

BIOMECHANICS

OCR AS AND GCE/A-LEVEL PHYSICAL EDUCATION



OCR AS and GCE/A-Level Physical Education

Biomechanics

For teaching from September 2016

The aim of this Teacher Resource File (TRF) is to provide time saving, high quality and reliable support for dedicated, hard working, busy, teachers of the OCR AS / GCE-A Level PE specification –the biomechanics topic (one of three in the physiological component). It has been designed to mirror and support teaching and learning of the specification perfectly.

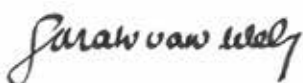
In the TRF you'll find quizzes, worksheets, fill-ins, match up games and many other 'masters' to photocopy and use in your classroom. Some will help learners with course organisation while others are ideal as warm up and plenary tasks. Some will be great class or homework activities to reinforce learning, while others are for making resources such as question cards that can be used year after year to underpin key knowledge and skills. Multi-choice exam style questions are also included – along with some suggested links for the longer synoptic style questions.

The file comprises 213 pages! On pages 3-12 we've outlined a range of ideas for using the resources in your classroom. We're sure you'll be able to think of more! It's not expected that you'll use everything each year with each group but will select, develop and adapt items to suit your needs and your learners.

This biomechanics TRF has been written by Ali Woodward who is a highly experienced teacher of A Level Physical Education having taught the course for several years. She works in a large comprehensive school and her A Level PE groups include the full range of academic abilities. She is also a very experienced examiner.

This is one of six TRFs in our range for the 'new spec'. The others are: Anatomy & Physiology, Exercise Physiology, Skill Acquisition, Sports Psychology and Socio-Cultural Studies. Information about all of these and our other resource, along with sample pages, can be found at **www.pefocus.com**

Ali and I hope that you and your students find this resource stimulating, engaging, and productive and wish you all the very best for an enjoyable and beneficial teaching and learning experience. Enjoy!



Sarah van Wely

PEfocus

Contents and supplementary ideas for using the resources.

Items marked with an asterisk (*) are GCE/A-Level only.

Item / Resource	Page
Contents and supplementary ideas for using the resources	
Biomechanics specification - for teacher and student reference	
Revision checklists - for student use	
Outline scheme of work - for teacher reference/adaptation	
Glossaries of key terms <ul style="list-style-type: none"> • full glossary - for teacher use 	
<ul style="list-style-type: none"> • topic by topic glossary blanks - for student use can be found after the 'must know /understand' resource 	

Herewith the contents & supplementary ideas info with 'just a few' sample pages from the new biomechanics TRF – which comprises over 200 pages.

Hopefully it'll give you a realistic flavour of the final product – which we're confident you'll love.

All tasks, quizzes and activities have answers included.

Page numbers will be added to the table of contents pages.

Key term card match: using the resource

- photocopy, laminate and cut cards into sets (keep sets separate).
- spread all cards out on table then match the pairs.
- memory game: cards face down in two separate areas (key terms separate to definitions) Students turn over one card from each area, keep if a pair, return if not. If a pair is found, student has another go.
- just a minute: Can be played in various ways, all with as many as possible responses in one minute. In pairs, one student with key terms, the other with definitions. Key term read out, correct definition card put down.

As previous, but definitions read out and key term played. As previous but only one player has any cards, the other plays from memory (this is more difficult so is a differentiation opportunity).

- key term bingo: students draw and fill out a grid with their choice of key terms from the cards. Definition cards then picked and read out; students work out which term is being defined, then cross it off their grid.

*GCE/A level only

1a. Biomechanical principles	
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1b. The use of technology	
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* 2a. Linear motion terms and units	
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* 2b. Linear motion graphs **	
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* 3. Angular motion	
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* 4. Fluid mechanics and projectile motion	
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** Linear motion graphs cards can be copied back to back so the graph cards have the correct motion description on the reverse. Students can then self-check their answers.

