Athlete Training Principles…

- **Overload & Specificity**
  - Both become more refined and specific to meet the special needs of the athlete

- **Overload – periodization**

- **Specificity** - Needs analysis becomes more detailed as the more similar the training activity is to the actual sport, the more positive transfer there will be between the training and the sport performance (but this does not mean you only train in movement in patterns identical to sport performance)

Readings:

- NSCA text: Chapter 23 pp 589 – 598
  - Information, examples & details also drawn from NSCA Strength & Conditioning text
  - Recommended reading beyond the scope of this course:

- **Power**
  - Becomes a very important/most important parameter for high force & speed producing athletes
Athlete Needs Analysis

Determine for performance:
- Body parts involved
- Direction & angles of joint movement

<table>
<thead>
<tr>
<th>Sample skill</th>
<th>Related sport-specific exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball dribbling and passing</td>
<td>Close grip, box passing, reverse, cut, scoops, pushdowns</td>
</tr>
<tr>
<td>Tackling</td>
<td>Unilateral hip abduction/adduction, leg flexion/extension, leg raise</td>
</tr>
<tr>
<td>Freestyle swimming</td>
<td>Lat pulldown, lateral raise, large</td>
</tr>
<tr>
<td>Jumping</td>
<td>Power clean, push jerk, back squat</td>
</tr>
<tr>
<td>Lacrosse</td>
<td>Strengthen hip, lower extremity row, anti contraction</td>
</tr>
<tr>
<td>Running</td>
<td>Walkover row, scissor row, hip add</td>
</tr>
<tr>
<td>Running/Sprinting</td>
<td>Large, squat, toe raise, sidestep</td>
</tr>
<tr>
<td>Throwing/Blocking</td>
<td>Pullover, overhead throw extension, shoulder internal/external rotation</td>
</tr>
</tbody>
</table>

*This list is not exhaustive; many more sport-specific exercises can be included.*

Athlete Needs Analysis

Determine for performance:
- Force, time/speed, power production
- Metabolic system producing most of the ATP

<table>
<thead>
<tr>
<th>Example</th>
<th>World's strongest man competition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration to exhaustion</td>
<td>One to few seconds duration</td>
</tr>
<tr>
<td>One to 30 secs</td>
<td>&gt;30 secs, up to several minutes</td>
</tr>
<tr>
<td>&gt;5 min</td>
<td></td>
</tr>
<tr>
<td>Muscle contraction level</td>
<td>Max contraction - speed is not important &amp; likely slow</td>
</tr>
<tr>
<td>Max contraction - As fast as possible</td>
<td>Sub max contraction</td>
</tr>
<tr>
<td>VERY low level contraction</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Muscular Strength</th>
<th>Muscular Endurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength Power</td>
<td>Endurance</td>
</tr>
<tr>
<td>Power Power</td>
<td>Power</td>
</tr>
<tr>
<td>Power Power</td>
<td>Power</td>
</tr>
</tbody>
</table>

Muscular endurance cardiovascular endurance Cardiovascular endurance

*Anaerobic*
**Athlete Needs Analysis**

Determine for performance:

- **Work:Rest time cycles = metabolic demands**
  - Interval between repeated sprints, jumps, medium length runs, volleys
  - Soccer, football, tennis, volleyball

- **Directions of movement & change in direction = agility**
  - Only track runners move in a straight line?

**Periodization**

Involves shifting training priorities from non-sport-specific activities of high volume and low intensity to sport-specific activities of low volume and high intensity over a period of many weeks to prevent overtraining and optimize performance.

