16}.

10. Training at 30-60\% of 1 RM may produce greater improvements in force production at higher velocities.

11. In an EMG study performed with box lifts, it was noted that cutting the lifting time from 1.5 seconds to 0.75 seconds produced inertial torque four times as large\textsuperscript{27}. This has specific relevance to calculation of joint loads during high velocity lifting and is an indicator of potential joint stress with excessive high intensity lifting volume.

12. Stabilizer training (Type I dominant) requires submaximal loads (=/\textless{} 40\% max) and slow tempos; > 100 sec TUT:
   - Belt Squat @ 10 x 616 = 130 seconds time under tension

13. Dynamic Postural Loading
   - Type II A < 100 seconds loading at 40 - 75\% 1RM
     - Moderate to slow speeds of movement
   - Type II B < 12-15 (~10) seconds loading at 75 - 100\% 1RM
     - Slow Speed/High Intensity
     - High Speed/Mod. Intensity
     - High Speed/Low Intensity

14. When using high intensity training for maximal strength, an effort should be made to accelerate the load as fast as possible, even if the weight moves slowly. This is beneficial for developing the various manifestations of power, i.e., acceleration, explosive, and starting strength. Such training will aid in:
   a. Reducing time to maximal motor unit recruitment.
   b. Improved synchronization of motor units.
   c. Improved rate coding of motor units.
   d. Developing movement qualities similar to those required of most sports.
1. Progress training from slower to faster movements.

2. Begin with a solid foundation of base conditioning prior to attempting high velocity training techniques.

3. For best results, alternate 2-3 week periods of slower training with higher velocity training. 

Peridization of Speed of Contraction

Telle (9, pg.192) shows us that fatigue time of Type IIB fibers begins in 2-3 seconds and is complete between 12-15 seconds. Recovery takes 3-5 minutes. Type IIA fibers begin fatiguing in 6 seconds and are totally fatigued in 30-120 seconds. Slow twitch fibers (Type I) begin fatiguing in 6 seconds and are fully fatigued in 3-5 minutes. NOTE: When a fiber fatigues, it doesn’t stop producing force, it just produces less force. Recovery is considered a return to approximately pre-exercise levels.

15. Rapid movements should be periodized with slower movements for developing maximal strength and/or hypertrophy for the following three reasons:
   a. Rapidly accelerating a load increases the effective loading on a muscle, but only for the time-frame of acceleration, thereafter the loading is reduced because of momentum.
   b. Maximum tension is critical for strength increases.
   c. The risk of trauma is greater with high velocity training (see No.11 above).
Practice Program

1. Please add tempo to your practice program based on your new knowledge of tempo manipulation!

<table>
<thead>
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## Practice Program Answers

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<td>12-20</td>
<td>303</td>
<td>1-4</td>
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The Science of Rest Periods

1. In general, rest periods in strength training should be between 2-5 minutes, with an average of 3-5 minutes.

2. For the purposes of hypertrophy training and exercise programs directed at weight loss or body slimming, short rest periods of 30-60 seconds coupled with high volume training have been found to cause elevated levels of growth hormone and testosterone.

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Actions</th>
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<tbody>
<tr>
<td>Testosterone</td>
<td>Stimulates somatomedians, protein synthesis, growth, &amp; organic metabolism</td>
</tr>
<tr>
<td>Growth Hormone</td>
<td>Stimulates development &amp; maintenance of male sex characteristics, growth and increased protein anabolism</td>
</tr>
</tbody>
</table>

Table 4. Action of Testosterone or Growth Hormone

3. The higher the training intensity and the larger the man, the longer the rest interval should be.

4. Inadequate rest periods result in the following:
   a. Progressive activation of alternate energy systems, i.e. fast glycolytic (lactic acid system), followed by the aerobic energy system

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Actions</th>
</tr>
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<tbody>
<tr>
<td>Glucocorticoids</td>
<td>Inhibits or retards amino acid incorporation into proteins, maintains normal blood sugar level, conserves glucose, promotes storage of fat</td>
</tr>
</tbody>
</table>

Table 5. Actions of Glucocorticoids

NOTE: Activation of the aerobic energy system encourages Glucocorticoid release (cortisol, cortisone, etc.). These hormones are antagonistic to strength and hypertrophy development.
b. Inability to maintain optimal levels of muscle tension

c. Altered recruitment of targeted muscle fibers:

1. **When targeting type I, or II A fibers**, inadequate rest will force recruitment of type II B and reserve fibers in attempt to continue work demand.

2. **When targeting II B fibers**, inadequate rest will result in forced recruitment of II A, and eventually type I fibers. This will significantly effect speed of movement, strength, and muscle tension.

d. Neural fatigue and associated regression of motor skills

e. Accumulation of metabolic waste

f. Psychological fatigue

5. Too much rest between sets may result in the following:

a. Loss of body temperature, causing need to warm up again

b. Loss of nervous system facilitation/stimulation, often resulting in decreased next set performance

c. Increased likelihood of injury after prolonged rest periods

6. Rest period length is vital during skill and/or explosive training. If rest periods are inadequate, fatigue hampers motor learning. Because explosive training frequently has a strong motor learning component, and high levels of IIB fiber recruitment, inadequate rest significantly retards performance.

7. Rest periods can be manipulated to keep an athlete in the lactic acid energy system for tolerance training. Short rest periods coupled with high repetition/low resistance training activates the aerobic energy system. Rest period manipulation may serve as an effective stimulus for program variation.

