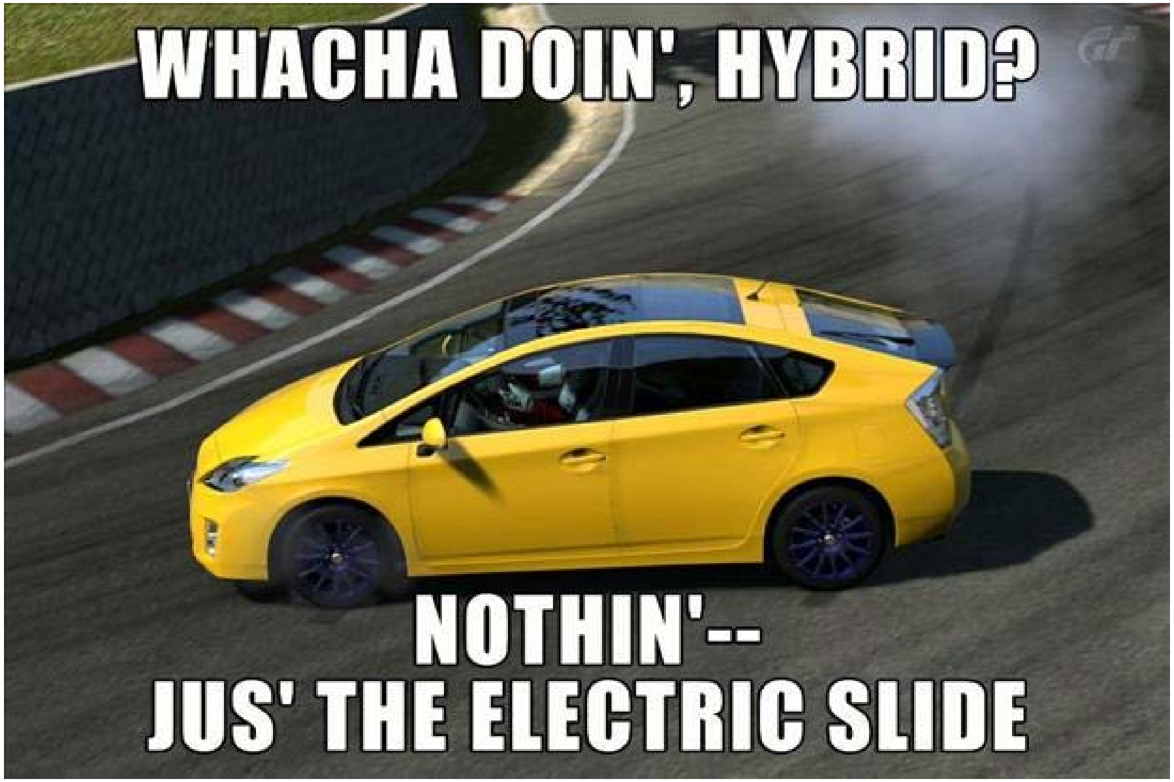
In Motion



Outcomes:

S2-3-01 Analyze the relationship between displacement, time, and velocity for an object in uniform motion.

The Language of Motion…

Physicists have developed a specialized language to describe **MOTION** as well as a standard set of **SYMBOLS**, and particular **SI** units of **MEASUREMENT**. This way, observations made can be understood by people everywhere.

Vocabulary:

