



LONG TERM ATHLETE DEVELOPMENT: The U.S. Ski Team Approach



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Ted Ligety



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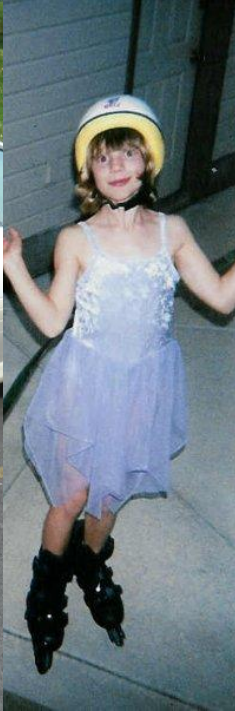


Park City, Utah



U.S. Ski Team Training Facility







Parent, Coaches, Athlete

**Stakeholders
see this...**

**...and imagine
this!**



If they look like Ted, why can't they train like Ted?

**Is early specialization
a prerequisite for adult
expertise?**





Early specialization...

- 10 year rule
- 10,000 hours
- Power law of practice
- Deliberate practice



Simon & Chase (1972), "Skill in Chess".



Newell & Rosenbloom, (1981), "Mechanisms of skill acquisition and the law of practice".



Ericsson, et al., (1993), "The role of deliberate practice in the acquisition of expert performance".

All Valid!

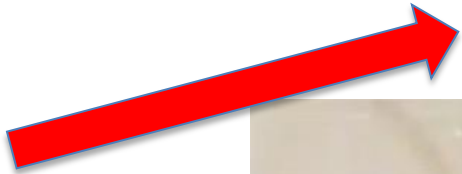


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But... One thing is missing...

Athlete AGE???

- Chronological age
- Biological age
- Training age



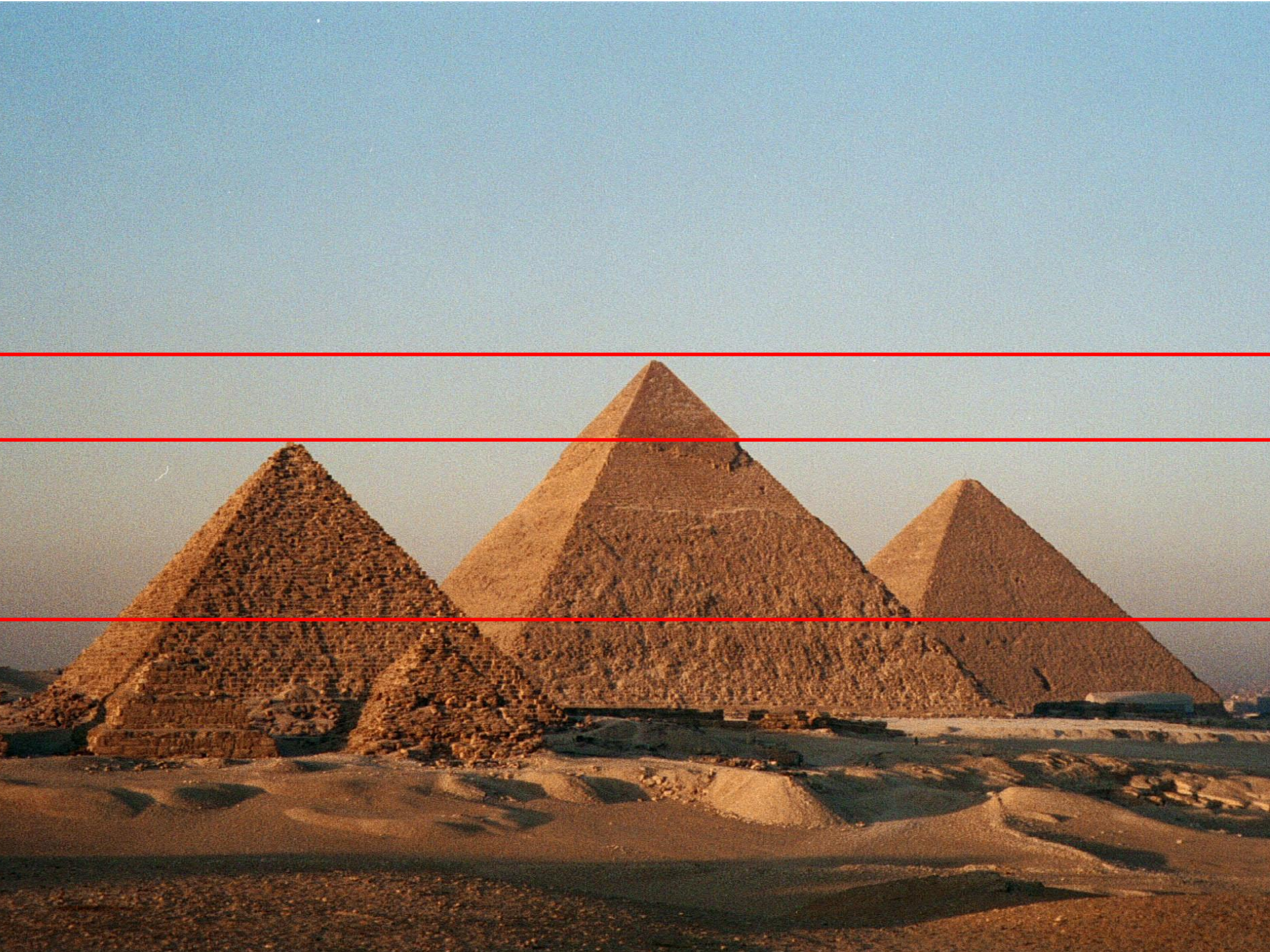
Ron LeMaster

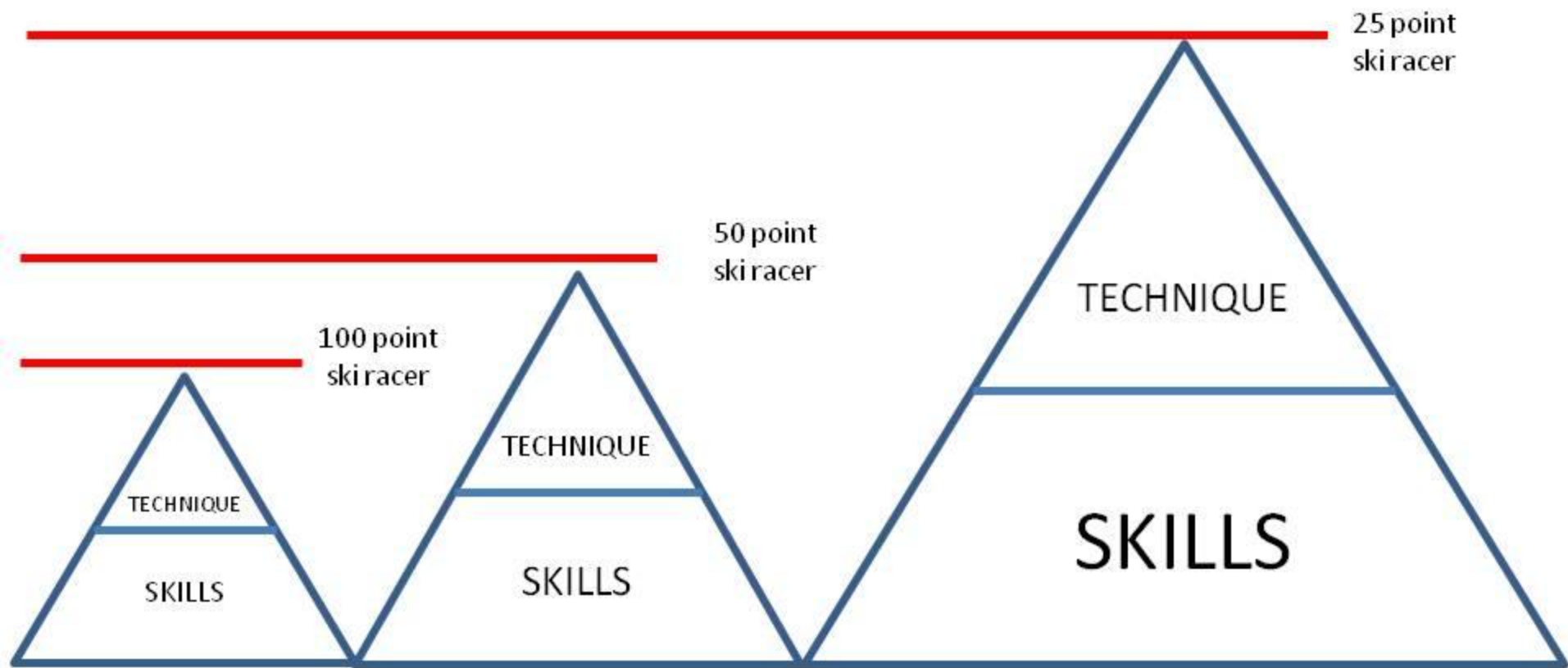
“Training AGE” is dependent on...

