

Plotting the Plight of the Cattle

Skills: Math, Science

Objective: Students will interpret and hypothesize reasons for trends in epidemiological data.

Background:

Bovine spongiform encephalopathy (BSE), commonly (and erroneously) referred to as “mad cow disease,” is a rare fatal disease that affects the central nervous system of cattle. “Spongiform” refers to the spongy appearance of a brain affected by BSE, when viewed under a microscope. BSE is in the same family of diseases as scrapie in sheep and goats, chronic wasting disease in deer and elk, and Creutzfeldt-Jakob disease in humans.

BSE is not a contagious disease and is not passed among cattle through direct contact. In the US there have been three reported cases of BSE in domestic cattle. The US Department of Agriculture's (USDA) Animal and Plant Health Inspection Service aggressively monitors the US cattle population to prevent the spread of BSE. In addition, the beef industry works vigorously to ensure the safety of beef in the US. Beginning in 2004, the USDA banned all downer cattle from the human food chain. Downer cattle are cattle that are unable to walk. Loss of balance is one of the symptoms of BSE.

Cattle get BSE by eating contaminated feed. The substance that causes BSE is found in the brain, spinal cord and retinas of cattle infected with BSE. BSE could also have originated from cattle feed contaminated with scrapie-infected sheep products. In 1996, the US cattle industry voluntarily stopped the feeding practices that could spread BSE. The US Food and Drug Administration made this feed ban law in 1997.

Symptoms of BSE in cattle include aggression, nervousness, loss of balance, loss of weight, and abnormal posture. This behavior in infected cattle is what led to the name “mad cow disease.”

Sources: Centers for Disease Control, USDA Food Safety and Inspection Service, World Health Organization, The National Creutzfeldt-Jakob Disease Surveillance Unit

Activities

1. Read and discuss background.
2. Provide students with the table included in this lesson.
 - Students will determine the total number of cases per year and the highest and lowest number of cases per year.
 - Lead a discussion of graphing. (See “Graphs” in the “Resource” section.)

P.A.S.S.

GRADE 6

Math Process—3.3; 5.1,4

Math Content—5.1

Science Process—4.1, 4.2,
4.3

GRADE 7

Math Process—3.3; 5.1,4

Math Content—2.1a

Science Process—4.1, 4.2,
4.3

Life Science—3.1; 4.2

GRADE 8

Math Process—3.3; 5.1,4

Math Content—5.1

Science Process—4.1, 4.2,
4.3

Life Science—3.2

Resources Needed

graph paper

calculators

world map

Vocabulary

contagious—able to be passed on by contact between individuals

degenerative—of, relating to, involving, or causing a lowering of effective power, vitality, or essential quality to an enfeebled and worsened kind or state

downer cattle—cattle that cannot walk

epidemiology—the study of the causes of diseases and how they are spread (and controlled)

fatal—causing death

necropsy—an autopsy performed on an animal

scrapie—a usually fatal spongiform encephalopathy especially of sheep that is caused by a prion and is characterized by twitching, intense itching, excessive thirst, emaciation, weakness, and finally paralysis

surveillance—monitoring a population for the occurrence of a particular disease

—Assign a country to each student to graph.

—Using the data from the table, students will make a graph of the annual incidence rate (number of cases diagnosed or identified by surveillance) of BSE per million cattle over 24-months-old in their assigned countries.

—Students will compare their graphs and list trends noted by country and worldwide.

3. Lead a discussion about possible reasons for trends.

—On which continents are numbers increasing?

—On which continents are numbers decreasing?

—Why are the numbers reported per million cattle instead of the total number of infected animals?

—Why are cattle under 24 months old not counted in the report?

—What are some reasons the numbers of cases would increase? (infection spreading, long incubation period, etc.)

—What are some reasons the numbers of cases would decrease? (better surveillance and notification, better knowledge of disease, more cooperation between health authorities and livestock breeders, etc.)

4. Research one of the countries listed on the table to discover what their BSE surveillance methods are, how they report suspected BSE, and what they are doing to decrease or eliminate the problem of BSE in their country.

Extra Reading

Hoff, Brent, and Carter Smith, *Mapping Epidemics: A Historical Atlas of Disease*, Franklin Watts, 2000.

Koch, Tom, *Cartographies of Disease: Maps, Mapping, and Medicine*, ESRI, 2005.

Sheen, Barbara, *Mad Cow Disease*, Lucent, 2004. Franklin Watts, 2000.

BSE Cases Worldwide

Annual incidence rate (per million cattle over 24 months old) of BSE in selected countries for the years 1989-2005 (rounded to the nearest tenth)

Country/Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2.1
Belgium	0	0	0	0	0	0	0	0	0.6	3.7	1.8	5.5	28.2	25.8	10.5	7.9	1.4
Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.1	0.1
Czech Rep	0	0	0	0	0	0	0	0	0	0	0	0	2.9	2.5	5.8	10.3	12
Denmark	0	0	0	0	0	0	0	0	0	0	0	1.1	6.8	3.4	2.4	1.3	1.3
Finland	0	0	0	0	0	0	0	0	0	0	0	0	2.4	0	0	0	0
France	0	0	0.5	0	0.1	0.3	0.3	1.1	0.5	1.6	2.8	14.7	19.7	21	12	4.7	2.7
Germany	0	0	0	0	0	0	0	0	0	0	0	1.1	20	17	8.7	10.9	5
Greece	0	0	0	0	0	0	0	0	0	0	0	0	3.3	0	0	0	0
Ireland	4.4	4.1	5	5.1	4.6	5.4	4.6	20.3	21.4	20.8	22.8	38.2	61.8	88.4	57.8	43.3	24
Israel	0	0	0	0	0	0	0	0	0	0	0	0	0	6.3	0	0	0
Italy	0	0	0	0	0	0	0	0	0	0	0	0	14.1	10.6	9.9	2.3	2.4
Japan	0	0	0	0	0	0	0	0	0	0	0	0	1.4	1	2	2.5	3.6
Luxembourg	0	0	0	0	0	0	0	0	10	0	0	0	0	14.5	0	*	10.9
Netherlands	0	0	0	0	0	0	0	0	1	1	1	1.1	10.3	13.2	10.9	3.4	0.8
Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3	1.5	3.6	*
Portugal	0	0	0	0	0	15.1	18.8	38.9	37.6	159.4	199.5	187	137.9	107.8	137.2	94.9	53
Slovakia	0	0	0	0	0	0	0	0	0	0	0	0	18.3	18.7	6.7	24.6	43.4
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	4.3	4.4	4.4	9.2	4.6
Spain	0	0	0	0	0	0	0	0	0	0	0	0.6	24.2	38	46.3	38.9	27.8
Switzerland	0	1	9.2	15.5	30.3	67.6	73.6	48.5	45.4	16	58.7	40.6	49.1	27.9	24.9	3.8	3.7
U.K.	1264.1	2507	4467.2	6636.1	6264.1	4277.8	2582	1416.8	794.4	585.7	416.4	270.6	232.8	228.2	122.3	68.8	45.7
U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* = no data available