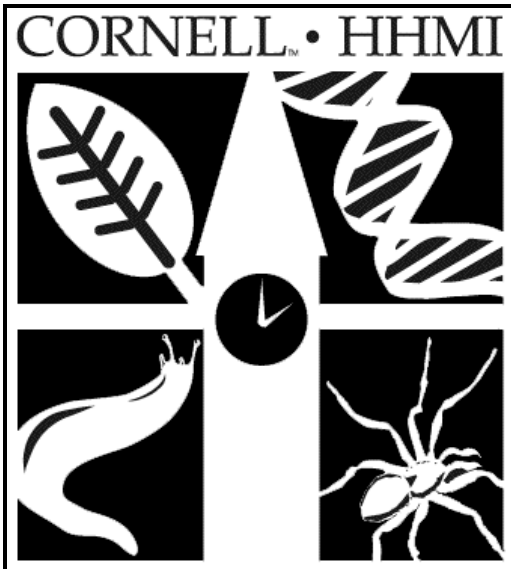


Cornell Institute for Biology Teachers

Lab Developed: 6/2007
Lab Revised: 2/2015

Title: **Crickthermometer**

Authors: Florianna Blanton, CIBT, Cornell University, Ithaca, NY
Revised by Florianna Blanton, Laurel Southard, and Sarah Hutchinson, CIBT, Cornell University, Ithaca, NY, 2/2015

Appropriate Level: Grades 4-6

Elementary Science Core Curriculum (NYS): Standard 1: Analysis, Inquiry and Design (Mathematical Analysis): Key Idea 1: M1.1c, M2.1b; (Scientific Inquiry): Key Idea 1: S1.1a, S1.2, S1.3; Key Idea 2: (S2.1), S2.3a,b; Key Idea 3: S3.1, S3.2, S3.3, S3.4

Standard 6: Interconnectedness: Common Themes: Key Idea 2, Key Idea 3, Key Idea 5, Key Idea 6.

Standard 7: Interdisciplinary Problem Solving

Standard 4: The Living Environment: Key Idea 1: 1.1a, 1.2a; Key Idea 3: 3.1a, (3.1c, 3.2a); Key Idea 4: 4.2b; Key Idea 5: 5.1a,b; 5.2c, (5.2d), 5.2f, g; Key Idea 6: 6.1b,e.

Abstract: Students will design and carry out an experiment to find out whether they can predict air temperature by counting the number of times a cricket chirps. According to different sources, outside, ground and cricket habitat temperature (in degrees Fahrenheit) can be estimated by counting the number of times a cricket chirps in 15 seconds and adding a certain number. Students will experiment to determine if this is correct. They will put into practice what they have learned about controls, forming hypotheses, repeats, data recording and interpreting, and reaching logical conclusions.

Time Requirement: 60 min.

Additional Teacher Information

Note: This lab should be implemented *only* after students have completed the three other World of Crickets labs: "What do Crickets Eat?", "Crickets' Response to Light," and "The Musical World of Crickets."

Objectives

Students will design and carry out an experiment to test a pre-existing equation, which claims that crickets' chirps can be used to estimate temperature.

Materials

Use the crickets already in the classroom, and the supplies previously used by the class. Suggestions of materials that may be useful for this exercise include: transparent plastic containers, mesh, freezing packs, heating packs, thermometers, stopwatches. Make sure to freeze the freezing packs as flat as possible the day before the experiment, so students can use them if they choose.

Lab Set-Up

Adult males of most cricket species chirp by rubbing their forewings together. This process is called *stridulation*. The adult male stridulating organ consists of a smooth scraper on one forewing that is drawn across a serrated file on the other forewing to produce a song. Because crickets spend most of their time hidden in the grass or under leaves and almost never see each other, sound is one of their most important communication tools. Some males use the chirping sounds to mark their territory. Chirping patterns are specific to each species and females respond only to the song of their own species.

Scientists have noticed an unusual relationship between cricket chirping frequency and temperature. On very cold days, there are large intervals between cricket chirps (the chirps are not very frequent). On hotter days, the frequency of their chirping increases significantly. A quick glance online reveals different 'formulas' that link the number of times a cricket chirps plus another number to estimate either the temperature outside, the temperature in the cricket's environment or the ground temperature–all in degrees Fahrenheit. Here are a few examples:

# of chirps in 15 seconds + 37 = approximate outside temperature

# of chirps in 15 seconds + 48 = approximate temperature in crickets' environment

# of chirps in 15 seconds + 40 = approximate ground temperature

(# of chirps in 60 seconds / 4) + 40 = approximate ground temperature

note that these two are equivalent

Note that you can use the first equation in the spring or fall, whenever the outside temperature is approximately equal to the temperature inside the classroom. Share these equations with the students and have them choose one to be the focus of the experiment. Ask them to come up with things they can do to determine if the chosen equation is true or not. Then have students work in groups to fill in the prediction, the list of materials, and the procedure. Before beginning the lab, lay out suggested materials

for students to choose from. Help them decide what is appropriate to use for their experiments.Groups should also design the data tables where the results will be recorded. This is an example of a *shortened* data table for this particular investigation:

Cricket #	Number of Chirps	Predicted Temperature (°F) (equation written here)	Actual Temperature (°F)
		(*)	

(*) solve the equation in this column for the number of chirps

Why does it work? Insects cannot control their body temperature. The rate of their metabolism and activity depends on the temperature immediately around them. For crickets, the body temperature depends on the temperature of the air: the higher the air temperature, the higher their body temperature and metabolism.

Throughout the investigation remind students of the importance of keeping variables constant, accurate data recording, accurate use of equipment, and size of the sample: the more crickets they can survey, the more valid the results will be.

Teacher Resources

"Biology as a Source for Algebra Equations" by Virginia Horak. Mathematics Teacher Vol. 99, No.1. 8/2005.

Create Your Own Cricket Radio
http://www.hup.harvard.edu/features/cricket-radio/

Cricket Chirp Temperature Calculator
http://www.csgnetwork.com/crickettempcalc.html

The Cricket Classroom Page
http://telusplanet.net/public/ecade/CricketsintheClassroom/cricketsintheclassroom.html

The Critter Catalog
http://www.biokids.umich.edu/critters/Gryllidae/

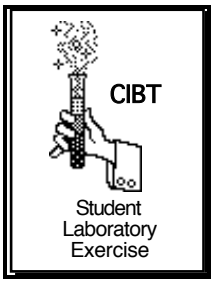
Enchanted Learning
http://www.enchantedlearning.com/subjects/insects/orthoptera/Cricket.shtml

LOC "Everyday Mysteries": *Can you tell the temperature by listening to the chirping of a cricket?*
http://www.loc.gov/rr/scitech/mysteries/cricket.html

Mr. Nussbaum
http://www.mrnussbaum.com/cricket.htm

NOAA Cricket Chirp Converter
http://www.srh.noaa.gov/epz/?n=wxcalc_cricketconvert

Crickthermometer



Name: _____

Introduction

Adult males of most cricket species chirp by rubbing their forewings together. This process is called *stridulation*. The adult male stridulating organ consists of a smooth scraper on one forewing that is drawn across a serrated file on the other forewing to produce a song. Because crickets spend most of their time hidden in the grass or under leaves and almost never see each other, sound is one of their most important communication tools. Some males use the chirping sounds to mark their territory. Chirping patterns are specific to each species and females respond only to the song of their own species.

Scientists have noticed an unusual relationship between cricket chirping frequency and temperature. On very cold days, there are large intervals between cricket chirps (the chirps are not very frequent). On hotter days, the frequency of their chirping increases significantly. There are a number of formulas that are said to link the number of times a cricket chirps plus another number to estimate either the temperature outside, the temperature in the cricket's environment, or the ground temperature–all in degrees Fahrenheit. Here are a few examples:

# of chirps in 15 seconds + 37 = approximate outside temperature

# of chirps in 15 seconds + 48 = approximate temperature in crickets' environment

# of chirps in 15 seconds + 40 = approximate ground temperature

(# of chirps in 60 seconds / 4) + 40 = approximate ground temperature

note that these two are equivalent

Why does it work? Insects cannot control their body temperature. The rate of their metabolism and activity depends on the temperature immediately around them. For crickets, the body temperature depends on the temperature of the air: the higher the air temperature, the higher their body temperature and metabolism.

Prediction

What are you trying to find out?

_____

_____

Write the formula you're testing below:

_____

Materials

After brainstorming with your group, write the list of materials you will need to carry out this experiment. Be specific and don't forget to write amounts!

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Procedure

Write down, step by step, how you are going to use these materials to carry out your experiment.

1. _____

   _____

2. _____

   _____

3. _____

   _____

4. _____

   _____

5. _____

   _____

6. _____

   _____

7. _____

   _____

Data Tables

Working with your group, determine how many crickets you will be sampling, how many times you will count a cricket's chirp, and what data you need to record. Design one or more data tables *on a separate piece of paper*. Don't forget to title each data table.

Analysis and Discussion

1. Using the data in your data table(s), explain whether you proved or disproved the idea that you can use cricket chirping to predict the temperature.

_____

_____

_____

_____

_____

2. Look at the set-up of your experiment. What other factors might have affected the number of times the crickets chirped?