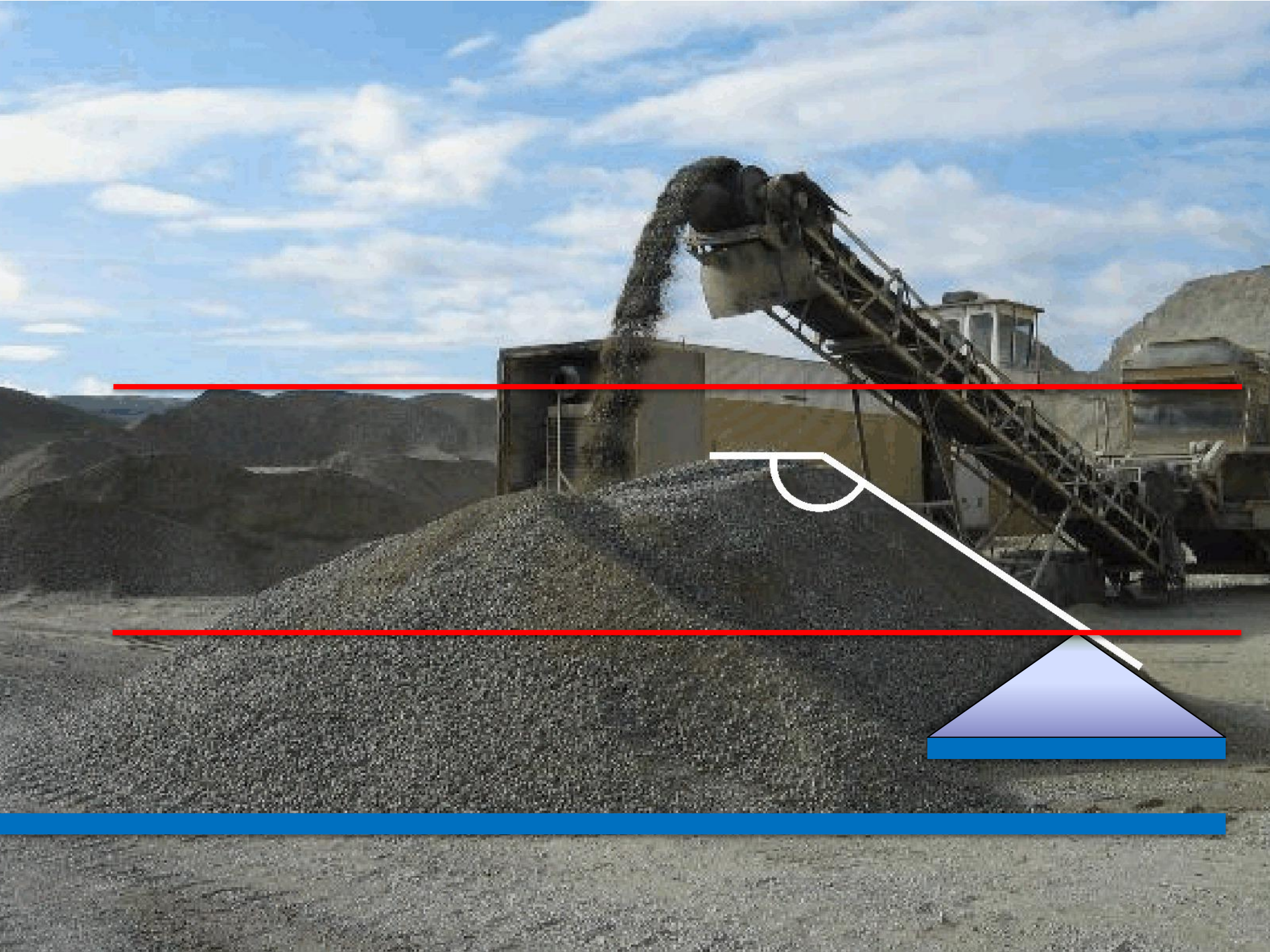
- Volume
- Intensity
- Density

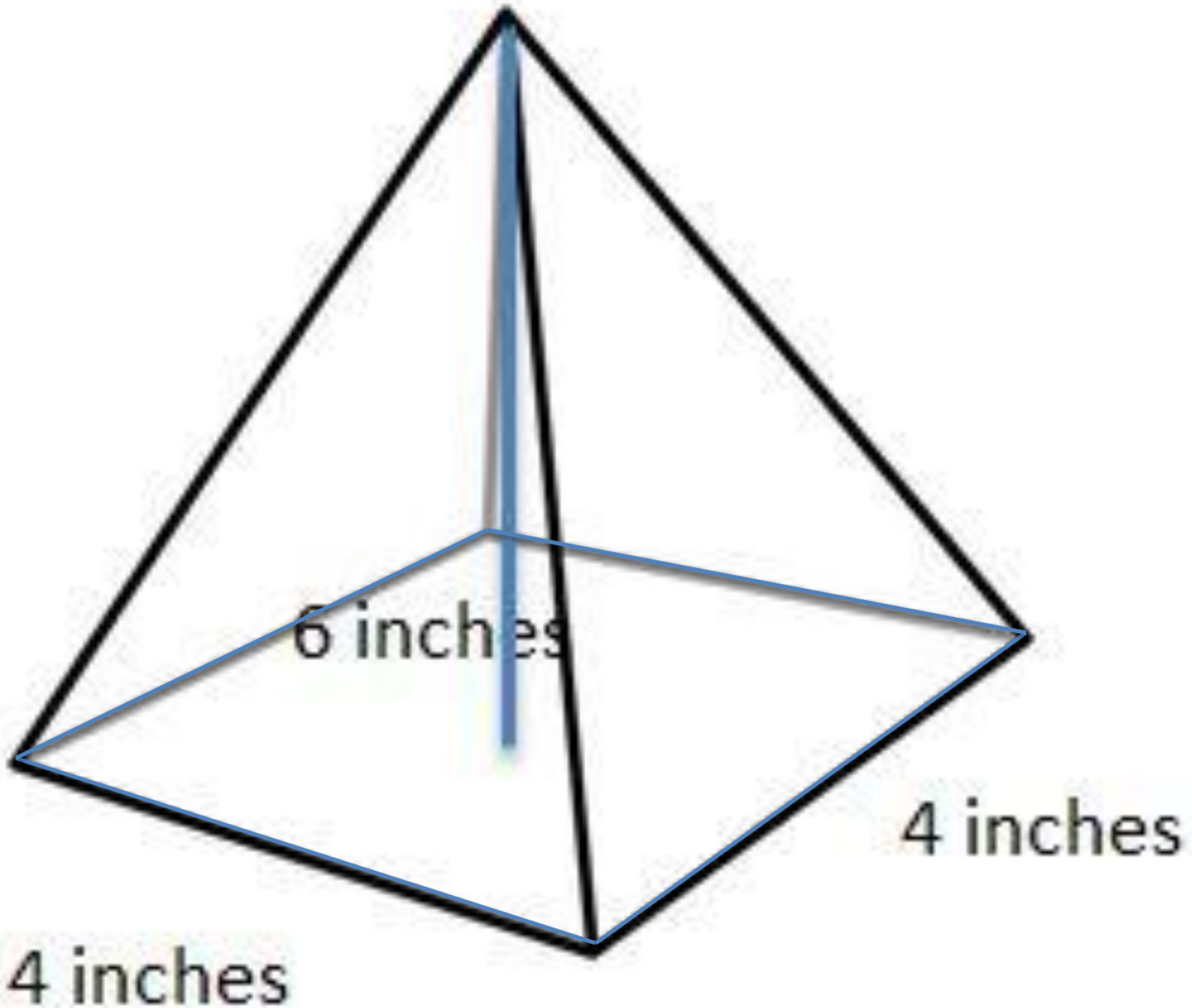


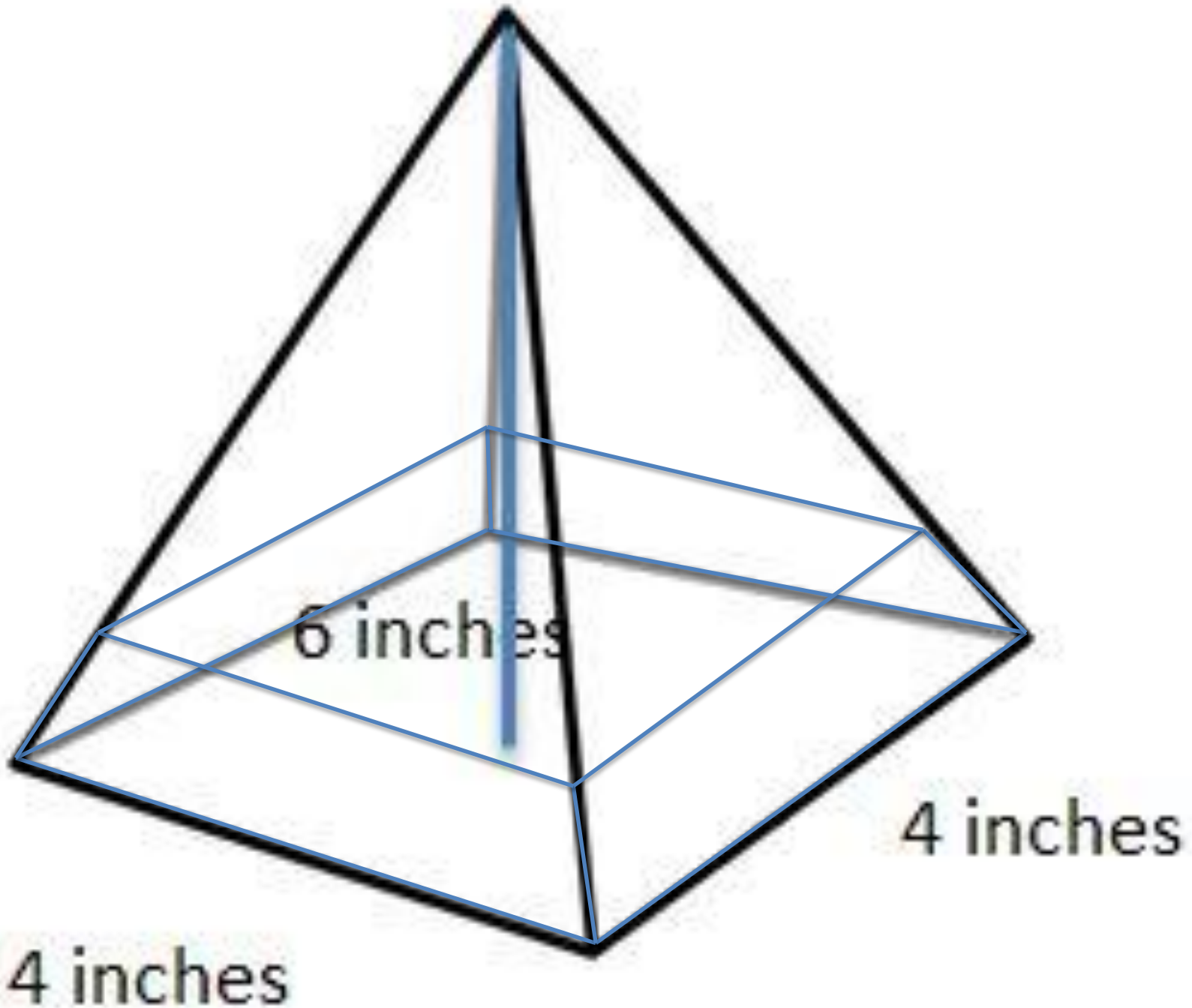


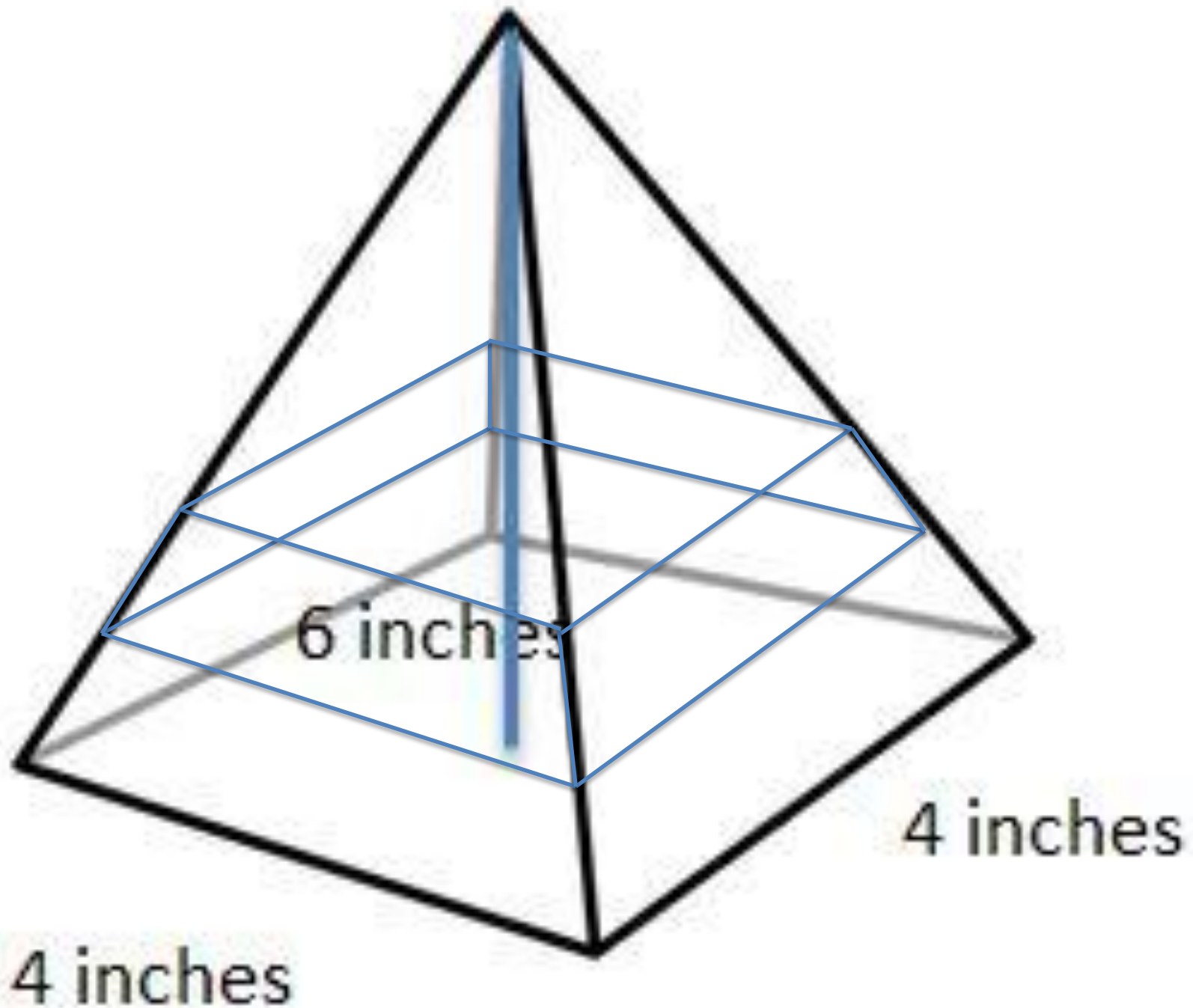


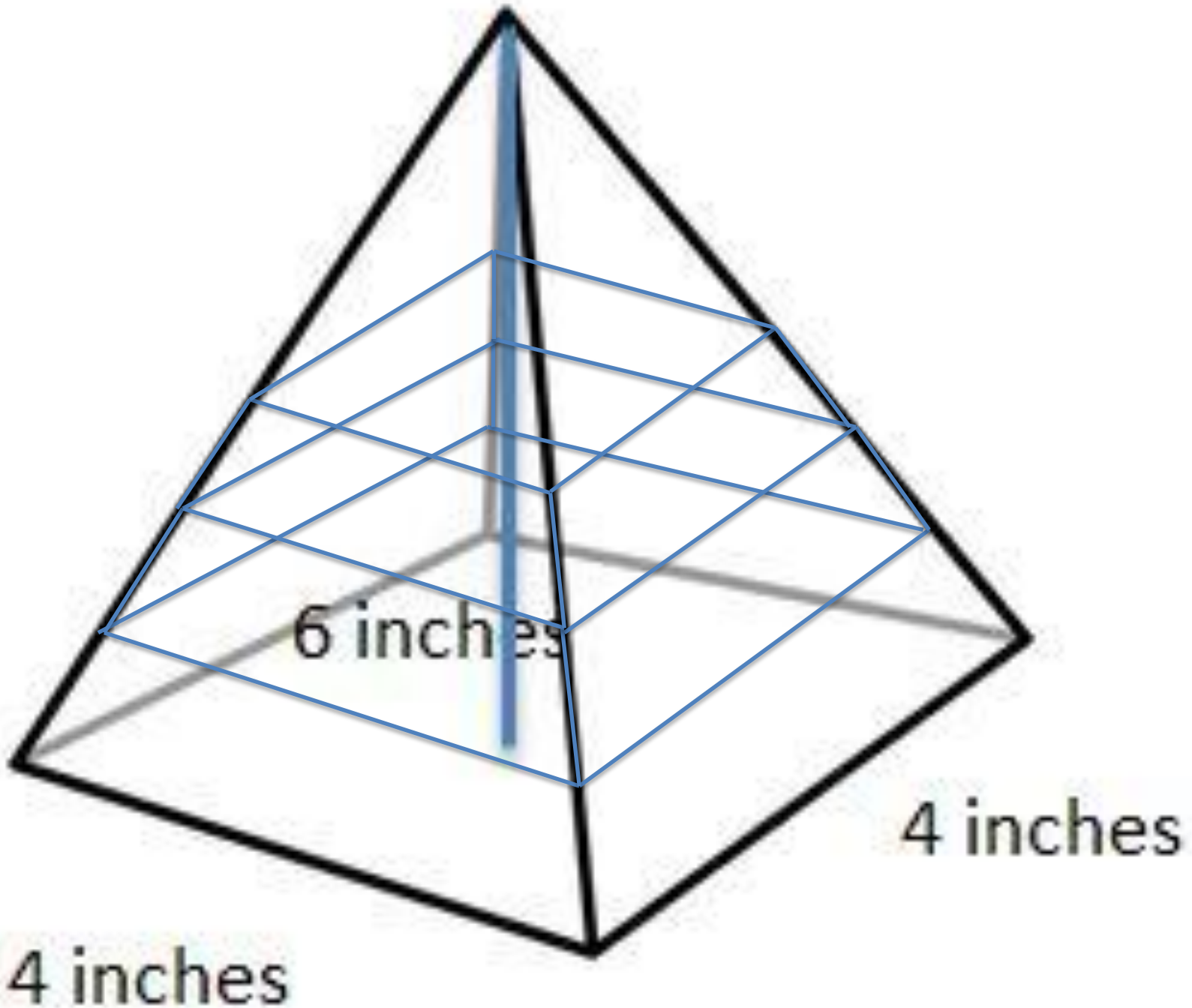


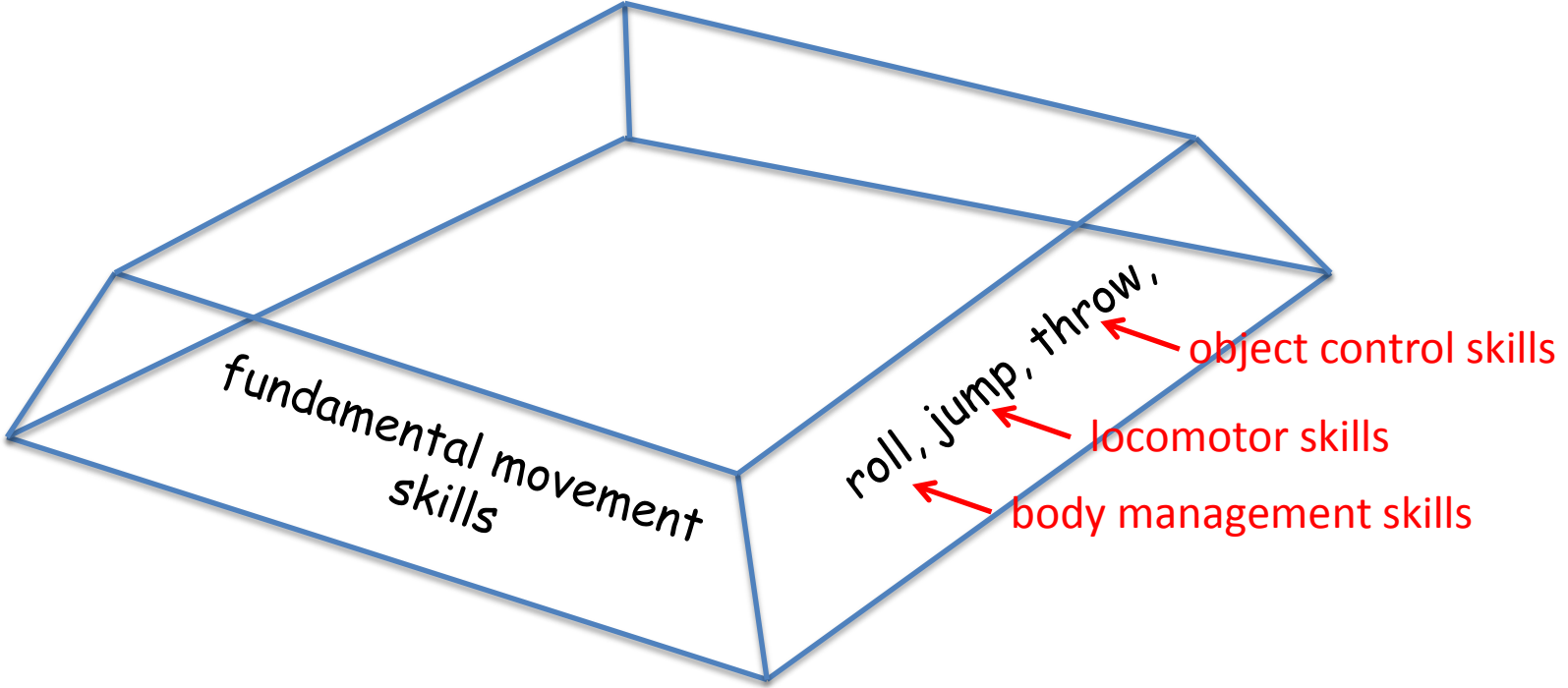


