Lesson 5: Newton’s Second Law (forces and motion)

P3: FORCES FOR TRANSPORT

IF THESE ARE THE ANSWERS, WHAT ARE THE QUESTIONS?

1) The gradient
2) The area under the graph
3) Air resistance, thrust, weight, reaction, friction

NEWTON'S SECOND LAW (F=ma)

OBJECTIVES

- Understand how forces act on stationary and moving objects (everybody)
- Understand the equation F=ma and its alternative arrangements (most)
- Understand how an object moving at constant speed can still be accelerating (some)

SUCCESS CRITERIA

- Correctly answer 9 worksheet questions on forces
- Correctly answer F=ma calculations including re-arranging the equation
- Correctly describe how an object can accelerate at the same time as moving at a constant speed

ACCELERATION AT CONSTANT SPEED

- Observe the ball being swung around on string
- You can drive around a roundabout at a constant speed but the car is still accelerating
- Driver applies force towards centre of roundabout to get car to change direction – this force is actually causing an acceleration towards the centre of the roundabout

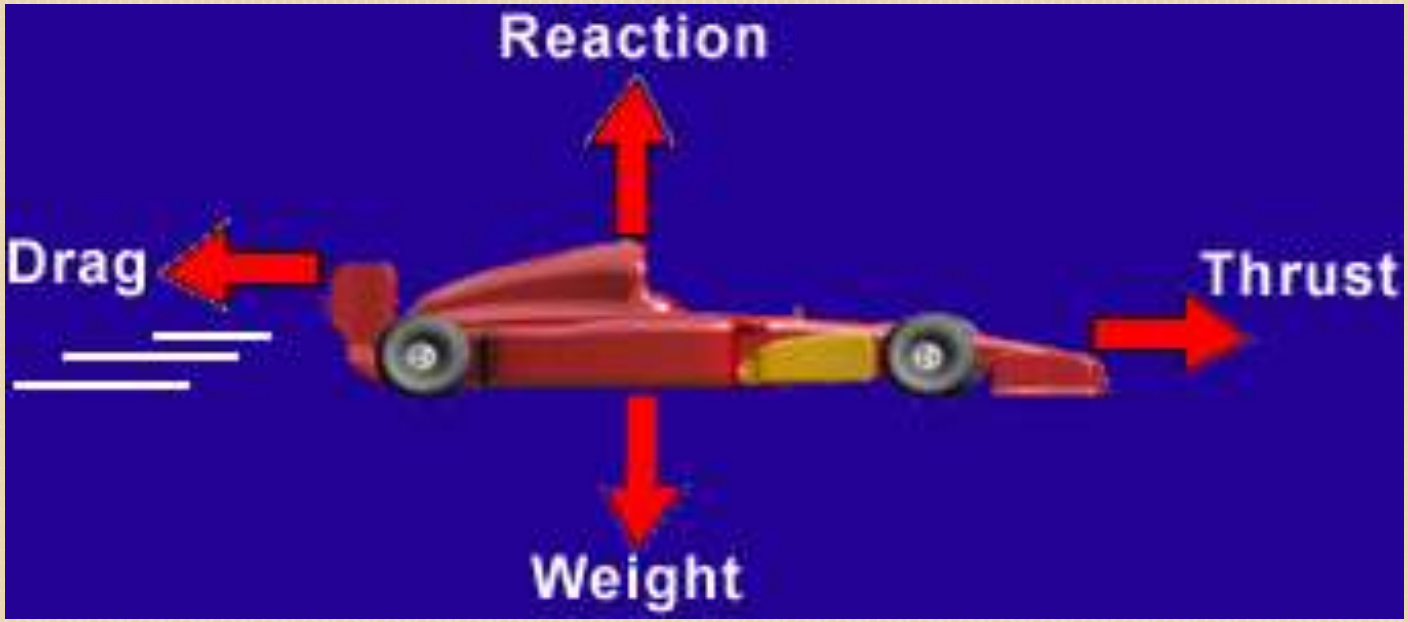
WRITE DOWN....

In your own words (3 minutes)....

