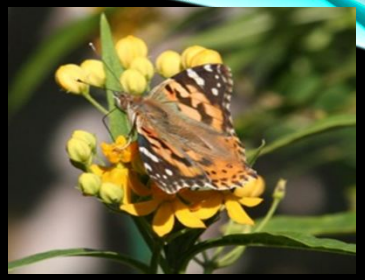
PAINTED LADY BUTTERFLY LAB

Primary Consumer Energy Flow

PRE-LAB INFO…

- You should have read:
  1. the background information
  2. the procedure

- You each should have answered the pre-lab questions



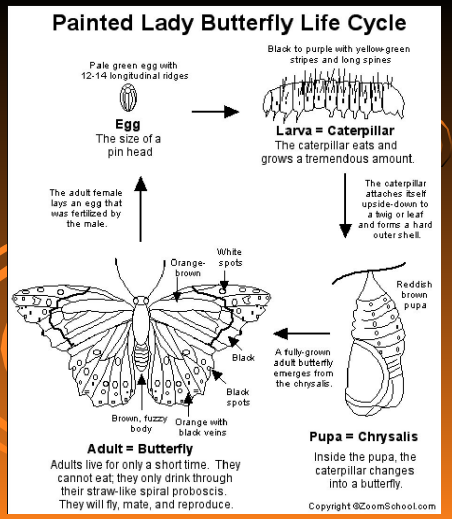
GOALS OF THE LAB…

1. **Measure the efficiency of energy transfer from one trophic level to another**
   - Larvae = Primary Consumer
   - Growth Medium = Primary Producer

2. Calculate the transfer of biomass through a food chain based on 10% ecological efficiency

3. Construct a trophic level diagram

4. Observe the life cycle of the painted butterfly



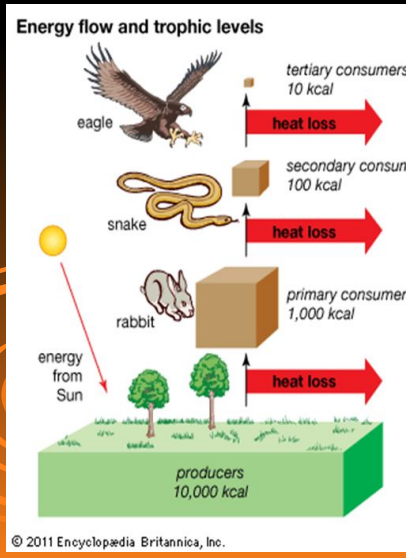
TURN AND TALK- NOT ALL ENERGY IS TRANSFERRED FROM ONE TROPHIC LEVEL TO THE NEXT. WHAT HAPPENS TO IT?

ENERGY TRANSFER…

- First law of thermodynamics:
  - Energy can neither be created nor destroyed. It can only change forms. In any process, the total energy of the universe remains the same. For a thermodynamic cycle the net heat supplied to the system equals the net work done by the system.

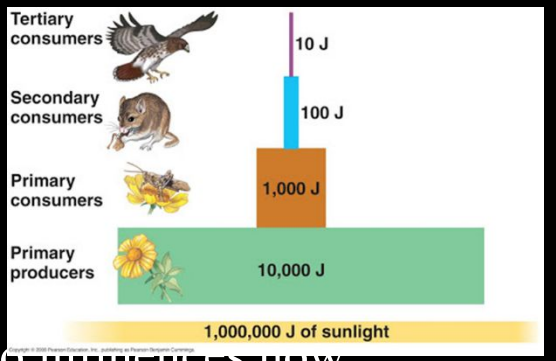
- **As things get eaten in a food chain, some of the energy in the food is…**
  - **lost as heat** (lower quality energy)
  - **doesn't get eaten**
  - **can't be digested**
  - **becomes waste**

So how much energy is actually transferred to the consumer?