Bingo game grids	
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What am I describing? using the resource	
<ul style="list-style-type: none"> play in pairs like the board game Articulate: students describe the term on the card without using the words on it. play as charades either in pairs or teams. If in teams, several of the cards can be acted out or done as a freeze frame eg: for the graphs cards, students can make a human graph. <p>*GCE/A level only</p>	
1. Biomechanical principles, levers, technology. Cards and sheet with possible clues.	
* 2. Linear motion. Cards and sheet with possible clues.	
* 3. Angular motion. Cards and sheet with possible clues.	
* 4. Fluid mechanics and projectiles. Cards and sheet with possible clues.	
Quick quiz: using the resource	
<ul style="list-style-type: none"> as a plenary after completing a topic as a homework task. slice up and use as an information race. In teams/pairs: a student "runner" is given the first question only. They return to their team, write an answer and take it back to the teacher for checking. If they are correct, they are given the next question otherwise corrections must be made. The winning team is the first to complete all of the questions correctly <p>*GCE/A level only</p>	
1. Biomechanical principles, levers and technology. Quiz sheet and answer sheet	
* 2. Linear motion. Quiz sheet and answer sheet	
* 3. Angular motion. Quiz sheet and answer sheet	
* 4. Fluid mechanics and projectile motion. Quiz sheet and answer sheet	

True or False Quiz and Beat the Teacher: using the resource

- students choose which activity to complete – True or False OR Beat the Teacher (differentiation by task)
- students can be paired and challenged to complete both activities; then peer check answers.
- can be used as topic introductory starter (what do you already know?) then revisited when topic completed to demonstrate progress.

*GCE/A level only

1a. Force and stability. Tasks and answer sheet	
1b. Levers. Tasks and answer sheet	
1c. Technology. Tasks and answer sheet	
* 2. Linear motion. Tasks and answer sheet	
* 3. Angular motion. Tasks and answer sheet	
* 4. Fluid mechanics and projectile motion. Tasks and answer sheet	

Dominoes/follow me/ puzzles: using the resource

All activities in this section must be copied (onto card and laminated) and cut.

- dominoes have a start card and can be played as normal rules in groups of up to four. There are multiple correct combinations
- dominoes can also be used as follow me cards where each student has a card and justifies why it can be the next in line
- follow me cards make a single chain of cards. Students can be given a full set or one each to discuss and arrange between them
- follow me cards can be used as topic introductory starter (what do you already know?) then revisited when topic completed to demonstrate progress.
- the puzzles can be completed alone or in pairs . Key terms must be matched to definitions to build the puzzle. The task is made more accessible when student knows the shape of the completed puzzle.

*GCE/A level only

Follow me cards a. Biomechanical principles: forces and solution	
Follow me cards b. Biomechanical principles: Vertical free body diagrams and solution	
Follow me cards c. Biomechanical principles: Horizontal free body diagrams and solution	
Dominoes game d. Levers	
*Puzzle - Angular motion: Key terms and calculations and solution	
*Puzzle - Fluids and projectiles and solution	

Walk around/pass around question cards: using the resource

- slice up the question cards and give students 1 each. They find a partner and ask each other the questions on their cards. If neither student knows the answer, they access the answer sheet for help. If one of them knows, they peer coach the other. If both know they congratulate each other and then try the extension question (these are higher up Bloom's taxonomy). Students then **swap question cards**, find another partner then repeat the exercise.

**For very small groups use 'Think and Share' (see next page) which are the same questions in worksheet format.

- use selected cards as consolidation and extension tasks for individual students who can self-check using the answer sheets.

*GCE/A level only

1. Biomechanical principles, levers and technology. Cards and answers	
* 2. Linear motion. Cards and answers	
* 3. Angular motion. Cards and answers	
* 4. Fluid mechanics and projectile motion. Cards and answers	

Think and share: using the resource

These are the same questions as in the previous resource (walk around/pass around) but this time, on a single sheet, making them more useable for small groups.

- as a learning/homework activity - students set the challenge of researching an extension question(s) and reporting back to the group/preparing a presentation.
- recall and extension questions may be useful as a stimulus for discussing the requirements of different command words.
- students can write their own supplementary or further extension questions to challenge each other.
- students can be given the 'Think and Share' sheet
 - having read the questions, each student then 'bids' the number of 'recall of facts' questions (LH column) they think they can answer correctly. They could write their bid on a mini white board or hold up the appropriate number of fingers to indicate their bid
 - their 'bluff' is then called by the teacher or (in a small group) by a peer
 - they work through the number of answers to match their bid (in a small group, the teacher should question those with the lowest bids first)
 - other students then address unanswered questions
 - check answers on answer sheets.

