
What is this thing?

What do they eat?

What do they eat?

How do they get food?

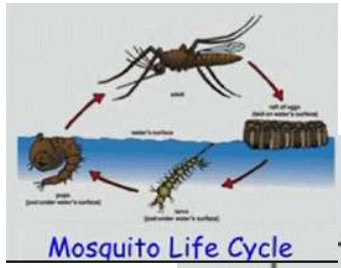
What do they eat?

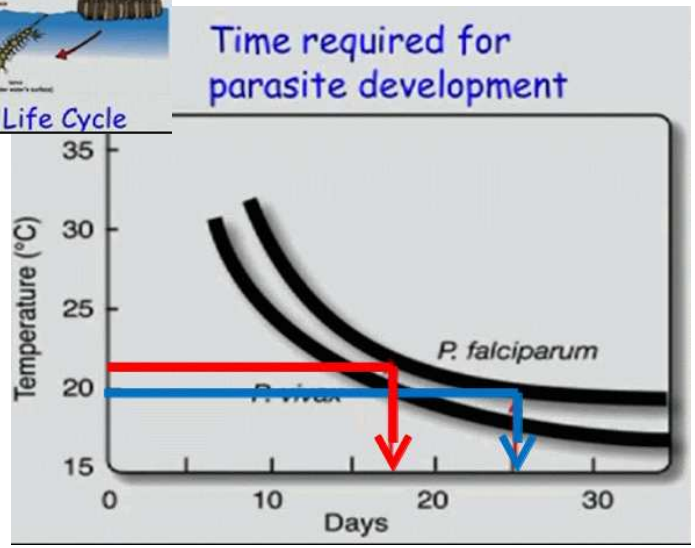
How do they get food?

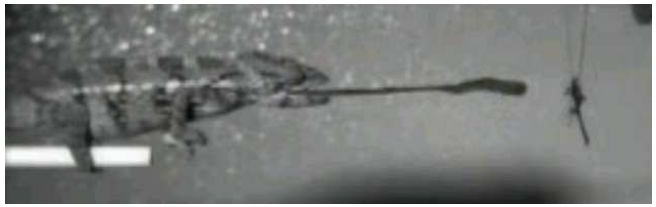
Crouching Chameleon - Jumping Fly

What Does This Have To Do With Climate Change?

- Global warming will alter the behavior of insects, recall DRJ's plot at the first meeting on insect life cycle.
- Flies have a sophisticated mechanism to detect and respond to threats.
- Chameleons have a powerful system for capturing prey.
- Chameleons and flies are cold-blooded.







G. M. Card, *Curr. Opin. Neurobiol.* 2012, 22:180-186

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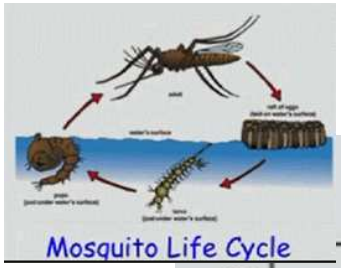

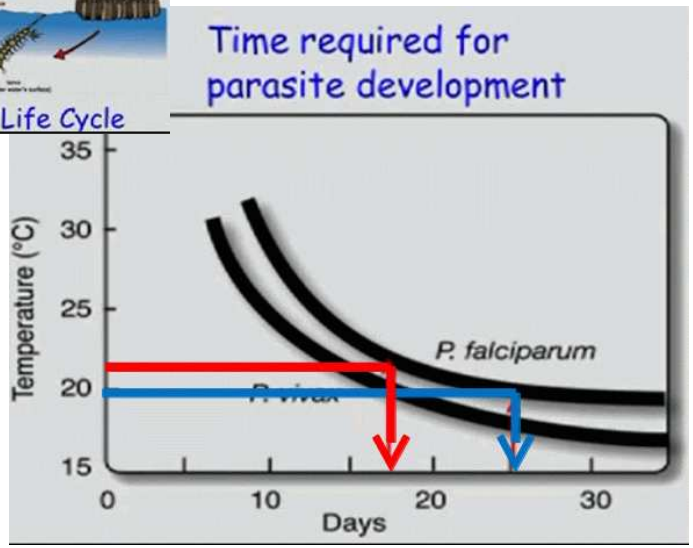

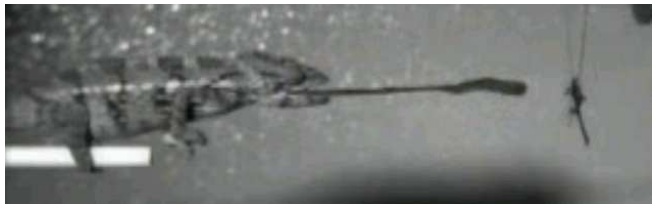

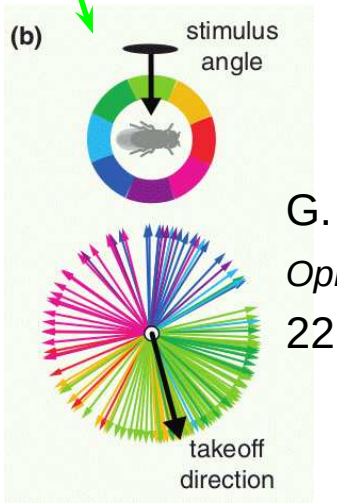

Predator-Prey interactions may be significantly altered by changing climate.