- Describe a situation in which you can accelerate even though your speed doesn’t change. Explain why.

CAR ON TABLE

- Net force zero if no movement
- If force applied (push) – net force is greater than zero
- Picture showing forces acting on moving car:



NEW TOPIC - NEWTON'S LAWS

NEWTON'S FIRST LAW

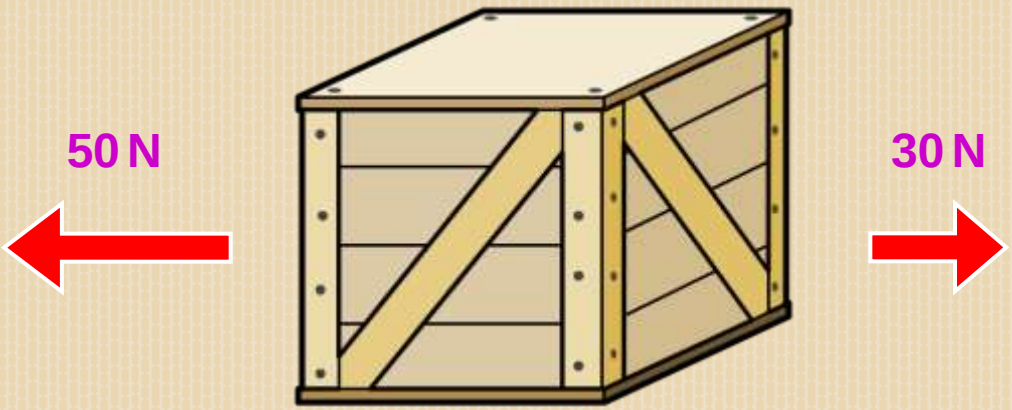
- If an object is speeding up or slowing down...there must be unbalanced forces acting upon it

- i.e. If resultant force is not zero – there will be some movement .....

WHAT ARE RESULTANT FORCES?

There are usually several different forces acting on an object. The overall motion of the object will depend on the size and direction of all the forces.

The motion of the object will depend on the **resultant force**. This is calculated by adding all the forces together, taking their direction into account.



