

## HOW DO ENVIRONMENTAL FACTORS AFFECT HUMAN HEALTH

Read the information below:

### ELLEN'S STORY - LIFE (AND DEATH) ON LIMESTONE RIDGE ROAD

Ellen had lived on Limestone Ridge for 44 years, all of her life except for the four years she had spent away at college. She was typical of many of the residents of Limestone Ridge Road whose parents and grandparents had lived there before them. All the households obtained their drinking water from wells, and most of the families had been farmers for several generations.

In the 40 years Ellen had lived on the road, many of the residents had died, especially in the last 10 years.

Ellen had just returned from yet another neighbor's funeral, a neighbor who had coincidentally, die of cancer. As Ellen began to think about those who had died in the last ten years, she was astonished to realize that almost every death she could remember could be attributed to cancer.

### LIMESTON RIDGE – Topography and well information

Limestone Ridge road climbs up the ridge located to the east of the map area. The area has no surface stream in the immediate area, but a stream does exit a cave to the east of the map, continues for a few hundred yards to the west before disappearing into a large depression that could be the beginning of a sinkhole. Dye tracings of the stream have been traced to a permanent river lying to the southwest of the map area. There is no sign of dye along the banks of the river. The dye appears to rise in the center of the river indicating the water enters along the stream bed.

The surface soil in the mapped area ranges from 5 to 15 feet deep and sits upon a layer of limestone. Where exposed at the surface the limestone appears jointed and fractured. The soil is a fine sand and silt mixture. The soil soaks up most rainwater with ponding occurring only during heavy thunderstorms. The upper elevations of the ridge are covered in hardwoods made mostly of White and Red Oaks, some Maple and Ash.

Wells in the neighborhood on the map date back to the 1950's. The wells are about 45 deep and extend into a sandstone aquifer that still supplies a steady flow of water. The sandstone sits upon a 30-foot layer of black, brown and gray shales. The aquifer is confined by the shales at the bottom and the overlying limestone formation.

There is a major highway located to the south of Limestone Ridge Road and a plastics plant was constructed in the area in the early 1960's. It operated steadily during through the 1980's and has been in operation sporadically since the early 90's. The plant produced polystyrene products used by local food packaging companies. It has not operated since 2005.

**Task:** Use the available data to determine what environmental factors may be affecting the people on Limestone Ridge Road.

## KARST TOPOGRAPHY

Limestone Ridge is located in an area of karst topography. Karst topography is a landscape formed from the dissolution (dissolving) of soluble rocks such as limestone, dolomite and gypsum. A karst landscape has sinkholes, sinking streams, caves and springs. A karst landscape most commonly develops on limestone. Precipitation infiltrates into the soil and flows into the subsurface from higher elevations and generally toward a stream at a lower elevation. Weak acids found naturally in and soil water slowly dissolve the tiny fractures in the soluble bedrock, enlarging the joints and bedding planes.

More than 25% of the world's population either lives on or obtains its water from karst aquifers. In the United States, 20% of the land surface is karst and 40 % of the groundwater used for drinking comes from karst aquifers.

Natural features of the landscape such as caves and springs are typical of karst regions. Karst landscapes are often spectacularly scenic areas. Examples include the sinkhole plains and caves of central Kentucky, the large crystal clear springs of Florida, and the complex, beautifully decorated caves of New Mexico.

Common geological characteristics of karst regions that influence human use of its land and water resources include ground subsidence, sinkhole collapse, groundwater contamination, and unpredictable water supply. Subterranean drainage may limit surface water with few to no rivers or lakes.

Karstifications of a landscape may result in a variety of large or small scale features both on the surface and beneath. On exposed surfaces, small features may include flutes, runnels, clints and grikes. Medium sized features may include sinkholes, vertical shafts, foibe (inverted funnel shaped sinkholes), disappearing streams, and reappearing springs. Large scale features may include karst valleys. Beneath the surface, complex underground drainage systems (such as karst aquifers) and extensive caves and cavern systems may form.