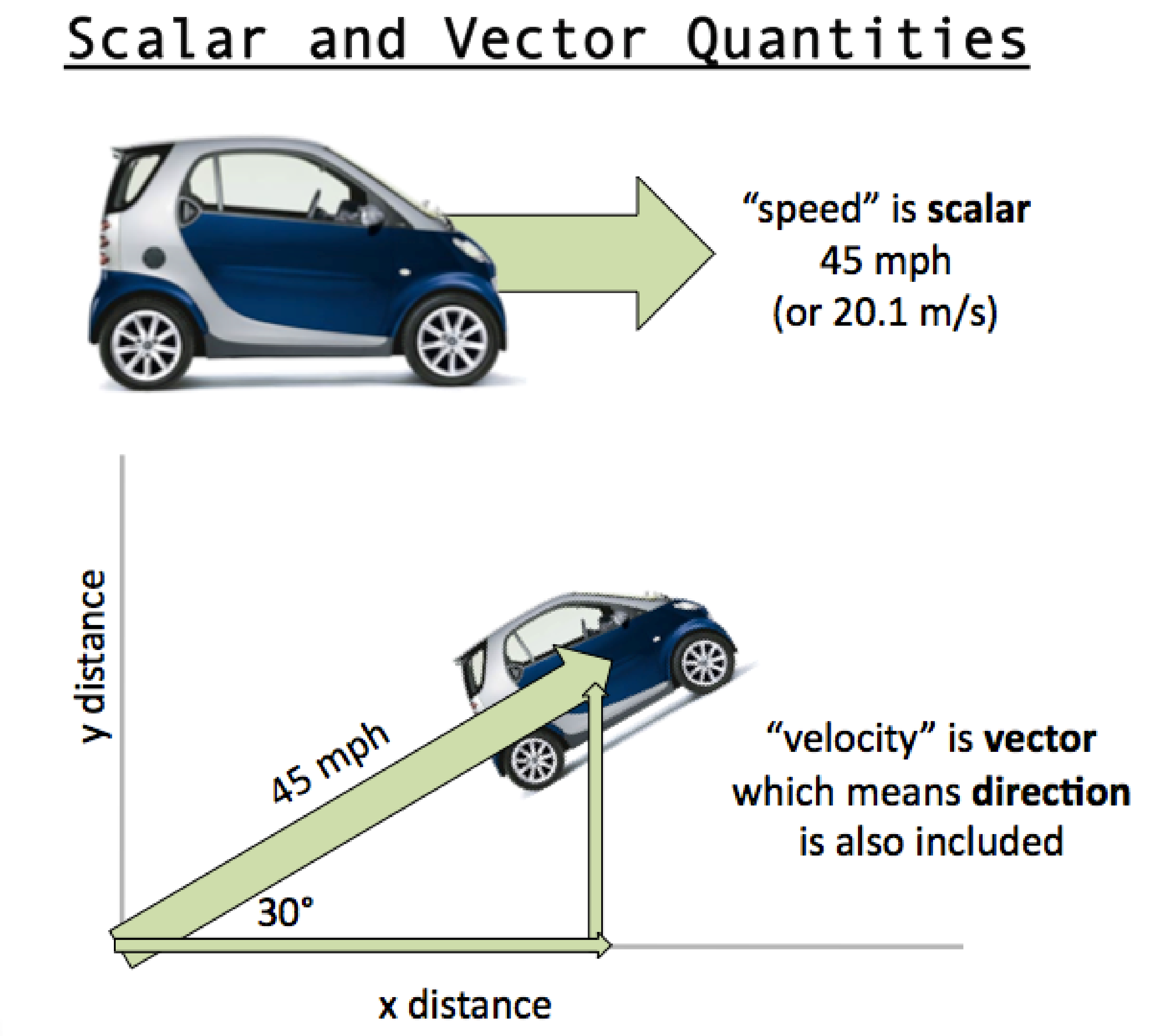
1. **DELTA (Δ)**
   - means "**CHANGE IN**"
     - i.e) **FINAL AMOUNT** – **INITIAL** amount
   - Ex) Δt means change in **TIME** ($t_2 - t_1$)
     - You studied for a science test from 4:00 to 6:00pm
       - $\Delta t = t_2 - t_1 = 6{:}00 - 4{:}00 = 2$ ***hrs***

2. **SCALAR**:
   - Quantities that only have a **MAGNITUDE** (**AMOUNT**)
   - Do **NOT** have **DIRECTION**
   - Ex) **Time (t)**, **mass (m)**, **distance (d)**
   - i.e. ***t = 20s*** *OR* ***m = 50kg*** *OR* ***d = 20m***