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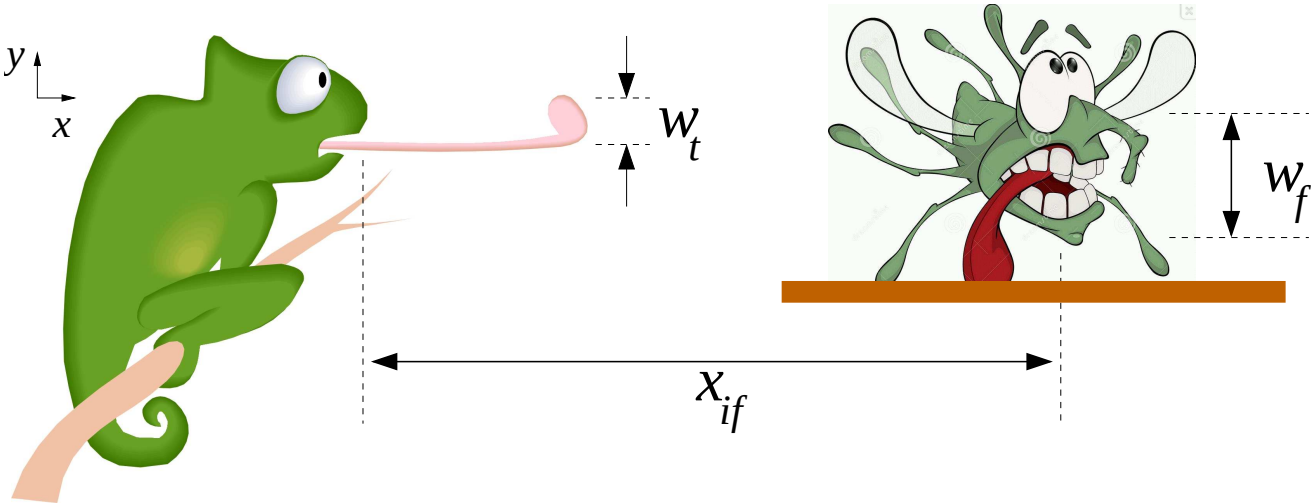
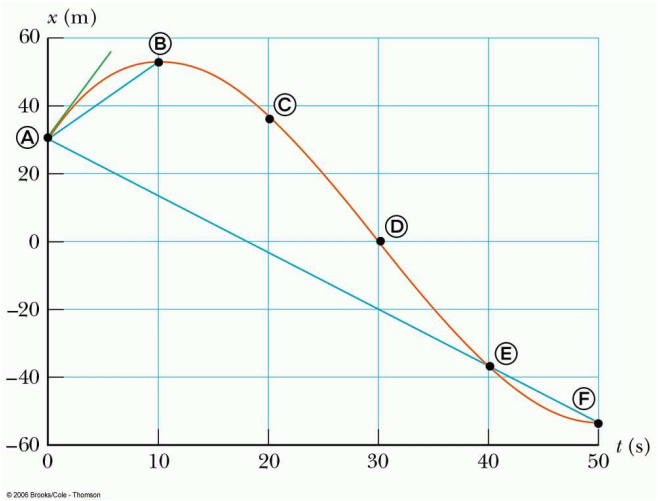
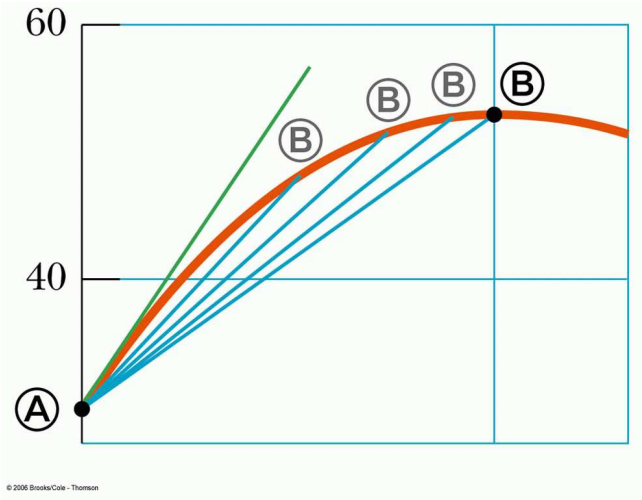
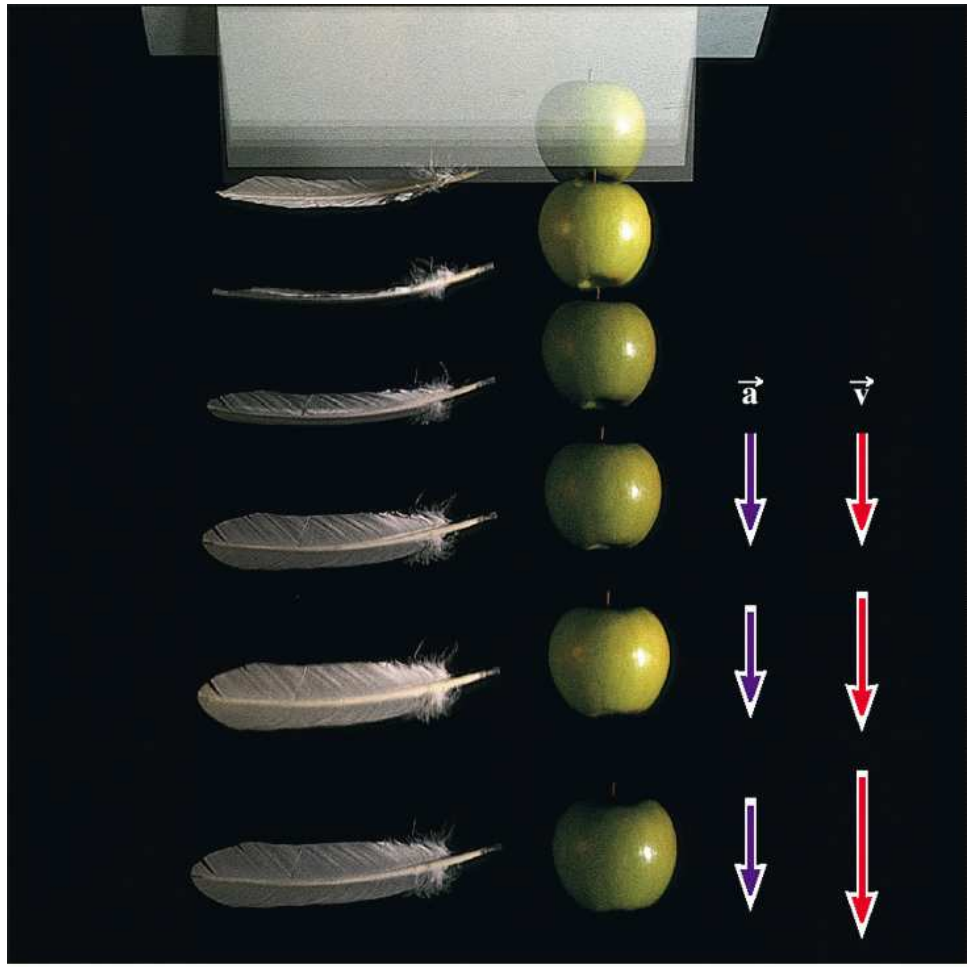


