

# General Science Quarterly

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## The Springfield Plan

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"I have heard of the Springfield plan. Please send me your course of study." Again and again this request has come to us from the teacher seeking help, from the teacher in search of statistics, and from the critic. Each of these is disappointed and apparently shocked when we try to point out that we lay no claim to having solved all of the problems of general science, and that our "course of study" is not a panacea for all the ills to which that subject is heir.

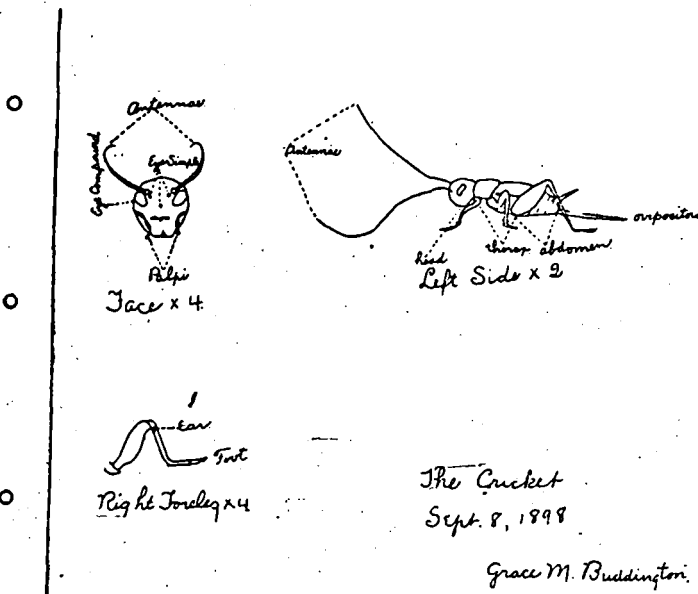
*The "Springfield Plan" is not a course of study.* It is a method of instruction which has served *our* needs well. This method is not peculiar to general science. It may be applied with equal facility to any and all science courses.

The "Springfield Plan" is not exactly a plan, either. It is, rather, the result of the growth of an idea; the result of study, trial and experiment. In attaining this result, the teacher has been absolutely unhampered. There has been no final examination to be met, no college requirement to consider. The only aim has been to minister to the needs of the pupil in the best possible manner.

This article is a brief story of that growth. It tells of a changing point of view, and a gradual approach to a more nearly satisfactory solution of the problem of elementary science.

When the new Central High School building was opened in September, 1898, great emphasis was being laid on the study and teaching of biology, particularly as a first year subject. This is well shown by the allotment of rooms in the science department. Of the eight rooms given over to science, four were biological laboratories, one a chemical laboratory, one a geological laboratory, and

two were physical laboratories. Exactly one-half of the science space was to be devoted to biological instruction. The course designed for the Freshmen, and required of them, was one in biology, so-called, and consisted of a half year of zoology and a half year of botany. The work was done mainly in the laboratory, and the nature and content of the course is well shown by the following outline and specimen page from the note book of a pupil who entered the school that year.



## BIOLOGY.

Central High School, Springfield, Mass.

1898—1899

THE CRICKET. Drawing—1 page. (See cut.) Description. Sense organs. Metamorphosis: direct; indirect.

THE SPIDER. Drawing—1 page.

THE EARTHWORM. Drawing—1 page. Description.

PROTOZOA. Drawing—1 page. Protoplasm. Root animalcules. Gregarines. Infusoria. Amoeba: 1. Habitat. 2. Structure. 3. Feeding. 4. Excretion. 5. Respiration. 6. Locomotion. 7. Irritability. 8. Reproduction. 9. Resting stage.

PORIFERA. Drawing—1 page. Description. Classification.

THE HYDROID. Drawing—1 page. Description.

THE SEA ANEMONE. Drawing—1 page. Description.

HYDRA. Description.

THE STAR FISH. Drawing—3 pages. Description.

THE TULIP. Drawing—2 pages.

HORSE CHESTNUT. Drawing—2 pages.

CHERRY TWIG. Drawing—1 page.

SQUASH. Drawing of seed and plant—1 page.

CORN. Drawing of seed and plant—1 page.

THE PEA. Drawing of seed and plant—1 page.

THE VIOLET. Drawing—1 page.

STARCH. Drawing of starch grains—1 page.