8. Rest period manipulation:

- Ascending rest periods for beginners and high skill and or high intensity training
- Descending rest periods to induce metabolic shift

9. Strict management and recording of rest periods is essential for consistency of record keeping, and determining program outcomes. *If the rest periods change, the program has changed.*
Practice Program

1. Please add rest periods to your practice program based on your new knowledge of rest period manipulation!

<table>
<thead>
<tr>
<th>Pairs Figure Skater</th>
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<tbody>
<tr>
<td>Exercise</td>
<td>Rest</td>
<td>Intensity</td>
<td>Reps</td>
<td>Tempo</td>
<td>Sets</td>
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<thead>
<tr>
<th>Mother of Three Children</th>
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<tbody>
<tr>
<td>Exercise</td>
<td>Rest</td>
<td>Intensity</td>
<td>Reps</td>
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</table>
## Practice Program Answers

### Pairs Figure Skater

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Rest</th>
<th>Intensity</th>
<th>Reps</th>
<th>Tempo</th>
<th>Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.A. Push Press</td>
<td>3:30</td>
<td>-1</td>
<td>2-4 ea.</td>
<td>X01</td>
<td>6</td>
</tr>
<tr>
<td>D.B. Power Clean</td>
<td>3:30</td>
<td>-1</td>
<td>2-4 ea.</td>
<td>X</td>
<td>6</td>
</tr>
<tr>
<td>S.B. S.A. Squat Push Press</td>
<td>2-3:30</td>
<td>-1</td>
<td>2-4 ea.</td>
<td>101</td>
<td>2-4</td>
</tr>
</tbody>
</table>

### Mother of Three Children

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Rest</th>
<th>Intensity</th>
<th>Reps</th>
<th>Tempo</th>
<th>Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.A. Cable Push + String</td>
<td>1-2:00</td>
<td>-2</td>
<td>16-20</td>
<td>202</td>
<td>1-4</td>
</tr>
<tr>
<td>Box Step-up + String</td>
<td>1-2:00</td>
<td>-2</td>
<td>16-20</td>
<td>Mod</td>
<td>1-4</td>
</tr>
<tr>
<td>Jefferson Squat + String</td>
<td>1-2:00</td>
<td>-2</td>
<td>12-20</td>
<td>303</td>
<td>1-4</td>
</tr>
</tbody>
</table>
Periodization Concepts

WHO STARTED PERIODIZATION?

The ancient Greeks used a crude form of periodization in training for the ancient Olympic games. The Olympics were preceded by a nine month periodized training cycle. The last month was spent in specific competitive preparation at the Olympic site. The Greeks used a 4 day training cycle, known as the tetrad, which was characterized by different manipulations of volume and intensity such that there were “shock”, “base”, and “unloading” days within the cycle.

LINEAR PERIODIZATION

- Not as effective as undulating periodization because there is no mechanism to support muscle mass (hypertrophy) as intensity escalates.

- There may be increased chance of injury due to linear escalation of intensity (tissue stresses).

- Linear periodization is useful in the initial stages of rehabilitative exercise programs. This is due to the fact that initially, high rep / low resistance loading schemes are used, and a linear progression from neural to cellular adaptation is acceptable. At the point which loading intensity has reached 75-80% for 3-4 weeks, undulation should be considered for best progress.
EXAMPLE PROGRAM:

<table>
<thead>
<tr>
<th>WEEKS</th>
<th>1-4</th>
<th>5-8</th>
<th>9-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sets x Reps</td>
<td>5 x 10</td>
<td>5 x 5</td>
<td>4 x 1-4</td>
</tr>
<tr>
<td>Intensity</td>
<td>60-75%</td>
<td>80-90%</td>
<td>90-100%</td>
</tr>
</tbody>
</table>

There are rehabilitation applications for linear progression.

- It is during this stage of strengthening that gains are predominately neural and patients are commonly weak, or far below their genetic potential.
  - ~30% strength gain in first 4 weeks due to neural adaptation (D. Sale)

UNDULATING PERIODIZATION

- The concept of alternating periods of high volume (hypertrophy) training with periods of high intensity (neural) training.
- Undulation in training reduces or eliminates the psychological and physiological causes of progress stagnation caused by an overemphasized specialization on volume or intensity.
- Figures 16 an 17 represent use of undulation periodization for developing both absolute and relative strength.

Figure 16. Loading distribution based on a three-week cycle. Each block of the histogram represents a weekly volume of training in the form of percentage. Reference: Poliquin, 1989

Figure 17. Loading distribution based on a four-week cycle. Each block of the histogram represents a weekly volume of training in the form of percentage. Reference: Poliquin, 1989
A TEN-WEEK PROGRAM FOR A BREASTROKER TO DEVELOP THE STRENGTH AND POWER OF THE ARM EXTensors IN THE GENERAL PREPARATORY PHASE.

Every phase has a duration of two weeks, depending on calendar of competition.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Exercise</th>
<th>Sets/Reps</th>
<th>Speed of Contraction</th>
<th>Tempo</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.C.S</td>
<td>Incline presses, Flat dumbbell presses</td>
<td>3/15-10, 3/15-20</td>
<td>Moderate, Moderate</td>
<td>Stop &amp; Go, Stop &amp; Go</td>
</tr>
<tr>
<td>Acc 1</td>
<td>Bench press to neck, Bench press</td>
<td>3/10-12, 3/10-12</td>
<td>Moderate, Moderate</td>
<td>3s up/3s down</td>
</tr>
<tr>
<td>Int 1</td>
<td>Decline press to neck, Rope press downs</td>
<td>4/3-6, 3/4-6</td>
<td>Super slow, Super slow</td>
<td>5s up/5s down, 10s up/4s down</td>
</tr>
<tr>
<td>Acc 2</td>
<td>Bench press to neck, Lying triceps extensions</td>
<td>3/8-10, 3/8-10</td>
<td>Moderate, Moderate</td>
<td>2s up/4s down, 2s up/4s down</td>
</tr>
<tr>
<td>Int 2</td>
<td>Dips</td>
<td>5/3-5</td>
<td>Super slow</td>
<td>4s up/6s down</td>
</tr>
</tbody>
</table>

LEGEND
G.C.S. - General Conditioning Phase, Acc - Accumulation Phase, Int - Intensification Phase

ACCUMULATION / INTENSIFICATION PERIODIZATION

- By definition, “accumulation” indicates increases in volume, while “intensification” indicates increases in intensity.

- The terms undulating periodization and accumulation/intensification are often used interchangeably. This may lead to confusion, as accumulation indicates “increasing amount”, but does not necessarily indicate changes in intensity, as seen in the undulation style of periodization.