One-Dimensional Motion







Crouching Chameleon - Jumping Fly

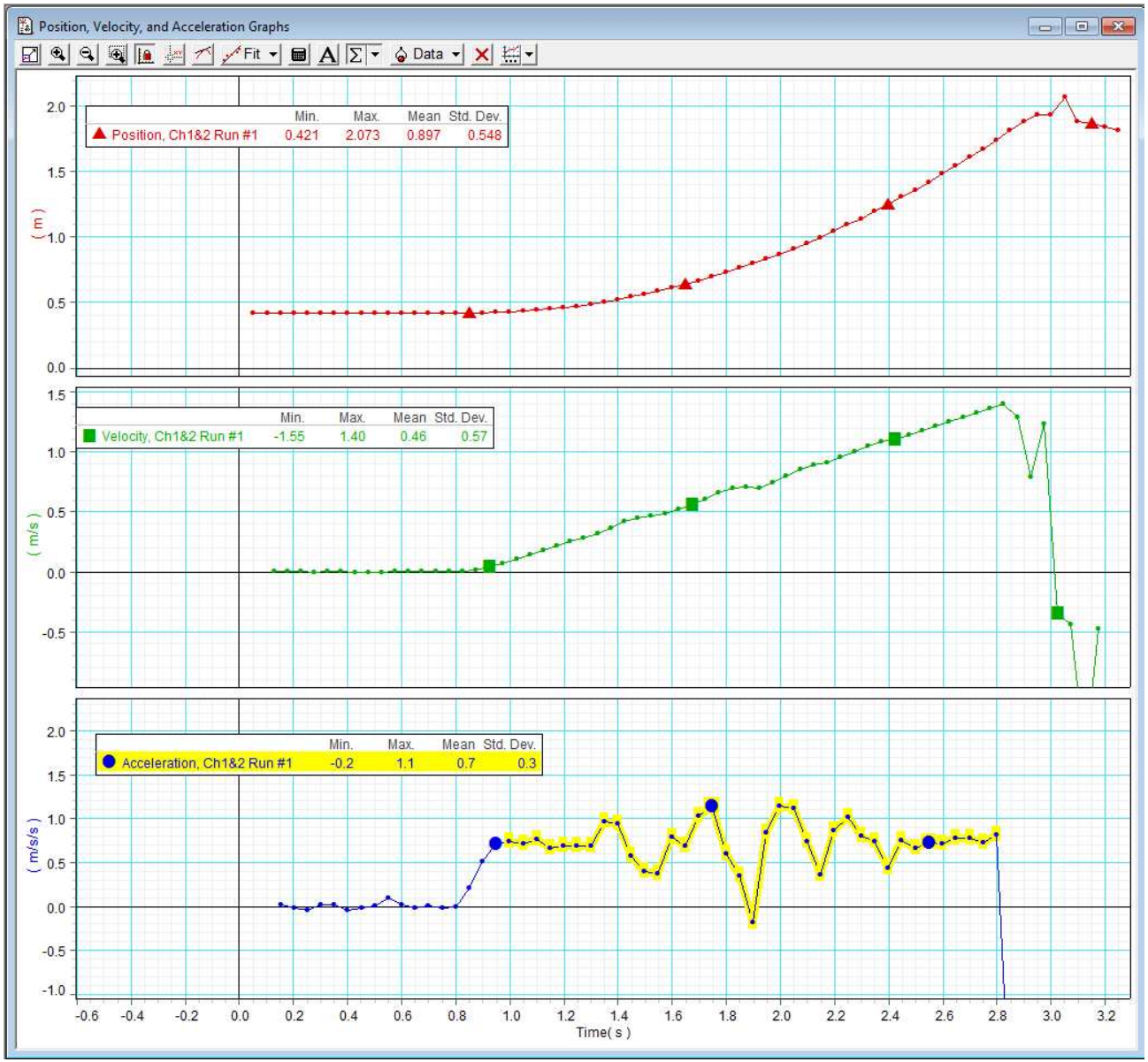
One-Dimensional Motion

An elevator in the world's tallest building, the Burj Khalifa in Dubai, United Arab Emirates, is moving and its vertical position is described by the following equation

$$y(t) = A + Bt + Ct^2$$

where $B = 2.1\ m/s$, and $C = -4.9\ m/s^2$. What is the instantaneous velocity at any time t? What is the average velocity between two times $t_0 = 0.0\ s$ and $t_1 = 1.0\ s$?

Lab motion data

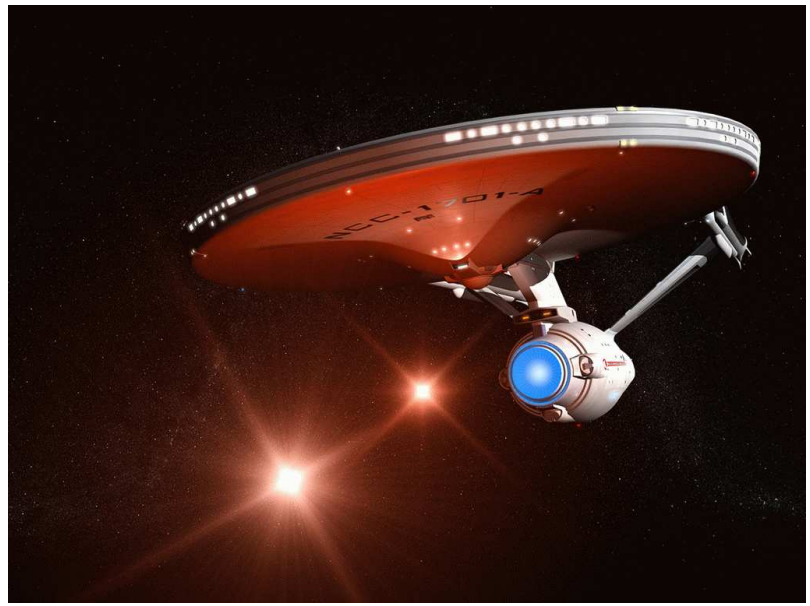


Captain Kirk's Bad Day

The starship Enterprise has lost power and is plunging straight into the heart of a black hole. Its velocity as a function of time is described by

$$v(t) = F + Gt$$

where $G = 9.0 \times 10^{10}\ m/s^2$.



What is the average acceleration between $t_1 = 1.0\ s$ and $t_2 = 2.0\ s$?

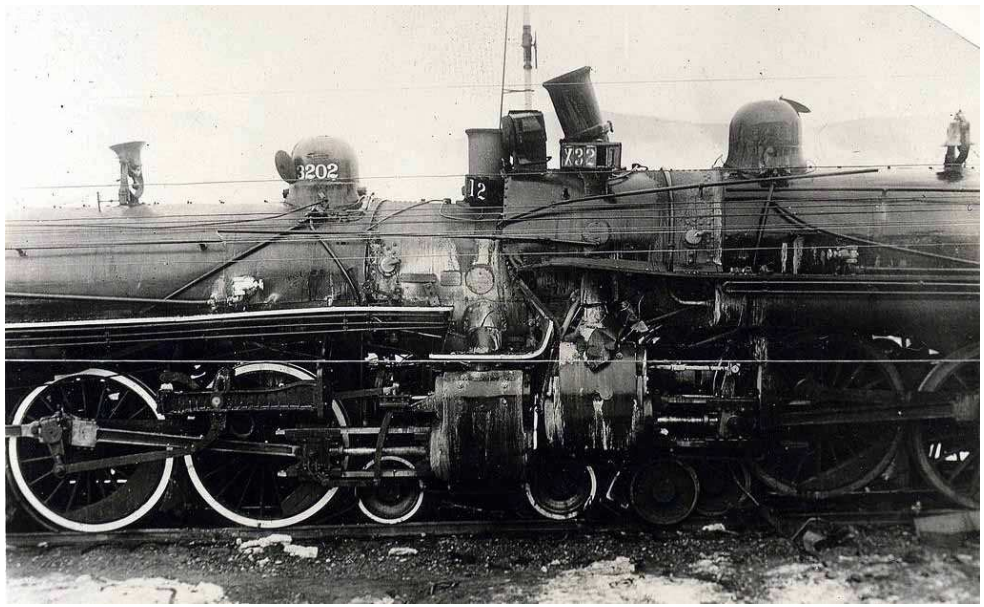
What is the instantaneous acceleration?

Catching Up

At the instant a traffic light turns green, an automobile starts with a constant acceleration $a = 2.2\ m/s^2$. At the same instant a truck, traveling with a constant speed $v_t = 9.5\ m/s$, is $5\ m$ behind the car in a different lane. How far does the car travel before overtaking the truck?

EEEEKKK!!