ECOLOGICAL RULE OF THUMB…

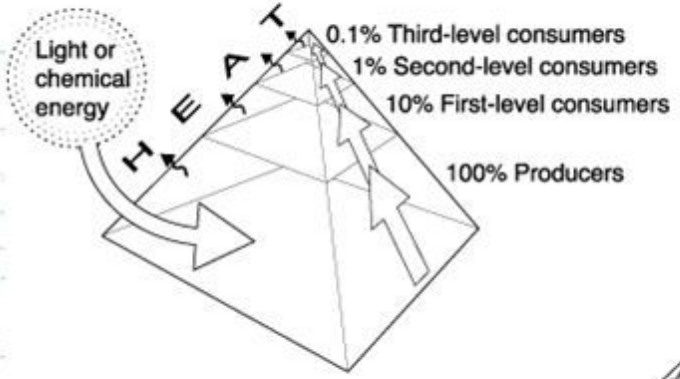
- About **10%** **of net energy production at one trophic level is passed on to the next level.** (can be from less than 1 to more than 25%)
- Processes that reduce the energy transferred between trophic levels include:
  - Respiration
  - Growth and reproduction
  - Defecation
  - Non-predatory death
    that die but are not eaten by consumers)
  - The nutritional quality of material that is consumed also influences how efficiently energy is transferred, because consumers can convert high-quality food sources into new living tissue more efficiently than low-quality food sources.



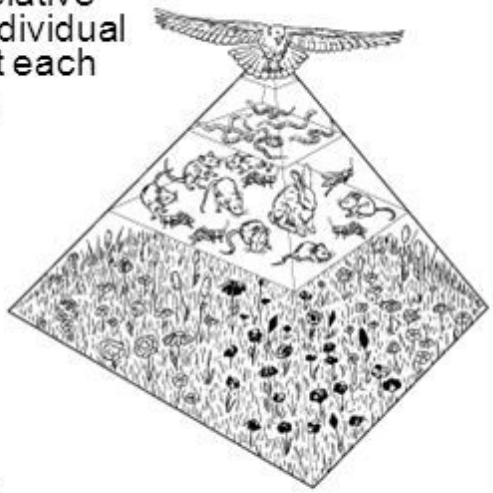
- **In terrestrial systems, the loss of energy from one trophic level to the next is related to the amount of biomass transferred from level to level**
- So in this lab, we will measure energy transfer by measuring the transfer of mass from level to level.

Ecological Pyramids

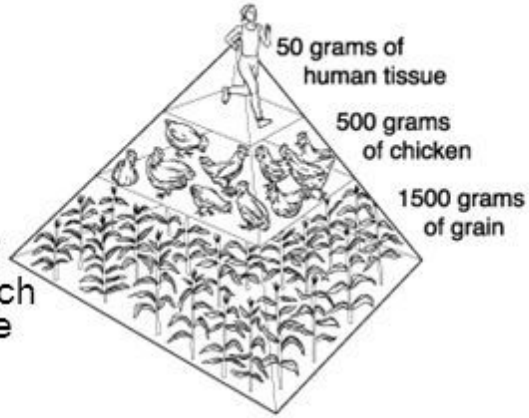
Energy Pyramid
Shows the relative amount of energy available at each trophic level. Organisms use about 10 percent of this energy for life processes. The rest is lost as heat.



Pyramid of Numbers
Shows the relative number of individual organisms at each trophic level.

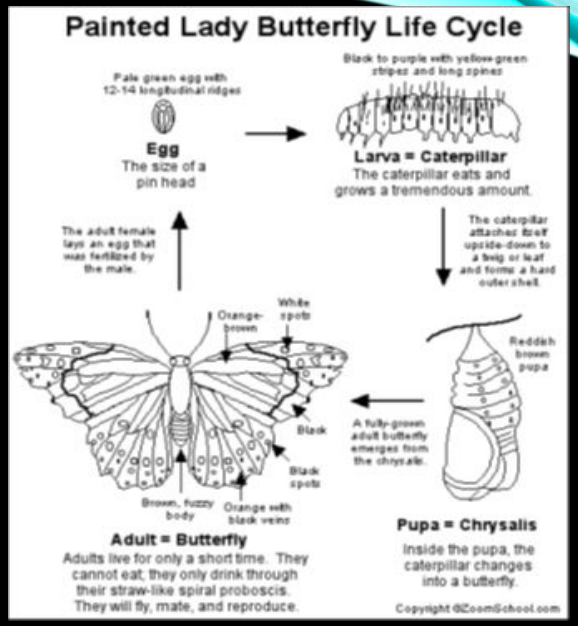


Biomass Pyramid
Represents the amount of living organic matter at each trophic level. Typically, the greatest biomass is at the base of the pyramid.



