

The Energetics Game

For use with the **BACKGROUND** section of *Southern Exposure*

Overview: Students will increase their understanding of energy budgets through participation in a role-playing game.

Learning Objectives:

The student will:

- Define the term: **energy budget**.
- Explain how Weddell seals earn and use energy to meet the requirements of life.
- Describe the role that body condition plays in an animal's ability to meet its energy needs.

Standards Addressed:

Alaska Science GLES :

5th: SA1.1, SC2.2, SC3.1

6th: SA1.1, SC2.2, SC3.1

7th: SA1.1, SC3.1

8th: SA1.1, SC2.2, SC3.1

National Science Education Standards:

Content Standard A: Science and Inquiry

- Abilities necessary to do scientific inquiry (5-8)

Content Standard B: Physical Sciences

- Transfer of Energy (5-8)

Content Standard C: Life Sciences

- Structure and function in living systems (5-8)

Materials Needed:

- *The Energetics Game scenario cards: Print (2-sided) and cut out FOUR sets of all cards (pages 6-13 of this document) using two different colors for Scenarios 1 and 2*
- *Worksheet for each student (½ page per student, see page 5 of this document)*
- *“What is Energetics?” video (in the Background section of Southern Exposure)*
- *Science Journals/Notebooks*
- *Pencils*
- *Gym or other large open space to play the game*

Teaching Time: 30 minutes

Preparation Time: 45 minutes

- *Review the Background section of Southern Exposure, including “What Is Energetics?” video.*
- *Print and cut out fish cards for Scenarios One and Two (use different colored paper for the two sets).*
- *Print student worksheets and **fill in a starting energy score** for each participant. Assign each student a starting energy score between 10 and 25 (scores should be evenly distributed throughout this range).*



Background:

Energetics is the study of how energy is used and transformed through a system. In animal physiology this means how animals earn (gain) and use energy to meet the requirements of life. As students learned in the *“What Is Energetics?”* video (on the Background page of *Southern Exposure*), animals gain energy by eating, respiring, and by absorbing heat from their environment. Alternately, animals use energy through movement and loss of heat to their environment, as well as by digesting food and producing waste.

The Energetics Game explores how different environmental variables impact an animal’s ability to maintain a balanced energy budget. Students begin the game as either a fat (high energy score) or a lean (low energy score) seal. In the first of two rounds, conditions in the environment are favorable (easy access to food, warmer temperatures, etc.) so energy can be easily earned while energy use is kept to a minimum. In this round, most animals will fare well, either maintaining a balanced energy budget (no significant change in energy score) or achieving a positive energy balance (increase in energy score). In round two, conditions are more challenging. Environmental variables presented in this round (limited access to food resources, inclement weather conditions, pups to support) result in seals using more energy per unit of energy gained. In this round some seals will maintain a balanced energy budget (no significant change in energy score) while others will end up with a negative energy balance (decrease in energy score). In the wild, a negative energy balance means that a seal must dip into its energy stores (existing fat and muscle) to rebalance its budget. If an animal continuously uses more energy than it takes in, its condition will deteriorate. In this game, if at any point an animal’s energy score drops to zero, the participant’s seal has died and they are out for the remainder of the round.

At the start of the game each student receives a pencil and a worksheet labeled with their initial energy score. *Scenario One* cards are laid around the room, face down. To play, students spread around the edges of the room. The spot where each student begins the game will be their ‘haulout site’, or their home base. To earn energy, students must forage by collecting fish cards. Fish cards feature a short narrative and two energy scores. The positive value on each card corresponds with the energy earned by collecting the card. The negative value represents the amount of energy the animal used to get that card. Each time a student collects a fish card, they must **return to their haulout site** and use their worksheet to recalculate their energy score. This process is repeated until all *Scenario One* cards have been collected.

The same procedures are repeated using *Scenario Two* cards. Discussion questions following each round prompt students to deepen their understanding of how animals are linked to their environments through the transfer of energy.