Two trains, one traveling at $20\ m/s$ and the other at $40\ m/s$, are headed toward one another along a straight, level track. When they are $950\ m$ apart, each engineer sees the other's train and instantly applies the brakes. The slow-moving train stops. The brakes decelerate each train at a rate of $1.0\ m/s^2$. Is there a collision?



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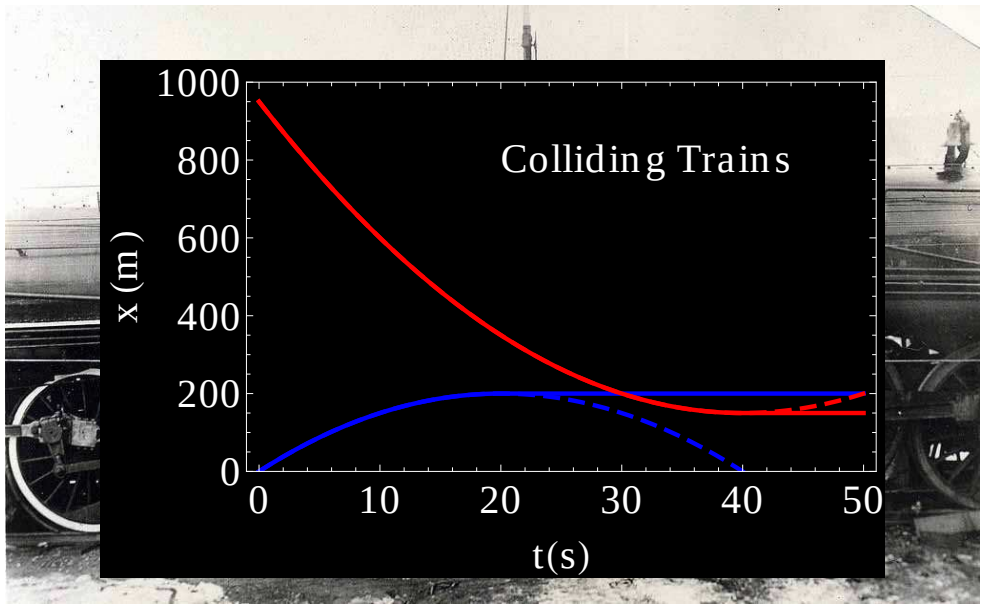
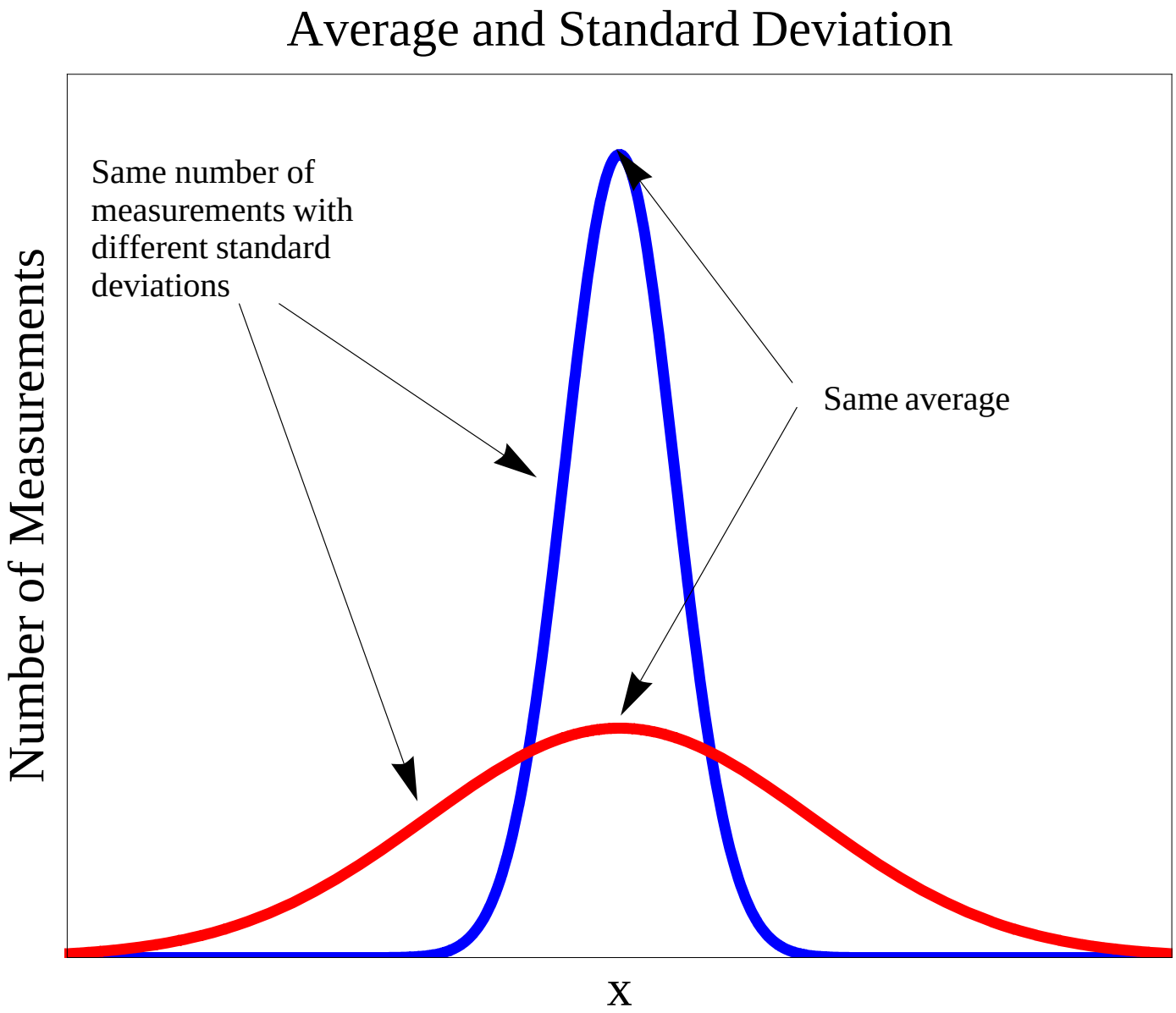
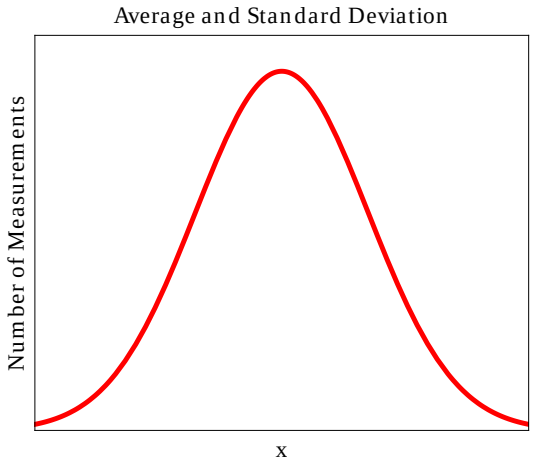


Measurement and Uncertainty

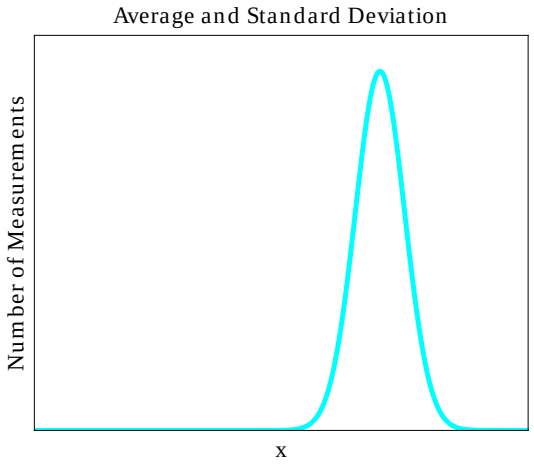


Precision versus Accuracy

Not precise.