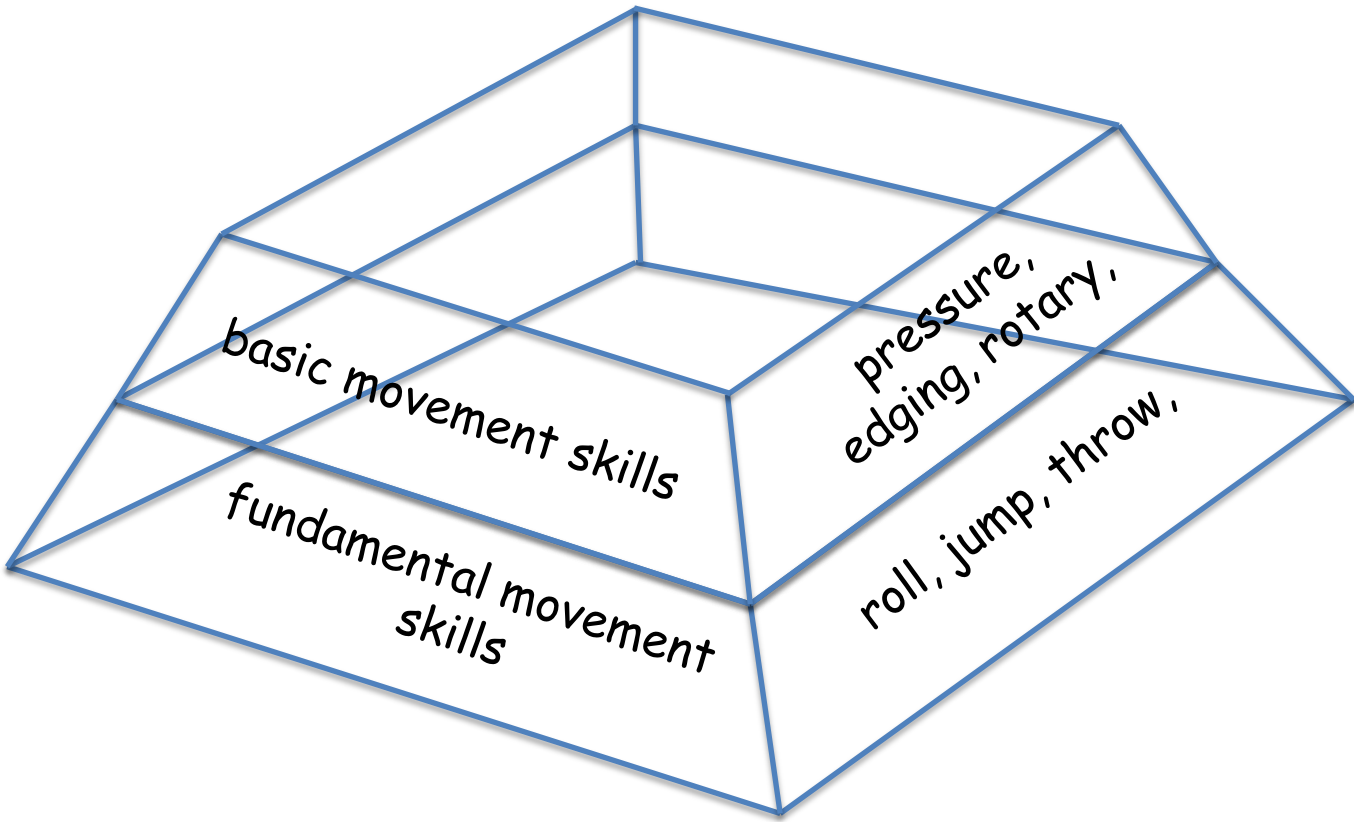










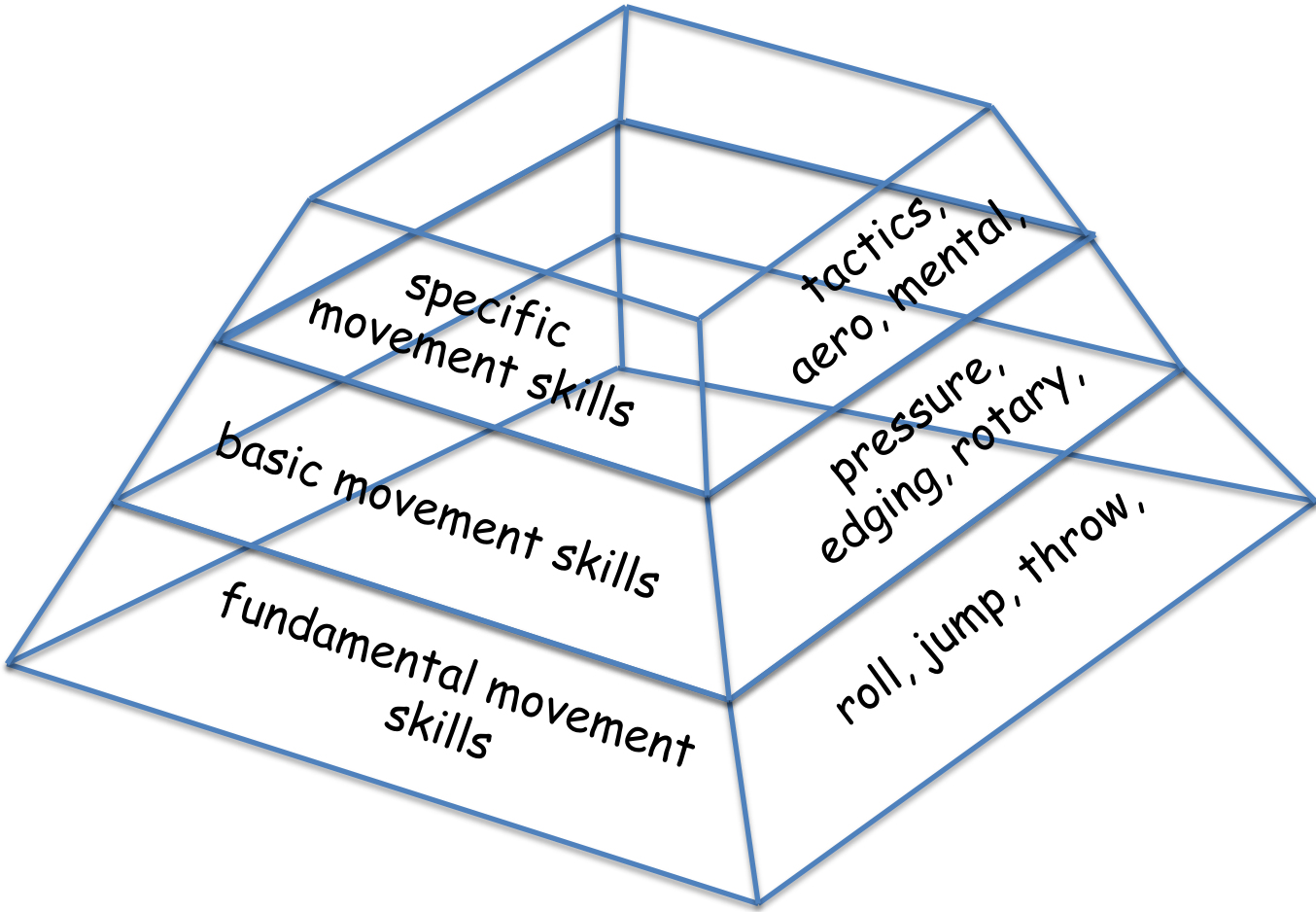


basic movement skills

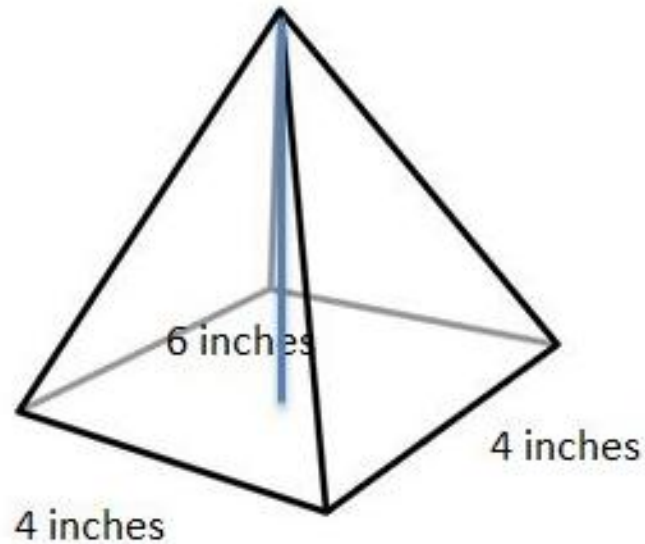
fundamental movement skills

pressure,
edging, rotary,

roll, jump, throw,



Pyramid can/should be based on...



- motor control
- aerobic
- anaerobic