Farming in karst areas must take into account the lack of surface water. The soils may be fertile enough, and rainfall may be adequate, but rainwater quickly moves through the crevices into the ground. Water supplies from wells in karst areas may have run unimpeded from a sinkhole, through a cavern and to the well, bypassing the normal filtering that occurs in a porous aquifer.

## Materials

You will be given a computer to conduct research, colored pencils and the data set of previous data collected from the site to conduct your investigation.

## Getting Started

You will need to organize your data and think about how it relates to the following questions:

1. What features on the map could affect the environment?
2. How does the movement of water affect the environment?
3. What are the properties of the chemicals listed in the data?
4. What processes are used in making plastics?

Connections to Crosscutting Concepts and the Nature of Science and the Nature of Scientific Inquiry.

- How scientists use models to study complex systems
- How do open and closed systems work
- How do Earth's systems affect humans

## Initial Argument

Once your group has finished researching and organizing your data, your group will need to develop an initial argument. Your initial argument needs to include a claim, evidence to support your claim, and a justification of the evidence. The claim is your group's answer to the guiding question. The evidence is analysis and interpretation of your data. Finally, justification of the evidence is why your group thinks the evidence matters. The justification of evidence is important because scientists can use different kinds of evidence to support their claims. Your group will create your initial argument on a whiteboard. Your whiteboard should include all the information shown in Figure 3.

## ARGUMENT PRESENTATION ON THE WHITE BOARD

THE GUIDING QUESTION:	
OUR CLAIM:	
OUR EVIDENCE:	OUR JUSTIFICATION OF THE EVIDENCE:

Figure 3. Argument Presentation on a whiteboard

### Argumentation Session

The Argumentation Session allows all of the groups to share their arguments. Two members of each group will stay at the lab session to share that group's argument, while the other members of the group go to the other lab station to listen to and critique the other arguments. This is similar to what scientists do when they propose, support, evaluate and refine new ideas during a poster session at conference. If you are presenting your group's argument, your goal is to share your ideas and answer questions. You should also keep a record of the critiques and suggestions made by your classmates so you can use this feedback to make your initial argument stronger. You can keep track of specific critiques and suggestions for improvement that your classmates suggest in the space below.

Critiques about our initial argument and suggestions for improvement.

If you are critiquing your classmates' arguments, your goal is to look for mistakes in your classmate's arguments and offer suggestions for improvement so these mistakes can be fixed. You should look for ways to make your initial argument stronger by looking for things that the other groups did well. You can keep track of interesting ideas that you see and hear during the argumentation in the space below. You can also use this space to keep track of any questions that you will need to discuss with your team.

Interesting ideas from other groups or question to take back to my group.

Once the argument session is complete, you will have a chance to meet with your group and revise your initial argument. Your group might need to gather more research or develop alternative claims as a part of this process. Remember, your goal in this investigation is to develop the best argument possible.

### **Report**

Once you have completed your research, you will need to prepare an *investigation report* that consists of three sections. Each section should provide an answer for the following questions.

1. What question were you trying to answer?
2. What did you do to answer your question and why?
3. What is your argument?

Your report should answer these questions in 2 pages or less. This report must be typed and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid.

DATA SHEET

TABLE 1

Chemical Used in Fields Behind Houses Indicated

Chemical	A	B	C	D	E	F	G	H	I	J	K	L	M
ALACHLOR					X	X	X	X			X		
SIMAZINE					X	X	X	X			X		
METHOXYCHLOR											X		X
HEXACHLORBENZENE											X		X
NITRATES					X	X	X	X			X		X