Precise, but not accurate.



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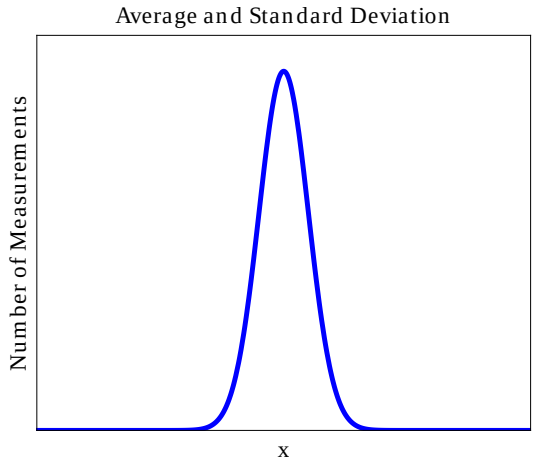
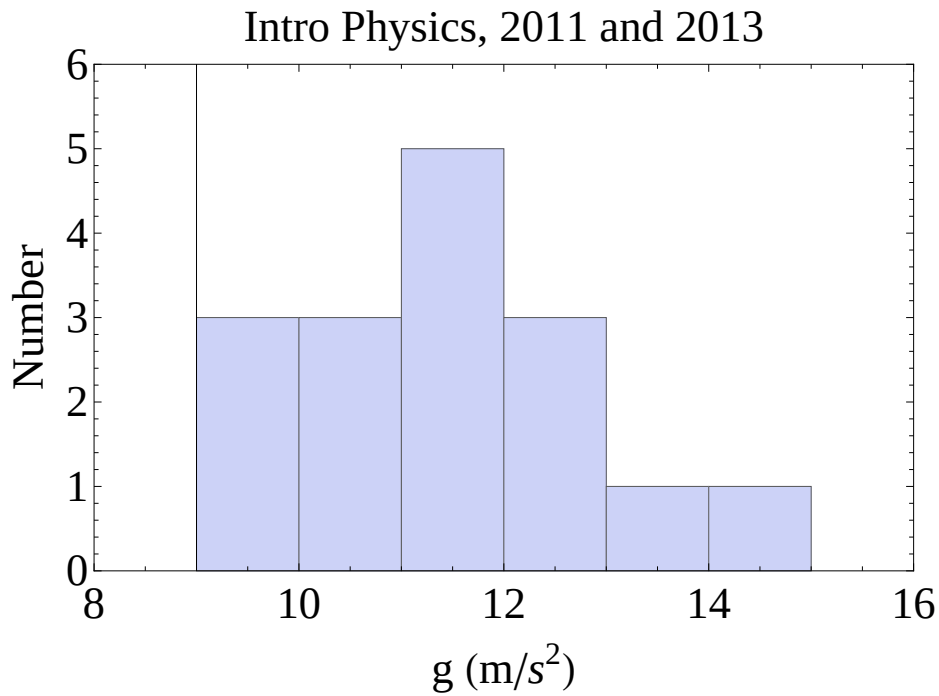


More on Precision versus Accuracy



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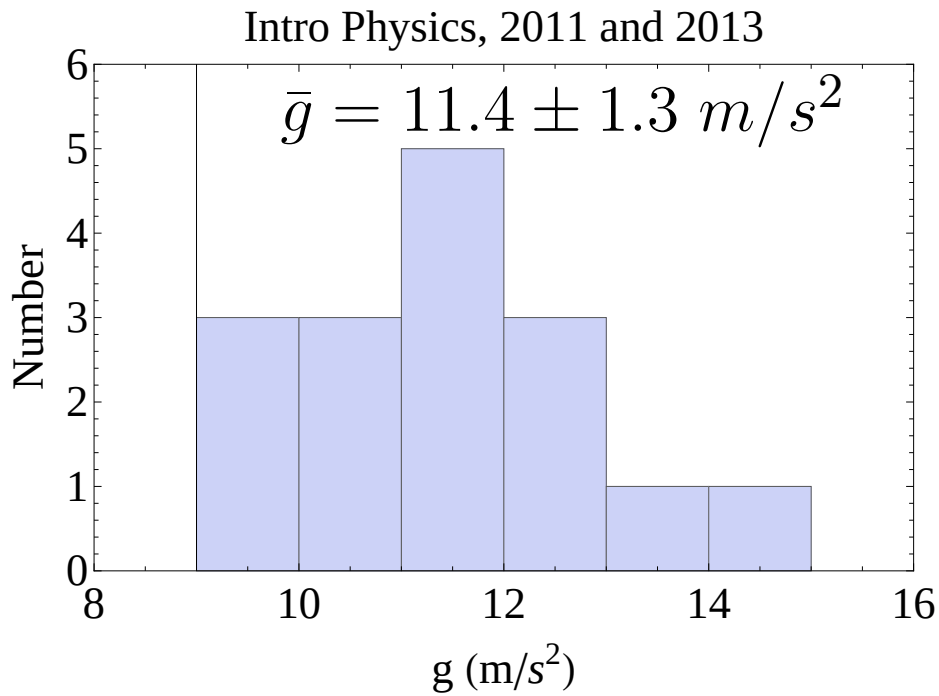

