SYLLABUS GUIDE
TO PUBLIC HEALTH EXHIBITS
IN THE
AMERICAN MUSEUM OF NATURAL HISTORY

DEALING WITH WATER SUPPLY,
DISPOSAL OF MUNICIPAL WASTES AND
INSECT-BORNE DISEASES

An Outline for Teachers and Students

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INTRODUCTION

Man is an animal and the story of his activities properly forms a chapter of natural history.

The exhibits of the Hall of Public Health are planned to illustrate certain important phases of man’s relation to his environment—to show how it affects him and how he modifies it with a view to making life safer and more healthful.

It is hoped that this Guide Leaflet may be of service to those who wish to learn briefly and connectedly the story which the exhibits have to tell.

PLAN OF HALL OF PUBLIC HEALTH

Showing the arrangement of the exhibits and location of the cases referred to in the Notes.
WATER SUPPLY

Most of the water on the earth’s surface is stored in the oceans, from which it is drawn up or evaporated by the sun to form the clouds.

The rain is the primary source of all water supplies. Rainfall varies considerably at different places.

Surface water flows off in rivers—which are swift at first, but slow and winding farther down.

Slowly flowing rivers, unless contaminated by sewage from towns on their banks, are less apt to be dangerous than rapid ones, but safer than either are lakes in which the water is stored—undergoing through storage a natural purification.

A common way of obtaining water supplies for large cities is by impounding streams in artificial lakes and reservoirs.

Another portion of the rain sinks at once into the ground, often to emerge at a lower level, forming a spring or well,—another common source of public water supply.

Water may be hard or soft, turbid or clear, depending upon the amount and nature of the matter which it contains in solution or in suspension.

Drinking water frequently contains microscopic organisms, most of which are harmless, although some of them produce tastes and odors in the water.

(Notes Referring to Exhibits)

See 1st panel of frieze, left wall.

WALL CASE 1 shows the number of rainy days at certain places and the actual rainfall in inches at others.

WALL CASE 2 presents graphically rainfall data for the whole United States.

See 3d panel of frieze.

See 4th panel of frieze.

See 2d panel of frieze.

Jars of rice in WALL CASE 3 indicate how typhoid bacilli die off during storage but CHART 1 shows a case where purification by storage failed.

CENTER CASE 1 shows how a reservoir was formed near Boston, Massachusetts, for this purpose.

In WALL CASE 4 is a section of an artesian well.

The physical character of five samples of water is indicated by blocks in WALL CASE 3.

In WALL CASE 3 are displayed enlarged glass models of micro-organisms (algae, diatoms and protozoa) which occur in water.

Their seasonal prevalence is shown by CHARTS 2 and 3.
Occasionally disease-producing bacteria are present, derived either from direct sewage discharge or from the washing in of human wastes from the shore or through the ground.

Impure water must be either stored or treated before it is safe for drinking. Treatment may be by slow sand filtration, by rapid mechanical filtration after the addition of chemicals which produce a flocculent filtering layer, or by disinfection.

Purification of a water supply is usually followed by a marked drop in the typhoid fever death rate; from a purely economic standpoint this saving of life far outweighs the cost of treatment.

**SEWAGE DISPOSAL**

Cities usually discharge their sewage into the nearest large body of water: New York, for example, uses its two rivers and the bay for this purpose.

The sewage, sometimes washed back and forth for days by the tides, causes our waterways to be grossly polluted. Such a condition, always a menace to health, is especially dangerous in fresh-water streams or lakes where the polluted water has access to the supply of some other city.

The food supply may also become contaminated in this way.

Such local nuisances and dangers to health may be avoided by treating sewage before it is finally discharged. To do this a city has several alternatives but the most effective process involves a number of successive treatments.

In CENTER CASE 2 and in CHART 5 are given instances of epidemics caused by disease-producing bacteria in drinking water.

In CENTER CASE 3 is a model of a mechanical filter and in CENTER CASE 4 that of a slow sand filter and of an apparatus for disinfection with liquid chlorine.

A model of a plant for treating water with bleaching powder is exhibited in CENTER CASE 5.

The data for a number of cities are presented in CHARTS 4 and 6.