Resultant force on the crate = 50 N – 30 N

= **20 N to the left**

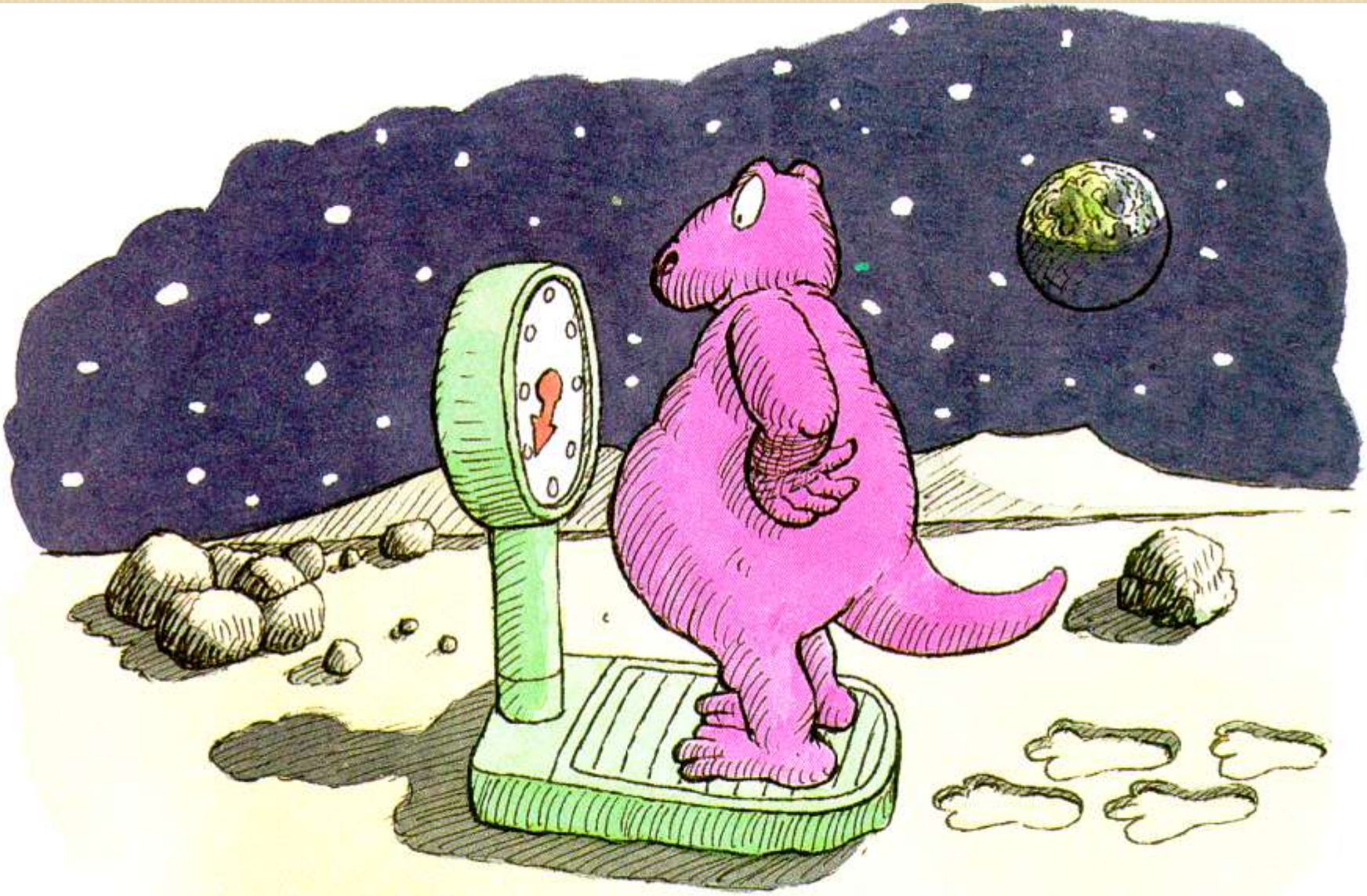
NEWTON'S SECOND LAW

- Can you define acceleration?
  - Acceleration = a change in speed (per second)

- Acceleration is influenced by:
  - **1)** the **unbalanced** force (remember we said that balanced forces lead to no change in speed)
  - **2)** the **mass** of the object

MASS AND WEIGHT

- Are they the same?
- No:
  - Mass = a measure of the amount of matter in an object (KG)
  - Weight = The force created by the gravitational attraction on a mass, measured in newtons (N).



mass still the same but weight down to one-sixth!

IN OTHER WORDS....