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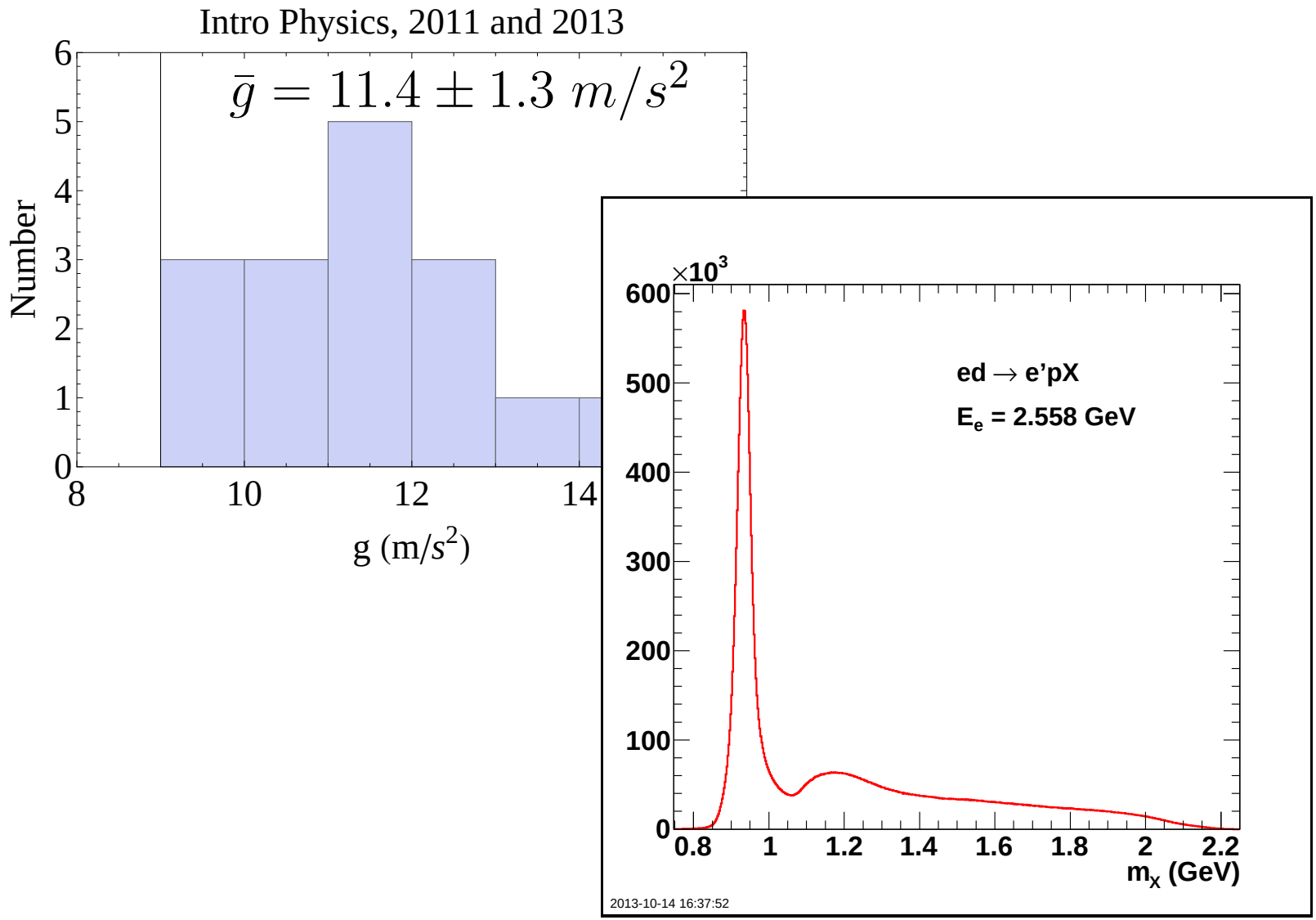

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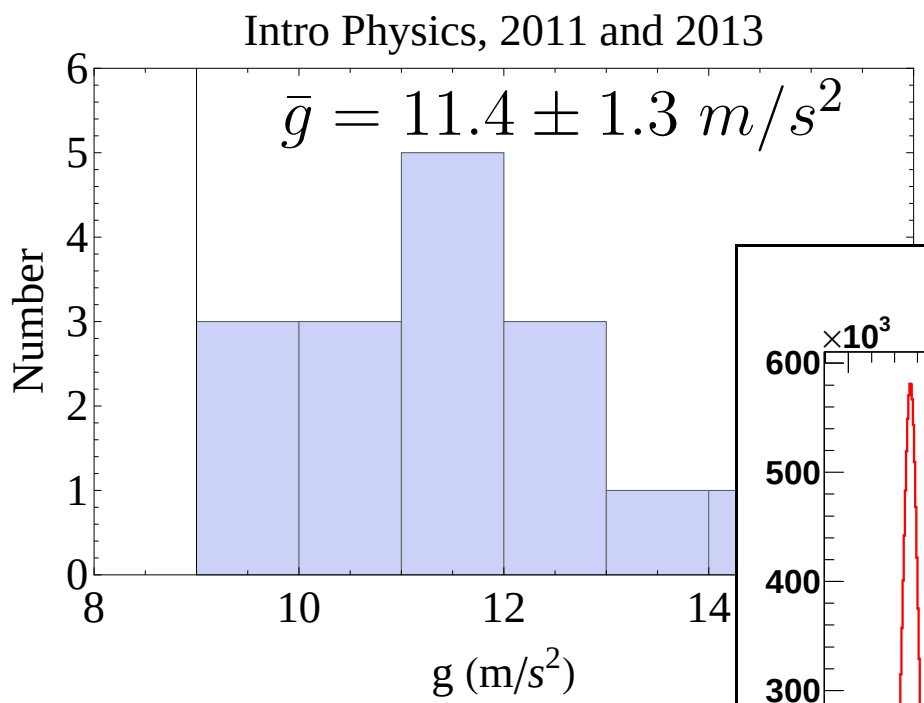
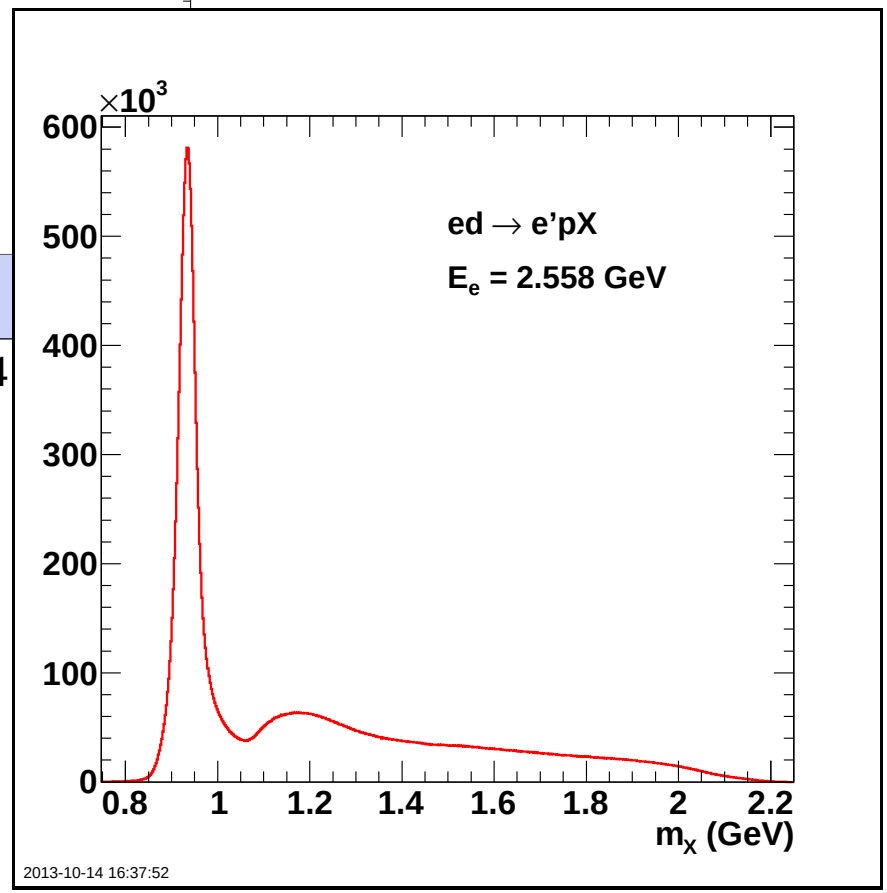
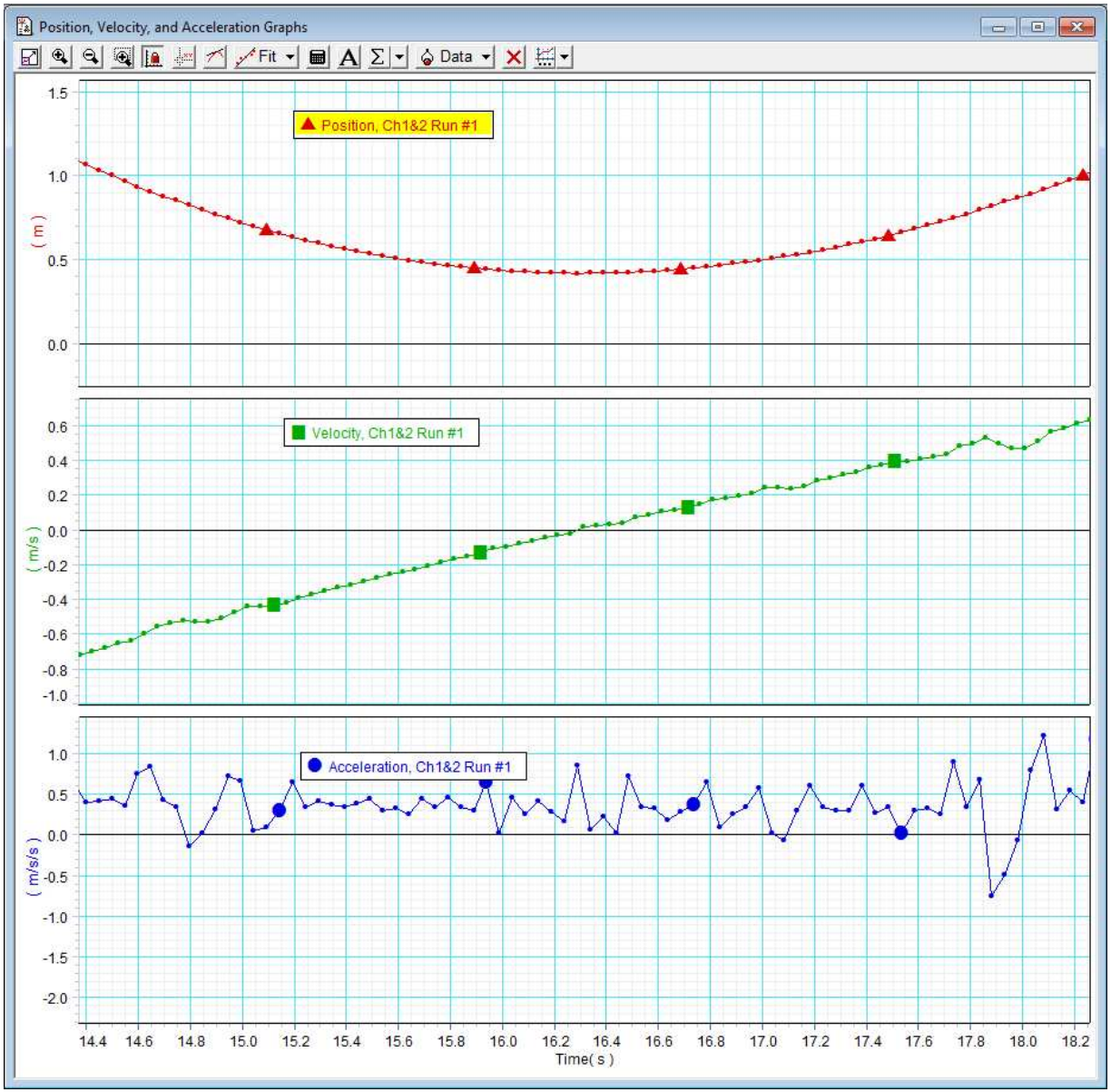