TABLE 2

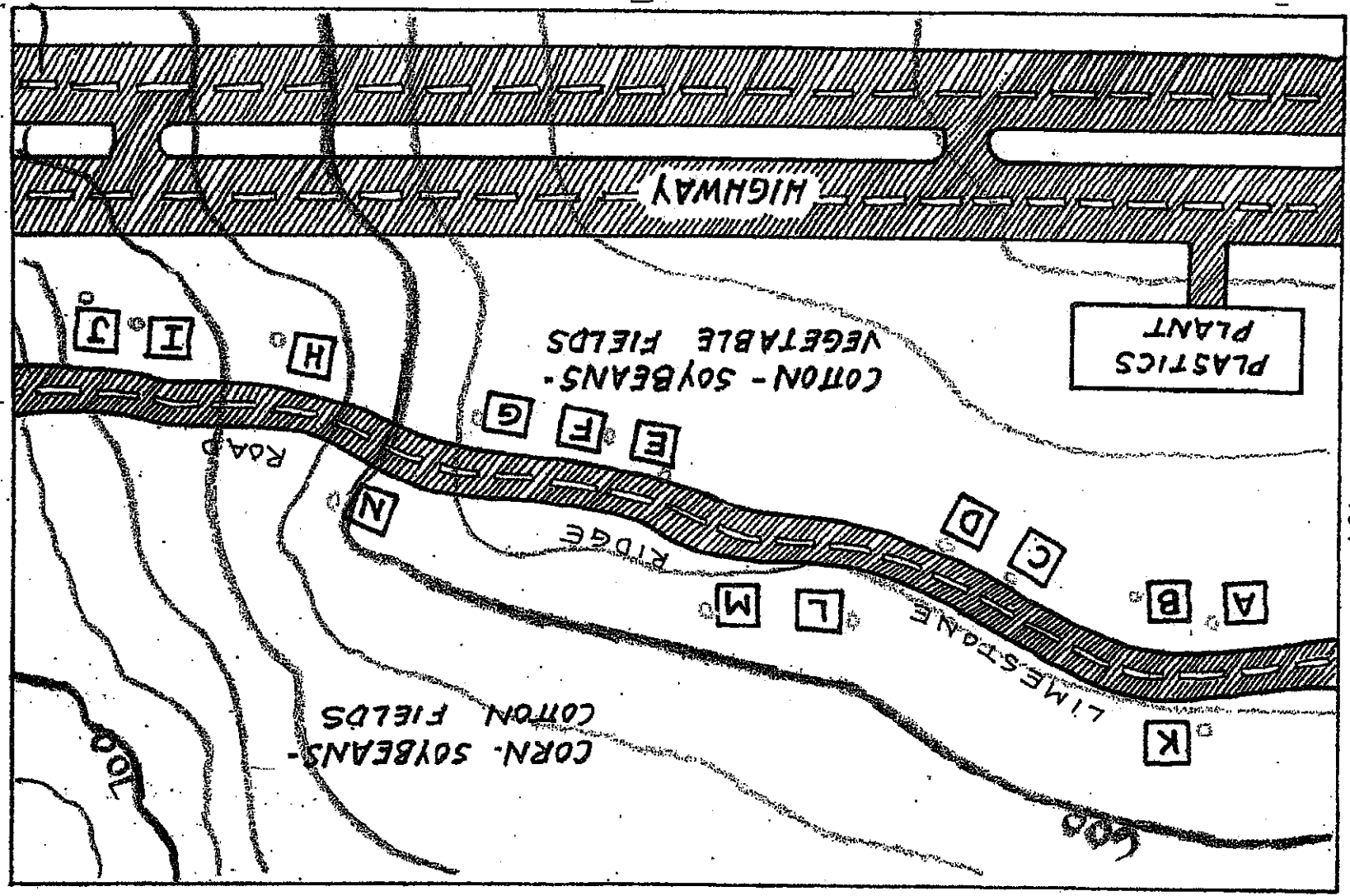
HOUSEHOLD INFORMATION

House Number in

Household

Death Information

A	4	Male, age 54 - heart attack; Female, age 52 - cancer
B	2	Male, age 72 - cause unknown
C	1	Female, age 62 - cancer
D	5	Male, age 14 - cancer
E	5	Male, age 53 - cancer
F	4	Female, age 64 - cancer; male, age 68 - cancer; Female, age 47 - cancer
G	2	Male, age 62 - heart attack
H	4	Female, age 41 - cause unknown
I	2	No deaths in 10 years
J	3	No deaths in 10 years
K	2	Female, age 60 - cancer
L	0	Unoccupied house
M	6	Male, age 51 - cancer
N	2	No deaths in 10 years



Contour interval: 20ft  
O - well

LIMESTONE RIDGE ROAD