

# Warm air in a closed “U” tube

## Description

In this experiment students relate the variation of gas pressure with temperature by placing, in a U-tub, closed at one end:

- a) Colored water.
- b) Fluorescein.

And heating the air in the tube (using an alcohol torch).

## Safety

See hazards in Table 1.

**Table 1.** Hazards of materials used<sup>a</sup>

Reagents	Hazard codes	Score: hazards to...		
		H	E	P
<b>Reagents</b>				
Air <sup>b, c</sup>	-	1	1	1
Water	-	1	1	1
Food dye <sup>c</sup>	-	1	1	1
Fluorescein	H319	2	1	1
<b>Auxiliary substances</b>				
Ethanol (alcohol torch) <sup>c</sup>	H225	1	1	3
<b>Waste</b>				
Dyed water	-	1	1	1
Fluorescein	H319	2	1	1

<sup>a</sup> H – Health; E – Environment; P –Physical; - not present.

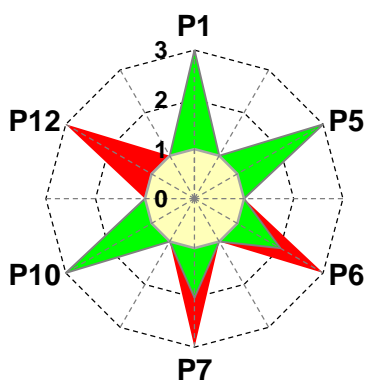
<sup>b</sup> Renewable

<sup>c</sup> Degradable to innocuous products

## Greenness assessment

For the assessment Green Star (GS) was used, results in Fig. 1-2.

a) Colored water.



$$\text{GSAI} = 66.67$$

**Figure 1.** Greenness assessment (GS)

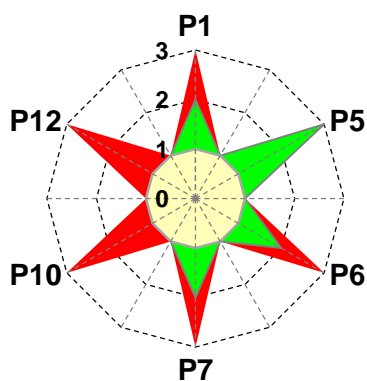
## Construction of GS

In Table 2 are presented the components and punctuations to construct the GS.

**Table 1.** Scores (S) used to construct the Green Star

Green Chemistry Principle	S	Explanation
<b>P1</b> Prevention	3	The waste is innocuous
<b>P5</b> Safer solvents and auxiliary substances	3	No indication of hazards
<b>P6</b> Increase energy efficiency	2	Room pressure and $0\text{ }^{\circ}\text{C} \leq T \leq 100\text{ }^{\circ}\text{C}$
<b>P7</b> Use renewable feedstocks	2	At least one raw material/feedstock (water excluded) is renewable
<b>P10</b> Design for degradation	3	All substances used are degradable to innocuous products
<b>P12</b> Safer chemistry for accident prevention	1	Ethanol, H225

b) Fluorescein.



$$\text{GSAI} = 41.67$$

**Figure 1.** Greenness assessment (GS)

### Construction of GS

In Table 2 are presented the components and punctuations to construct the GS.

**Table 2.** Scores (S) used to construct the Green Star

Green Chemistry Principle	S	Explanation
<b>P1</b> Prevention	2	Fluorescein, H319
<b>P5</b> Safer solvents and auxiliary substances	3	No indication of hazards
<b>P6</b> Increase energy efficiency	2	Room pressure and $0\text{ }^{\circ}\text{C} \leq T \leq 100\text{ }^{\circ}\text{C}$
<b>P7</b> Use renewable feedstocks	2	At least one raw material/feedstock (water excluded) is renewable
<b>P10</b> Design for degradation	1	At least one substance is not degradable to innocuous products
<b>P12</b> Safer chemistry for accident prevention	1	Ethanol, H225

### References

Dias, F. M. L.; Rodrigues, M. M. R. D. *Física e Química na Nossa Vida - 8ºano*, Porto Editora, Porto, 2010.