_____

_____

_____

3. Suppose that another group in the classroom chose the same 'chirping equation' as your group. Your results proved that the equation works correctly and the other group's results showed that the equation doesn't work at all. How can you find out who is right?

_____

_____

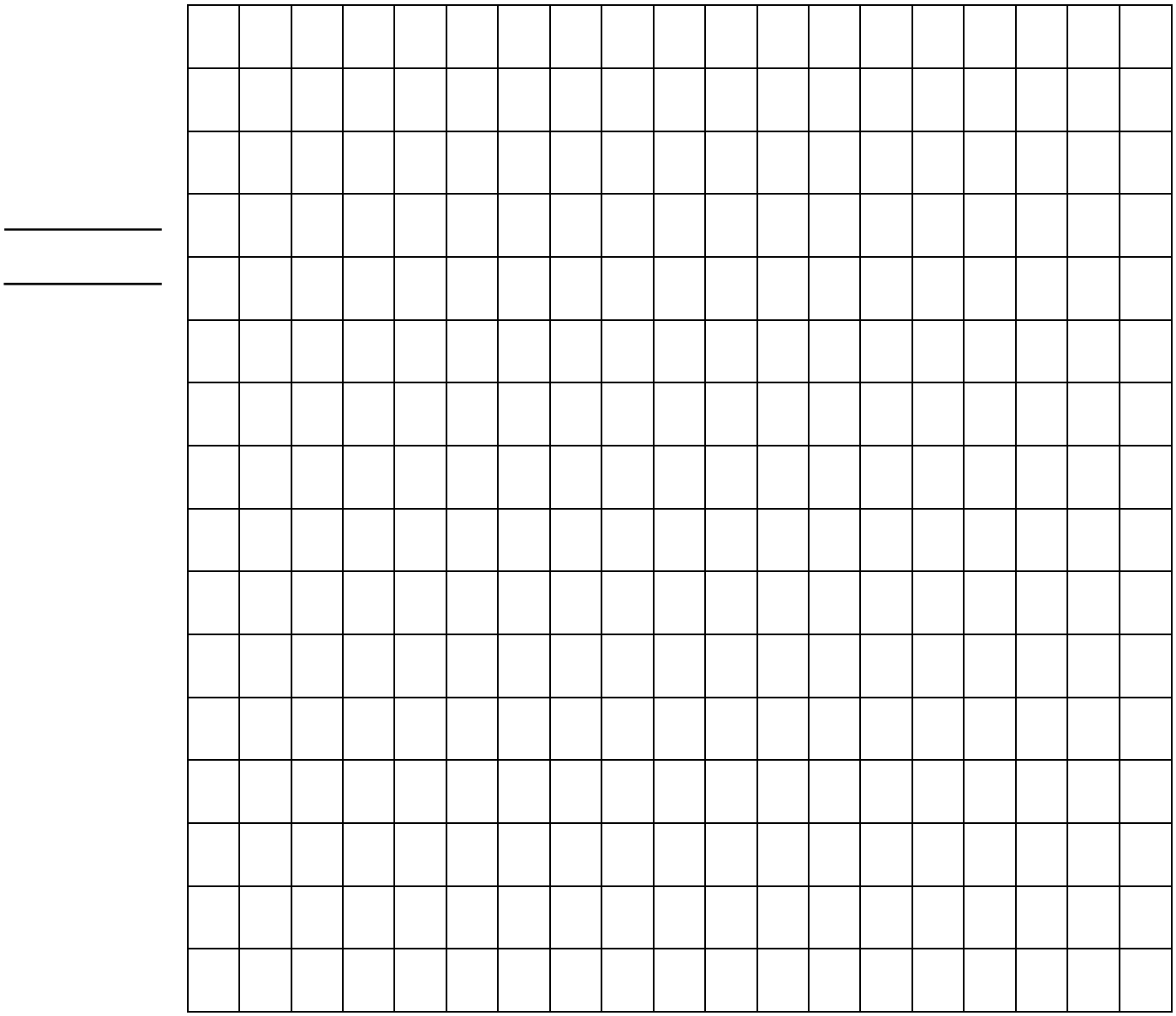
_____

4. Scientists conducting an outdoor temperature related experiment with crickets collected the following data:

Temperature (°F)	Number of Chirps in 30 seconds
55	36
60	46
63	52
65	56
68	62
71	68
74	74
76	78

Using the graph paper on the next page, build a graph with the data above. Remember to title your graph and label the axes. Ask if you need help!

Graph 1. _____



5. According to these findings, what is the relationship between temperature and the number of times that a cricket chirps in 30 seconds?

_____

_____

_____