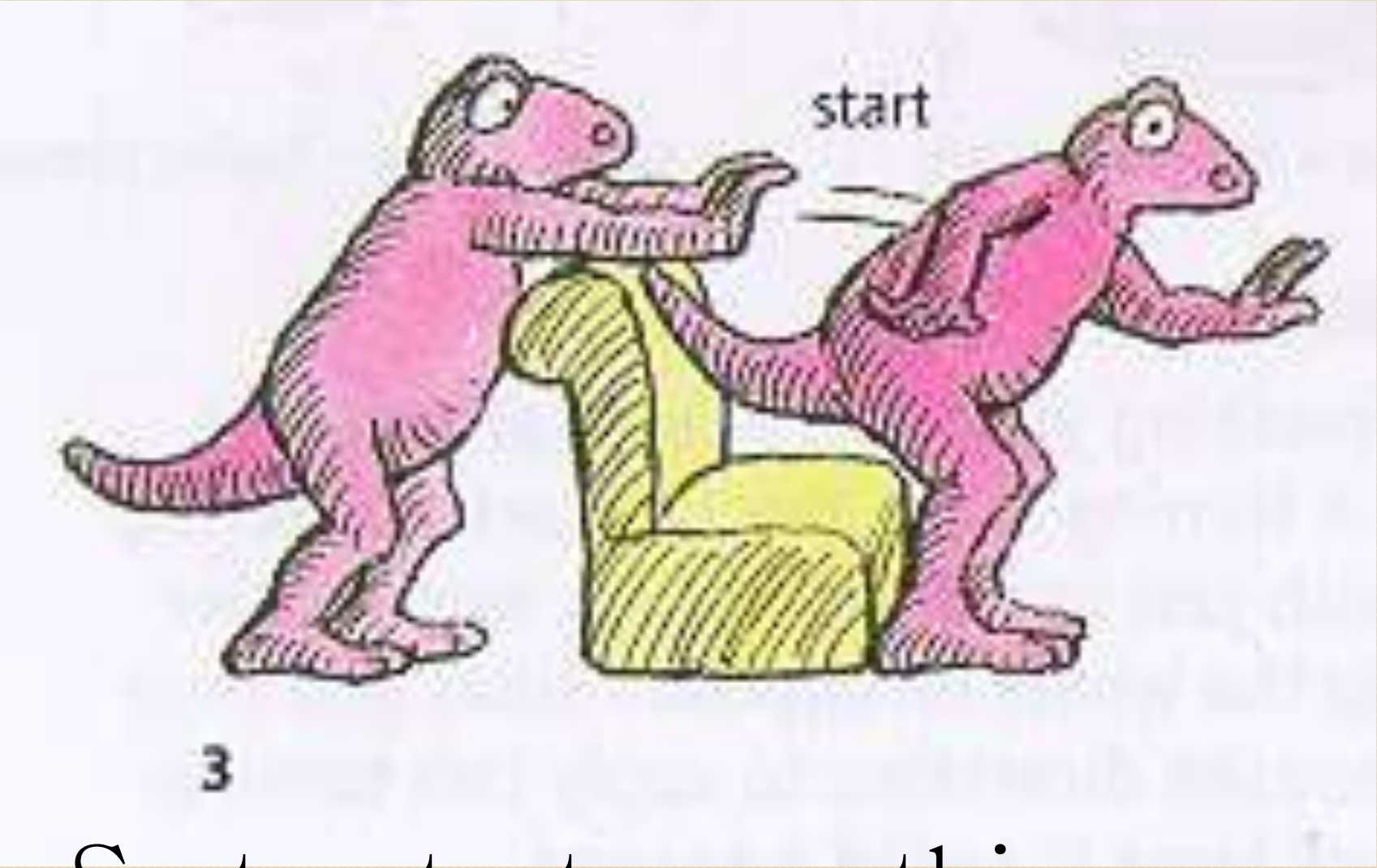
$$a = \frac{F}{m}$$

- a = acceleration (m/s2)
- F= force (Newtons)
- m = mass (kg)
  - So, the bigger the force, the bigger the acceleration (on a fixed mass) (e.g. Push the skate board hard – bigger acceleration)