- Core exercises, primarily, but assistance exercises can also be periodized

---

**Periodization – 3 Cycles & 5 Phases**

1. **Macrocycle** (largest cycle)
   - **Year** – for typical sports with yearly season
   - **4-yr** – for person training for Olympics

   Macrocycle is divided into **Mesocycles**

2. **Mesocycles**
   - Several weeks or few months duration
   - 5 sequential mesophases
     1. Hypertrophy
     2. Strength
     3. Strength/power
     4. Competition/peaking
     5. Active rest

   Mesocycle is divided into **Microcycles**
Periodization – 3 Cycles & 5 Phases

3. Microcycles
   - 1-4 weeks duration, with daily and weekly variation

Resistance training program for strength & power sport based on 5 Mesocycles, each with a specific goal
1. Hypertrophy  
2. Strength  
3. Strength/power  
4. Competition/peaking  
5. Active rest

Periodization

Macrocycle

<table>
<thead>
<tr>
<th>Macrocycle</th>
<th>Hypertrophy Mesocycle</th>
<th>Strength Mesocycle</th>
<th>Str/power Mesocycle</th>
<th>Competition Mesocycle</th>
<th>Rest Mesocycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hypertrophy (or called Hypertrophy / Endurance)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To develop muscular and metabolic base for more intense subsequent phases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sport specific &amp; non-sport specific exercises</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low to moderate intensity (50-75% of the 1RM and very high to moderate volume (three to five sets of 8-12 repetitions)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-4 weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Periodization – 3 Cycles & 5 Phases

2. **Strength**
   - To increase maximum muscle force
   - Sport specific exercises
   - High intensity (80-90% of 1RM) and moderate volume (three to five sets of 5 - 6 repetitions)
   - 2-4 weeks

3. **Strength/power**
   - To increase speed of force development (power)
   - Sport specific power / explosive exercises
   - High intensity (75-95% of 1RM, depending on the exercise, lighter for high speed power lifts) and low volume (three to five sets of 3 - 4 repetitions)
   - 2-4 weeks

4. **Competition/peaking**
   - To attain peak strength and/or power, and performance
   - Sport specific activities
   - For peaking (e.g. for single competition)
     - very high intensity (≥93% of the 1RM) and very low volume (one to three sets of 1 – 2 repetitions).
   - For maintenance (e.g., 82 games in NHL regular season)
     - moderate intensity (~80-85% of the 1RM) and moderate volume (about two to three sets of about 6-8 repetitions).

5. **Active rest**
   - To allow physical & mental recovery
   - Recreational activity
   - Possible low volume & intensity resistance training, or no resistance training
   - 1-3 weeks
Periodization – 3 Cycles & 5 Phases

5 Mesocycles for strength & power sport

1. Hypertrophy
2. Strength
3. Strength/power
4. Competition/peaking
5. Active rest

To maximize gains:
- 5 phases repeated 3+ times per year
  - In this case macrocycle is 1/3 year long (see similar Linear Periodization example 2 later)
- Exercises for a particular muscle group are varied

Periodization

- **Linear**: Traditional resistance training periodization model with gradually progressive mesocycle increases in intensity over time.

- **Undulating or Nonlinear**: A periodization model that involves large fluctuations in the load and volume assignments for core exercises

---

Matveyev's model of periodization

Appropriate for novice athletes

**Linear**

Traditional resistance training periodization model with gradually progressive mesocycle increases in intensity, and decreases in volume, over time.

- **Volume** (quantity)
- **Intensity** (quality)
- **Technique** (training)
- **Peaking at most important time**

---

Periodization - AEROBIC EXAMPLE

- **Linear**: Traditional resistance training periodization model with gradually progressive mesocycle increases in intensity, and decreases in volume, over time.

---

Periodization

- Linear
  - Decreasing volume, as reps decrease
  - Increasing intensity, as load increase