NOTE: Compare Figures 16 and 17 of above with accumulation/intensification program below.

- Many sports don’t lend themselves to periodization.

  *E.g. A skier’s program is very weather dependent. If the weather is conducive to skiing they ski, and if it is poor they are in the gym*. In football, a freshman may be on a schedule for optimal performance in training camp, while a senior is preparing to peak at a bowl game.

- What is the competitive schedule for your sport?

- What will be the duration and timing of the various training phases?
STRATEGIC OVERLOADING

1. Males should taper earlier than females:
   i.e. Swimming short distances: Males 10 days vs. Females 7 days

2. Tapering/muscle mass considerations: The greater the muscle mass of the athlete the longer the tapering period, e.g., 95 kg rower tapers for ten days vs. 60 kg rower tapers for 7 days

3. Energy system requirements: The longer the event the longer you need to taper.

   The periodization principles used for athletes can be used for rehabilitative strength training.
Program Design Considerations

GUIDELINES FOR DEVELOPING AN EFFECTIVE TRAINING PROGRAM

1. Set realistic, attainable goals for every training session and make every effort to attain them. Keep long-range goals in sight at all times.

2. Schedule training sessions and record necessary acute variables such as load, tempo, rest periods, reps and sets completed, and any musculoskeletal aches and pains that may be hindering training.

3. Take note of performance fluctuations with different programs as well as fatigue levels.

4. Increase training according to logical loading principles (super-compensation).

5. Always build off of a foundation of basic/general training.

6. Always schedule training over an entire year, being careful not to discontinue training, which may lead to stagnation and loss of performance. Avoid training breaks that may hinder long-term development.

7. Avoid injury by using appropriate warm-up and cool down techniques.

8. Administer tests for improvement or enter competitions regularly enough to determine the success of your current program. Beginners benefit highly from competitive experience and should not be afraid to compete regularly.

9. Use appropriate re-entry program after injury or illness.
Beginner Level Weight Training

TRAINING GUIDELINES

1. It is wise to use low percentages of maximum to introduce athletes to strength training (60-80%; 8-20 Repetitions)\(^1\). Research shows that the effectiveness of strength training in beginners depends only to a minor degree on the magnitude of resistance, providing the resistance exceeds 45-50%\(^4\). As the fitness level of the exerciser improves, resistance will have to progress for continued strength gains\(^24\), even in beginners.

2. Beginners can make significant gains in strength with 15-20 rep loads since they are at the bottom of their strength potential\(^1\).

3. Gains in strength with 15-25 RM loads are due to enhance motor performance. Exercising with these sub-maximal loads promotes great opportunity for technique control\(^1\).

4. Generally, breaks between sets range between 30-180 seconds depending on program design. During the first 4-6 wks. of training, beginners need not be worked to exhaustion to achieve strength gains as most progress is neural.

5. Strength training exercises requiring high levels of coordination (power cleans, power snatches, clean and jerk) are seldom performed for more than 6 repetitions per set\(^1\).
   - Careful selection must be administered when teaching complex exercises to beginners, if at all. When performed, using PVC pipes as bars and aluminum Olympic style bars make excellent tools for training beginners. Coaching for technique perfection is of paramount importance.

6. Teenagers (and beginners) should perform no more than 30-36 sets per workout, e.g. three exercises @ 12 sets each or 12 exercises @ 3 sets each\(^2\).

7. Athletes with less than 1-2 yrs of successful weight training should not be exposed to <5 RM loads.

8. Beginners must partake in foundation weight training. To partake in too rapid a training load increase, a one sided development of maximal strength, power, or muscular endurance (such as seen with some sport specific training programs) may be dangerous for beginners.
   - High resistance, high velocity, and complicated movements may be beyond the performance capacity and adaptability of an unprepared body, and may, under adverse conditions, cause physical injury. The body's supporting and holding structure is particularly at risk\(^4\).
   - Beginners should spend the first 6-9 months developing the body's basic support systems while getting accustomed to different types of weight lifting and training techniques and resistances. For that matter, programs with multiple exercises, using fewer sets are desirable\(^24\).
9. Select exercises that target the body’s major muscle groups, remembering that where weight loss is a concern, your best results come from exercises targeting large muscle groups, coupled with short rest periods.\textsuperscript{23,24}

10. Choose weights allowing full range of motion training.

11. When designing exercise programs for beginners, optimal results come from using 4-7 exercises per workout for station training and 6-18 exercises for circuit training.

12. During the first two weeks, two training sessions are sufficient. In the following weeks, better results may be obtained from 3-4 training sessions per week.

13. Because connective tissues heal approximately seven times slower than muscle tissue, exercise loads should be progressed slowly.
Strength Training Considerations
for Women and Children

WOMEN

1. The NSCA recommends that female athletes be exposed to resistance training methods in junior high and high school. It is logical that early participation in resistance training would prepare the female athletes for more advanced training methods in college.
   • Because free weight training activates the stabilizer muscles and requires higher levels of neuromuscular control, female athletes can achieve the benefits of resistance training (improved posture, improved joint stability, and improved connective tissue strength) that foster optimal development through adolescence.

2. Due to hormonal fluctuation, the coach/trainer should be aware that females will often test better on strength tests two to three days after the onset of menstruation.

3. Women need longer development times before exposure to extremely heavy weights, due to a lower threshold capacity in their connective and supportive tissues. This may be related to higher levels of relaxin and fluctuation of hormonal states in a woman’s body.

4. Empirical evidence suggests that female athletes lose their strength faster than their male counterparts. Because of this finding it is suggested that females continue to train through the competitive season using 80-90% loading.

5. More multi-joint exercises need to be introduced to the female athlete earlier in her exposure to weight training.
   • Too many women are first introduced to machine training as the “safest” way for females to train.

NOTE: Machine training does little to develop the postural and stabilizer muscles, which is essential training for the modern adolescent female. In fact, coach Goss referenced Fitness Risk Management for stating that 19 out of 20 injuries in health clubs happen on machines, not free weights!