**CHARTS in CENTER CASE 6 show** the system of sewers in use by New York at present and the system as it will be when completed, the path of a float set adrift in the Hudson River, and the extent of pollution at various points. In the same case is depicted a scene on the water-front showing one dangerous phase of pollution.

Another model in CENTER CASE 6 shows one way in which shellfish become polluted.
SEWAGE DISPOSAL

The coarse matter may first be removed by screening, after which the finer material may be allowed to settle as the sewage flows slowly through a sedimentation tank.

Or sedimentation may be combined with digestion of the solids removed by the use of either a septic or an Imhoff tank.

The principle of both is the same, viz., that sludge, if allowed to accumulate under water, will be reduced in amount by the bacteria present in it. Imhoff tanks provide a separate lower chamber for this process.

The treatment may stop here or a final stage may be added, in which the organic matter in the sewage is oxidized and changed to a harmless mineral form.

This oxidation, which is brought about by bacteria, may be effected in either an intermittent sand filter, a contact bed of broken stone alternately filled with sewage and emptied, or a trickling filter—a bed of broken stone through which the sewage percolates after being sprayed over the surface.

In the so-called activated sludge process the oxidizing bacteria are cultivated in the sewage sludge itself and are supplied with compressed air from the bottom of the tank.

The country dweller may purify his sewage by installing a small septic tank and allowing its effluent to percolate through the sandy soil.

CENTER CASE 7 contains models of a coarse bar screen, a revolving mechanical screen and a rotating Riensch-Wurl screen. A sedimentation tank is also represented in CENTER CASE 7.

Models of each of these will be found in CENTER CASE 8.

CENTER CASE 9 contains an intermittent sand filter in miniature.

Models of two contact beds are shown in CENTER CASE 10.

In CENTER CASE 11 a trickling filter is shown in action.

An activated sludge tank will be found in CENTER CASE 8.

One possible arrangement is shown by a model in CENTER CASE 8.
BACTERIA

Bacteria are minute single-celled plants. Most of them are harmless; some are necessary to the life and industrial pursuits of man; a few cause disease. When properly stained and viewed through a microscope, they are seen to occur in three shapes:

- balls
- rods
- spirals

Different bacteria vary greatly in proportions and appearance. Some species have long, thread-like processes (flagella), which enable them to swim about, while others are surrounded with slime. A great many contain resistant spores and others contain granules, which give them a barred or spotted appearance.

Bacteria may be made to live and multiply by planting them on a specially prepared jelly. Soon their numbers so increase that a colony of millions of microbes becomes visible at each point where a single germ was planted originally.

INSECT-BORNE DISEASES

An insect may carry disease from one man, or from one animal, to another in two ways:

1. By acquiring and dispersing the parasites during the act of biting. A few of the most important diseases carried in this way are:
   - Bubonic Plague — carried by the flea.
   - Malaria — carried by Anopheles mosquitoes.
   - Yellow Fever — carried by the Aedes mosquito.
   - Typhus Fever — carried by the body louse.
   - Sleeping Sickness — carried by the Tsetse fly.
   - Tick Fevers — carried by ticks.

   With the exception of Bubonic Plague, these diseases can be contracted only through the agency of insects and in the way described above.

2. By spreading germs lodged on its body and feet. Typhoid fever organisms and germ of infant diarrhoea are sometimes carried in this way by the fly.
BUBONIC PLAGUE

Since the sixth century, Bubonic Plague has swept three times over the world, killing millions of people.

It is a bacterial disease, primarily of the rat, spread and carried to man by the bites of infected fleas.

In California two species of squirrels are subject to the disease, while in Asia the marmot must be reckoned with. To control the plague we must fight the rat and the other rodents mentioned.

The most effective measures are:
1. Prevention of rat breeding — Clean up rubbish and cut off the rats' food supply.
2. Destruction of rats — Poison or trap them and fumigate enclosed spaces.
3. Exclusion of rats from dwellings by rat-proofing.
4. Quarantine against vessels from infected regions by placing rat guards on the hawsers, etc.

Plague, under certain conditions, may also be spread by the mouth spray from a coughing patient.

A fair degree of immunity may be produced for a short time by the use of vaccine.

(Notes Relating to Exhibits)

CHART 7 gives the range of each pandemic.