 - strength
 - power
 - speed



blood volume
stroke volume
cardiac output



capillary volume
capillary density
mitochondrial volume
mitochondrial density
oxidative enzyme

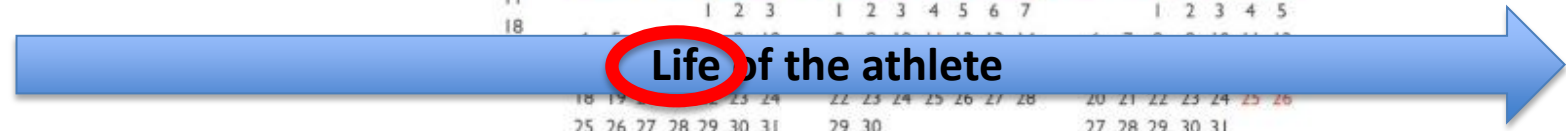
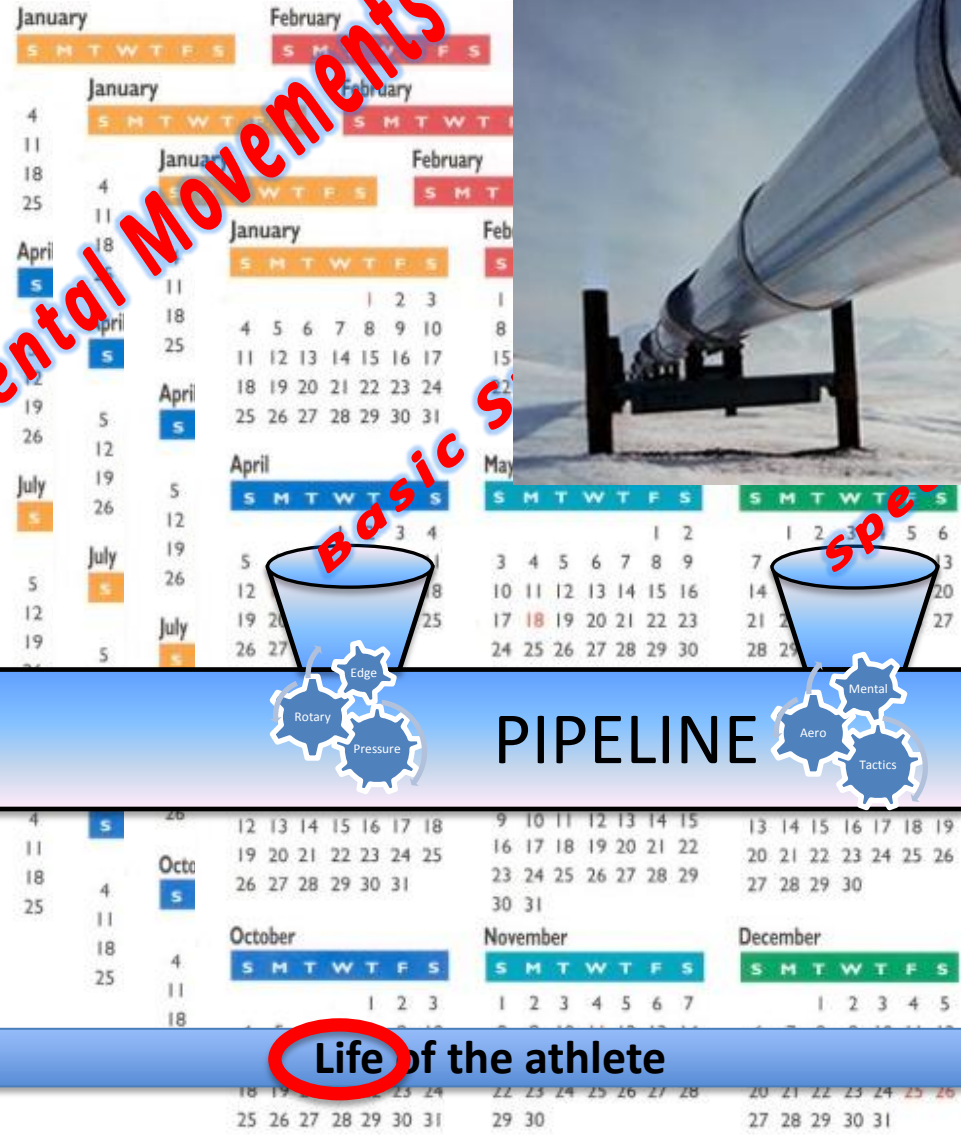
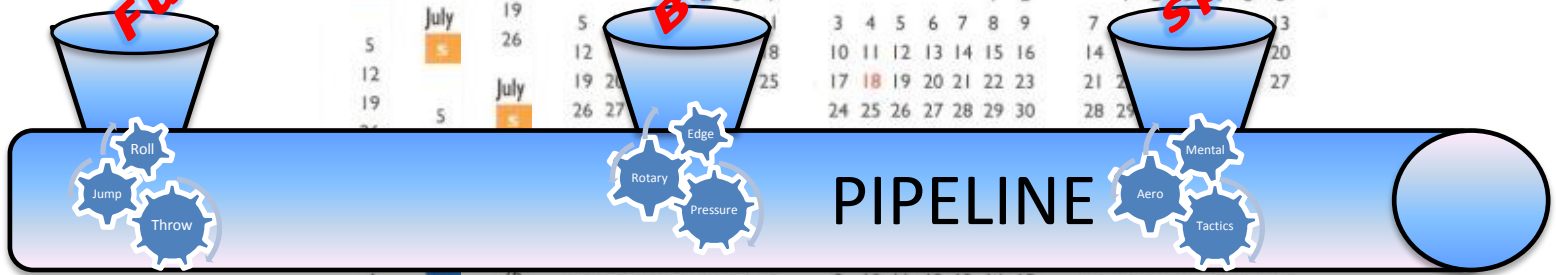