6. Females should be encouraged to strengthen their upper body, with particular attention to the triceps, low back, abdominal, and elbow flexor musculature.
   • Poliquin states that because women have a much higher incidence of joint laxity (elbow hyper extension), strengthening their elbow flexors aids in stabilizing the joint.

7. Because of body weight increases during menstruation, volume and intensity of plyometric exercises should be monitored carefully during this time period.
8. The female body is biologically more adept to training for endurance events due to muscle composition favoring a dominance of slow twitch muscle fibers.

NB: This topic is covered extensively in Equal, But Not the Same by the C.H.E.K Institute © 1998.

CHILDREN / ADOLESCENTS

1. The optimal time to begin resistance training is 11-13 yrs. for girls and 13-15 for boys, although the use of high resistances should be avoided until well into adolescence; even then it needs to be monitored very carefully.

2. Children, adolescents, and adults beginning resistance training of any type should always begin with body weight exercises.

3. Children should be heavily encouraged to participate in activities which develop the neuromuscular system, as this training becomes the foundation upon which both posture and sports performance are built upon in adolescence and adulthood. Examples of such exercises include:
   a. Training on unstable objects such as large balls, teeter totters, swing sets, balance beams, and trampolines.
   b. Climbing ropes, monkey bars, and trees.
   c. Riding bicycles, roller skating, skate boarding, and horse back riding.

NOTE: Goss quotes Russian coaches who state that children are capable of greater capacity for speed development and train ability of the nervous system in the adolescence period.

4. Training for children and adolescents should offer variety to retain their attention. Flexibility should be emphasized.

5. Particular attention should be given to development of abdominal, spinal, and scapulo-thoracic muscles. It is these muscles that are essential to postural development, which has correlation with balance and agility development.

6. Avoid over use of sport specific exercise prescription with children and adolescents due to increased likelihood of sport specific muscle imbalances.

7. Eccentric exercises should assume low priority in children's exercise programs.
Intermediate and Advanced
Weight Training

For more qualified athletes (intermediate and advanced) fewer exercises are needed, although more sets are needed. Soviet weight lifting expert, Arkady Voroboyev, recommends 2-7 exercises with 4-6 being the average. The current trend is to have more frequent workouts of shorter duration.

This allows:
- More sets per exercise.
- Improved inter-muscular coordination via increased volume per exercise.
- Splitting workouts into body parts for optimal concentration of work load.
- Splitting workouts into multi-joint and single joint exercises.

NB: This topic is covered extensively in Advanced Program Design by the C.H.E.K Institute © 1998.

Frequency of Training

1. In the early stages of training, 2 sessions per week are adequate to stimulate strength gains, e.g., Monday and Thursday.

2. The frequency of training is a function of:
   a. Training age
   b. Sex: Women need more training to accomplish strength levels attained by men with less volume at the same intensity.
   c. Nature of muscle trained:
      Larger muscles need less training sessions while smaller muscles can handle more training sessions per week.

3. Empirical evidence suggests that larger men recover slower and thus should be exposed to less frequent training sessions than smaller men.

Strength Coach Charles Poliquin states that the law of least effort should be followed:
- Only increase sets and frequency when gains are no longer appreciable, and do it very gradually.
NOTES
Variety in Strength Training

1. When training elite athletes, the coach must consider that strength training programs lose their efficiency after only two weeks. With intermediate athletes you may have up to three weeks, depending upon their neuro-developmental background. Beginners need their programs modified approximately every four weeks to prevent both nervous system adaptation and injury.

2. **LONG TERM VARIATION**: In regard to long-term variation, Poliquin quotes Tschiene for recommending the following progression of variations of strength training for the sport disciplines:
   - **Step 1** Training of maximal strength, speed strength, and strength endurance. Emphasis is put on general development, the so-called strength training base.
   - **Step 2** Training of maximal strength of the specific muscles involved in the sport without too much concern over the specificity of the movement direction and speed.
   - **Step 3** Training of strength specific to the sport.
   - **Step 4** Plyometric training.

3. **SHORT TERM VARIATION**: Short term variation refers to the manipulation of acute exercise variables, including the exercise selection.

4. **VARIATION OF MAGNITUDE OF TRAINING**: In order to obtain optimal progress, phases of high volume (low intensity), high intensity (low volume), and unloading phases must be alternated.

5. **VARIATION OF CONTRACTION TYPES**: Soviet National Weight Lifting Coach, A.K. Worobjow, (1984) recommends the following proportion between the different types of contractions for optimal strength development:
   - 70% concentric, 20% eccentric, 10% isometric.
   - When training elite athletes, up to 50% eccentric loads may be used in training.

6. Because different parts of a muscle often have different task specific recruitment patterns, a variety of exercises should be used to strengthen any given muscle, e.g., the abdominal musculature are segmentally innervated and have multiple functions which could never adequately be strengthened with only one or two exercises.

7. The biceps femoris has a short and long head, as well as having dual innervation. To effectively strengthen this muscle, resisted movements of hip extension, and knee flexion must be incorporated into a strengthening program.

NB: This topic is covered extensively in *Advanced Program Design* by the C.H.E.K Institute © 1998.
References

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2. Full instructions to complete your exam can be found with the exam.
3. There is only one correct answer for each question. Select the best possible answer.
4. Choose one correct letter (A/B/C/D) for the multiple choice answers or the correct option (A/B) for True/False questions.

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• There is only one correct answer for each question. Select the best possible answer. Choose the correct letter (A/B/C/D) for your answers to the multiple choice questions or the correct option for True/False questions (A or B).
• You must apply what you have learned from the concepts and techniques presented in this course in order to answer some of the exam questions.

Pass Mark
The pass mark is 80%. Each question is worth 1 point. You will need to score at least 80 points of the possible 100 points.

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• If you do not pass the exam, you may retake it twice more online for no additional fee. If you fail to pass on the third attempt you will need to purchase a new exam with a new registration number for $25.
If You Do Not Have Access to the Internet
1. Complete the answer sheet on page 119-120 in the manual.