CHARTS 9 to 12 are copies of old paintings, showing how the scourge impressed the ancients.

An enlarged glass model of the germ (Bacillus pestis) will be found in WALL CASE 5, and on the same shelf are displayed four species of rats most often concerned. CENTER CASE 12 contains a model of part of an actual house, which was badly infested with rats.

A flea is mounted under a lens in WINDOW CASE 3 and an accurate model of the insect, magnified one hundred and twenty times, is installed in a case at the entrance to the Hall.

Mounted specimens are in WALL CASE 5, and in CENTER CASE 13 the most important species is shown in its natural surroundings.

CHART 8 summarizes the methods of control and CHART 13 shows some phases of an anti-plague campaign in New Orleans.

In WALL CASE 5 are three good traps and beside them is a model showing the results from their use.

On the 1st shelf is a model of a farm protected against rats and one of a schooner with rat guards in position.

On the top shelf of WALL CASE 5 are shown the costume and respirator worn to protect against this danger.

Samples of the commercial product are just beneath.
MALARIA

Malaria is an important disease responsible for an annual loss of $100,000,000 in the United States.

It is caused by a protozoan parasite (*Plasmodium*), living part of its life in the blood of human beings, and part in the body of the *Anopheles* mosquito.

Mosquitoes of this kind become infected by biting a malaria sufferer and spread the disease by subsequently biting healthy persons.

To wipe out malaria we must cure cases by quinine treatment and exterminate the insect-carrier.

To fight an enemy successfully, its habits must be known. Those of the mosquito are well understood.

Water is essential to mosquito breeding, for on its surface the eggs are laid and in it the early stages must live.

In warm weather mosquitoes reproduce most rapidly.

Our safety from malaria depends on the following mosquito-control measures:

1. Prevention of mosquito breeding —
   
   Swamps should be drained by ditching.

Overhanging grass should be cut from the edges of all ditches, streams and pools.

An enlarged glass model of *Plasmodium* will be found in WALL CASE 9, and CHART 18 shows its life cycle.

A chart in the top of WALL CASE 6 gives the points of difference between the malaria carrier and the common mosquito. The geographic distribution of the disease and that of its carrier are mapped in CHART 24.

A chart in the upper right corner of WALL CASE 6 shows the intimate relationship between the mosquito season and the prevalence of mosquito-borne disease.

A model on the middle shelf illustrates the use of quinine in Panama, and a chart just above it indicates the reduction of malaria in Italy due to the use of quinine dispensed by the Government.

A series of three jars giving the life cycle of the mosquito (left) and a set of collecting implements used in studying its natural history are also shown in WALL CASE 6.

CENTER CASE 14 (to be installed) will contain the reproduction of an actual pool in which malaria mosquitoes were found breeding, while a chart in WALL CASE 6 pictures a breeding place on the shore of the Nile.

Relief maps in CENTER CASES 15 and 16 (near the entrance to the hall) indicate the prevalence of malaria near marshlands.

A chart in the upper left corner of WALL CASE 6 gives data to illustrate this fact.

CHART 23 summarizes the methods of control.

A special spade for digging ditches is shown in WALL CASE 6, while in CENTER CASE 15 is a relief map of a well-drained marsh. CHART 19 shows a swamp before and after drainage. That drainage pays is proven by a model in CENTER CASE 16 and by the facts presented in CHART 20. In WALL CASE 7 is a model of a concrete ditch as constructed in Panama.

In the bottom of WALL CASE 7 is a group showing how this is done in Panama.
YELLOW FEVER

Cast-out pots and cans should be removed to prevent the accumulation of rain-water, while for rain-barrels, screening is essential.

2. Destruction of wigglers —
   They may be suffocated by oiling the surface of the water in which they live, or killed by poisoning.

   Their natural enemies, especially small fishes, should be encouraged.

3. Destruction of adult mosquitoes by fumigating —
   Cellars in which they hibernate and houses in which cases of malaria have occurred should receive special attention.

4. Screening to keep mosquitoes away from malaria patients from whom infection may be derived and away from healthy persons whom they might infect.

   When the use of screens is impracticable it is often possible to drive mosquitoes away by the use of repellants.

   The phenomenal success of the battle against mosquito-borne disease is discussed in the section on yellow fever.