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Fundamental Movements

Basic Skills

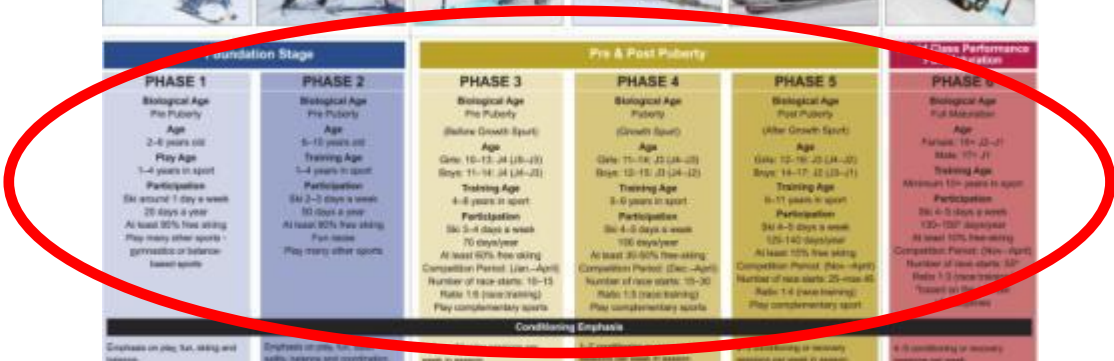
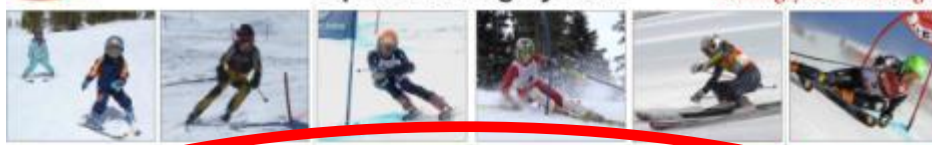
Specialized





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Development Stage		Pre & Post Puberty			Class Performance
PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6
<p>Biological Age Pre Puberty</p> <p>Age 2-6 years old</p> <p>Play Age 1-4 years in sport</p> <p>Participation Sk amount: 1 day a week 20 days a year At least 50% free skiing Play many other sports - gymnastics or balance beam sports</p>	<p>Biological Age Pre Puberty</p> <p>Age 5-10 years old</p> <p>Training Age 1-4 years in sport</p> <p>Participation Sk 2-3 days a week 30 days a year At least 80% free skiing Fun focus Play many other sports</p>	<p>Biological Age Growth Spurt</p> <p>Age Girls: 10-13, JM (10-13) Boys: 11-14, JM (10-12)</p> <p>Training Age 4-6 years in sport</p> <p>Participation Sk 3-4 days a week 70 days/year At least 90% free skiing Competition Period: Jan-April Number of race starts: 10-15 Ratio: 1:6 (race training) Play complementary sports</p>	<p>Biological Age Puberty</p> <p>Age Growth Spurt</p> <p>Age Girls: 11-14, JM (10-12) Boys: 12-15, JM (10-12)</p> <p>Training Age 3-6 years in sport</p> <p>Participation Sk 4-5 days a week 100 days/year At least 90-95% free skiing Competition Period: Dec-April Number of race starts: 15-30 Ratio: 1:3 (race training) Play complementary sports</p>	<p>Biological Age Post Puberty</p> <p>Age Growth Spurt</p> <p>Age Girls: 12-16, JM (10-12) Boys: 14-17, JM (10-11)</p> <p>Training Age 5-11 years in sport</p> <p>Participation Sk 4-5 days a week 120-140 days/year At least 100% free skiing Competition Period: Nov-April Number of race starts: 25-max 40 Ratio: 1:4 (race training) Play complementary sport</p>	<p>Biological Age Full Maturity</p> <p>Age Females: 15+ JM (10-11) Males: 17+ JM</p> <p>Training Age Minimum 10+ years in sport</p> <p>Participation Sk 4-5 days a week 120-140 days/year At least 100% free skiing Competition Period: Nov-April Number of race starts: 50+ Ratio: 1:3 (race training) Play complementary sports</p>
Conditioning Emphasis					
Emphasize on play, fun, skiing and balance.	Emphasis on skills, fun, agility, balance and coordination. Introduce activities that develop endurance (2-10 min) and general endurance.	Focus on aerobic.	Emphasize on aerobic and strength training.	Emphasize on aerobic and strength training.	Emphasize on aerobic and strength training.
Technical and Tactical Emphasis					
Active start - learning and fun movements. Do and play on skis.	Adventure stage - using of terrain. Free play, guided free skiing and skills are an integral part of development. On-snow time needs to be spent skiing. Apply the fundamental skills in a challenging context and appropriate practice runs with coaching and feeding. Introduce to learning, use of upper and lower body separation for angulation, and pole plant.	Technical stage - Develop the skills to carve. Learn correct fundamental technical skills. Exercise correct carved turns with all the technical components in a variety of terrain. Acquire specific technical and tactical skills including gate handling, speed elements, course inspection, anticipation of turns, line and turn shape. Free on all terrain with confidence, with an emphasis on balance and carving.	Technical stage - Learning the art and strategy. Actively research technical skills through the growth spurt. Emphasize use of tactics to achieve career turns on the most responsive line for the athlete. Develop speed and efficiency by refining carving and steering movements to achieve the desired turn radius in courses. Use a variety of course sets, conditions and terrain to teach the skier to adapt to different situations.	Technical and Tactical Refinement stage - refine specific technical and tactical skills. Refine technique and tactics after growth spurt. Integrate the skier to achieve a more optimized. Refine event specific technical and tactical skills (turn, lower recovery, long turn, etc.). Advanced tactics to difficult situations (unfamiliar course sets, difficult conditions and terrain).	Mastery of movement progression specific technical and tactical elements. Mastery of technical and tactical skills based on the individual's style. Optimize line for ability level and continue to new situations and conditions in new situations. Apply equipment innovations.
Equipment Selection & Preparation					
<p>Equipment Selection & Preparation</p> <p>Side: Clear high with a variation based on height, weight and skill level.</p> <p>Boots: Proper foot fit with soft even forward flex for ankle movement to facilitate a balanced, athletic stance.</p> <p>Protection: Minimal required at all times.</p> <p>Poles: Optional - introduce at other levels as skill level develops.</p>	<p>Equipment Selection & Preparation</p> <p>Side: 1 pair of poles is sufficient for the group. Ideal height with a variation based on height, weight and skill level - introduce as appropriate.</p> <p>Boots: Proper foot fit with soft even forward flex for ankle movement to facilitate a balanced, athletic stance.</p> <p>Protection: Minimal required. Older athletes may need otherwise protection.</p> <p>Poles: Standard length is forearm dependent with pole tip in snow.</p>	<p>Equipment Selection & Preparation</p> <p>Side: Skis, Sticks, GS and super D skis. Develop turning skills.</p> <p>Boots: Proper foot fit and flex are critical for performance. Boot flex and response as it interacts with the ski and pole.</p> <p>Protection: Head, arm, hand, shoulder, back, both (front-guard) and shin protection recommended, based on event.</p> <p>Poles: GS standard length. GS pole guard for tracking & protection, pole may be slightly shorter.</p>	<p>Equipment Selection & Preparation</p> <p>Side: Skis, Sticks, GS and super D skis. Refine turning skills.</p> <p>Boots: Proper foot fit and flex are critical for performance. Boot flex and response as it interacts with the ski and pole. Performance considerations may include flex, cant, forward lean, wing angle and foot beds.</p> <p>Protection: Head, arm, hand, shoulder, back, both (front-guard) and shin protection recommended, based on event.</p> <p>Poles: GS standard length. GS pole guard for tracking and protection, pole may be slightly shorter. Custom pole fitting and canting for individuals.</p>	<p>Equipment Selection & Preparation</p> <p>Side: Skis, Sticks, GS and super D skis. Continue to improve. Height and weight gain may require necessary for local skiers.</p> <p>Boots: Proper foot fit, flex and performance. Boot flex and response as it interacts with the ski and pole. Performance considerations may include flex, cant, forward lean, wing angle and foot beds.</p> <p>Protection: Head, arm, hand, shoulder, back, both (front-guard) and shin protection recommended, based on event.</p> <p>Poles: GS standard length. GS pole guard for tracking and protection, pole may be slightly shorter. Custom pole fitting and canting for individuals.</p>	<p>Equipment Selection & Preparation</p> <p>Side: Skis, Sticks, GS and super D skis. Tuning skills continue to improve. Height and weight gain may require necessary for local skiers.</p> <p>Boots: Proper foot fit, flex and performance. Boot flex and response as it interacts with the ski and pole. Performance considerations may include flex, cant, forward lean, wing angle and foot beds.</p> <p>Protection: Head, arm, hand, shoulder, back, both (front-guard) and shin protection recommended, based on event.</p> <p>Poles: GS standard length. GS pole guard for tracking & protection, pole may be slightly shorter. Custom pole fitting and canting for individuals.</p>
Performance Psychology Emphasis					
Fun, variety, positive reinforcement and encouragement. Positive parental support is essential.	Sampling Years Encourage and encourage with. Develop a balanced therapy that encourages healthy habits and promotes success in sport over life. Positive parental support is essential. Parents get involved with their kids.	Sampling Years Positive self talk, work ethic and perseverance with a focus on the process not results. Encourage the use of imagery and visualization goal technique. Demonstrate teamwork and sportsmanship. Positive parental support and club involvement.	Sampling Years Positive self talk, work ethic and perseverance. Goal setting with a focus on the process and not results. Continue to use imagery and visualization goal technique. Teamwork and sportsmanship. Positive parental support and club involvement.	Commitment Develop an inner voice that is positive. Develop mental rehearsal routines, refine goal setting process, and to focus on what works on new day thinking. "What's your" to approach resources and life. Document through journaling. Parents continue to support the commitment of the athlete in the sport.	Specialization and Mastery Refine performance psychology skills. Integrate goal and resources performance planning, attention and focus, self-regulatory skills & confidence. Identify optimal performance state. Working with competition. Use, follow up with. Parents continue to support the commitment of the athlete in the sport.
Competition Emphasis					
Local competition. Inclusive with FIS level international events.	Local racing leads to state and occasional championships which may lead to regional events.	Local racing leads to state and occasional championships which may lead to regional events and Junior Olympics.	Local racing leads to state and occasional championships which may lead to regional events and Junior Olympics.	Appropriate level and number of race starts ranging from local to national and international representation.	Regional FIS events, FIS U, NIS, ISF and European FIS events. Olympics, World Cup, World Ski Championships, World & Pan American Cup.