Directions:

1. After completing the BACKGROUND section of *Southern Exposure*, explain to your class that you'd like to play a game to help solidify their understanding of **energetics**.
2. In their science notebooks have students write down what they understand about **how animals earn and use energy**. This may include: specific behaviors that they associate with using/gaining energy, environmental conditions they associate with the topic, or contexts they've heard the concept talked about/in, etc.
3. Introduce *The Energetics Game*, explaining that **energetics** is the study of how living things earn and use energy. Let students know that, as part of the game, they'll all be taking on the role of seals to learn about how wild animals earn and use energy to meet the requirements of life.
4. Pass out pencils and worksheets to each student.
5. Refer students to their worksheets. Point out that each student has their own 'starting energy score'. Explain that this score represents the overall health of their seal at the start of the game, with a higher number representing a fatter seal and a lower number representing a leaner seal.
6. Ask students to share what they know about how animals earn and use energy. Highlight the relationship between animals and their environment.
7. Describe the logistics of the game, highlighting the rules of play (see rules above). Emphasize that it's important that students read through each fish card narrative before recalculating their energy score.
8. Gather students in gym, or other large open space. Lay out *Scenario One* fish cards around the room, face down.
9. Play through *The Energetics Game* using the *Scenario One* cards.
10. When all cards have been collected and students have tallied their final energy scores, have students arrange themselves into three groups based on their score: positive ending balance (+ change of >5 points), energy scored remained the same (+ or - change of <5 points), and negative ending balance (- change of >5 points).
11. Facilitate a class discussion (using *Scenario One* questions below) about student experiences in the round.
12. Set-up *Scenario Two* cards and play the game again using the same procedures.
13. When all cards have been collected and students have tallied their final energy scores, have students arrange themselves into four groups based on their score: positive ending balance (+ change of >5 points), energy scored remained the same (+ or - change of <5 points), and negative ending balance (- change of >5 points), and deceased (energy score that dropped to/below zero).
14. Initiate another class discussion (using *Scenario Two* questions below) comparing and contrasting student experiences in the two rounds.



Discussion Questions:

Scenario One:

- How did your seal earn energy during Round One?
- What cost your seal energy in Round One?
- What might the outcome be for an animal that experiences a positive change to its energy balance? What about a negative change?
- Was it relatively easy or hard to be a seal in that scenario? Why?
- Do you think that your seal could continue living this way for a long period of time? Why or why not?
- In Scenario One most students experienced a positive or unchanged energy balance. Based on this fact, what can be said about the environmental conditions these seals were living in?

Scenario Two:

- Compare your experiences in Rounds One and Two of the game. Was it easier, harder, or about the same to be a seal in this second round? Why?
- Which environmental conditions do you think you'd prefer to live in as a seal?
- How did your seal earn energy during Round Two?
- What cost your seal energy in Round Two?
- Of those students in the 'deceased seal' group, who began as a fat seal and who began as a lean seal?
- What can this round teach us about how body condition affects a seal's ability to meet its needs under challenging environmental conditions?
- Do you think that your seal could continue living in this way for a long period of time? Why or Why not?
- In Scenario Two most students ended up with a negative balance to their energy budget. Based on this fact, what can be said about the environmental conditions these seals were living in?
- If a real animal or population of animals were faced with a situation where they regularly used more energy than they took in, what might you expect to happen?

Extensions:

- 1.) Have students diagram how energy moves between living and non-living things in the environment. (Example: seals get energy from the foods they eat and through heat absorption. Animals give energy to the environment through waste, heat loss, etc.).
- 2.) In their science journals, have students compare ice-dependent seals to an animal native to your local environment. Are there some variables that affect the cost of living of all animals? How do conditions in your local environment impact an animal's ability to maintain a balanced energy budget? Help students recognize that while the ways in which animals interact with their environment vary, all living things rely on their environment to help them meet the requirements of life.



Name: _____

THE ENERGETICS GAME

Student worksheet

Starting energy score: _____

Round ONE	Round TWO
<p>Final Score: _____</p>	<p>Final Score: _____</p>

Name: _____

THE ENERGETICS GAME

Student worksheet

Starting energy score: _____

Round ONE	Round TWO
<div></div> <div>Final Score: _____</div>	<div></div> <div>Final Score: _____</div>















