25. Piles of powder

Opponent:
Team Romania

Reporter:
Team Greece - Fryganiotis

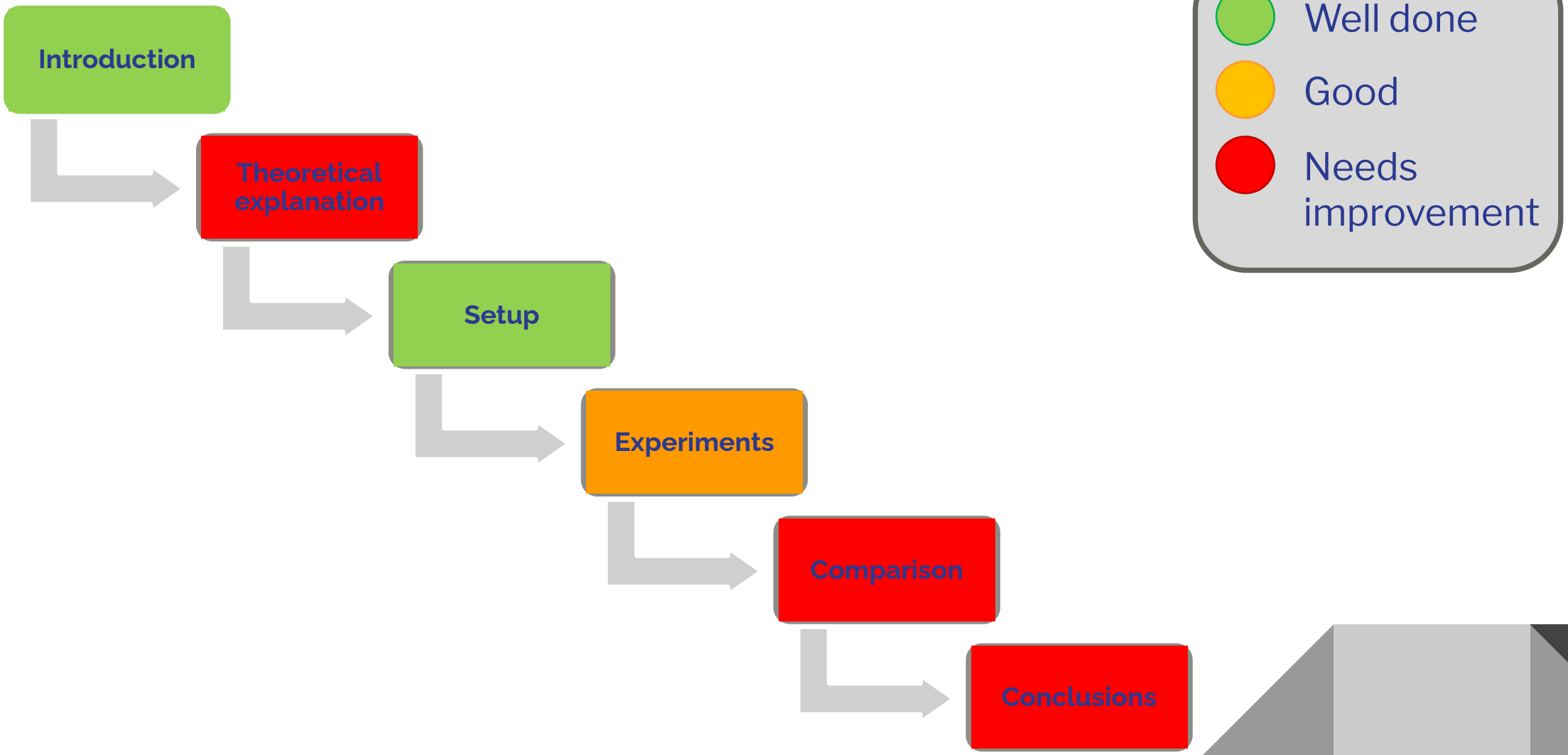
Task

A powder of your choice is poured onto a table, e.g. through a tube or a funnel. Investigate how the height of the pile depends on time. Investigate how the shape of the pile depends on time.

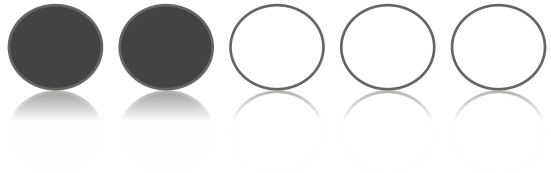
Pouring a powder on a table through a funnel - Shape of pile
- Theoretical explanation

Height of the pile depending on time
- Experimental

Outline


Introduction
Theoretical explanation
Setup
Experiments
Comparison
Conclusions
Well done
Good
Needs improvement

Theoretical part



Strong points

- Good definition of terms (crystalline structure)
- Good structure (hypotheses, experiments, conclusions)
- Keeping some parameters constant

Weak points

- No theoretical model of the phenomenon was presented
- No mention of the shape of the granules
- No explanation about the spreading of the powder

Experimental part

Strong points

- Clear setup
- Experiments made in a controlled manner

Weak points

- No experimental theory was presented
- No quantitative data
- The mass of powder that have been used was too small - thus the phenomenon was not visible
- Visual aids could have helped (graphs)
- The third experiment had a hypothesis that was true only for the 2 heights considered
- No clear justification of the conclusions
- Experiments not concluded to clear results
- No conclusions about the shape
- Shape has **not** been **studied** (problem task)
- Density not studied- important factor

Discussion topics

- Mass flow rate (debit masic) - how was it maintained constant
- Shape of the pile (cone)
- Relation between radius and height of the cone
- Height between the tube and the table
- Relevant parameters (mass, density)

Appendix 1 - Sphere packing coefficient

A random packing of equal spheres generally has a density around 64%.

Appendix 2 - Formula for radius

$$V = \frac{m \cdot 100}{\rho_s \omega} \qquad V = \frac{\pi r^2 h}{3} \qquad h \simeq r$$

$$\frac{\pi h^3}{3} = \frac{m \cdot 100}{\rho_s \omega}$$

for sugar:

$$h = \sqrt[3]{\frac{m \cdot 300}{1.59 \cdot 64 \cdot 3.14}} \qquad h = 0.98\sqrt[3]{m}$$