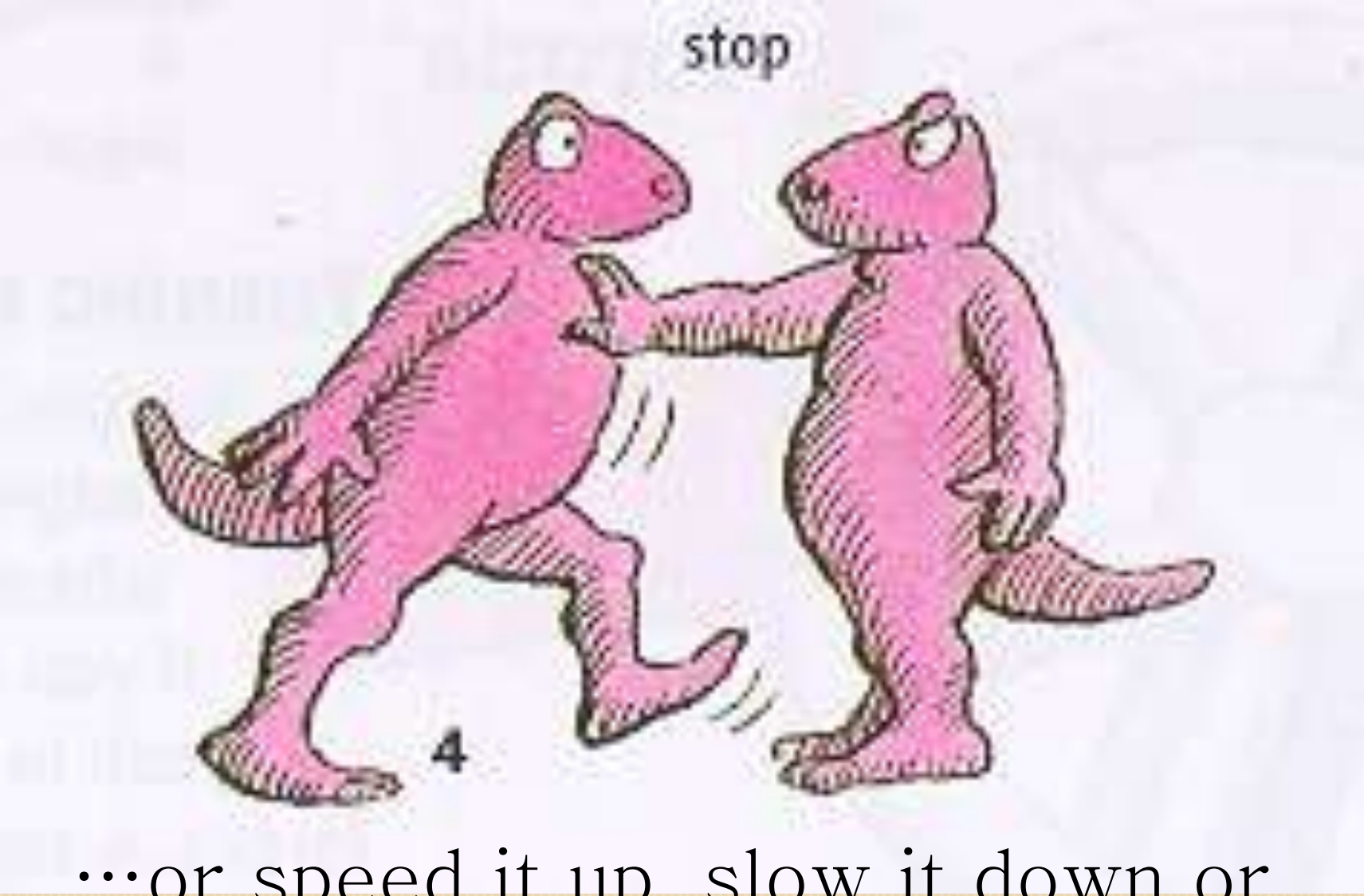
Also re-arranged to: F = ma

  - So, the bigger the mass and/or acceleration, the bigger the force required to achieve that

For example, you would be able to throw a tennis ball much further than a football