The Language of Motion…

3. **VECTOR**:
   - Quantities that have **BOTH** **MAGNITUDE** and **DIRECTION**.
   - **DIRECTION** is usually found in **SQUARE** **BRACKETS** after the **UNITS**.
   - **COMPASS** points (**N,S,E,W**) or **POSITIVE**/**NEGATIVE** signs are used.
   - Usually represented with an **ARROW** over the **SYMBOL**.
   - Ex) **Displacement ($\vec{d}$)**, or **velocity ($\vec{v}$)**
     - i.e. $\vec{d}$ = 20m [N] *OR* $\vec{v}$ = +12km/hr

The Language of Motion…



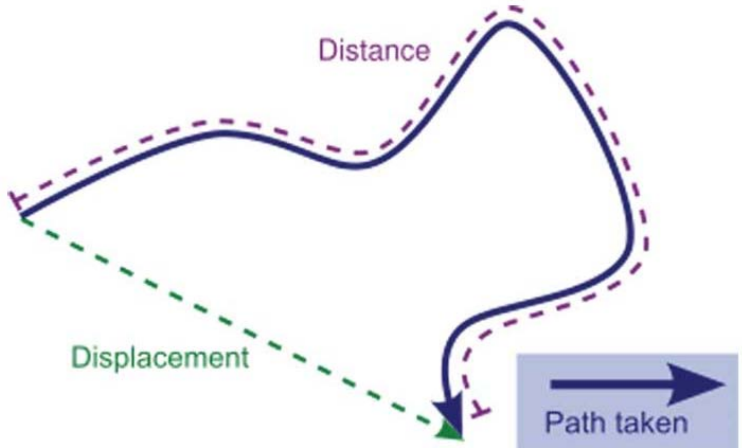
The Language of Motion…

4. **POSITION**
    - An objects **LOCATION** in terms of a **FRAME** of **REFERENCE**.
    - Symbol is **d**, and units are usually **METERS**(**m**)
    - An objects starting position is usually **d_1 = 0** or the **ORIGIN**.
    - **VECTOR** quantities need **DIRECTION**:
        - Ex) The accident happened **25km SOUTH** of Winnipeg.

The Language of Motion…

5. **DISTANCE** (**d**)
   - The **TOTAL LENGTH** of a **JOURNEY**.
   - Is **SCALAR**, $\Delta d = d_2 - d_1$, where d is in **METERS** (**m**)
     - Ex) ***100m race; 26 mile marathon; distance to Brandon and back is 400km.***

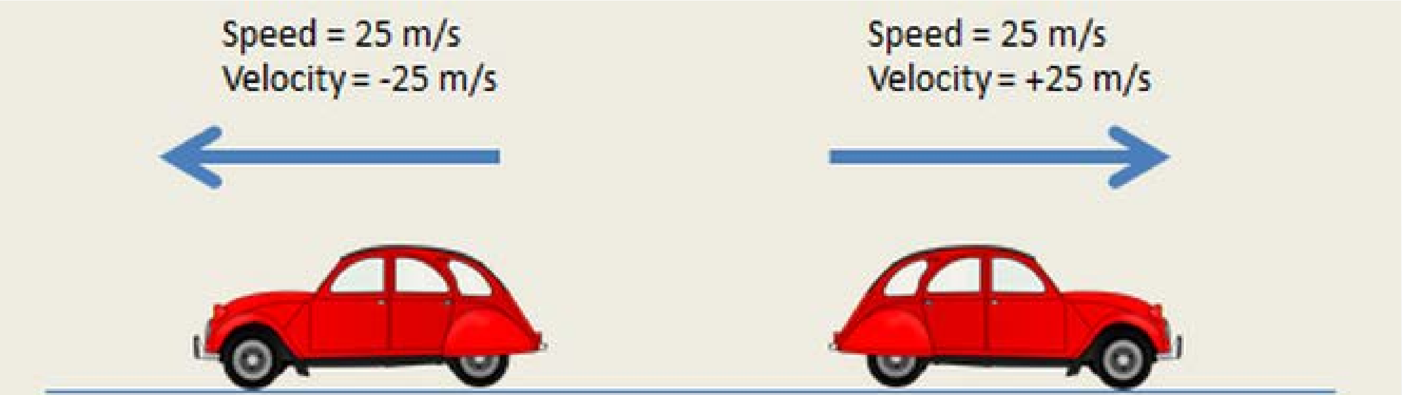
6. **DISPLACEMENT** ($\vec{d}$)
   - **DISTANCE** traveled **RELATIVE** to the **ORIGIN** (change in **POSITION**).
   - Is a **VECTOR**, $\Delta\vec{d} = \vec{d}_2 - \vec{d}_1$, where d is in **METERS** (**m**).
   - If an object ends up where it **STARTED**, displacement is **ZERO**.
     - Ex) ***the boat drifted 28m west; displacement from Winnipeg to Brandon and back is zero km.***