YELLOW FEVER

Yellow fever is a tropical disease, the cause of which was shrouded in mystery until the beginning of this century, when its connection with the mosquito was established.
SLEEPING SICKNESS

The germ remains as yet undiscovered, but it is known to be carried by the *Aedes* mosquito just as the malaria parasite is borne by the *Anopheles*.

*Aedes*, being an inhabitant of houses, breeds more often in vessels of stagnant water than in swamps and streams. It is fought by practically the same measures as *Anopheles*, though fumigation is more important than in the case of the malaria carrier. It is the common practice in Panama to fumigate an entire house in which a case of yellow fever has occurred.

The wonderful success of the battle against mosquito-borne disease is nowhere better illustrated than in the history of the Panama Canal.

Our country was not the first to attempt this enterprise but it was the first to cope with the mosquito, and hence to succeed in building the canal.

Without the sanitarian, the engineer was helpless; with him the greatest engineering feat in history was accomplished.

Many other plague spots have been cleaned up by the same means, and other projects than the great Canal have been made possible by war on the deadly mosquito.

SLEEPING SICKNESS

Sleeping sickness is a disease of man which has caused enormous fatality in Africa.

It is produced by minute parasites called Trypanosomes, which live and multiply in the blood.

Watercolor sketches of *Aedes* will be found in CHART 15.

Such a scene is shown in WALL CASE 7.

CHART 21 is a view of part of the completed Canal.

In WALL CASE 7 are shown a French and an American hospital at Panama. The difference explains why France failed and America built the Canal.

These facts are presented to the eye by a series of models on the middle shelf. A chart at the top gives the drop in death rate resulting from the anti-mosquito campaign, and CHART 14 is a picture of the man who directed the work.

CHART 22 and a chart in the bottom of WALL CASE 7 give the results of sanitary work in Havana. A map in WALL CASE 7 and a model just beneath it illustrate one such instance.

In WALL CASE 10 will be found a picture of a sufferer and near it a map showing the distribution of the disease.

In WALL CASE 9 is an enlarged glass model of the parasite, and in WALL CASE 10 a photomicrograph of the organisms in the blood.
OTHER INSECT-BORNE DISEASES

Various species of these parasites cause a number of tropical diseases of man and animals.

The organisms are spread by the biting tsetse-fly (Glossina) which inhabits dense wet places.

Sleeping sickness is sometimes treated by drugs.

Our best means of fighting the disease is by controlling the insect-carrier. The most effective control measures are:

2. Control of infected human beings and animals so that flies may not acquire infection. Inspection and quarantine will accomplish this.
3. Protection of healthy persons against fly bites. Proper clothing and screening and avoidance of dangerous localities are the means. Marked success has attended the fight against the tsetse-fly.

Specimens of the insect and pictures of its native haunts are in WALL CASE 10.

A sample of Atoxyl (the drug used) is shown.

CHART 26 summarizes the control measures.

A model in WALL CASE 10 helps to visualize this process.

Another model shows a quarantine camp.

A small chart gives the drop in death rate in one instance.

OTHER INSECT-BORNE DISEASES

There are a great number of other diseases which depend for their existence upon insect-carriers. A few of these are treated in the Public Health exhibits.

Diseases of Man: Typhus fever is a disease which was once very prevalent in army camps. It is caused by a parasite which is transmitted by the bite of the body louse.

Modern sanitary methods have brought it largely under control.

A large wax model of the body louse will be found in a case at the entrance to the Hall, and specimens of it are in WINDOW CASE 3.

The upper shelf of WALL CASE 10 is devoted to typhus control, and a chart in the center indicates the effectiveness of the campaign.
Relapsing fever is a tropical disease carried by ticks and caused by a blood parasite (*Spirocheta*).

Owing to social conditions in the tropics, control is difficult, and the method most often employed is the destruction of the infected dwellings.

Elephantiasis is another tropical disease caused by a relatively large, worm-like parasite called *Filaria*. This animal obstructs the blood vessels, causing an enlargement of some extremity.

Mosquitoes of the genus *Culex* carry the young parasites from diseased to healthy persons.

Chagas fever is a disease of children in Brazil, which is carried by the bites of certain bugs.