2. Circle the correct letter (A/B/C/D) for your answers to the multiple choice questions or the correct option (A or B) for True/False questions.

3. Keep a copy of your exam for your records, as your exam will not be returned to you.

4. Complete the Grading Request sheet on page 121 of the manual. There is a $30 grading fee, which includes a paper certificate. You can pay by US check, money order, Pay Pal or credit card.

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Program Design
Correspondence Course Test
(Revised 2010)

1. Examples of acute exercise variables are __________.
   A. Flexibility, stability, strength and power
   B. Volume, intensity, density and time under tension
   C. Training age, max HR, lactic threshold and VO2 max
   D. Reps, sets, loads, tempo and rest periods

2. The squat exercise requires joint motion predominately in which plane?
   A. Sagittal
   B. Frontal
   C. Transverse
   D. All of the above

3. Which plane divides the body into a top and bottom portion?
   A. Sagittal
   B. Transverse
   C. Frontal
   D. None of the above

4. Moving toward the fetal position is an example of __________.
   A. Abduction
   B. Horizontal abduction
   C. Pronation
   D. Supination

5. A sprinter coming out of the blocks is an example of __________.
   A. Pronation
   B. Supination
   C. Circumduction
   D. Adduction
6. Dynamic Strength/Contraction is a more accurate description of the term _________.

A. Kinesthetic
B. Isotonic
C. Eccentric
D. Isometric

7. Relative strength is especially important for _________.

A. Football
B. Wrestling
C. Rugby
D. Golf

8. When a muscle shortens under load this is a ________ contraction.

A. Isometric
B. Eccentric
C. Concentric
D. Quadraplex

9. When muscle contractions are performed at varying joint speeds, this is termed a ________ contraction.

A. Isometric
B. Eccentric
C. Limit
D. Dynamic

10. Competitive maximum strength produces greater measurable strength than limit strength.

A. True
B. False
11. Optimal strength may be defined as the amount of strength __________.
   A. Needed to perform a one rep max with prolonged exposure to strength training
   B. Comparable to an elite 100 meter sprinter
   C. Needed to perform any given sport at a high level
   D. Needed for maximum performance, in that additional strength will not improve performance

12. Improving the ability for muscles to work together in complex movements such as a lat pull-down exercise would be considered improvement in __________.
   A. Intramuscular Coordination
   B. Lumbo Pelvic Coordination
   C. Hand-Eye Coordination
   D. Intermuscular Coordination

13. Intramuscular coordination may best be defined as __________.
   A. Improved ability to recruit motor units within the working muscles of any complex exercise
   B. Improved ability for muscles to perform force during an exercise
   C. Increased ability to recruit a greater percentage of available motor units in any given muscle
   D. The ability for a muscle to improve a synchronous stimulation

14. When a client begins a training program, the initial increase in recruitment of motor units __________.
   A. Starts out slowly and continues slowly as training continues
   B. Starts out slowly and then increases as training continues
   C. Starts out quickly and continues quickly as training continues
   D. Starts out quickly and continues more slowly as training continues

15. During lateral flexion of the trunk in the frontal plane, the ipsilateral internal and external obliques act as prime movers as well as functioning together as __________ to counteract each other.
   A. Agonists
   B. Antagonists
   C. Stabilizers
   D. Neutralizers
16. During a biceps curl, the tricep muscle is acting as the __________.

A. Agonist  
B. Antagonist  
C. Stabilizer  
D. Neutralizer

17. Performing a series of sets with scheduled rest periods on one machine or with one exercise would best be described as __________.

A. Circuit Training  
B. Super Setting  
C. Station Training  
D. Compartmentalized Training

18. When calculating training volume, it is essential that total repetitions performed be correlated with total pounds lifted to determine the true magnitude and/or intensity training volume.

A. True  
B. False

19. The term “Intense Workout” is appropriately used to describe an aerobic exercise program which has been shown to cause heavy sweating and exhaustion in the class participants.

A. True  
B. False

20. When lifting weights, which repetition range best describes intense weight training?

A. 12 – 20 reps  
B. 15 – 18 reps  
C. 6 - 10 reps  
D. 2 - 4 reps

21. It is commonly understood that performing exercises with intensities greater than 80% 1RM recruit __________.

A. Fast twitch type fibers type 2B  
B. Fast twitch type fibers type 2A  
C. Type 1 muscle fibers  
D. All of the above
22. The “effect” of a training load is __________.
   A. Measureable
   B. Subjective
   C. Determined by the trainer’s observation
   D. None of the above

23. The “affect” of a training load is __________.
   A. Measureable
   B. Quantifiable
   C. Determined by the trainer’s observation
   D. None of the above

24. An individual is considered an advanced weight lifter when presenting with greater than two years
    experience of consistent strength training.
   A. True
   B. False

25. It is important to use a health appraisal questionnaire __________.
   A. To determine the total physiological load on a client
   B. To determine potential road blocks for a client
   C. To use as a quantitative measure of a client’s health status
   D. All of the above

26. After an injury or illness it is best to __________.
   A. Continue exactly where you left off before the injury or illness
   B. Have a warm-up phase to ease back into the training program
   C. Start at the beginning so that the injury does not occur again
   D. None of the above

27. The aerobic fast Glycolytic (lactic acid) and anaerobic energy systems are activated independently of
    each other.
   A. True
   B. False
28. Most sports predominately use _________.

A. The long term or aerobic energy system
B. Intermediate or lactic acid energy system
C. Short term energy system
D. All of the above

29. Turning a screw driver is an example of _________.

A. Pronation
B. Supination
C. Adduction
D. Circumduction

30. The single most important exercise variable is _________.

A. Tempo
B. Load
C. Sets
D. Reps

31. When training for the development of maximum strength, you should restrict yourself to repetition ranges of between ________ and _________.