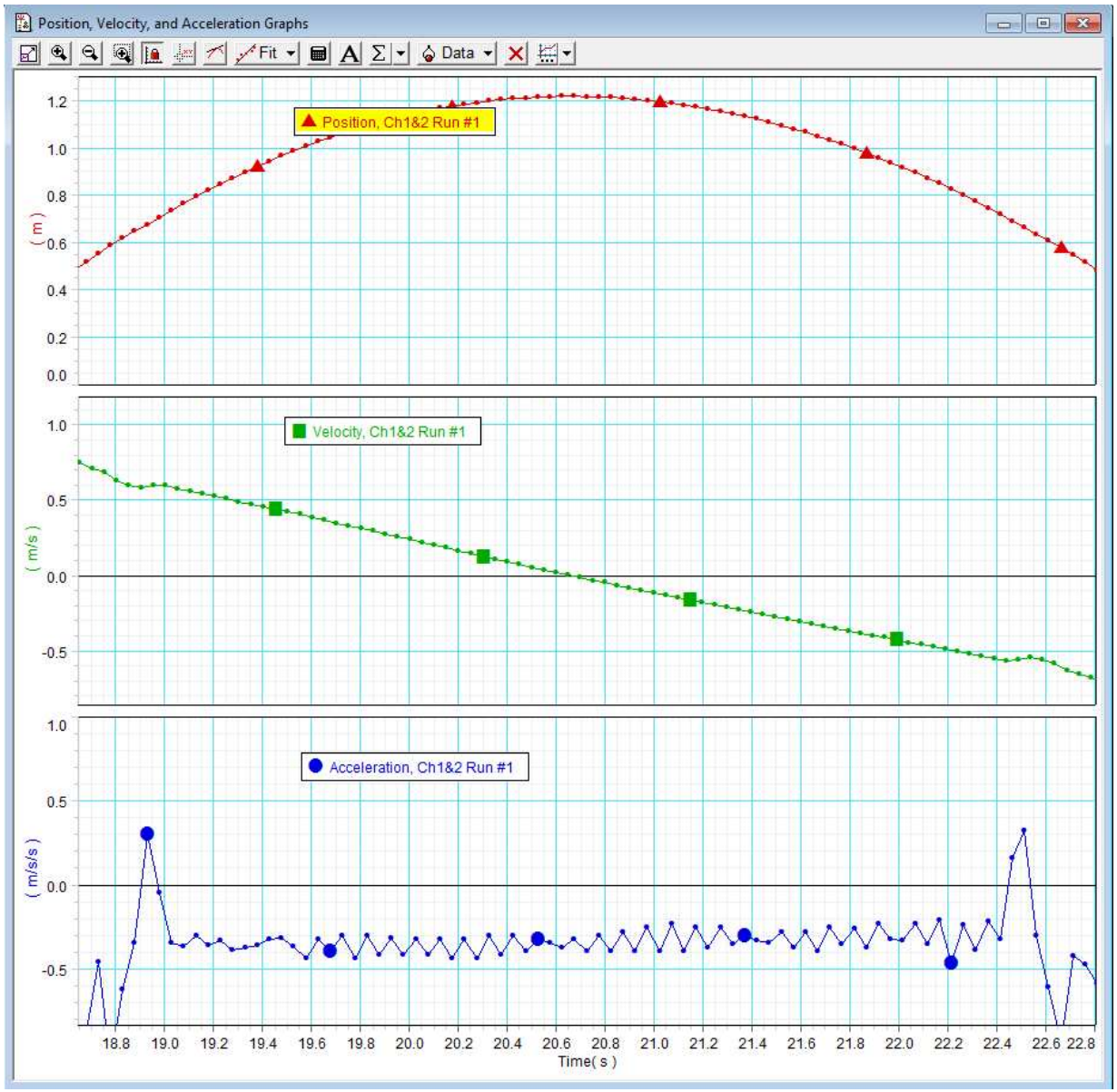
- For 'simple' distributions the average and standard deviation are useful.
- For other distributions, more information is needed.

