

Program name: Humans versus Zombies - An Adventure with Radio Telemetry.

Grade Level(s): 7, 9-12.

Recommended Group Size: less than 20 students.

This program is designed to suit:

- Grade 7 science unit- Interactions and Ecosystems
- Grade 9 science unit- Biological Diversity (Social and Environmental Emphasis)
- Biology 20 unit- Ecosystem and population change
- Science 20 unit- Changes in Living Systems (chapter 2- Changing Populations)
- Biology 30 unit- Population and Community Dynamics

This program will be specifically, relevant to ecological concepts such as home range, habitat, population dynamics, migration, and much more (Alberta education [accessed 2017 Oct 9]).

Background: Radio telemetry also known as radio-tracking, is a tool used for determining information about an animal using radio signals from or to a device carried by the animal (Mech 1983). “Telemetry” is the transmission of information through the atmosphere usually by radio waves, so radio-tracking involves telemetry, and there is much overlap between the two concepts.

Components of radio telemetric equipment:

- (1) Transmitting subsystem consisting of a radio transmitter, a power source and a propagating antenna.
- (2) Receiving subsystem including a “pick-up” antenna, a signal receiver with reception indicator (speaker and/or display) and a power source



Figure 1: Person holding radio telemetric equipment (receiver with attached Yagi antenna). Image courtesy of <http://elte.prompt.hu/sites/default/files/tananyagok/EthologyPractical/ch19s02.html>

Tracking methods:

Homing- This technique involves following a signal toward its greatest strength. As the researcher closes in on the animal, the signal increases and the receiver gain must be reduced to further observe the signal's direction. The process of moving forward and continually decreasing the gain is repeated until the researcher sees the animal or otherwise estimates its location when sufficiently near (Mech and Barber 2002).

Triangulating-Triangulating involves obtaining two signal bearings from different locations (preferably at angles of about 90 degrees to one another) which then cross at the animal. However, it is better to take three or four bearings because antenna directionality is imprecise (Heezen and Tester 1967).

Student Learning Objectives:

- Students will gain an opportunity to use current scientific instruments such as a radio telemetry receiver while interacting with the natural environment.
- Students will be able to develop and demonstrate group work skill in learning, working, and living environments.
- Through this activity, the participants will develop understanding regarding the purpose of radio telemetry in field research through first hand experience.

Brief program overview: Each student group will be required to visually locate the tagged object (using radio telemetry). To accomplish this goal, students will first have to answer key questions to gain access to the radio telemetry receiver.

Activity context: This activity will be framed in the form of a narrated story. Read this story out to the students before the commencement of the activity. There are two missions in this activity, with two opportunities to win.

The story goes as such:

September 9th 2084- Germany.

Context: Humans have exploited the earth. CO₂ emissions have continued to rise, natural resources have diminished, and habitats destroyed. As a result, many animals, birds, fish and even most of the coral reefs have completely disappeared. As a final attempt to save the remaining lives, humans have turned to nuclear power in desperation. They built nuclear power plants to completely replace power plants that polluted the atmosphere, in major cities such as Beijing (China), Toronto (Canada), Mumbai (India), San Francisco (U.S) and Frankfurt (Germany). However, in their urgency they did not test the effects of nuclear radiation in highly populated areas; they needed energy more than anything. Within two years of it's operation humans have began to show signs of radiation poisoning. Some cases have been so severe that doctors have documented patients experiencing vivid hallucinations with intense, uncontrollable cannibalistic urges. The symptoms of radiation poisoning appear to be transferred through the exchange of bodily fluids such as saliva, blood etc. The street name for patients exhibiting these symptoms are "Zombies". The spread of this disease has been so vast the New Global Alliance of Science and Security (NGASS-international organization established since 2072) have ordered a quarantine over all major cities and shut down all their nuclear power plants. No one can leave these cities. All airports are closed; roads and underground subways blockaded or demolished.

There is no electricity; businesses are shut down; people are hungry, and worst of all, the zombies are roaming free.