A. 12 - 20
B. 8 - 10
C. 1 - 8
D. 15 - 30

32. Which repetition loading scheme puts the greatest tension on connective tissue and joints?

A. 15 - 30
B. 8 - 12
C. 6 - 8
D. 1 - 4
33. The first year of training adolescent and beginners should be devoted to repetition scheme of _________.
   A. 8 repetitions or greater, such as 8-12 RM
   B. 6 repetitions or greater, such as 6-8 RM
   C. 12 repetitions or greater, such as 12-16 RM
   D. 4 repetitions or greater, such as 4-8 RM

34. At which repetition loading zone are contributions approximately equal between neural and muscular?
   A. 1 - 3
   B. 3 - 5
   C. 6 - 8
   D. 8 - 12

35. To determine approximate percentage of slow twitch muscle fiber (in the intermediate/advanced lifter) for any given exercise, you should perform a 1 rep maximum test followed by an appropriate rest and then 1 set to fatigue with what percentage of your 1 RM?
   A. 65
   B. 75
   C. 85
   D. 95

36. To determine the appropriate weight with which to train slow twitch muscle fibers you would multiply ________ by your 1 RM result for the test exercise?
   A. Your determined repetition maximum with .75 of your 1 RM
   B. The amount of repetitions performed on your third set for any given exercise
   C. 50 % of your 1 RM
   D. Your determined % of your slow twitch muscle fibers

37. Repetition intensity relationships are the same for most exercises.
   A. True
   B. False
38. With a rep range of 8-12 per set, you will be working in the __________.

   A. Max Strength Zone  
   B. Strength Endurance Zone  
   C. Body Building Zone  
   D. Power Zone

39. Repairing the nervous system __________.

   A. Takes about the same amount of time as repairing muscles  
   B. Takes 5-6 times as long as repairing muscles  
   C. Takes less time as repairing muscles  
   D. None of the above

40. Once you have reached optimal strength there is no reason to increase strength any further.

   A. True  
   B. False

41. What best describes the relationships between reps and sets?

   A. Linear  
   B. Correlative  
   C. Inverse  
   D. Transverse

42. In the first 6 weeks of a training program for beginner athletes, how many sets is generally enough to bring about positive adaptations in strength?

   A. 3 - 4  
   B. 2 - 3  
   C. 1 - 2  
   D. 6

43. In order to progress to higher levels of strength, which of the following approaches is best?

   A. A progressive increase in the number of sets with specific rest periods  
   B. Always perform 4 -- 6 sets with 30 second rest periods  
   C. Do whatever technique seems to be working that day  
   D. Use the 1 set to maximum approach and progressively increase the weight
44. Which of the following muscles generally react to fewer sets, with respect to volume intensity relationships, than the remainder of the body’s prime movers?

A. The quadriceps
B. Hamstrings
C. Gluteus maximus
D. Hip adductors

45. Which of the following muscle groups will most likely recover from exercise quicker than the quadriceps?

A. Triceps
B. Deltoids
C. Biceps
D. All of the above

46. The total maximum recommended number of sets per workout is __________.

A. 15 - 20
B. 20 - 25
C. 30 - 36
D. 36 - 40

47. It is suggested that for optimal results the number of sets per workout be kept between __________.

A. 20 - 25
B. 30 - 36
C. 15 - 20
D. 40 - 50

48. An athlete presents himself in a fatigue state prior to beginning your workout. Which is the most effective method for training that individual without overloading the athlete and creating an over-training response, yet maintaining current strength levels?

A. Reducing the amount of weight lifted per set
B. Taking 3 days off
C. Using cold dips prior to training
D. Reducing the amount of total sets per exercise without reducing intensity
49. Connective tissues take __________ to heal as muscles.

A. The same amount of time  
B. Less time  
C. 2-3 times as long  
D. 4-5 times as long

50. __________ is the best time to work out because cortisol levels are the highest.

A. In the evening  
B. Afternoon  
C. In the morning  
D. After a meal

51. If the intensity in a given set varies with the following scenario 75% times three sets, 95% times two sets, 75% times two sets 95% times one set, which form of loading would this best represent?

A. Linear  
B. Pyramid  
C. Inverted pyramid  
D. Wave

52. Which type of relationship should always exist between volume and intensity when developing an exercise program?

A. Linear  
B. Eccentric  
C. Symbiotic  
D. Inverse

53. The following physiological adaptations best describe the body’s response to exercise in which loading parameter (increased neurodrive to muscle, increased synchronization of motor units, increased activation of the contractile apparatus, decreased inhibition by protective mechanism of the muscles (Golgi tendon organ)?

A. 12 – 20 RM  
B. 1 – 5 RM  
C. 15 – 30 RM  
D. None of the above
54. Specific eccentric loading should only be used by athletes who have performed at least __________ years of strength training?

A. 1/2  
B. 1 - 2  
C. 3 – 4  
D. 4 - 5

55. The intensity repetition relationship is the same between males and females for both concentric and eccentric loading.

A. True  
B. False

56. A decrease in performance after eccentric training may last for _______ days?

A. 1 - 3  
B. 2 - 6  
C. 7 - 10  
D. 12 - 20

57. Which form of loading generates the most mechanical loading per motor unit?

A. Concentric  
B. Isometric  
C. Eccentric  
D. Dynamic

58. With an eccentric training program, there will often be greater increases in concentric strength than when training concentrically and measuring eccentric strength.

A. True  
B. False

59. When utilizing eccentric training programs, they should last no longer than __________ weeks without a break?

A. 2  
B. 3  
C. 4  
D. 6
60. Which of the following factors influence strength development?

A. Tempo  
B. Intensity  
C. Volume  
D. All of the above

61. No more than 60 seconds of work per set should be performed when developing maximum strength for which of the following reasons?

A. With sets lasting longer than sixty seconds, the stress on the energy systems becomes progressively more aerobic.  
B. As a muscle fatigues, the capacity to develop muscle tension is lost.  
C. Extended total work times of greater than 60 seconds per set may cause the release of glucocorticoids which are antagonistic to the development of strength.  
D. All of the above

62. The connective tissues in joints will be less stressed with __________.

A. Moderate tempo training  
B. Slow tempo training  
C. Fast tempo training  
D. Explosive tempo training

63. Which tempo of training will best activate type 2B muscle fibers when combined with resistances of 30-60% 1 RM for periods of up to twelve seconds total work time?

