# Does the metabolic theory of ecology apply to the bean beetle?

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## Introduction

In 2004, on a quest to find a universal theory in ecology applicable to all levels, Brown et al. established the metabolic theory of ecology (MTE).

The MTE establishes an equation that links temperature (T) and body mass (M) to metabolic rate

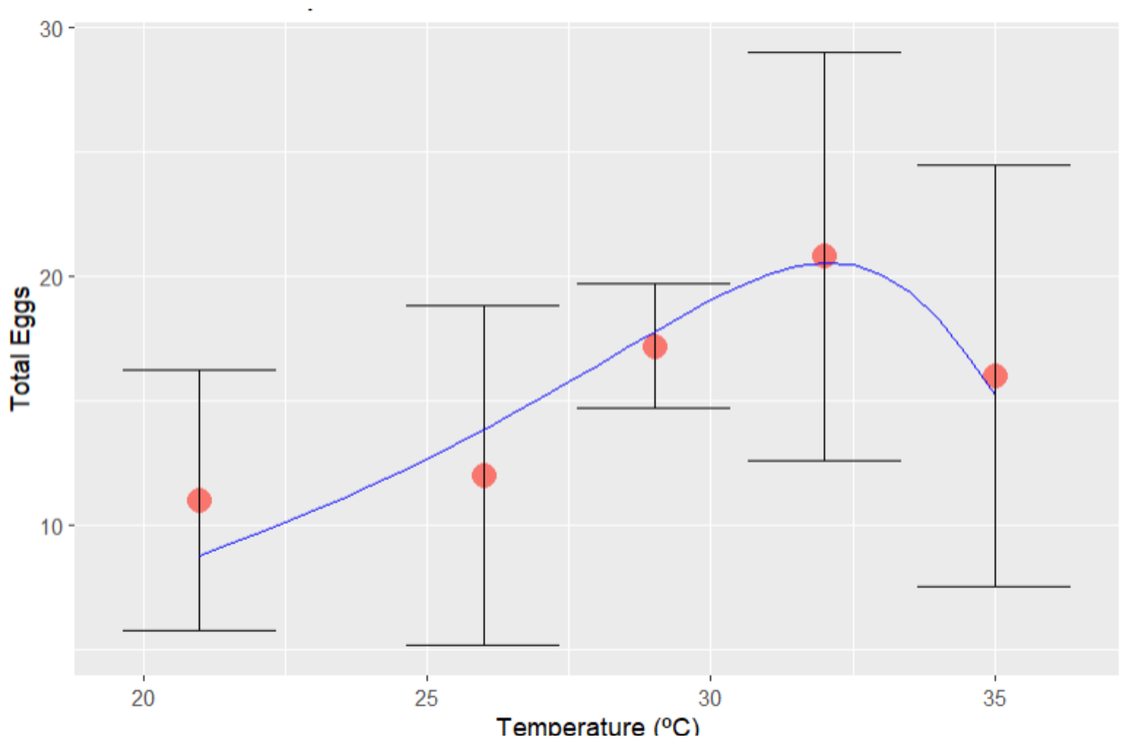
$$I = i_0 M^{3/4} e^{-E/kT}$$

and when linearized, it predicts that the activation energy for any metabolic process should be **0.62 eV** and that this should be the case at all different levels, from organism to population.

This raises the question if the MTE also applies to the egg laying rate of bean beetles?
If this is the case, **our hypothesis is that the number of eggs laid will increase up to a certain temperature and then decrease**.

## Results

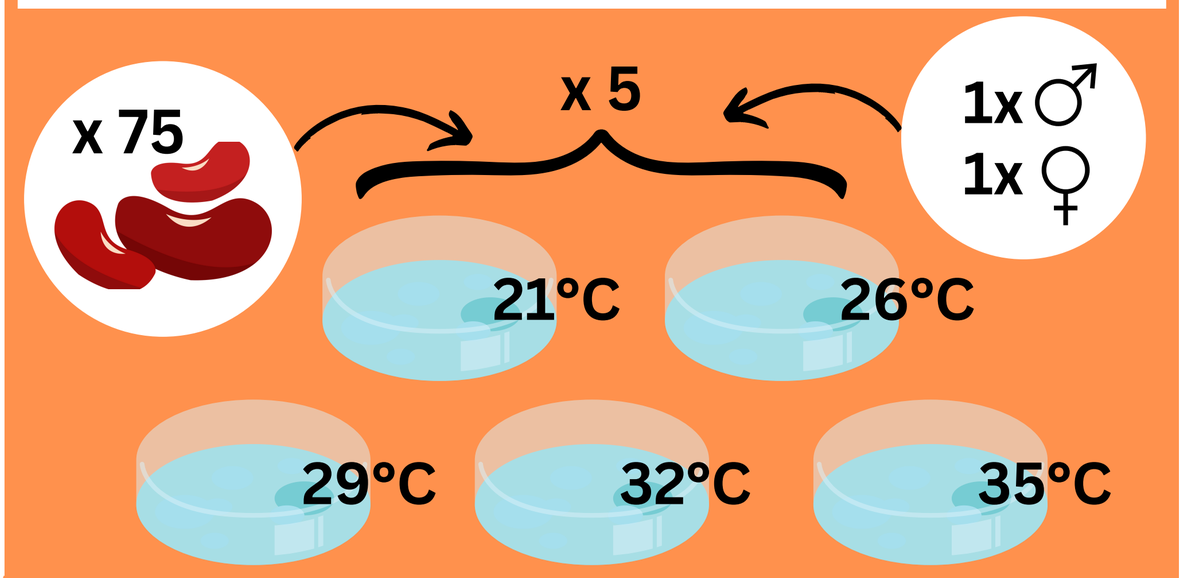
- The bean beetles have an optimal temperature at 32 °C, as more eggs were laid at this temperature.
- Temperature and egg total means were used in a Sharpe-Schoolfield unimodal model and yielded an activation energy estimate of 0.6944.




## Methods

**<u>Eggs and offspring produced counted from 5 temperatures with:</u>**

- 5 x petri dishes:
  - 75 beans
  - 1 male + 1 female




## Discussion

- The results confirm our hypothesis that the number of eggs laid will increase up to an optimal temperature and then decrease.

- Our results could not fit a linear model (p-value 0.1205), and a Sharpe-Schoolfield curve was used instead. The activation energy value estimated by the Sharpe-Schoolfield model is close to the theoretical values predicted for the activation energy.

- The mean value and standard error for the number of eggs at each temperature were used instead of the raw data.

- This model does not correct for mass.

## Conclusion

The number of eggs bean beetles lay is maximized at the optimal temperature of **32 °C** and we can say that the MTE also applies to the egg laying rate of the beetles.

## References

**1: Brown et al. (2004).**Toward a metabolic theory of ecology. *Ecology*, 85: 1771-1789. https://doi.org/10.1890/03-9000