LIFE CYCLE OF PAINTED LADY BUTTERFLIES…

- Stage 1: Egg (5-10 days)
- Stage 2: Caterpillar (larva) 5-10 days
- Stage 3: Chrysalis (pupa) a week
- Stage 4: Adult (butterfly)



BUTTERFLY LAB GENERAL INFO…

- I will do the control cup and give you data regularly.
- **Your group is responsible for regular measurements to be done in class.** (~3 weeks)
  - Qualitative Data: descriptions
  - Quantitative Data: mass measurements, data table

CONTINUED

…

- Label your cup/lid with "Period – Group #" (Ex. 3-1) and "Larvae"
- Punch the same number of holes into both container's lids with the pushpin~ *1mm in diameter each*

- Using a pen, trace a circle on a paper towel/tissue paper using the lid, then cut 1.5 centimeters bigger than your circle

CONTINUED…

- Weigh the combined mass of the larvae cup, lid, & 2 sheets of cut paper towels first
- Record the data to the nearest 0.01g in the data table
- Then zero it out and weigh each separately and record.

  Lid: _____ Paper: _____ Cup: _____
- Add the food with the wooden stick, 1.5cm high (2-3 grams)

- Re-weigh and record cup, lid, paper, food…
  - the difference is the mass of the food
- THEN gently, add the larvae (2 per cup) re-weigh

CONTINUED

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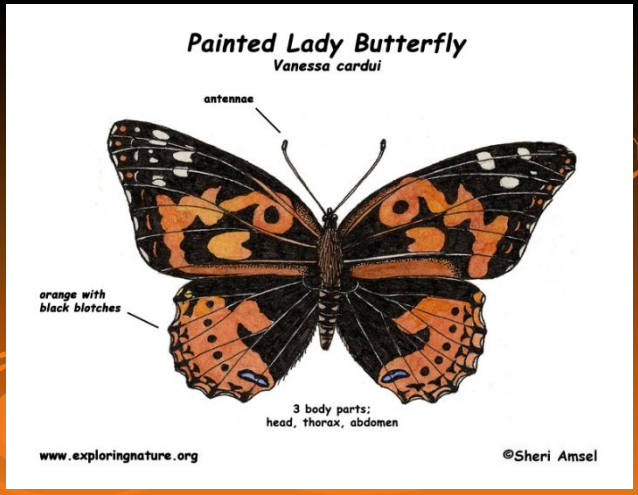
- Place the paper towels over the opening of the larvae cup, carefully close the lid
  - Do NOT damage the lid or cup!
- Place your cup on the side counter



Data Tables

Data Table 1	Control Cup	Larvae Cup
At Beginning of Experiment		
Mass of Empty Cup		
Original Mass of Cup Containing Medium		
At End of Experiment		
Final Mass of Cup Containing Medium		
Mass of Chrysalises		

Data Table 2: Daily Log

Date	Control Cup Mass (g)	Control Daily Mass Loss (g)	Larvae Cup Mass w/o Frass (g)	Larvae Daily Mass Loss (g)	Larvae Daily Mass Loss Minus Control Daily Mass Loss (g)	Observations

= data that I will give you

= what you need to do today

Today's Date is 4/20

GOOD LUCK!

Any Questions?

	Control	Larvae
Mass of Cup, Lid and Tissue Paper:		
Original Mass of Food Medium:		
Final Mass of Chrysalises:	N/A	
Total Mass Loss:		
% Efficiency:	N/A	

Record the mass of the chrysalises.
(chrysalis with paper) – (mass of the paper) = Mass of chrysalis only

Don't forget : if you added any food during the last week, make sure to add that amount to the original mass of food medium.

Cumulative larvae mass loss – Cumulative control mass loss = total mass loss

Date	Control Cup Mass (g)	Control Daily Mass Loss (g)	Cumulative Control Mass Loss (g)	Larvae Cup Mass (g)	Larvae Daily Mass Loss (g)	Cumulative Larvae Mass Loss (g)	La Los
4/20	10.78	N/A	N/A	10.66	N/A	N/A	
4/21	10.66	0.12	0.12	10.54	0.12	0.12	
4/22	10.49	0.17	0.29	10.34	0.20	0.32	

	Control	Larvae
Mass of Cup, Lid and Tissue Paper:		
Original Mass of Food Medium:		
Final Mass of Chrysalises:	N/A	
Total Mass Loss:		
% Efficiency:	N/A	

Mass of chrysalis/ original mass food in the larvae cup = % efficiency

CONDITIONAL ACTION: if there was food left over in your cup, your original mass of food in the larvae cup should be (original food mass) – (left over food mass)

% efficiency is the efficiency of mass moving from one trophic level to the next, or the efficiency of energy moving from one trophic level to the next. Did your experiment follow the 10% rule?

Don't forget to write the student's name next to the conclusion Q answered.