A. Slow  
B. Fast  
C. Moderate  
D. Combined tempos

64. Performing 6 reps at maximum velocity during which of the following exercises will produce the fastest tempos (velocity) of training?

A. Un-weighted vertical jumping  
B. Power cleans at 30% 1 RM  
C. Squat jumping at 50% 1 RM  
D. Squat push press with 60 lbs
65. There is a positive correlation between strength and speed of movement at all loads.
   A. True
   B. False

66. For the greatest training effect on the neuromuscular system, which tempo produces optimal results?
   A. Slow
   B. Moderate
   C. Fast
   D. Combination tempo training

67. Fast tempo training results in which of the following adaptations?
   A. Reduced time to maximal motor unit recruitment
   B. Improved synchronization of motor units
   C. Developing motor unit recruitment at velocities similar to those required in most sports
   D. All of the above

68. Rest periods of what length have been found to stimulate a release of growth hormone and testosterone?
   A. 3 – 4 minutes
   B. 2 – 3 minutes
   C. 1 – 2 minutes
   D. 30 – 60 seconds

69. When performing multiple sets of squats at 5 RM intensity, a man at which body weight will require a greater rest period?
   A. 250 lbs
   B. 175 pounds
   C. 200 pounds
   D. 150 pounds
70. When designing an exercise program for specific conditioning in a competitive rower, performing sets of 20 repetitions at 60% of 1 RM coupled with _________ of rest would be most likely to force the athlete into the fast glycolytic, lactic acid energy system?

A. 3 minutes  
B. 2 minutes  
C. 5 minutes  
D. 30 seconds

71. Inadequate rest periods between sets over the duration of multiple sets may force the athlete into the aerobic energy system as a recovery mechanism. This is contraindicated when trying to develop maximal strength for which of the following reasons?

A. Because the aerobic energy system is best used for distance sports such as 10K running and long distance cycling  
B. Because activation of the aerobic energy system encourages glucocorticoid release, the effects of which are antagonistic to developing maximal strength  
C. Because aerobic system activation is often coupled with extreme hunger responses  
D. None of the above

72. Which of the following muscle fiber types has the quickest recovery times when optimally fatigued?

A. Type 2B  
B. Type 2A  
C. Type 1  
D. Type 2C

73. When attempting to isolate type 2B muscle fibers with explosive training, rest periods of what duration are necessary for regeneration/recuperation from the associated neuro fatigue?

A. 1 – 2 minutes  
B. 2 – 3 minutes  
C. 3 – 5 minutes  
D. 30 – 60 seconds
74. If an athlete performs biceps curls in a drop set format with 15 second rest periods for the duration of 6 sets, with the final set being performed at momentary 1 RM, which muscle fibers are most likely to be fatigued?

A. Type 2B  
B. Type 2A  
C. Type 1  
D. All of the above

75. Loss of body temperature and lack of next set performance often result from __________.

A. Too short of a rest period  
B. Drinking too much during the rest periods  
C. Too long of a rest period  
D. Not taking a rest period

76. Management and recording of rest periods is essential for which of the following reasons?

A. Record keeping  
B. Determining program outcomes  
C. Consistency of physiological responses  
D. All of the above

77. During which part of the season would base/hypertrophy training be optimally performed?

A. In Season  
B. Pre-Season  
C. Pre-Season/In Season  
D. Off Season/Pre Season

78. During the In Season which of the following principles should be followed for the best outcomes when designing an exercise program?

A. Keep exercises limited to 4 - 6 key exercises  
B. Incorporate lower volumes of strength training as sports participation increases and include sports specific plyometrics  
C. Training of antagonists  
D. All of the above
79. For obtaining hypertrophy, linear periodization is not as effective as undulation periodization because as intensity increases, volume of work decreases.

A. True
B. False

80. Periodization training programs do not tend to work well with athletes such as tennis players who travel constantly and play year round.

A. True
B. False

81. Linear Periodization often works well in which setting?

A. Training sports teams
B. Training middle aged housewives
C. Training body builders
D. The rehabilitative setting

82. Which of the following factors would indicate the need for a longer tapering period?

A. When training an athlete with increased muscle mass
B. Increased distance in sport
C. Increased duration of event
D. All of the above

83. The base conditioning phase is the most important phase because ___________.

A. It corrects posture
B. It corrects length-tension relationships
C. It strengthens the stabilizers
D. All of the above

84. Environmental demand is the key factor in choosing intensive or extensive endurance___________.

A. True
B. False
85. Speed strength __________.
   A. Consists of explosive strength and strength endurance
   B. Consists of starting strength, explosive strength and reactive strength
   C. Consists of optimal strength, limit strength and relative strength
   D. All of the above

86. Total training time per workout is an important factor in determining __________.
   A. Sets
   B. Loads
   C. Periodization
   D. Tempo

87. Aerobic workouts called “high intensity aerobics” would be more accurately defined as __________.
   A. High density aerobics
   B. High volume aerobics
   C. High load aerobics
   D. High frequency aerobics

88. During skill and explosive training, if rest periods are inadequate __________.
   A. Fatigue will hamper strength development
   B. Fatigue will improve motor learning
   C. Fatigue will hamper motor learning
   D. Fatigue will improve coordination

89. Intensification can be defined as a __________.
   A. Increase in intensity
   B. Increase in accumulation
   C. Increase in volume
   D. All of the Above
90. The optimal time to begin resistance training is _________ for girls and _________ for boys, although the use of high resistances should be avoided until well into adolescence; even then it needs to be monitored very carefully.

A. 11-13 years old, 11-13 years old  
B. 13-15 years old, 11-13 years old  
C. 11-13 years old, 13-15 years old  
D. 13-15 years old, 13-15 years old

91. A rest period of 3:30 was used during the S.A. Push Press in the pairs figure skater program to allow for proper recovery of _________ muscle fibers.