So to start something moving…



…or speed it up, slow it down or stop it…

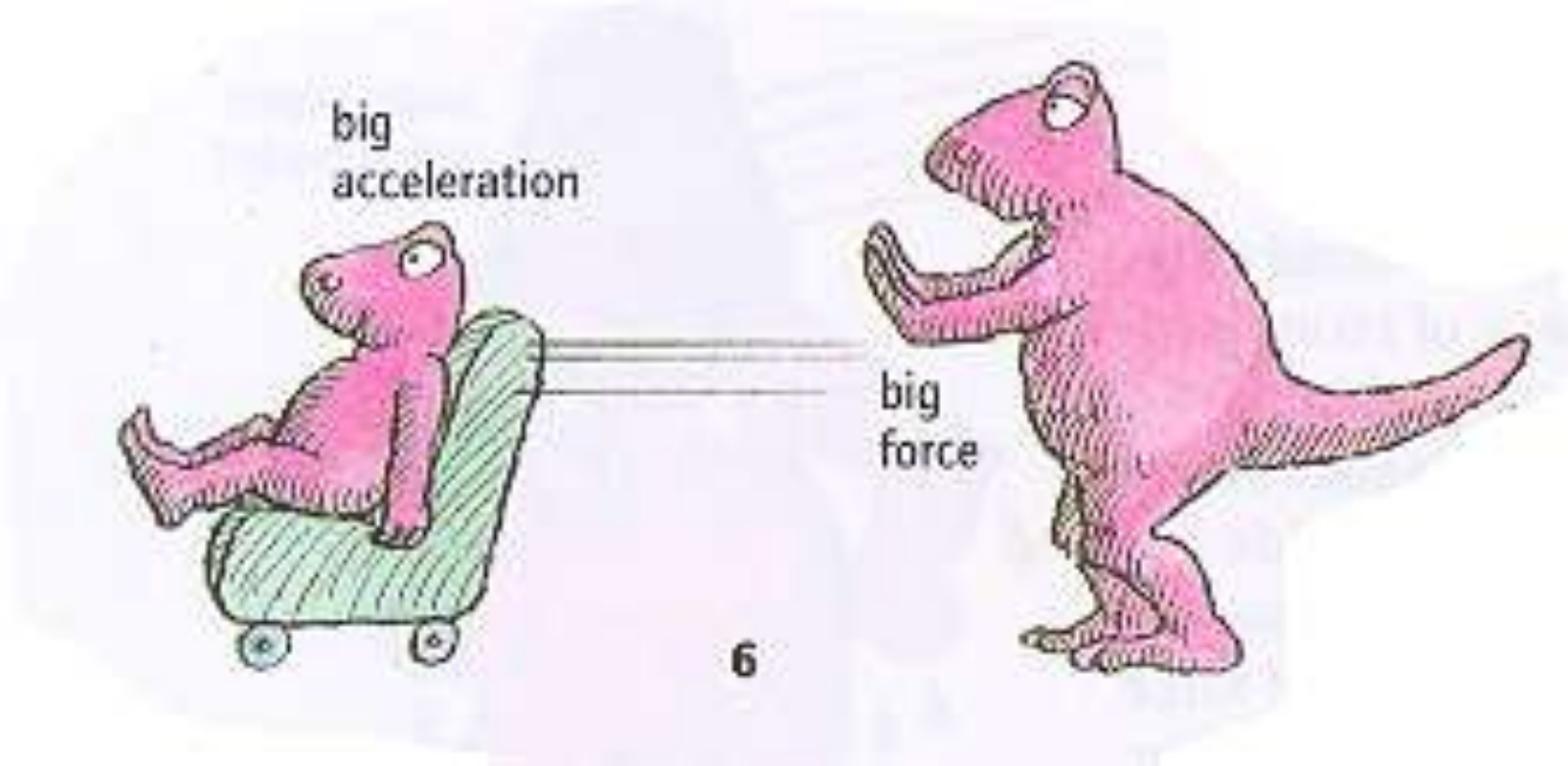
…or change its direction…

A FORCE MUST BE APPLIED.