*GCE/A level only

1. Biomechanical principles, levers and technology. Student sheet and answer sheet	
* 2. Linear motion. Student sheet and answer sheet	
* 3. Angular motion. Student sheet and answer sheet	
* 4. Fluid mechanics and projectile motion. Student sheet and answer sheet	

If this is the answer, what is the question? using the resource

- answer cards and possible questions are displayed in the resource so that they can be copied back to back if required.
- students take an answer card and suggest possible questions that would lead to that answer. They can then check the back of the card for suggested questions (these are suggestions only).
- students can play in pairs, where they give each other the answer and peer check suggested questions for accuracy.
- pairs 'just a minute', where one student gives the answer and then counts how many appropriate questions their partner can suggest in a minute.
- cards can be copied with answers and questions separated, then used as a matching pairs exercise.

*GCE/A level only

1. Forces. Answer cards and possible question cards	
* 2. Linear motion. Answer cards and possible question cards	
* 3. Angular motion. Answer cards and possible question cards	
* 4. Projectile motion. Answer cards and possible question cards	

Match-up: key terms and meanings: using the resource

- match the key word to the appropriate definition by putting the identifying number in the box. Answer sheet included
- use for starters or plenaries.
- group activity where students suggest one answer each – students with lower predicted grades go first to increase chances of success.

*GCE/A level only

1a. Biomechanical principles: force. Student sheet and answer sheet	
1b. Levers. Student sheet and answer sheet	
* 2. Linear motion. Student sheet and answer sheet	
* 3. Angular motion. Student sheet and answer sheet	
* 4. Projectile motion. Student sheet and answer sheet	

MK/U- Must Know/Understand – Essential 'Can Do': using the resource

- for student reference / to check knowledge at the end of each topic area.
- students can buddy check definitions and 'Minimum Can Do' skills.

Topic by topic key word blanks

- students can build an ongoing key term bank.

*GCE/A level only

1a: Biomechanical principles: Newton's laws, force, centre of mass and stability	
1b: Levers	
1c: Use of technology	
* 2. Linear motion	
* 3. Angular motion	
* 4a: Fluid mechanics	
* 4b: Projectile motion: Horizontal distance travelled and flight paths, Bernoulli's principle, Magnus effect	
Topic by topic key word blank: Biomechanical principles	
Topic by topic key word blank: Levers	
Topic by topic key word blank: Analysing movement through the use of technology	
* Topic by topic key word blank: Linear motion	
* Topic by topic key word blank: Angular motion	
* Topic by topic key word blank: Fluid mechanics	
* Topic by topic key word blank: Projectile motion	

Multi-choice style exam questions: Using the resource

- sample multiple choice questions for each section that can be used as starter, plenary or homework.
- as a class activity, students can show their answer on a white board and then be asked for reasons why they have chosen their answer/ rejected the other three alternatives.

*GCE/A level only

1. Biomechanical principles

* 2. Linear motion

* 3. Angular motion

* 4. Fluid mechanics and projectile motion

Multiple choice answers for all sections

Synoptic style exam questions: rationale and links

Key term card match 1a. Biomechanical principles

**Force
calculation**

***Mass x
acceleration***

Friction

***The force
opposing the
sliding motion
of one surface
across another***

**Air
resistance**

***The force
opposing the
motion of a
body through
air***

What am I describing? 1. Biomechanical principles, levers, technology

Newton's first law	Newton's second law
Newton's third law	Net force
Balanced forces	Weight
Friction	Air resistance