A. Type 1  
B. Type 2B  
C. Type 3  
D. Type 1A

92. In the pairs figure skating program, intensity is written as -1 which indicates _________.

A. Use a weight that allows you to meet the rep range with 1 good rep left  
B. Use a weight that is 90% 1RM  
C. Use a weight that allows the intensity to be lower than normal  
D. Use a weight that is 10% 1RM

93. The “X” in the Tempo column of the pairs figure skater means _________.

A. Perform the exercise at your own pace  
B. Perform the exercise slowly  
C. Use a moderate tempo  
D. Perform the exercise explosively

94. If we increase the rep range in the practice program for the pairs figure skater to 8-12 reps per exercise, based on what was presented in this program we’d also expect _________.

A. Rest periods to increase  
B. Sets to decrease  
C. Tempo to increase  
D. Volume to decrease
95. In the practice program for the pairs figure skater, the exercises chosen are _________.

A. Appropriate for his sport  
B. Appropriate for his training age  
C. Appropriate for his skill level  
D. All of the Above

96. In the practice program for the mother of three, a string is used with each exercise to _________.

A. Train proper recruitment of core stabilizers  
B. Prevent a inverted breathing pattern  
C. Stabilize the trunk  
D. Remind the client she has kids

97. Based on the acute exercise variables in the practice program for the mother of three, you can conclude this program is designed _________.

A. To promote flexibility  
B. To increase speed  
C. To build strength and stability  
D. All of the Above

98. The Jefferson squat is a good exercise for the mother of three because _________.

A. The exercise has high carry-over to her daily activities  
B. She does not need to perform a normal squat at home  
C. The exercise does not cause great fatigue  
D. All of the Above

99. In the practice program for the mother of three, sets are listed as 1-4. This is an example of a _________.

A. Super set  
B. Circuit  
C. Drop set  
D. Set window
100. In the practice program for the mother of three, the tempos indicate that she will be working

A. At her own pace  
B. At slow to moderate speeds  
C. At moderate to fast speeds  
D. Explosively

**Congratulations!**

You have completed this course.
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### Answer Sheet for Program Design Exam

This exam is designed to be taken online. If you are unable to take exam online, you will need to submit:

1. Answer Sheet - page 119  
2. Grading Request - page 121

**Directions:** Circle the correct letter (A/B/C/D etc) for your answers to the multiple choice questions. There is only one correct answer for each question. You must apply what you have learned from the concepts and philosophies presented in this course in order to answer some of the questions.

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| 1 | A | B | C | D | 9 | A | B | C | D | 17 | A | B | C | D | 25 | A | B | C | D |
| 2 | A | B | C | D | 10 | A | B | 18 | A | B | 26 | A | B | C | D |
| 3 | A | B | C | D | 11 | A | B | C | D | 19 | A | B | 27 | A | B |
| 4 | A | B | C | D | 12 | A | B | C | D | 20 | A | B | C | D | 28 | A | B | C | D |
| 5 | A | B | C | D | 13 | A | B | C | D | 21 | A | B | C | D | 29 | A | B | C | D |
| 6 | A | B | C | D | 14 | A | B | C | D | 22 | A | B | C | D | 30 | A | B | C | D |
| 7 | A | B | C | D | 15 | A | B | C | D | 23 | A | B | C | D | 31 | A | B | C | D |
| 8 | A | B | C | D | 16 | A | B | C | D | 24 | A | B | 32 | A | B | C | D |

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Grading Request for Program Design

Directions for taking this exam are on pages 96-97. You can use the answer sheet to practice on before taking the exam online. If you need to send this Exam Answer Sheet into the C.H.E.K Institute to be graded, there is a US$30 fee. The normal turn around time for exams mailed or faxed to the C.H.E.K Institute is 2-3 weeks.

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**Paul Chek** HHP is a prominent expert in the field of holistic health and corrective and high-performance exercise. For over twenty-six years, Paul's unique, holistic approach to clinical assessment, intervention, treatment rehabilitation and education has changed the lives of countless individuals worldwide. By treating the body as a whole system and finding the root cause of a problem, Paul has successfully coached clients toward complete resolution of their health and performance challenges, where traditional approaches have consistently failed.

Paul is the founder of the C.H.E.K (Corrective Holistic Exercise Kinesiology) Institute and the PPS Success Mastery Program based in San Diego, California. He developed the C.H.E.K Advanced Training Programs in 1995, which currently have over 6000 C.H.E.K Institute Trained Professionals worldwide.

For over twenty-six years, Paul's unique, holistic approach to clinical intervention, treatment and education has changed the lives of countless individuals worldwide. As a walking, talking definition of success, Paul is above all an educator: teaching and applying his methods to benefit others. His programs are not only cutting-edge, students leave his courses and trainings with practical information that can be applied to achieve successful results right away.

Paul is a sought after presenter and has consulted for organizations such as the Chicago Bulls, Australia's Canberra Raiders, New Zealand’s Canterbury Crusader’s and the US Air Force Academy. Paul was the keynote speaker for the NZ Musculoskeletal Conference in 1998 and was rated number one speaker by participants at the 1998 IHRSA conference.

From 1992 to present, Paul has produced over 50 videos and advanced level home study courses designed for the fitness and clinical professional, such as his Scientific Core Conditioning and Scientific Back Training series. He is a regular contributor to several publications and websites. His book, *The Golf Biomechanics Manual* and course are PGA approved, and has been adopted for use by professional golf schools, as well as featured on the Golf Channel in 2000.

**Certifications:** Holistic Health Practitioner (California), Certified Neuromuscular Therapist, Clinical Exercise Specialist (ACE), Massage Therapist (CAMTC)

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“Paul's workshops and videos are easily understood and provide excellent tips on proper biomechanics. These programs are a must for anyone in the rehabilitative or exercise fields.”

-Darryl Curl, D.D.S., D.C.

“Paul's approach reflects a unique synthesis of scientific principles and clinical experience that the practitioner can immediately apply.”

-Jay Smith, MD