**TABLE 23.2**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Length (weeks)</th>
<th>Sets</th>
<th>Goal repetitions</th>
<th>Rest period length</th>
<th>Assigned load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophy/Endurance</td>
<td>2-4</td>
<td>1-3</td>
<td>8-12</td>
<td>1-2 minutes</td>
<td>~75% 1RM</td>
</tr>
<tr>
<td>Strength</td>
<td>2-4</td>
<td>3-5</td>
<td>5-6</td>
<td>3-5 minutes</td>
<td>~95% 1RM</td>
</tr>
<tr>
<td>Strength/Power</td>
<td>2-4</td>
<td>3-5</td>
<td>3-4</td>
<td>2-3 minutes*</td>
<td>90-93% 1RM**</td>
</tr>
<tr>
<td>Competition</td>
<td>2-3</td>
<td>3-4</td>
<td>1-2</td>
<td>3-5 minutes</td>
<td>~95% 1RM**</td>
</tr>
<tr>
<td>Active rest</td>
<td>1-3</td>
<td></td>
<td>No resistance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Some exercises or situations may require up to a 5-minute rest.
**The loads for power exercises (e.g., push press, power clean) need to be somewhat lighter to permit rapid and explosive movements (consult reference 3 for details about assigning loads for power exercises).

Macrocycle (e.g., single competitive season)

Microcycles detailed on next slides

**Periodization - Linear**

**TABLE 10.1**

**A Periodization Model for Resistance Training**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Phase</th>
<th>Hypertrophy/Endurance</th>
<th>Basic strength</th>
<th>Strength/Power</th>
<th>Peaking</th>
<th>OK</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>Low</td>
<td>High</td>
<td>Very high</td>
<td>High</td>
<td>Moderate</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Volume</td>
<td>High</td>
<td>Moderate</td>
<td>Very low</td>
<td>Moderate</td>
<td>Low</td>
<td></td>
<td>Low</td>
</tr>
</tbody>
</table>

Microcycles, across weeks in one mesocycle

**TABLE 21.1**

**Sample Three-Day Linear Periodization Program**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Week</th>
<th>Sets</th>
<th>Goal Load</th>
<th>Reps</th>
<th>1RM</th>
<th>1RM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertrophy/Endurance</td>
<td>1</td>
<td>5</td>
<td>12</td>
<td>1</td>
<td>~75% 1RM</td>
<td>~75% 1RM</td>
</tr>
<tr>
<td>Strength</td>
<td>2</td>
<td>10</td>
<td>15</td>
<td>1.5</td>
<td>~85% 1RM</td>
<td>~85% 1RM</td>
</tr>
<tr>
<td>Strength/Power</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>~90% 1RM</td>
<td>~90% 1RM</td>
</tr>
<tr>
<td>Competition</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>~95% 1RM</td>
<td>~95% 1RM</td>
</tr>
</tbody>
</table>

*These loads are for power exercises only. Curves had assignments, where no reference is made to intensity, are used.
**These percentages of 1RM and the rep ranges apply to power exercises only.
---

Periodization - Linear

**TABLE 16.1**

**A Periodization Model for Resistance Training**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Phase</th>
<th>Hypertrophy/Endurance</th>
<th>Basic strength</th>
<th>Strength/Power</th>
<th>Peaking</th>
<th>OK</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>Low</td>
<td>High</td>
<td>Very high</td>
<td>High</td>
<td>Moderate</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Volume</td>
<td>High</td>
<td>Moderate</td>
<td>Very low</td>
<td>Moderate</td>
<td>Low</td>
<td></td>
<td>Low</td>
</tr>
</tbody>
</table>

Microcycles, across weeks in one mesocycle

---

Athlete Training 25

Athlete Training 26

Athlete Training 27
**Periodization**

**Linear: Example 1**

**Performance changes in world-class kayakers following two different training periodization models**

Jesús García-Pallarés, Miguel García-Fernández, Luis Sánchez-Medina and Mikel Izquierdo

European Journal of Applied Physiology © Springer-Verlag 2010
10.1007/s00421-010-1484-9, Published online: 23 April 2010

**Periodization applied to ENDURANCE training**
- Only one of the two periodization programs in the study discussed in this example
- This study/training program also included resistance training, not discussed in this example

---

**In a LINEAR periodization program: There is a sequence of training for hypertrophy then strength then power, each phase lasting a few weeks; there is a dramatic progressive decrease in volume and increase in intensity across the macrocycle.**

---

**Periodization Linear: Example 1**

**Performance changes in world-class kayakers following two different training periodization models**

Jesús García-Pallarés, Miguel García-Fernández, Luis Sánchez-Medina and Mikel Izquierdo