*Quick quiz 4. Fluid mechanics and projectile motion

Question	Answer
1. Newton's third law	L _ _ / _ _ / _ _ _ _ _ _ _ _
2. The reluctance of a body to change its state of motion	I _ _ _ _ _ _ _ _
3. The amount of motion possessed by a moving body	M _ _ _ _ _ _ _ _
4. When two or more forces acting on a body are equal in size but opposite in direction	B _ _ _ _ _ _ _ _ / _ _ _ _ _ _ _ _
5. A branch of mechanics that studies motion of a body	K _ _ _ _ _ _ _ _
6. A force caused by muscular contraction from within the performer's body	I _ _ _ _ _ _ _ _ / _ _ _ _ _ _ _ _
7. The component of the ground reaction force which acts perpendicular (at 90°) to the surface from the point of contact	N _ _ _ _ _ _ _ _ / _ _ _ _ _ _ _ _ / _ _ _ _ _ _ _ _
8. A force that comes from outside the body	E _ _ _ _ _ _ _ _ / _ _ _ _ _ _ _ _
9. When a lever is efficient at moving a heavy load or less effort is required to move a set load.	M _ _ _ _ _ _ _ _ / _ _ _ _ _ _ _ _
10. The force acting to oppose the motion of a body through air	A _ _ / _ _ _ _ _ _ _ _
11. Where the effort lies between the load and the fulcrum	T _ _ _ _ _ _ / _ _ _ _ _ _ / _ _ _ _ _ _
12. The force opposing the sliding motion of one surface across another	_ _ I _ _ _ _ _ _
13. The point at which a body is balanced in all directions	C _ _ _ _ _ _ / _ _ / _ _ _ _ _ _
14. A measure of how easily a body is moved from a position of equilibrium	S _ _ _ _ _ _ _ _

True or false quiz / beat the teacher 1a. Force and stability answers

	Statement	T/F?
1	The weight of a body depends on its mass	T
2	A net force acts when forces in all directions are balanced	F
3	Friction acts in the direction that one object slides across another	F
4	Air resistance is reduced if the surface of a body is smooth	T
5	A reaction force is present at every point of contact with the ground	T
6	Momentum is calculated by mass \div velocity	F
7	Acceleration is calculated by force \div mass	T
8	Force is calculated by mass x acceleration	T
9	The position of the centre of mass is determined by body shape	T
10	A body is most stable if the line of gravity falls at the edge of the base of support	F

Beat the teacher corrections noted after identification of the errors.

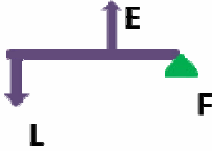
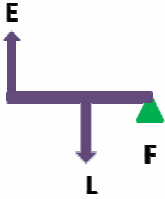
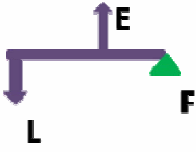
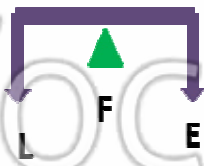
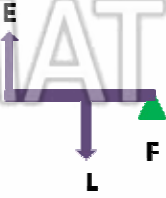
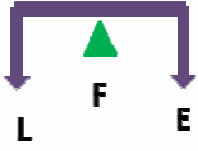
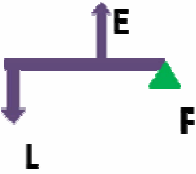
Balanced forces are present when all forces acting on a body are equal in size and opposite in direction. If this is the case, the body will remain at rest **or constant velocity**. For the body to have motion **acceleration**, there must be unbalanced forces acting. For example a gymnast in a headstand has balanced ~~horizontal~~ **vertical** forces of weight and ground reaction and so is stationary.

Unbalanced forces mean that a net force is acting. Net forces cause a body to accelerate. The body accelerates in the direction of the net force, which is an application of Newton's ~~third~~ **second** law. The amount of acceleration depends on the size of the net force according to the formula ~~$a=Fm$~~ , **$a=F \div m$** which also shows that acceleration is ~~proportional~~ **inversely proportional** to the mass of the body.

If a runner wants to accelerate, they will increase the backwards force applied on the track by their foot. This generates a large forwards frictional force and a net force in the direction of motion if it is larger than air resistance. Air resistance will ~~decrease~~ **increase** if the runner accelerates. On a free body diagram, ~~both of these forces are drawn from the centre of mass.~~ **air resistance is drawn from the centre of mass and friction from the point of contact with the ground**

During the take off phase of a high jump, the ground reaction force needs to be ~~minimised~~ **maximised** to overcome the inertia of the performer and generate upwards acceleration. Inertia is the reluctance of a body to change its motion and is ~~proportional to the air resistance acting on~~ **mass of** the body