The Language of Motion…

7. **SPEED** (**v**)
   - The **DISTANCE** covered in a certain amount of **TIME** (how **FAST** an object is going).
   - A **SCALAR** quantity, with units **m/s**
     - Ex) ***110km/hr, 5m/s***

8. **VELOCITY** ($\vec{v}$)
   - The **SPEED** *and* **DIRECTION** of motion. Describes how **FAST** an objects **POSITION** is **CHANGING**.
   - **AVERAGE** velocity (v_{av}), **INSTANTANEOUS** velocity (v_{inst})
   - A **VECTOR** quantity with units **m/s**
     - ***Ex) 5 m/s [N], 100km/hr [W]***



The Language of Motion…

9. **ACCELERATION ($\vec{a}$)**
    - How quickly an objects **VELOCITY** is **CHANGING**.
    - **AVERAGE** acceleration (a_{av}), **INSTANTANEOUS** acceleration (a_{inst})
    - A **VECTOR** quantity with units **m/s^2**
    - Ex) Earth's gravity:
        - ***A skydiver accelerates at $9.8 m/s^2$ as he falls.***

Uniform Motion…

When an object is travelling at a constant speed or velocity it is said to have uniform motion.

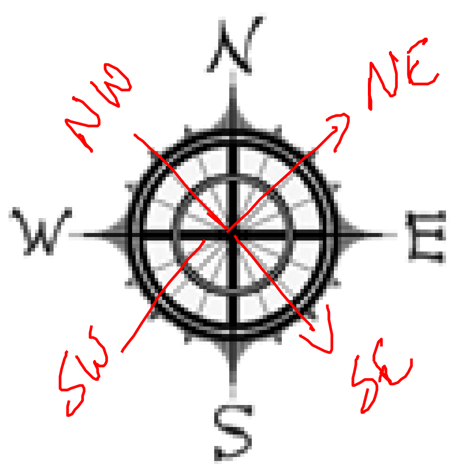
→It is not speeding up or slowing down.

In this course, we will always be looking at **LINEAR** motion, where an object is only moving in **ONE DIRECTION** at a time. To describe the position of an object, we will have to use the directions like **POSITIVE** (+),**NEGATIVE** (-), or **COMPASS** points:

→ ***Positive (+) means up or to the right*** - also East, or North

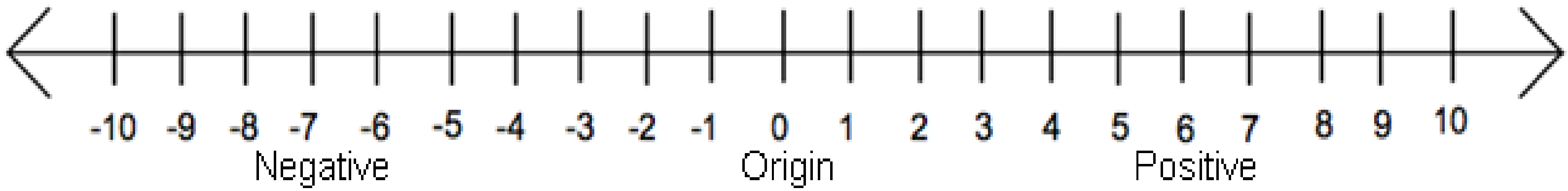
→ ***Negative (-) means down or to the left*** - also West or South