Position and Velocity

Turning Around 1



Turning Around 2



Crouching Chameleon - Jumping Fly

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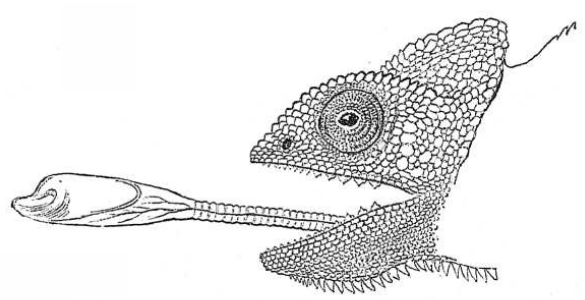

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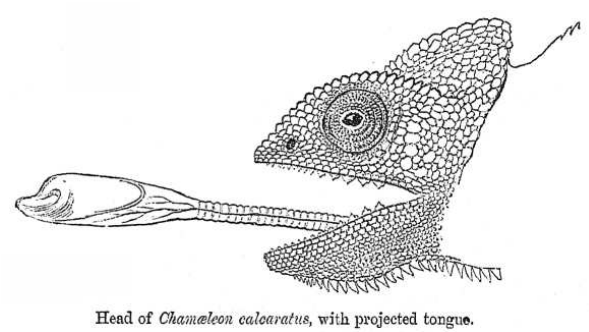
- Tongue projection reaches the prey in less than 0.1 seconds. See it here.



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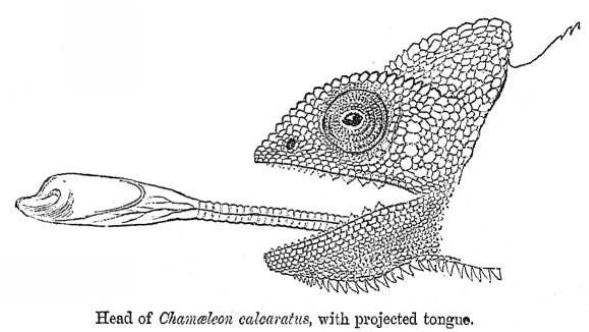

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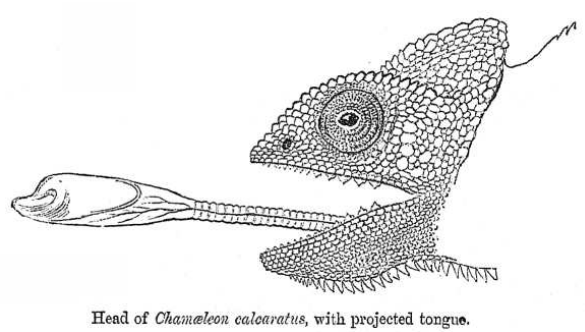

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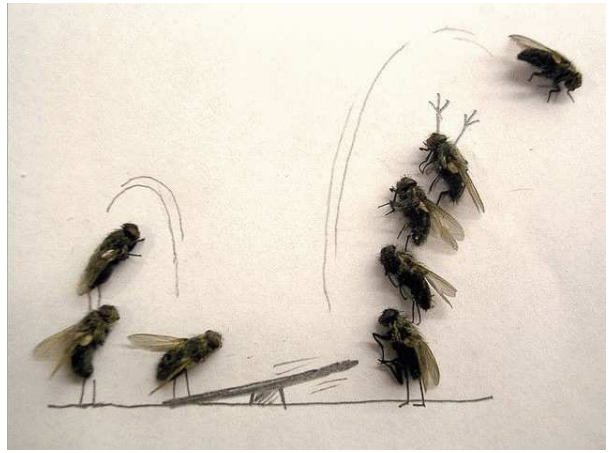
- To avoid becoming prey flies make spectacular jumps.
- Before impact the fly calculates the location of the threat, then maneuvers its legs to jump out of the way. See it here.



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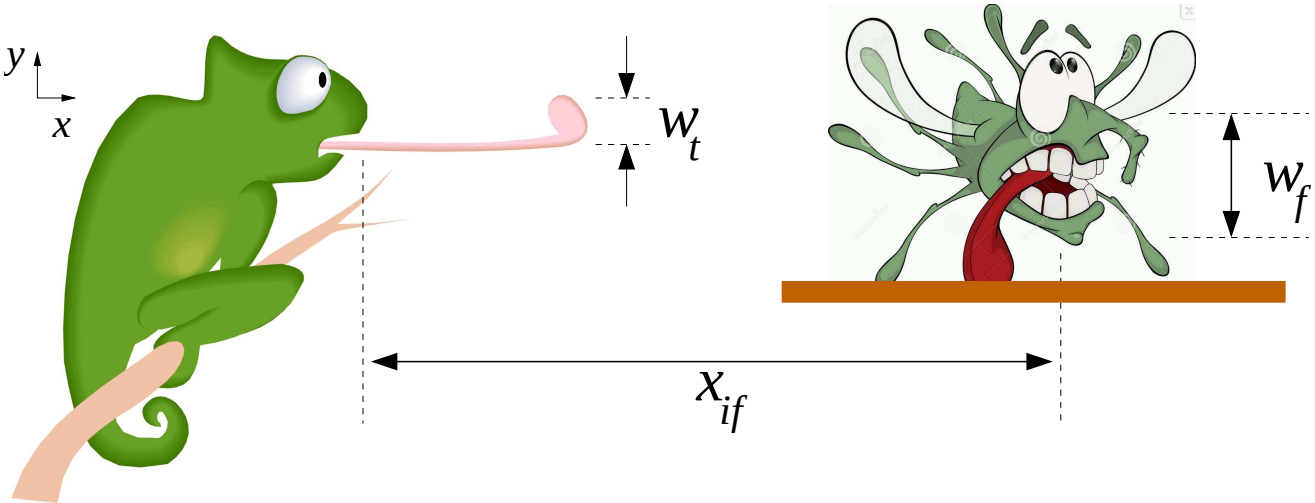

Crouching Chameleon - Jumping Fly: Fly Parameters

- Size - use the Wiki.
- Speed - *Performance trade-offs in the flight initiation of Drosophila*, Card and Dickinson, Jour. Exp. Biol. 211, 341-353 (2008).
- Timing - *Visually Mediated Motor Planning in the Escape Response of Drosophila*, Card and Dickinson, Curr. Biol. 18, 1300-1307 (2008).