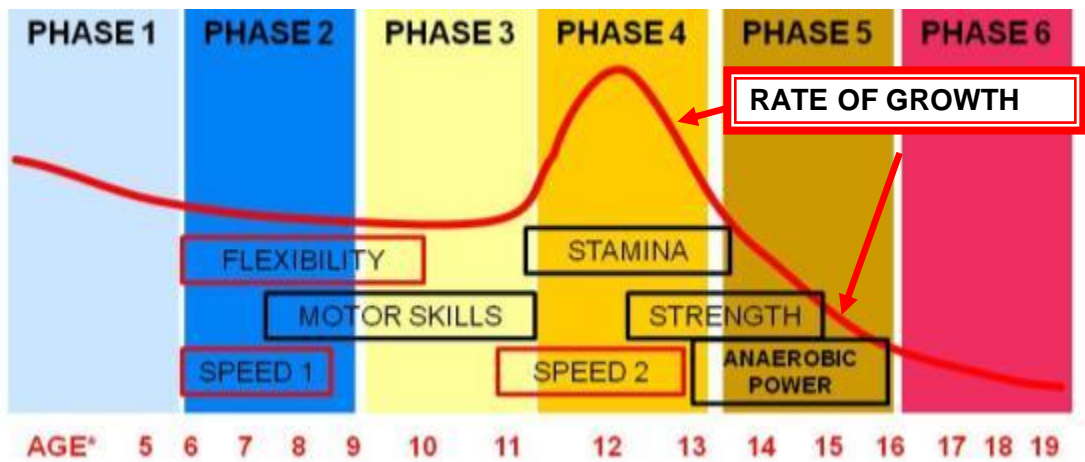


What Should We Help Them Focus On?

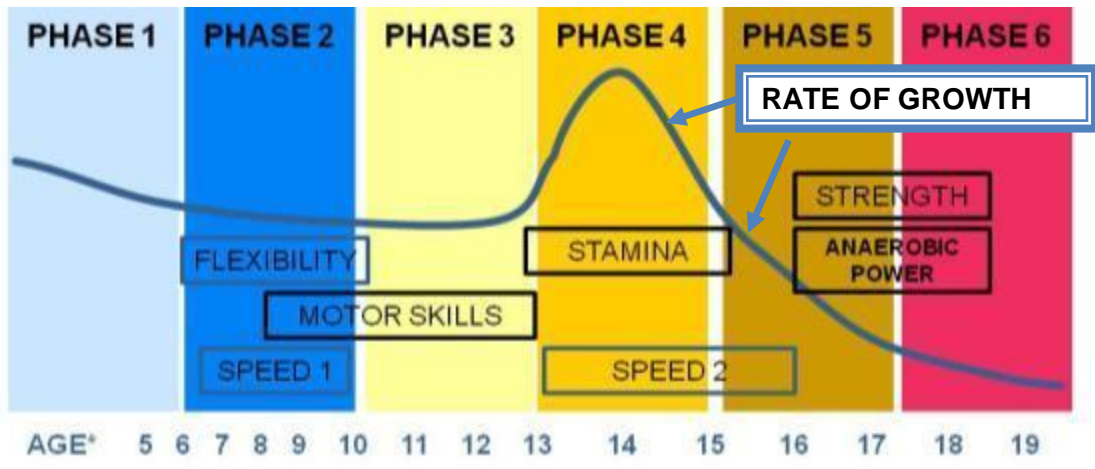
Foundation Stage		Pre & Post Puberty			World Class Performance Full Maturation
PHASE 1 Biological Age Pre Puberty Age 2-6 years old Play Age 1-4 years in sport Participation Ski around 1 day a week 20 days a year At least 95% free skiing Play many other sports - gymnastics or balance-based sports	PHASE 2 Biological Age Pre Puberty Age 6-10 years old Training Age 1-4 years in sport Participation Ski 2-3 days a week 50 days a year At least 90% free skiing Fun races Play many other sports	PHASE 3 Biological Age Pre Puberty (Before Growth Spurt) Age Girls: 10-13: J4 (J3-J3) Boys: 11-14: J4 (J4-J3) Training Age 4-8 years in sport Participation Ski 3-4 days a week 70 days/year At least 60% free skiing Competition Period: (Jan.-April) Number of race starts: 10-15 Ratio 1:6 (race:training) Play complementary sports	PHASE 4 Biological Age Puberty (Growth Spurt) Age Girls: 11-14: J3 (J4-J3) Boys: 12-15: J3 (J4-J2) Training Age 5-9 years in sport Participation Ski 4-5 days a week 100 days/year At least 30-50% free-skiing Competition Period: (Dec.-April) Number of race starts: 15-30 Ratio 1:5 (race:training) Play complementary sports	PHASE 5 Biological Age Post Puberty (After Growth Spurt) Age Girls: 12-16: J3 (J4-J2) Boys: 14-17: J2 (J3-J1) Training Age 6-11 years in sport Participation Ski 4-5 days a week 120-140 days/year At least 15% free skiing Competition Period: (Nov.-April) Number of race starts: 25-max 45 Ratio 1:4 (race:training) Play complementary sport	PHASE 6 Biological Age Full Maturation Age Female: 16+ J2-J1 Male: 17+ J1 Training Age Minimum 10+ years in sport Participation Ski 4-5 days a week 130-150* days/year At least 10% free-skiing Competition Period: (Nov.-April) Number of race starts: 55* Ratio 1:3 (race:training) *based on the number of disciplines



Sensitivity Windows



Sensitivity windows for girls relating to rate of growth, developmental phase, and chronological age (adapted from Balyi & Way, 2005)



Sensitivity windows for boys relating to rate of growth, developmental phase, and chronological age (adapted from Balyi & Way, 2005)



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on Stage

Pre & Post Puberty

World Class Performance Full Maturation

PHASE 2

PHASE 3

PHASE 4

PHASE 5

PHASE 6

FUNDamentals

Learn to Train

Train to Train

Train to Compete

World Class Performance

Age
6–10 years old

(Before Growth Spurt)
Age

(Growth Spurt)
Age

(After Growth Spurt)
Age

Age
Female: 16+ J2–J1

Sampling

Specializing

Investment

Participation
Ski 2–3 days a week
50 days a year
At least 90% free skiing
Fun races
Play many other sports

Training Age
4–8 years in sport
Participation
Ski 3–4 days a week
70 days/year
At least 60% free skiing
Competition Period: (Jan.–April)
Number of race starts: 10–15
Ratio 1:6 (race:training)
Play complementary sports

Training Age
5–9 years in sport
Participation
Ski 4–5 days a week
100 days/year
At least 30-50% free-skiing
Competition Period: (Dec.–April)
Number of race starts: 15–30
Ratio 1:5 (race:training)
Play complementary sports

Training Age
6–11 years in sport
Participation
Ski 4–5 days a week
120-140 days/year
At least 15% free skiing
Competition Period: (Nov.–April)
Number of race starts: 25–max 45
Ratio 1:4 (race:training)
Play complementary sport

Minimum 10+ years in sport
Participation
Ski 4–5 days a week
130–150* days/year
At least 10% free-skiing
Competition Period: (Nov.–April)
Number of race starts: 55*
Ratio 1:3 (race:training)
*based on the number of disciplines





Negative consequences of early specialization:

- lack of sport choices
- depression
- eating disorders
- chronic fatigue
- one-dimensional self concept
- overuse injuries
- chronic injuries
- obsession with winning
- imbalanced lifestyle
- increased pressure from parents
- burnout
- underperform later in life
- loss of control over their life
- dropout from sport

The “doing well early” paradox

Early Maturers



Late Maturers

- Are usually larger than their peers.
- As a result of being “bigger” they perform better at many sports.
- They end up not training as hard and eventually fall back.
- Are usually smaller.
- Do not have “amazing” performances.
- Since they are late maturers they will end up with longer “sensitivity windows”, where learning is maximized.



How can we keep “late maturers in the sport?”





SkillsQuest

The main title "SkillsQuest" is rendered in a large, stylized font. The letters are primarily gold with a thick blue outline. The letter "l" is significantly taller than the others. A blue five-pointed star is positioned behind the "l". The letter "s" has a white, snow-like texture on its top curve. The entire text is set against a white background with a blue and white wave-like graphic at the bottom.



Designed to:



- ✓ Promote skills
- ✓ Teach skills
- ✓ Measure skills
- ✓ Track skills
- ✓ Reward for skills attained.