#### EXPERIMENTS:

1. Does light assist germination? Does light retard germination?
2. Will seeds germinate without air?
3. Are the cotyledons of a seed of any use to the seedling?
4. Does the amount of material in a seed have anything to do with its germination?
5. Of how much use to the corn seedling is the endosperm?
6. Do seeds contain starch?
7. How can the presence of grape sugar be detected?
8. What change does the starch in seeds undergo during germination?
9. Do seeds contain oil?
10. Do seeds contain proteids?
11. How is the growth of the pea carried on after the destruction of the plumule?
12. Do two liquids in contact with one another mingle?
13. Can two liquids separated from one another by a moist membrane mingle?
14. If the two liquids in Experiment 13 are of unequal density, is the greater flow from the denser to the less dense or vice versa?

THE RADISH. Drawing—1 page.

ROOT OF DAHLIA. Drawing—1 page.

UNDERGROUND STEMS. Drawing—1 page.

This course was intended to introduce the pupil to the world of science and to arouse his interest in science work, but in meeting the latter part of this aim it was not an unqualified success. It was worked out according to the best pedagogical practice, but instead of interest, a marked distaste, almost amounting to disgust, appeared. "How we hated that old bugology! I can smell the pickle yet," said one of the pupils to me recently. Work of this sort, particularly the zoology, is by its very nature calculated to arouse either intense enthusiasm or profound dislike—the enthusiasm being limited, usually, to a very few. As a matter of fact, no one science will ever arouse and hold the interest of a class composed of a large number of individual boys and girls whose tastes

run to all sorts of extremes. In this case biology failed because, as taught, it was a subject too deep for the age of the pupil, requiring skill in dissection, clearness in reasoning, and the ability to differentiate.

The course continued, however, in substantially the same form for six years, becoming more and more unsatisfactory all the while. Occasionally a teacher of more than ordinary ability could make the work endurable, but on the whole, it failed to prove its right to an existence. It was found, also, that the unsatisfactory introduction to the science work was reacting unfavorably on the whole science department. The size of classes in the elective sciences was decreasing, because to the pupil "science" was synonymous with the course in biology. It was evident that some radical change must be made if the science was to hold the place it deserved in the work of the school. To none was the need for a change more evident than to Dr. Thomas M. Balliet, then Superintendent of Schools, and Mr. William Orr, then Principal of Central High School, and Springfield owes whatever of credit she has received for originating a plan of first year science work to the courage and foresight of these two men—a fact which they are far too modest to admit.

It was determined to break sharply with the old course and to start afresh along new lines and with somewhat different aims. The purpose of the new course was two-fold:

1. To give the pupil a broad and helpful view of the whole field of science, especially as it touched his daily life.
2. To lay special emphasis upon the fact that the science of the school and the science of the "outside world" are identical.

In scope, the course has gone far beyond even the dreams of the far-seeing men who planned its beginning, but it has adhered steadfastly to their ideals, and with uniform success.

In September, 1904, Mr. Waterman S. C. Russell was secured to be the first teacher of the course, and to him is due the credit of instituting a practical plan of work. On account of conditions within the science department, the course for the first year consisted mainly of mild physics, with numerous practical illustrations, together with some chemical notions, but the relief from the strain of the biology course was evident immediately, and there was every inducement to continue. The next year something of astronomy crept in, and the course became more definitely and distinctly re-

lated to the home. Little by little the other sciences found their place, until the course became in fact, as well as name, a course in *general science*.

Almost from its inception the epithet "hash" was thrown at the work by those who failed to appreciate its purpose, or who were definitely committed to some one subject, such as biology or physiography, as an introduction to science. To some extent this criticism was justified. The various problems—the term "project" was not in use at that time—were not closely related, and there was a lack of cumulative effect, which made it difficult to group the knowledge and experience gained under general heads.

This need of closer and more systematic organization was felt quite as acutely by the friends of the course as by its critics, and various plans for overcoming the difficulty were tried. The final solution was the organization of the material into a number of large general units, each having a definite relation to the life of the city, and, therefore, a definite interest to the pupil. Problems thus presented seemed to him worthy of solution. He could, and did, bring to bear his previous experience, and he could appreciate, to a much greater degree, the general underlying principles.

