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Senior Secondary

27 mins

Biomechanics of the Body

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Biomechanics of the Body

For Teachers:

Introduction

To achieve at high levels in sport, talent, discipline, plus a lot of training and hard work are all key ingredients. But knowing how to best make use of this talent is just as important.

Biomechanics is an area of study which applies the laws of physics to the human body and the way it moves. Knowledge about the principles behind human movement can be used to optimise athletes' performances, and in turn help them realise their fullest potential.

This program analyses the key components of biomechanics.

The following topics are covered in this program:

- Force
- Levers
- Motion
- Friction
- Balance and stability.

Program Timeline

00:00:30	Introduction
00:01:48	Forces
00:07:19	Levers
00:11:33	Motion
00:19:14	Friction
00:22:19	Balance and Stability
00:25:02	Conclusion
00:25:37	Credits
00:27:40	End Program

Website References

<http://www.sportsci.com/adi2001/intro.asp>

<http://www.biomech.com/>

<http://www.exploratorium.edu/sports/index.html>

http://en.wikipedia.org/wiki/Isaac_Newton

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Student Worksheet:

Before Viewing the Program

1. Explain what you think biomechanics are.

2. How do you think the study of biomechanics has improved sporting performances? Use examples where possible.

3. What equipment/methods does a biomechanist use to enhance an athlete's performance?

4. Sir Isaac Newton is renowned in many areas of science and mathematics, and his theories form the basis for many of the biomechanical principles. Explain what you know about Newton.

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While Viewing the Program

1. What is Newton's first law of motion?

2. What is Newton's second law of motion?

3. What is Newton's third law of motion?

4. What is an isometric force? When would one occur during sport?

5. Explain what an isotonic force is. Give an example of one from a sporting situation.

6. What is a sub-maximal force? Why would an athlete use this instead of a maximal force?

7. A maximal force can be achieved in two different ways. Explain each:

a.

b.

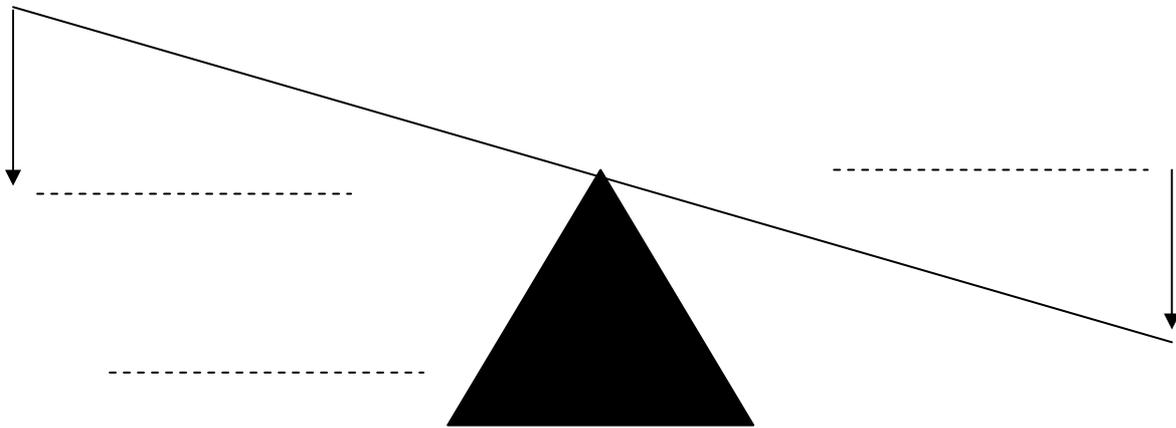
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8. Explain inertia.