SkillsQuest is broken down into “Phases”

Skill	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
<i>Pressure</i>	Pole jumpers	Pole jumpers in tuck	Straight run in wave track	Linked turns in wave track	Camel jump in wave track
<i>Edging</i>	Outside ski turns	One ski skiing	One ski skiing with lane changes	One ski skiing without poles	One ski skiing hourglass
<i>Rotary</i>	Straight run to side slip with edge set	Pivot slips	Sideslip to straight run to sideslip	Hop turns	Vertical brush quickness course
<i>Balance</i>	Freeski with pole usage	Freeski – lane changes	Freeski – hourglass	Freeski – varied terrain and snow conditions	Freeski – moguls in “V” shaped corridor



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On Stage

Pre & Post Puberty

World Class Performance Full Maturation

PHASE 2
<p>Biological Age Pre Puberty</p> <p>Age 6–10 years old</p> <p>Training Age 1–4 years in sport</p> <p>Participation Ski 2–3 days a week 50 days a year At least 90% free skiing Fun races Play many other sports</p>

PHASE 3
<p>Biological Age Pre Puberty (Before Growth Spurt)</p> <p>Age Girls: 10–13: J4 (J5–J3) Boys: 11–14: J4 (J4–J3)</p> <p>Training Age 4–8 years in sport</p> <p>Participation Ski 3–4 days a week 70 days/year At least 60% free skiing Competition Period: (Jan.–April) Number of race starts: 10–15 Ratio 1:6 (race:training) Play complementary sports</p>

PHASE 4
<p>Biological Age Puberty (Growth Spurt)</p> <p>Age Girls: 11–14: J3 (J4–J3) Boys: 12–15: J3 (J4–J2)</p> <p>Training Age 5–9 years in sport</p> <p>Participation Ski 4–5 days a week 100 days/year At least 30-50% free-skiing Competition Period: (Dec.–April) Number of race starts: 15–30 Ratio 1:5 (race:training) Play complementary sports</p>

PHASE 5
<p>Biological Age Post Puberty (After Growth Spurt)</p> <p>Age Girls: 12–16: J3 (J4–J2) Boys: 14–17: J2 (J3–J1)</p> <p>Training Age 6–11 years in sport</p> <p>Participation Ski 4–5 days a week 120-140 days/year At least 15% free skiing Competition Period: (Nov.–April) Number of race starts: 25–max 45 Ratio 1:4 (race:training) Play complementary sport</p>

PHASE 6
<p>Biological Age Full Maturation</p> <p>Age Female: 16+ J2–J1 Male: 17+ J1</p> <p>Training Age Minimum 10+ years in sport</p> <p>Participation Ski 4–5 days a week 130–150* days/year At least 10% free-skiing Competition Period: (Nov.–April) Number of race starts: 55* Ratio 1:3 (race:training) *based on the number of disciplines</p>

Each Phase has four tests

Skill	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
<i>Pressure</i>	Pole jumpers	Pole jumpers in tuck	Straight run in wave track	Linked turns in wave track	Camel jump in wave track
<i>Edging</i>	Outside ski turns	One ski skiing	One ski skiing with lane changes	One ski skiing without poles	One ski skiing hourglass
<i>Rotary</i>	Straight run to side slip with edge set	Pivot slips	Sideslip to straight run to sideslip	Hop turns	Vertical brush quickness course
<i>Balance</i>	Freeski with pole usage	Freeski – lane changes	Freeski – hourglass	Freeski – varied terrain and snow conditions	Freeski – moguls in “V” shaped corridor







Relative Age Effect

January

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

April

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

May

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

June

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

August

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

September

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

October

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

November

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

December

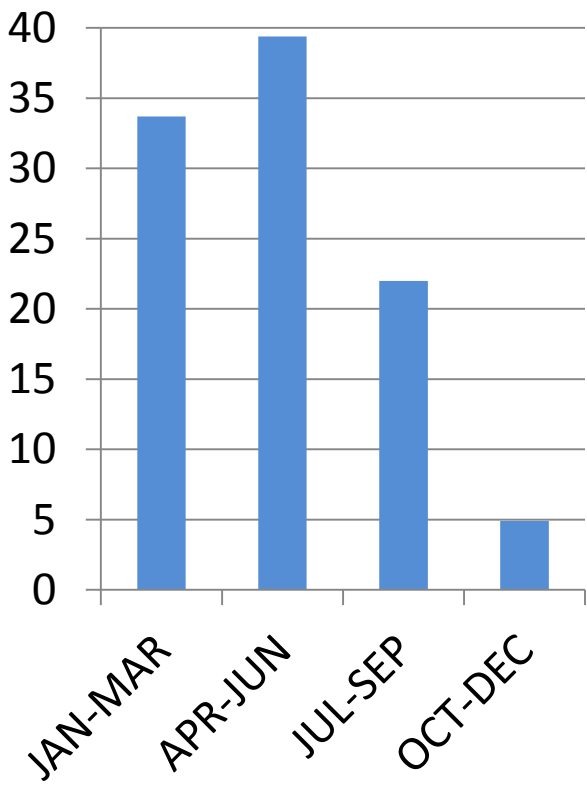
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					





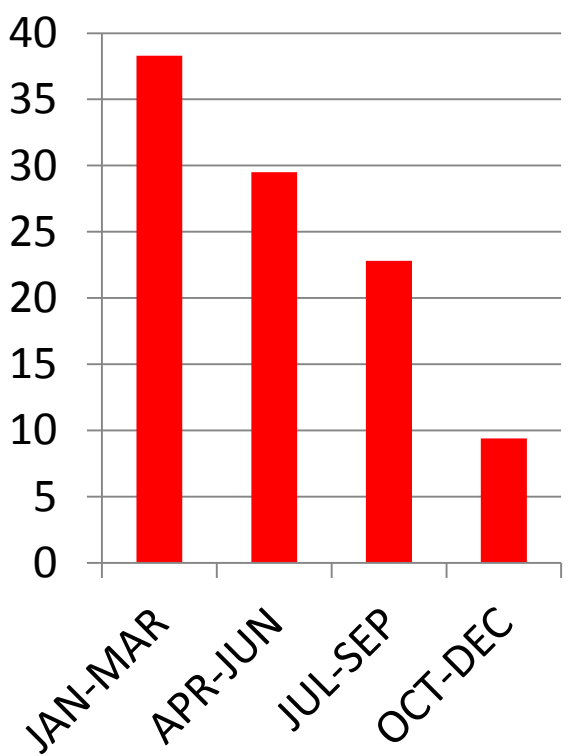
Analysis of Birth Month Relationship to Results At Different Levels in Alpine Skiing