Story: It is an early Wednesday afternoon and you have received an emergency message from Dr. James Johansen. During one of his flights from Switzerland to Denmark, he came across unexpected turbulence which forced him to either return to back Switzerland where he was conducting his research or take an alternative route through Germany. Dr. Johansen using his discretion now realized he only had enough fuel to travel through Germany and proceeded on with his journey. Assuming the flight over Germany would only last 30 minutes he reassured himself. Things somehow managed to get worse. With a loud bang one of his turbines gave out and he began to dramatically lose lift. Looking out of the window, he could see his plane's wings rollicking back and forth; he was so high up, the houses looked like toys and the cars like ants. He assured himself that he wasn't crashing, so he thought, "OK, one of our engines has blown, but we have another engine, I will arrive at Demark soon.... everything is under control." He didn't realize that both engines had now failed. Dr. Johansen was on a crash path towards an unfamiliar forested region. During the emergency landing, one of his wings caught a tree and sent the plane spiraling towards the ground. Luckily Dr. Johansen experienced no fatal injuries however he now has a broken right arm and compromised his general location to surrounding zombies. Fortunately using his teletransmitter was he able to transmit his location to you.

You are working with a network of underground rebels in Germany, who are trying to return home (out of Germany). Dr. Johansen promised to fly the rebels out of Germany, if they are able to find him alive (after repairing the plane). Dr. Johansen has set his teletransmitter to send his location for 30 minutes until his remaining battery power is exhausted. Your mission is to find Dr. Johansen before the Zombies do.

Note: Now divide the class into three equal groups.

*Teletransmitter- Cell phone capable of sending confidential messages without a service provider, in coded format; began manufacturing since 2053.

Mission: Part 1

Before you save Dr. Johansen there are a few mini-missions that must be successfully completed. There are three specific locations that each group must find which is essential for the remainder of the mission.

Finding the locations:

Using the map provided each group of students must find the three locations. At each location there will be a unique stamp (must be stamped on every individual member of the team).



Figure 2: GIS image of Augustana Miquelon Lake Research Station. Courtesy of Dr. Glynnis Hood.

Location A will have medicine (first aid, morphine, wraps etc.) for Dr. Johansen

Location B will have a flare gun (used to signal to the rescue helicopter the location of Dr. Johansen and your group). The rescue helicopter cannot be used by the rescuers to leave Germany, as it is GPS tracked and monitored by NGASS. So, they must find Dr. Johansen at any cost.

Location C will have the radio telemetry receiver. Once location C is found the group must successfully answer four security questions correctly to gain access to the radio telemetry receiver.

Note: None of these locations will have any of the physical items but a stamp with a unique design, tied to a tree with flagging tape. During this mission the groups should be timed.

1) What is radio telemetry commonly used for in research?

Radio telemetry is used in a variety of ways such as determining habitat use of tagged animals, observing roost and foraging habitat preferences, studying the home range and movement of populations, observing specific migratory routes and dispersal behavior, mortality studies, predation and co-evolution, sleep characteristics and much more (Mech and Barber 2002).



Figure 3: Image courtesy of <http://npshistory.com/publications/wildlife/radio-tracking-2002.pdf>

2) Name at least two benefits and limitations with using radio telemetry?

Benefits- Relatively low cost (compared to GPS, and satellite tracking), reasonably accurate location, long life, etc.

Limitations- Requires live capture for animals to be tagged for most circumstances, labor-intensive and can be influenced by the weather if the animal is tracked from an aircraft.

3) What biome is the Miquelon Lake Provincial Park located in?

Miquelon Lake Provincial Park is located within the southern dry mixed-wood boreal forest biome (Nyland 1970).

4) Name five biotic organisms commonly found in Miquelon Lake Provincial Park (both common and scientific name)?

Student's do not need to follow this.