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**Periodization applied to ENDURANCE training**
- Only one of the two periodization programs in the study discussed in this example
- This study/training program also included resistance training, not discussed in this example

---

**Periodization Linear: Example 1**

**Contribution of each exercise intensity zone to the total endurance training time performed in each phase and cycle**

<table>
<thead>
<tr>
<th>Phase</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>17.4 ± 0.8 (33%)</td>
<td>11.9 ± 0.5 (24%)</td>
<td>5.0 ± 0.2 (27%)</td>
</tr>
<tr>
<td>Week 2</td>
<td>11.9 ± 0.5 (24%)</td>
<td>15.8 ± 0.3 (32%)</td>
<td>4.8 ± 0.1 (26%)</td>
</tr>
<tr>
<td>Week 3</td>
<td>5.3 ± 0.9 (10%)</td>
<td>21.8 ± 1.0 (44%)</td>
<td>8.6 ± 0.8 (47%)</td>
</tr>
</tbody>
</table>

Total training time (5 wks, 5 wks, 2 wks): 52.7
Training time per week: 10.54

Data are expressed in hours as mean ± SD (% of total time)

Increase proportion of high intensity work
Slight decreased volume (greatest in last 1 week of 2 in Phase C?)
Periodization

Linear: Example 2, The Path to Athletic Power, Boyd Epley, pg 182

- Year-round program for single season: Repeat first 2-4 phases, 3x, to prepare for season. Keeps each phase to 3-4 weeks.
- 2 phases
- 3 phases
- 3 phases Again (Cont.)
- 3 phases again
- Maintenance phase during football season

Periodization


- 4 running phases (periods)
- 4 resistance training phases (periods)

Periodization

Linear: Example 4, Mike Bahn, Senior Strength & Conditioning Coach, US Ski and Snowboard Association, Feb 2013

- Loads = intensity, 1= light, 5= hard
- Muscular endurance
- Metabolic levels explained on next slide...

Periodization

Linear: Example 4, Mike Bahn, Senior Strength & Conditioning Coach, US Ski and Snowboard Association, Feb 2013

- A1 = training zone which is very low intensity/high volume. A conversational pace that can be maintained for long duration.
- A1/LT = training zone that is near their lactate threshold; difficult to maintain for more than a 5-10’
- VO2 = the maximum effort that can be maintained for up to 20’
- ModTol = As hard as possible for 1-2’
- Tolerance = As hard a possible for a short duration, usually ~30”
Periodization
Nonlinear (Undulating): A periodization model that involves large fluctuations in the load and volume assignments for core exercises.

In a NONLINEAR periodization program:
• hypertrophy, strength & power workouts are all within the same week
• there is no dramatic progressive decrease in volume and increase in intensity across the macrocycle

LISTEN to Dr. Bill Kramer, one of the originators of nonlinear (undulating) periodization, describe it. 6'20''
Source: Strength & Power hour podcast, 09-06-14. Strengthpowerhour.com

Example 5a, Faster, Better, Stronger, Heiden, Testa, Musolf, pg 111+
This form of periodization takes full advantage of the recovery week preceding the start of each cycle.
Week 1: Hardest exercise
Week 2: Fasted exercise
Week 3: Moderate exercise
Week 4: Easiest exercise
Repeat.

This modality of periodization dictates the hardest work after the easiest week, which makes sense: you are in the best condition when you need it. The difficulty of the third type of periodization, however, is that even though the exercise in such successive weeks is “easier,” it will feel harder due to the work you have done the previous week. Say, for example, you run 70 miles in the first and hardest week. In the second—supposedly easier—week, you run 30 to 40 miles, but it will feel like 70. During the third—and even easier—week, you run even fewer miles, but once it has been three weeks since your last period of recovery, it is going to feel very difficult—and it will break your body remarkably. Perhaps this third week, you do active recovery, and will it be wonderful? And when the cycle is repeated, the easiest/hardest weeks are in sync.