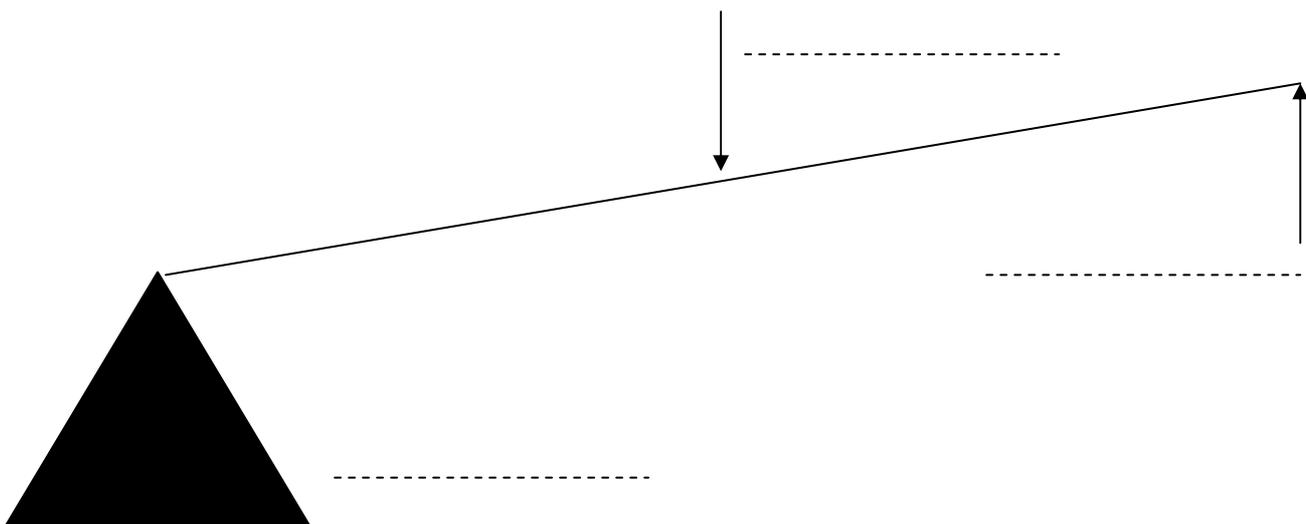
9. What is force reception? Explain how it could be used in a sport of your choice.

10. Label the following levers: (fulcrum, resistance and force)

1st class lever:

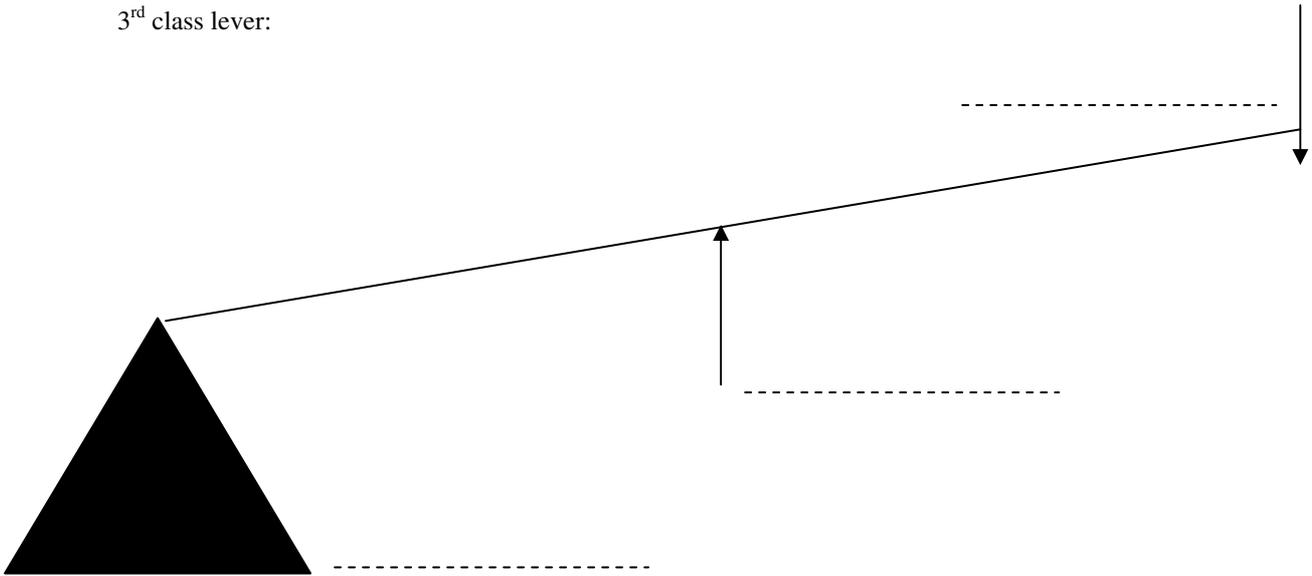


2nd class lever:



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3rd class lever:



11. List and briefly describe the three types of motion. Also, give an example of where/when each type of motion would occur in sport.

a.

b.

c.

12. What is the name given to the resistance of an object/body when beginning angular motion?

13. In theory, the optimal angle of release for a projectile is 45 degrees. Explain why?

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14. List five factors that can influence the angle of release of a projectile:

a.

b.

c.

d.

e.