Mountain blue bird (*Sialia currucoides*), Moose (*Alces americanus*), Wood frog (*Lithobates sylvaticus*), American beaver (*Castor canadensis*)

Mission: Part 2

Note: Meet at muster point beside the research station, once each group has found all three locations. They may then assemble themselves into one big group. However, if the group is larger than 20 students you may divide the students into two smaller groups (one group being the rescue rebels and the other the zombies). After Dr. Johansen is found the two groups can switch roles. This is so that each group can optimize their time with radio telemetry.

Story: Hooray! Good news: You have now completed your first three tasks. Bad news: Dr. Johansen was attacked by a herd of zombies; however, he was able to narrowly escape but now he is lost and wandering towards a much bigger herd of zombies. Fortunately, before Dr. Johansen was attacked he left his teletransmitter underneath his belt which continued to transmit his current location.

Using the radio telemetry receiver, you may track Dr. Johansen into the herd of zombies. During your mission you will encounter some zombies along the route however you can pass them by tossing grenades (socks balls) at them. The zombies have the power to stop a group from proceeding if they tag (two hand touch) an individual in the group. Every time an individual is tagged they will have to return to their starting location (muster point). The group to locate and find Dr. Johansen with the shortest time wins (use stop watch).

Rules for the Zombies:

- Every zombie must always wear their red bandana around their head during the activity. Wearing it around the wrist or covering it will automatically disqualify the tag and will send the zombie into a 30 second time out.
- You may only tag the opposing team by placing two palms on an individual, anything else will not qualify and the rescuers may proceed with no affect to them.
- You may only approach the rescuers by hopping on one foot. You are allowed to move as fast as you would like as long as only one foot is on the ground.
- If you have been hit with a grenade (sock ball) you must remain in that spot for 30 seconds. You are not allowed to tag anyone, or help your team during the time out period.

Rules for the Rescuers:

- Every time a member of your team is tagged you must return to the muster point and start again.
- You are not allowed to throw anything other than sock balls at the other team.
- Collect the sock balls immediately after they have been thrown. Therefore, try to conserve them and try not to throw them too far.

Equipment & Resources Provided:

Research station facilities- Two washrooms; fully equipped kitchen and dining room; two bedrooms (2 sets of bunk beds per room); wet lab space and multipurpose rooms for indoor lessons, work space, and living space 3 tents WiFi, Park maps

Items provided for the activities- Whole telemetry system (receiver, cords, Yagi antenna, two transmitters), instructions for telemetry equipment, three unique stamps, flagging tape.

Practical recommendations:

- Encourage students to stay hydrated throughout the activities.
- Discourage students from hiding the stamps, or miss placing them to prevent the other team from finding it.
- Please ensure any item that is taken is signed out by the student and must be returned to the teacher/ event host in charge before the end of the day.
- It is beneficial for a teacher to be accompanied by someone else, for supervision purposes.
- Please print out the rules that apply to each team (print on one page and cut it in two), so that they may reference them throughout the game.
- Print out the map ahead of time (must be in color).
- Please contact the station park manager as soon as possible, as the AMLRS may be reserved for other purposes.
- If the questions for unlocking the radio telemetry receiver are too challenging, you may convert them into multiple-choice form.
Ex. What is radio telemetry commonly used for in research?
 - a) For tracking tagged animals
 - b) For contacting other researchers in areas without cell service
 - c) Nothing- nobody uses radios anymore
 - d) None of the above

Important contact information :

Station Manager, augamlrs@ualberta.ca

Literature Cited

Alberta education. [date unknown]. Programs of study; [accessed 2017 Oct 9].

<https://education.alberta.ca/science-10-12/programs-of-study>

Heezen KL, Tester JR. 1967. Evaluation of radio-tracking by triangulation with special reference to deer movements. *Journal of Wildlife Management* 31:124-141.

Mech LD, Barber SM. 2002. A Critique of wildlife radio-tracking and its use in national parks. Univ. of Minn. Press, Mpls: [accessed 2017 Nov 30].
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Nyland E. 1970. Miquelon Lake. *Alberta Lands Forests Parks Wildlife*. 13(1):18-25.