Some people will experience a huge drop in performance when the cycle reverses with the first—and hardest—week again in the next cycle. For this reason, some athletes use this form of periodization to peak for a specific event. But it’s important to know yourself; some people also find themselves overtraining. This is where training becomes more art than science. You have to know yourself and judge whether it works for you.

Example 5b, Faster, Better, Stronger, Heiden, Testa, Musolf, pg 111+
Fourth Type of Periodization
This modality works somewhat in reverse of the previous one. It’s what we most often counsel people to use when they are in competition season.
Week 1: Hard exercise
Week 2: Easy week or tapering (details on tapering in Chapter 7, “Better Rest”)
Week 3: Competition or hardest exercise
Week 4: Active rest
Repeat.

The fourth type of periodization is successful because the hardest week is always followed by active rest, so recovery and adaptation are allowed to occur. Unlike the first type of periodization, the fourth modality doesn’t place demands on your body that increase indefinitely. Instead, rest weeks are built in. (Our program also dictates rest days as an integral part of each week’s schedule.)

*Active rest in this context means doing the same workouts but at a lower intensity and volume, or working on specific techniques you need to develop to avoid injury or improve your performance.
**Periodization**

**Example 6, The Science of Running, Steve Magness, pgs 178, 239**

**Within Season Periodization**

The next step is looking at how to plan training for one season. While the basic ideas of periodization have been mentioned before, an in-depth look is needed. With older models of periodization you basically had one training period focused on one training goal, and the subsequent period focused on an entirely different goal. An example would be a base period focused on aerobic running, followed by a threshold period, then VO2max, then a speed phase.

Unlike this traditional model, in the following method there is really a period of training where only one or two types of work are done. The only exceptions are when coming back from a break post season or coming back from a long layoff. Instead, during each training period, the vast majority of the training components are included; the only thing that changes is their emphasis. The result is that peak fitness is never incredibly far away like in the traditional model, and also peak racing can be sustained for a longer time period. This is a necessity in modern track and road racing as athletes no longer plan for just one big race per year but have many important competitions throughout the season.

The training periods can be broken down into a base phase where general training is emphasized, a pre-competition phase where specific training is emphasized and a competition phase where specific training is emphasized. While I am breaking down the season into phases for the purpose of easy conceptualization, in reality they are really blends; they are not distinct and abrupt phases but rather blended into each other.

**Start backwards. Work the extremes. Bring it together. Never leave anything behind. Progress everything.**

In later phases still doing some of previous phases, but in lesser amount (e.g. in “power” phase you can’t neglect “strength” exercises)

---

**What to learn from this unit for a test?**

- Terms, definitions & patterns for cycles and phases
- Not: specific details in examples of loads, reps, sets for a specific week

---

**Example 5c, Faster, Better, Stronger, Heiden, Testa, Musolf, pg 111+**

**Athlete Training**

**Week to work in the program in Part Two, you will essentially plan the same sort of pattern, although the design gets a bit more sophisticated. You will alternate hard and easy sessions, by turns having days when you challenge your cardiovascular system and days when you challenge muscular adaptation. Each of your systems will keep going at its own pace while the system or systems you worked most recently are recovering, rebuilding, and preparing for their own load. While periodization is its strictest form will help you to prepare or peak for an event or a time period in the future when you want to be at your best, we are also applying it to your program on a day-to-day and week-to-week basis to capture your body’s taper response. We do this by recommending exercise that alternates types and builds from easiest to hardest and then allows rest and recovery before building again. This form of periodization will help ensure your success. The temps of hard and easy days also changes as you gain fitness. In the beginning we will give you only one hard day followed by two easy days (i.e., taking two hard days each week) because in the beginning you are also training your body to recover. Say you start with heavy days on Sunday and Monday. At first it will take until Tuesday for you to feel recovered. However, in time you will feel recovered by Monday. When that happens, we will urge you to do three heavy days a week and then four, eventually progressing to two hard days back to back to stimulate even more improvements.**