15. Explain the two ways that air affects the flight of a projectile.

a.

b.

16. Explain the type of friction that occurs in surfing, between the surfer and their surfboard.

17. Discuss the type of friction that occurs between the tyre and road in cycling.

18. What is the name given to the centre of an object's mass?

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After Viewing the Program

Choose a laboratory activity from the following to further understand biomechanics.

LABORATORY ACTIVITY #1

Balance and stability

Introduction:

The control that an athlete has over his or her balance and stability is vital in maximising performance. In some sports the emphasis is placed on increasing stability (eg. wrestling) whilst in others the athlete wishes to decrease stability to enhance performance (eg. sprint start).

The following factors will influence an athlete's balance and stability:

- Height and alignment of centre of gravity.
- Area of base of support.
- Alignment of base of support relative to forces.
- Mass
- Friction
- Momentum.

Aim:

To investigate the factors that affect a performer's balance and stability.

Equipment:

Stop watches

Tape measures

Procedure:

Task 1.

Have your partner try to push you off balance when you are in the following positions:

- a) Standing with your arms straight above your head.
- b) Standing with your arms at your sides.
- c) Standing in a crouched position (knees bent).

Ensure that the feet are always in the same position.

Task 2.

Have your partner try to push you off balance when you are in the following positions:

- a) Standing on tiptoes, with your feet as close together as possible.
- b) Standing with feet wide apart and flat footed.
- c) On all fours.

Ensure that the push is always from the side.

Task 3.

Have your partner try to push you off balance when you are in the following positions:

- a) Standing with feet spread wide to the front/back.
- b) Standing with feet spread wide to the side.
- c) Standing with your feet together.

Ensure that the push is always from the side.

Task 4.

Have your partner time you for a 10m sprint from the following starting positions:

- a) Standing straight with arms by your side.

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- b) Feet apart with a slight lean forward and arms in the ready position.
- c) Crouch start.

Results:

Tasks 1, 2 & 3:

	Most Stable	—————▶	Least Stable
Task 1			
Task 2			
Task 3			

Task 4:

Starting Position	Time
Standing	
Forward lean	
Crouch	

Questions:

1. What was the effect of the height of the centre of gravity on balance and stability? Why?
2. What was the effect of the area of the base of support on balance and stability? Why?
3. What was the effect on the alignment of the base of support on balance and stability? Why?
4. In terms of balance and stability, which starting position was the fastest? Why?

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LABORATORY ACTIVITY #2

Flattening the arc

Introduction:

The concept of accuracy is critical to the successful performance of many skills. In activities such as throwing, hitting and kicking, the accuracy of the performer is often vital for individual and/or team success.

When hitting, throwing, bowling and kicking, an arc is produced by the arm or leg. Flattening or lengthening this arc increases accuracy, and allows a greater distance over which the force can be applied, therefore increasing impulse.

Aim:

To illustrate the factors affecting the accuracy of a softball pitch.

Equipment:

Softballs/tennis balls
Targets
Chalk
Tape measure

Procedure:

Task 1:

From a distance of seven metres, each subject will throw a softball underarm five times at an archery target under the conditions below. Five points are recorded for a bullseye, four points for red, three for blue, two for black and one for inside the white circle. Zero is scored for hitting outside the circles.

- a. Shoulder and arm movements only.
- b. Stepping forward.

Subject	Condition (a)						Condition (b)					
	1	2	3	4	5	AV	1	2	3	4	5	AV
1												
2												
3												
4												
5												

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Task 2:

Stand next to a wall. Using chalk, draw the arcs produced by each of the following throwing conditions. Measure the length of each arc.

- a. Shoulder and arm movements only.
- b. Stepping forward with straight leg.
- c. Stepping forward with bent knee.

Draw each of the arcs from Task 2:

Questions:

1. Do the results indicate a difference in accuracy between the two conditions in Task 1? Use data from your results to support your answer.
2. If the ball hit the target (a) above or (b) below the bull's eye, what mistake have you made and how could it be corrected?
3. If the ball hit the target to the left or right of the bull's eye, what mistake have you made and how could it be corrected?
4. With reference to the arcs drawn in Task 2, how does (or why should) stepping forward increase the accuracy of the softball pitch.
5. Choose another skill where flattening the arc improves performance, and explain the importance of accuracy within this skill.
6. Why does flattening the arc increase impulse?