Dominoes game 4 - Levers

<p>First class lever</p>	<p>Elbow flexion uses this class of lever</p>		<p>The load arm is longer than the effort arm</p>
<p>The load arm is shorter than the effort arm</p>	<p>Third class lever</p>		
<p>Mechanical disadvantage</p>	<p>The load is between the effort and the fulcrum</p>		<p>First class lever</p>
<p>Ankle plantar flexion uses this class of lever</p>	<p>Third class lever</p>		<p>Third class lever</p>
<p>Second class lever</p>	<p>First class lever</p>		<p>Second class lever</p>
<p>Mechanical advantage</p>	<p>Second class lever</p>	<p>Start</p>	

*Walk around/pass around question cards: 3. Angular motion

angular motion

1. Define angular motion

Extension: Apply the definition to an example from sport

angular motion

2. Identify the type of force which initiates angular motion

Extension: Explain how angular motion about the three principle axes is initiated

angular motion

3. Define moment of inertia

Extension: State the formula used to calculate moment of inertia and the units it is measured in

angular motion

4. Define angular velocity

Extension: Explain the relationship between angular velocity and moment of inertia during a somersault

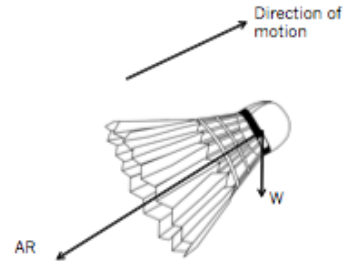
Recall the facts	Extend your understanding
1. <u>Define</u> Newton's 3 laws of motion	<u>Apply</u> each law to a tennis serve
2. <u>Identify</u> the factors affecting friction	Use examples to <u>explain</u> how each factor affects friction
3. <u>Identify</u> the vertical forces acting on a body	<u>Explain</u> the size of the vertical forces
4. <u>Describe</u> the factors affecting air resistance	<u>Explain</u> the effect of air resistance on a shot and on a hard hit shuttlecock
5. <u>State</u> the formulae for calculating force, momentum, acceleration and weight	<u>Explain</u> why a rugby player with large mass may be harder to tackle than a lighter player
6. <u>Describe</u> a 2nd class lever	<u>Evaluate</u> the use of a second class lever using an example from the human body
7. <u>Describe</u> a wind tunnel	<u>Evaluate</u> the use of wind tunnels to optimise performance in sport

If this is the answer, what is the question? 4. Projectile motion

1. If this is the answer, what is the question?

The object flies further horizontally

2. If this is the answer, what is the question?



3. If this is the answer, what is the question?



4. If this is the answer, what is the question?

The flight path is more parabolic

5. If this is the answer, what is the question?

This results in a lift force acting, and the projectile flies further

6. If this is the answer, what is the question?

The ball dips in flight

Match up: Key terms and meanings - answers

2. Linear motion

Linear motion	5
Direct force	9
Centre of mass	12
Distance	1
Displacement	10
Speed	7
Velocity	2
Acceleration	3
Deceleration	11
Body is stationary	8
Body has constant velocity	4
Body is accelerating	6

1	The length of the path taken by a body moving from one position to another
2	The speed of an object in a given direction or the rate of change of displacement
3	The rate of change in velocity
4	Horizontal line on a velocity/time graph
5	All parts of a body move at the same velocity in a straight or curved line
6	Line with increasing gradient on a distance/time graph
7	The movement of a body per unit of time (without reference to direction)
8	Horizontal line on a distance /time graph
9	A force applied through the centre of mass of a body
10	The shortest straight-line route between two positions
11	Negative change in velocity
12	The point at which a body is balanced in all directions, from which weight appears to act

* 2. Linear motion - GCE/A level only

1. The rate of change of displacement is the definition of what linear motion term?

Put a tick (✓) in the box next to the correct answer.

A. Speed

B. Velocity

C. Acceleration

D. Deceleration

2. What is the acceleration of a middle distance runner who increases their velocity from 6m/s to 8m/s over the final 8 seconds of the race?

Put a tick (✓) in the box next to the correct answer.

A. 16m/s^2

B. 1m/s^2

C. 0.75m/s^2

D. 0.25m/s^2

3. What is the displacement of a swimmer who swims 3 lengths of a 50 metre pool?

Put a tick (✓) in the box next to the correct answer.

A. 0.15km

B. 0m

C. 50m

D. 150m