



# Sequence 8: effect of forces on movement



**Fiches de synthèse mobilisées** (collection en français) :

- **Fiche n°6** : mouvements
- **Fiche n°7** : quelques interactions et forces particulières
- **Fiche n°8** : lois de Newton en mécanique



**Sommaire des activités ETLV :**

- ACTIVITY 1: Measuring the viscosity of honey

## ACTIVITY 1: Measuring the viscosity of honey

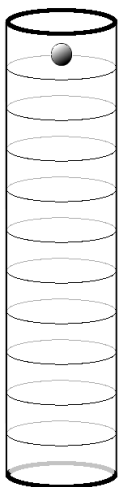
**Objective:** using Newton's laws, measuring the viscosity of honey

### DOCUMENT 1: Newton's laws

Newton's laws of motion are three laws of classical mechanics that describe the relationship between the motion of an object and the forces acting on it. These laws can be paraphrased as follows:

- Law 1. A body continues in its state of rest, or in uniform motion in a straight line, unless acted upon by a force.
- Law 2. A body acted upon by a force moves in such a manner that the time rate of change of momentum equals the force.
- Law 3. If two bodies exert forces on each other, these forces are equal in magnitude and opposite in direction

**Source:** Wikipedia



### DOCUMENT 2: Falling sphere viscometer

A technique for viscosity measurement is called the falling sphere viscometer, in which a sphere of known density is dropped into the fluid sample and the time it takes for the sphere to fall to a specified point is recorded. This method has been used on ships to monitor the quality of the fuel going into the ship's engine.

Viscosity can be computed using:

$$\eta = \frac{2 R^2 (\rho_a - \rho_m) g}{9 v_{\text{lim}}} \quad \text{and} \quad v_{\text{lim}} = \frac{L}{\Delta t}$$

With the densities of the marble and of honey:  $\rho_a = 7,83 \cdot 10^3 \text{ kg} \cdot \text{m}^{-3}$ ,  $\rho_m = 1,4 \cdot 10^3 \text{ kg} \cdot \text{m}^{-3}$ , R the radius of the sphere, g the gravity constant.



DOCUMENT 3: Comparing viscosity



Source : <https://www.youtube.com/watch?v=69iUhlqFJFk>

■ Acquiring vocabulary:

Watch the video, read the documents. Find a translation for the following expressions:

English	French
buoyancy	
drag	
gravity	
graduated cylinder	
syrup	
marble	
viscosity	
standard deviation	
	incertitude
	masse volumique

**■ Understanding:**

Draw the marble and the forces that apply to it once it has reached a constant speed:

Write an equation verified by the three forces if the speed of the marble is constant.

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**■ Applying:**

The following results were obtained in class:

$\eta$ Viscosity of honey at 20°C (Pa.s)
13.15
14.55
14.10
15,.0
13.85

Standard deviation:  $\sigma(\eta) = 0.77$  Pa.s and average:  $\bar{\eta} = 14, .17$  Pa.s. Express the result for viscosity as:

$$\bar{\eta} = \dots \text{ Pa.s}; u(\eta) = \dots \text{ Pa.s}$$

with the uncertainty computed on N values:

$$u(\eta) = \frac{\sigma}{\sqrt{N}}$$

Result:

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## Activity summary

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What you must remember:

- **speed**
- **force**
- **drag, buoyancy, gravity**
- **viscosity**
- **uncertainty**
- **standard deviation**

Skills linked to the curriculum:

Compétences	Capacités à maîtriser	Où dans cette séquence ?
APP	<ul style="list-style-type: none"><li>• Utiliser du vocabulaire spécifique</li></ul>	Activité 1
	<ul style="list-style-type: none"><li>• Lire et comprendre des documents scientifiques</li></ul>	Activité 1
COM	<ul style="list-style-type: none"><li>• S'exprimer à l'écrit et à l'oral en utilisant le vocabulaire adapté</li></ul>	Activité 1
REA	<ul style="list-style-type: none"><li>• Modéliser une action mécanique par une force.</li><li>• Établir un bilan de forces.</li><li>• Effectuer un bilan quantitatif de forces pour un système en mouvement rectiligne uniforme.</li></ul>	Activité 1