

## Details



**Completion Time:** More than a week

**Permission:** Download, Share, and Remix

## Calorimetry Lab

### Overview

Students will learn the basics of calorimetry, energetics and respiration as they pertain to their own bodies and to those of other species, including arctic animals.

### Objectives

Students will learn about respiration, calorimetry and the energetic needs of various species including their own. Students will compare food intake to daily energy consumption and consider the consequences of a caloric imbalance over a long period of time.

### Lesson Preparation

Questions to go over with students:

- What is respiration and what is its role in the body?
- What are calories? Why do we need them?
- How can someone calculate their own energetics? (field metabolic rate)
- How are the energetics calculated for various species?

### Procedure

(Refer to Resources section for further information)

Sequence of activities for the unit:

Week 1

1. Learn organelles of a cell
2. Identify mitochondria as the site of respiration

Week 2

3. Learn respiration equation
4. Calculate calories needed in one day based on individual energetics
5. Examine one domestic and one wild polar animal to discover energy requirements
6. Calorie lab-burning potato chips (see Resources section for information)
7. Web research on other animal energetics
8. Math lessons comparing Little auk known energetics

## Materials

- Computer
- Internet access

to copepod calories

9. Projections of Little auk survival if food type changes

- Students will develop a chart that compares their daily food intake to their daily energy consumption. A self portrait will be drawn that visually represents how students would appear if they maintained that same level of input to output .
- Students will use Internet resources to find polar species whose energetics have been studied.
- Students will take the known energetic data for one of these species and translate it into a 3-5 minute representative activity that demonstrates how much energy that animal uses regularly.

Engage:

- Get volunteers to do 20 jumping jacks. Reward with a snack whose calorie content matches the energy output from the exercise (popcorn, jolly rancher, etc.)

Explore:

- Students will keep track of daily food intake and energy expenditure
- Students will research to find out the calorie needs for themselves
- Students will research to find out the calorie needs for a domestic animal and a wild polar animal

Explain:

- Students will analyze the data and determine if the calorie intake balanced the energy expenditure.
- Students will then draw a self portrait that represents what their body would be like if that intake/output were maintained over a long period of time.
- Students will recognize the dietary needs of a domestic animal and of a wild animal and consider the consequences of a caloric imbalance over a long period of time.

Extend:

- Examine PolarTREC journals that refer to Little auk (<http://www.polartrec.com/greenland-seabird-ecology/journals/mary-pella-donnelly>)
- PolarTREC journal entry from the Greenland Seabird Ecology expedition with energetic calculation activity (<http://www.polartrec.com/node/1497>)

Evaluate:

- Find out energy expenditure compared to calorie intake. Recalculate based on possible food alteration due to ocean currents shifting and warming. Reflect upon how available food changing would impact the student.

**Extension**

N/A

### **Resources**

Dramatic population declines in the Kittlitz's murrelet: assessing the magnitude and potential causes of the decline

[http://www.absc.usgs.gov/research/seabird\\_foragefish/projects/index.html](http://www.absc.usgs.gov/research/seabird_foragefish/projects/index.html)

Seabirds

[http://www.absc.usgs.gov/research/seabird\\_foragefish/seabirds/index.html](http://www.absc.usgs.gov/research/seabird_foragefish/seabirds/index.html)

Possible calorimetry lab from PBS

[http://www.pbs.org/safarchive/4\\_class/45\\_pguides/pguide\\_502/4552\\_truth.html#act2](http://www.pbs.org/safarchive/4_class/45_pguides/pguide_502/4552_truth.html#act2)

This lab is well done, I would use Pringles potato chips instead. They are uniform, so the class data could be compiled.

PolarTREC journal entry from the Greenland Seabird Ecology expedition with energetic calculation activity

<http://www.polartrec.com/node/1497>

In conducting a web search for field metabolic rates for seabirds and other polar animals I found there were many papers written, but most were written for a professional audience. Students can sift through the material to find the metabolic rates, but will need a teacher's assistance. I will submit a summarized chart when I locate one.

### **Assessment**

Rubric attached to evaluate the calorimetry lab

Rubric Self portrait will assess understanding of calorie input/energy output

Activity modeling animal energetics will shown understanding of the effort it takes that animal to survive.

### **Credits**

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**National Science Education Standards (NSES):**

**Content Standards, Grades 5-8**

Content Standard A: Science As Inquiry

- a. Abilities necessary to do scientific inquiry

Content Standard C: Life Science

- a. Structure and function in living systems

Content Standard F: Science In Personal and Social Perspectives

- b. Populations, resources, and environments

**Content Standards, Grades 9-12**

Content Standard A: Science As Inquiry

- a. Abilities necessary to do scientific inquiry

Content Standard C: Life Science

- a. The cell
- e. Matter, energy, and organization in living systems

Content Standard F: Science In Personal and Social Perspectives

- b. Population growth
- c. Natural resources
- e. Natural and human-induced hazards

**Other Standards:**

California's Performance Standards

7.1.d Students know that mitochondria liberate energy for the work that cells do.

7.3.a Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms

7.3.e Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

## Calorimetry Lab Rubric

	<b>Fail</b>	<b>Progressing</b>	<b>Proficient</b>	<b>Score</b>
<b>Procedure with hypothesis</b>	No procedure	Procedure developing but needs work, hypothesis may be testable	Well planned and written procedure, hypothesis is testable	/10
<b>Data</b>	No data	Only one trial, incomplete information, Organized data table	Two or more trials, information is complete, data table is well labeled	/10
<b>Summary</b>	No summary	Summary incomplete, no detail	Completed, well written summary includes suggestions for future experiments	/5

## Rubric for Health Lesson Self Portrait

<b>Key Points to Assess</b>	3	4	5
<b>Portrait drawn with features representative of Student</b>	Sketch done minimally, features nondescript	Some details in sketch, features clear	Detailed sketch features clearly identify student
<b>Exaggerated features that visually represent health consequences of current diet</b>	Some health issues obvious not clearly identified	Health issues obvious, are identified	Health issues obvious, clearly identified
<b>Explanation in colored pen highlighting changes that could reduce health concern</b>	No explanation of how to improve health issue	Some explanation unclear how the change would improve health	Explanation in colored pen of how to reduce or eliminate that health concern