→ ***Compass points:***

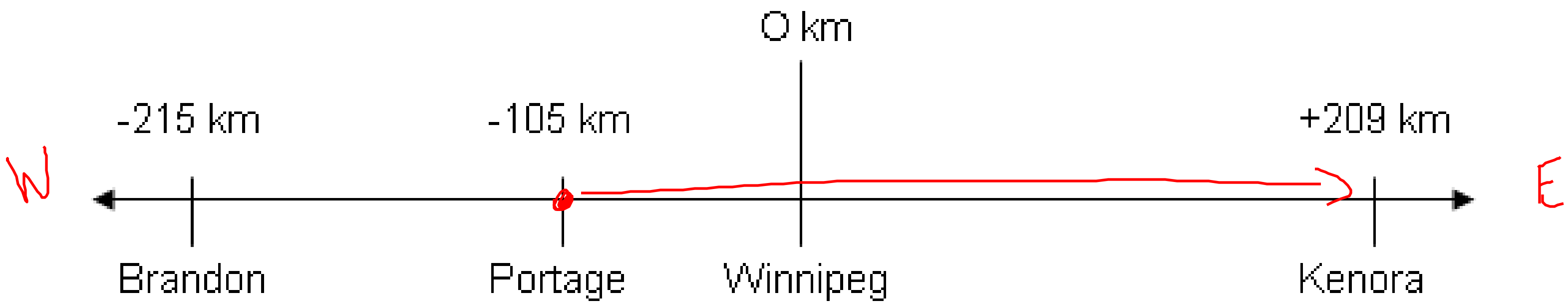


Position & Displacement…

We can use a **NUMBER LINE** to assign a **FRAME** of **REFERENCE**:



Using a number line, we can find the positions of places along a road:



The **POSITION** of Portage La Prairie is -105 km.

If we drove from Portage to Kenora, we would undergo a change in position, and we can calculate our **DISPLACEMENT** using the formula:

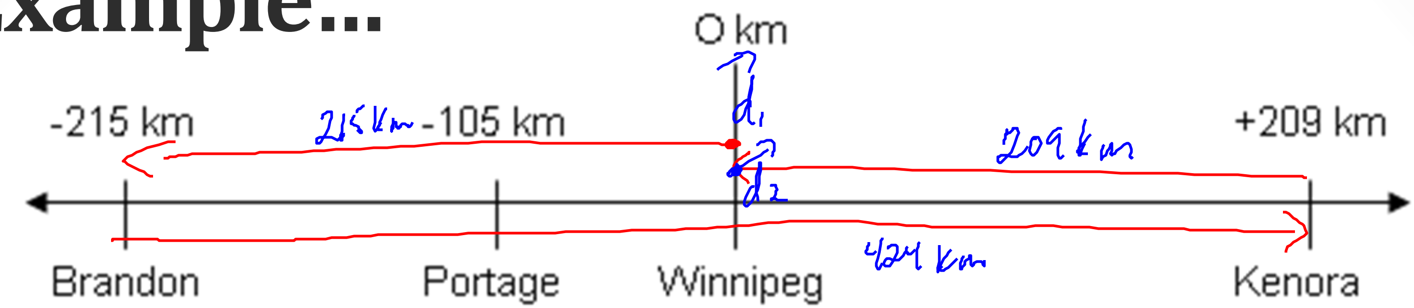
$$\vec{\Delta d} = \vec{d}_2 - \vec{d}_1$$

$$\Delta d = 209km - (-105km)$$

$$\vec{\Delta d} = +314km$$

or 314 km [E]

Example…



What would be your total **displacement** if you drove from Winnipeg to Brandon, then to Kenora, and back to Winnipeg?

$$\vec{d} = \vec{d}_2 - \vec{d}_1$$

$$= 0 \text{ km} - 0 \text{ km}$$

$$= 0 \text{ km}$$

What would be the **distance** you travelled?

distance = 215 km + 424 km + 209 km = 848 km