**Diseases of Cattle:** Cattle are frequently sufferers from the ravages of blood parasites of which little is known save that ticks are the sole carriers.

The diseases are very serious in some parts of the United States and are responsible for great financial loss to the country.

The most effective means of control is the frequent treatment of cattle with poisonous washes. Arsenic solutions—the poison most used—may be applied by immersion or by spraying.

**THE FLY**

A great many species of flies are found in houses, but the preponderant type is the well-known House Fly (*Muscadomestica*). This insect is our commonest and most dangerous household pest.

A glass model of a *Spirocheta* will be found among the blood parasites in WALL CASE 9.

A model at the right of the bottom in WALL CASE 10 depicts such a scene.

See model in WALL CASE 9.

In WALL CASE 10 is a picture of a person so afflicted.

Specimens of these bugs are shown in WALL CASE 10.

In WALL CASE 10 are specimens of the principal offending ticks and a piece of cowhide which tells the story of the creature’s abundance.

CHART 25 gives the distribution of the disease, and in CASE 10 is a picture of Bitter Root Valley, where a human tick-borne disease, Rocky Mountain Spotted Fever, has prevailed.

The right of the middle shelf of WALL CASE 10 is devoted to the various devices used by cattle raisers for the protection of their stock.

Just above CHART 33 will be found specimens of some of the commonest species of flies, and CHARTS 28 and 33 include enlarged drawings of them.
During its life the fly passes through four stages: egg, larva, pupa and adult.

The eggs are laid by the female in filth of some sort — preferably in horse manure, but frequently in human excreta.

The larva or maggot, hatching from the egg, feeds upon this substance and grows to a length of perhaps half an inch, when it burrows down to a dry place and, upon casting its skin, becomes a dormant pupa. From this pupa the adult fly emerges, to wing its way from filth to our food.

As each female lays an average of one hundred and twenty eggs, and as nine generations are possible in one season, a single female may, under ideal conditions, be responsible for several hundred trillion offspring.

As a result of its nasty habits, the fly is a germ-laden creature.

If it has access to human discharge and then to food the fly may become a disease bearer. The fly was largely responsible for typhoid fever during the Spanish-American War, while it has been suspected of causing epidemics in times of peace. It has been shown that infants in fly-infested houses of New York City are visited by two and a half times as much summer complaint as those in clean homes.

Such conditions as these demonstrate the necessity of ridding ourselves of the fly. This is best done by the following means:

In a case at the entrance to the Hall is a huge model of the House Fly. In WALL CASE II a series of four jars illustrates the fly’s life cycle, while charts give the time required at various temperatures for the complete transformation and the relative importance of various breeding substances. A jar on the bottom shelf shows the number of flies found breeding in a pound of manure. CHART 32 shows two typical breeding places.

This fact is illustrated by four jars and a picture on the top shelf of WALL CASE II.

Several culture plates in the same case show the bacteria which developed in the tracks of a fly, and tubes of sand represent the number of bacteria washed from flies. CHART 31 shows a much enlarged fly foot with disease bacteria clinging to it.

See a model in WALL CASE II (top shelf, right) and a small map at the extreme left.

A model in the center of the same case illustrates this fact.

For summary see CHART 29.
THE FLY

1. Prevention of fly breeding:
   All manure should be either covered or disinfected.
   Exposed refuse should be cleaned up. Maggots may be destroyed in a maggot trap. The fly's natural enemies should be encouraged.

2. Destruction of adult flies:
   They should be trapped or killed with fly-paper, fly-poison and the swatter.

3. Guarding human excreta against access of flies:
   Flies cannot carry typhoid from a properly screened and enclosed privy.

4. Keeping flies out of houses and away from food:
   A screened window in summer may be valuable health insurance.
   The storekeeper who does not protect his foods from flies is your enemy.

Facts and figures have shown that war on the fly is worth while.

A covered manure bin and samples of borax and hellebore for disinfecting manure are shown.

One such trap is exhibited. The most important fly enemies are grouped in WALL CASE 12.

A good fly-trap is shown in WALL CASE 11,

and on the shelf above are two types of safe privies explained by models.

CHART 34 shows the effect of the application of control measures.
THE HOUSE FLY OR TYPHOID FLY
One of the Exhibits in the Hall of Public Health