THE SECOND LAW STATES

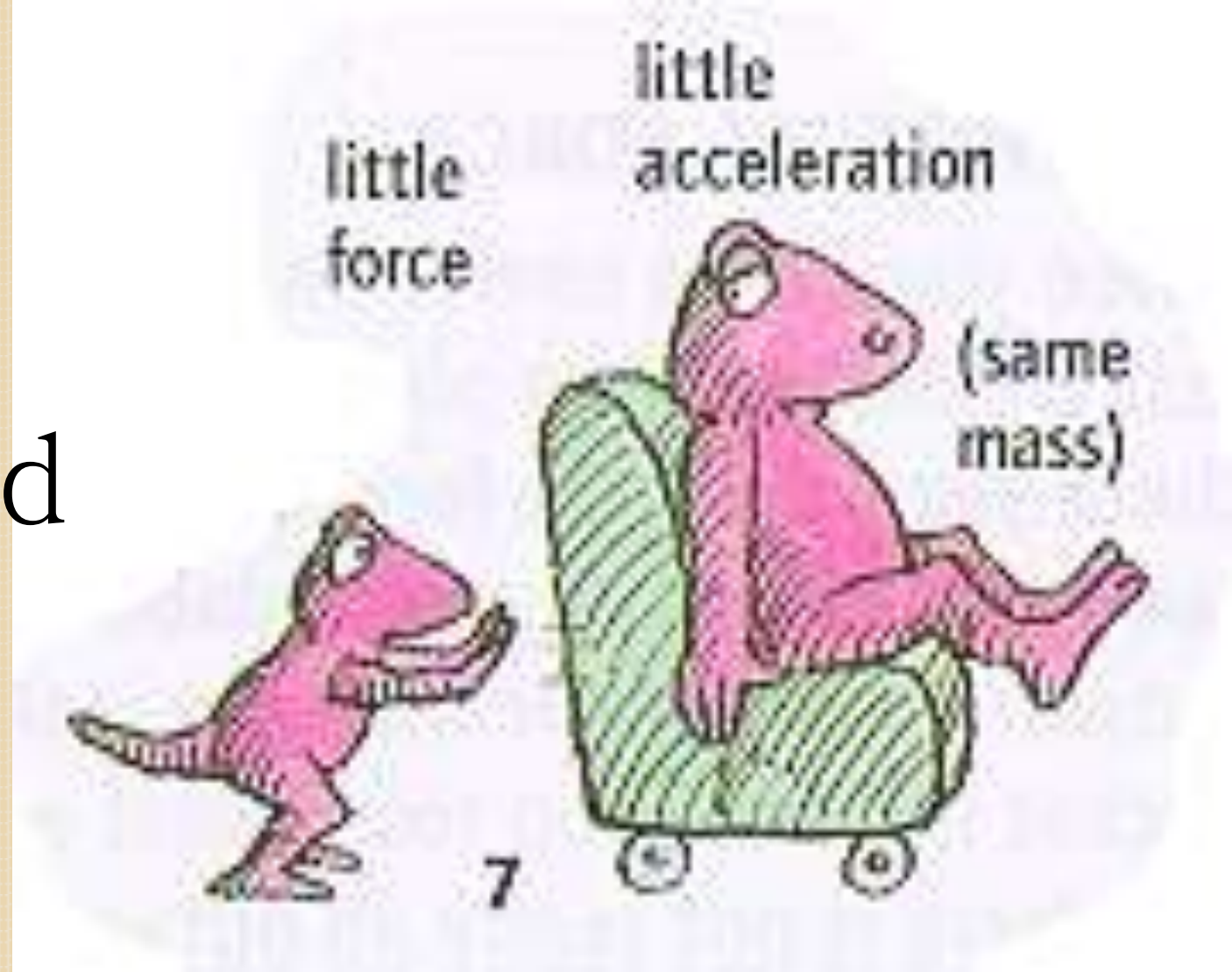
A force applied to an object will change its speed **in the same direction as the force.**

A change in speed is called **acceleration** and the amount of acceleration depends on the strength of the force.



A big force will give a bigger acceleration than…

… a small force applied to the same mass.



CONSIDER THIS EXAMPLE

$$a = \frac{F}{m}$$

- Consider a force of 10N and a mass of 2kg.
  - Acceleration would be what? 5m/s2
- Consider a force of 10N and a mass of 5kg.
  - Acceleration would be what? 2m/s2

    - So the object with the smaller mass had the greatest acceleration for the same force

- We also learned that the equation can be re-arranged to find force....
- F=ma
- So if a tennis player hit a 2kg ball (it’s unrealistic but let’s just imagine..) at an acceleration of 2m/s2..what would the force exerted on the ball be?
- F=ma = 2X2 = 4N

WATCH THE MOVIE CLIP

- As the movie is playing you need to be making notes. Write down at least 7 key points.

- http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/forces/forcemassrev4.shtml

Now answer the questions on your worksheet

This song will help you…

http://www.youtube.com/watch?v=dQmYBF_Sd8I

Swap books and check answers – how many people got full marks?

PLENARY

What effect do resultant forces have on objects?

	if resultant force = 0	if resultant force > 0
a stationary object		
a moving object		