J4 JO medalists



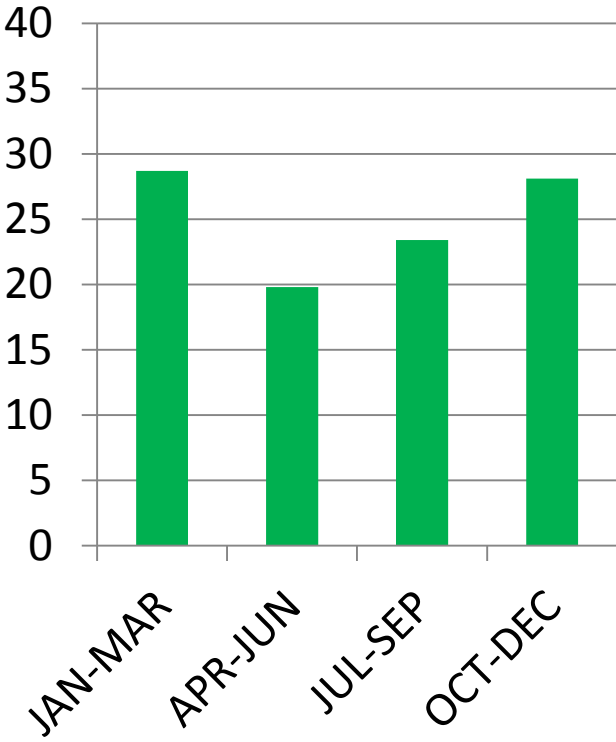
BORN 1ST HALF OF YEAR: **73%**

J3 JO medalists



BORN 1ST HALF OF YEAR: **68%**

World Cup Top 30



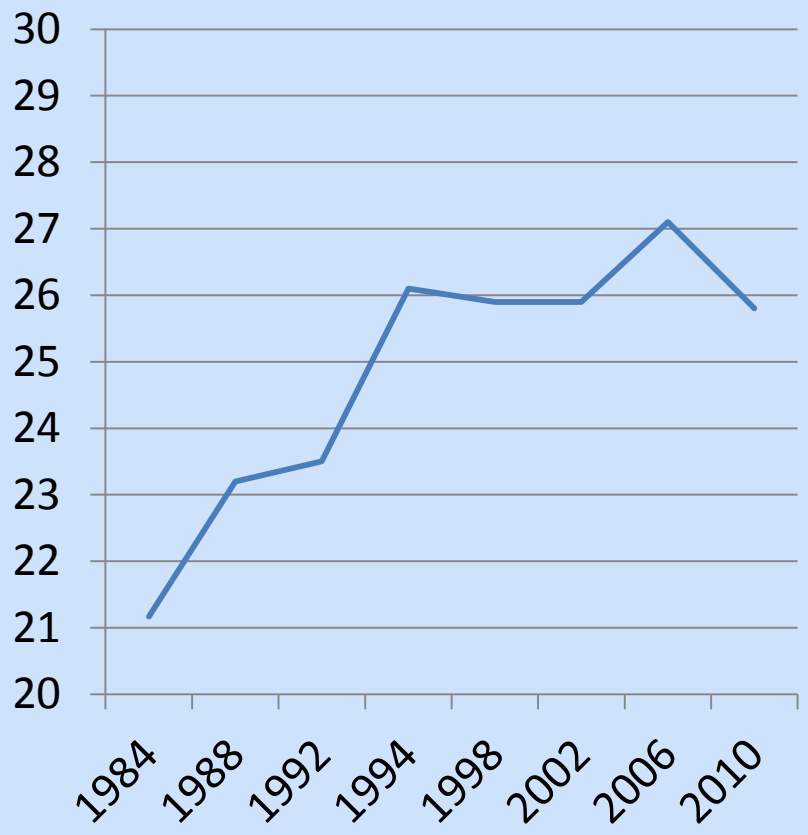
BORN 1ST HALF OF YEAR: **48%**

2010 ALPINE OLYMPIC GOLD MEDALISTS BORN 1ST HALF OF YEAR: 0%

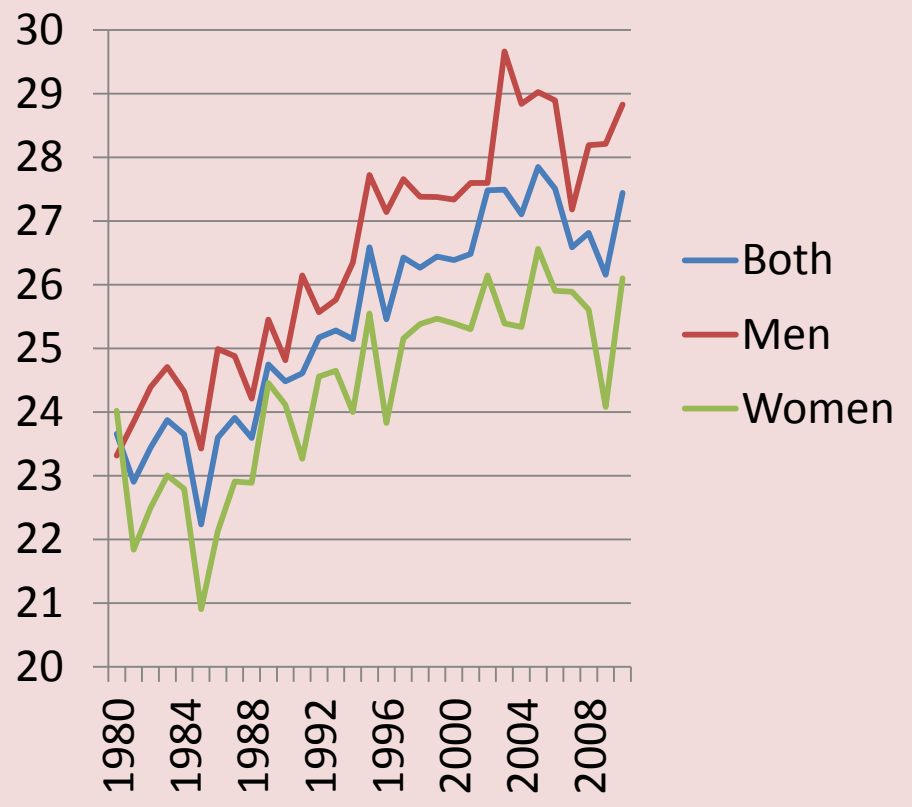


Ages For Elite Performance In Alpine Ski Racing

Average Age of Olympic Gold Medalists



Average Age of World Cup Race Winners

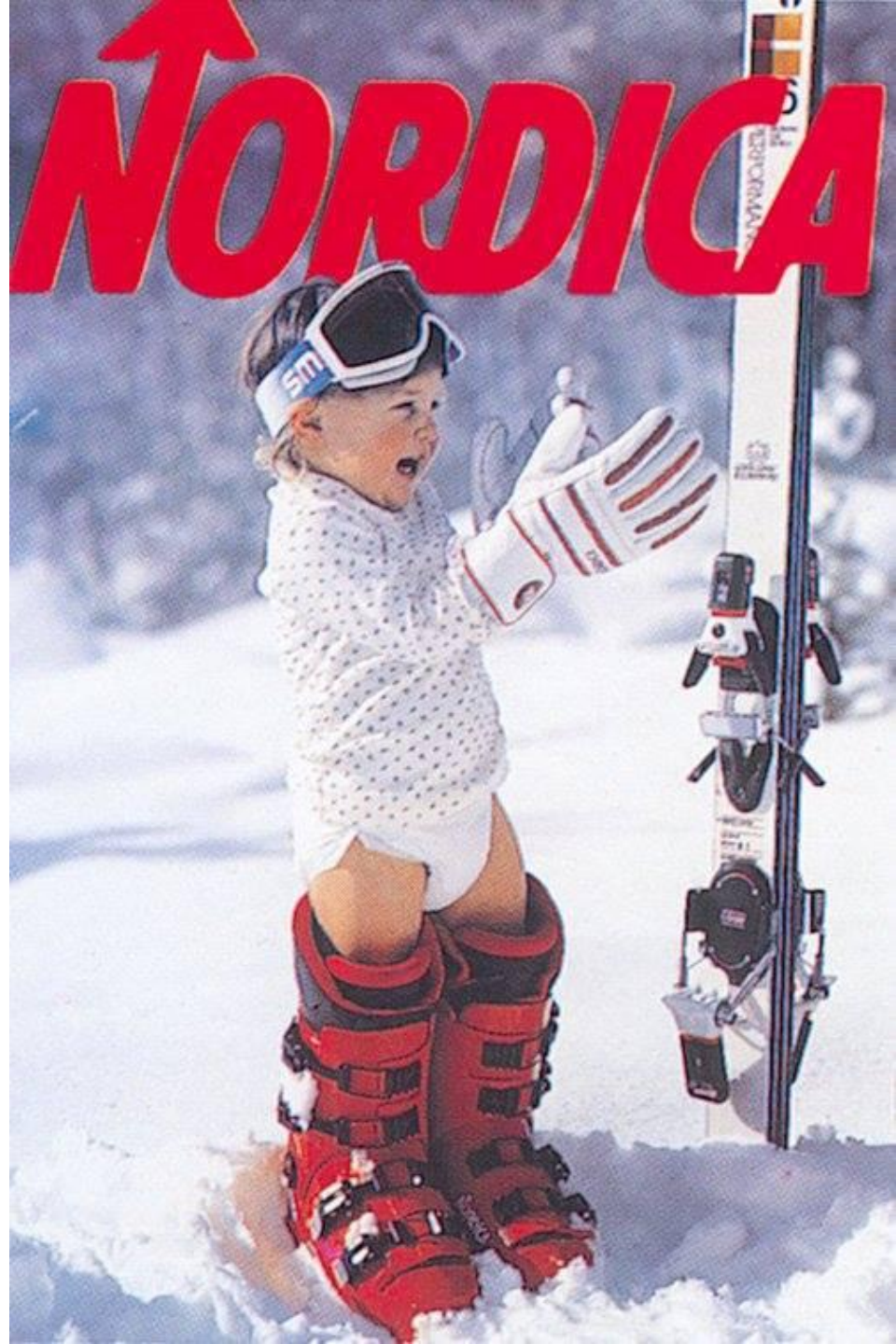




U.S. Ski Team Tenents of LTAD



Children are not simply miniature adults. They need a program that is geared to their developmental needs that will prepare them for the demands of their sport when they are an adult.





Training and competition plans should be designed based on individual needs. Age alone does not give the full picture.





Children develop and mature at different rates. Age alone does not give the full picture.



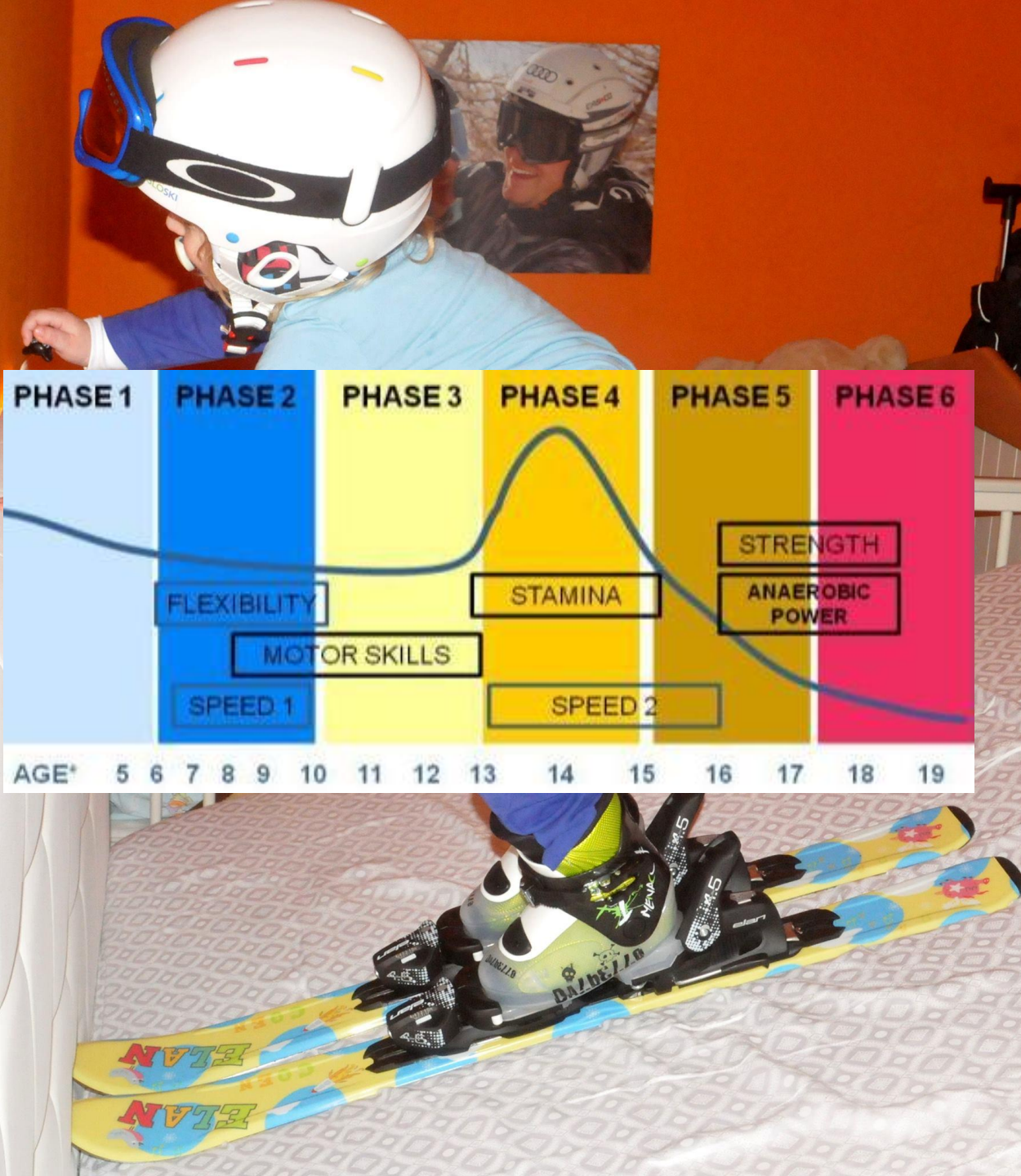


We should consider the child's physiological, cognitive, and emotional development when planning their training.





There are certain periods in a child's development where they can make maximal gains in certain areas, so different aspects of training will take priority during different phases.





Competition at each age level should reward their efforts in training as much as possible. Since their training focus will vary through the phases, the competition format should look different from that of a fully mature athlete.





A long-term approach to success may run counter to a short-term approach focused on results.



The athletes have to enjoy what they're doing to commit to it at higher levels and to pursue it as a life-long sport.





other versions...

Long Term _____ **Development**

- **LT Athlete D**
- **LT Coach D**
- **LT Participants D**
- **LT Mentors D**
- **LT Resources D**

In summary:

- **LTAD**
- Training volume is important
- Training density is paramount
- “Sensitivity windows” should be recognized
- Specific training should not be limited to the “sensitivity windows”





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