It was found, also, that this method brought together the whole family of sciences in harmonious relations. For example, one unit studied—the classic one—is "Springfield's Water Supply." When this is studied from its source in the springs and brooks to its use in the homes of the pupils, it is necessary that reference be made to almost every branch of science, though the specific names of these branches may never be mentioned. Physics and chemistry, biology, physiography, bacteriology, forestry and sanitation—a knowledge of each is essential to the construction and proper operation of a modern water system. In a similar way other common activities may be grouped into general units, and taught more effectively and forcefully than as isolated topics, each comparatively meager in content. As a practical working plan, this system needs no defense. Its success is its own justification.

With the formal inauguration of the junior high school in February, 1917, a new situation was produced. Previously each of the three high schools had determined its own course. Now it became necessary to formulate one uniform course which should be acceptable to each of the senior high schools, and which should not be a hindrance to any pupil in future science work. Somewhat to the surprise of all, the heads of the science departments in the

three high schools were found to be in complete accord, and with principals of grammar schools and the supervisor of nature study in agreement, the following course was suggested and adopted:

#### GENERAL SCIENCE.

JUNIOR 3.

##### Outline of the Course

**PURPOSE.**—The chief purpose of this course is to offer an opportunity whereby the pupil may broaden and deepen his interest in natural phenomena. His study of the subject should promote a wide outlook, and should minister to his intellectual life by the gratification of mental desires in an increasing appreciation of the delight and satisfaction to be found in the study of nature.

The primary aim of general science is to give large opportunities for the exercise, along the line of the pupil's interests, of his inherent desire to know more of his physical environment, rather than to require the mastery of a certain body of organized knowledge or a command of formulae, or to develop expert scientists, or to train explicitly in scientific method.

Instruction in general science should lead to a more extended reading of articles on science, in magazines and newspapers, and of scientific books of both popular and technical character. There should be a readier understanding of scientific allusions, increasingly found in general literature.

The pupil should learn, also, how to use certain instruments and appliances, as balances, rulers, and graph paper. Practice should be given in the systematic arrangement of data in tabular form and graphic presentation. The pupils should gain in skill and power to use reference books, such as dictionary, encyclopedia and readable texts. Information on scientific matters should thus be made easily accessible.

**ORGANIZATION OF THE COURSE.**—In organizing the course, the following factors should be kept constantly in mind.

1. The course is to be planned with particular reference to Springfield, its location, its interests and its needs.
2. It is to be a course in *general* as opposed to *particular* or *specific* science.
3. It will be a half-year course, that is, five (5) periods of work a week for twenty (20) weeks.
4. It is to include a considerable amount of laboratory work done by the pupil, either in school or at home.
5. It should consider carefully and, in every way possible, build upon the work previously done in the grades. Incidentally, it should include a continual review of former science work.

**ORGANIZATION OF MATERIAL.**—General science material should be organized as a number of general units. Each unit should consist of a large central theme involving problems of various kinds so re-

lated to the experience and interests of the pupil as to make him feel that their solution is worth while. These problems should of themselves make it clear that the science of the school and the science of the "outside world" are identical.

When these units are wisely selected and well organized, the pupil should find something in each to arouse genuine enthusiasm and to challenge to vigorous effort. While at times the several problems in a unit may seem to be unrelated, when the results are summarized the relation of each to the main unit should be clearly seen.

While each project or problem in a given unit should be complete in itself, cumulative effect is produced by grouping together a number of projects belonging in the same field. Without such relationship a succession of isolated and comparatively limited projects and undertakings will result, and there will be failure to group the knowledge and experience gained under general heads.

OUTLINE.—The following general units are selected for this course. As it will be found impossible to complete, even approximately, all of them in the space of the half-year allotted, certain portions have been starred (\*) as required. The remaining portions may be considered, as time permits, at the discretion of the teacher and according to the bent of the class.

1. Foods.
2. The Houses We Live In.
3. Keeping Well.
4. Cleansing and Dyeing.
5. Household Electrical Appliances.
6. The Weather.
7. Our Neighbors In Space.
8. What Time Is It?
9. Springfield's Water Supply.

These units may include, along with reading, study and original investigation by the pupil, the following lectures, or talks *with the class*, and exercises, laboratory or home, which bear upon the same subjects.

#### FOODS

##### CLASS TALKS

- |                                    |                                 |
|------------------------------------|---------------------------------|
| *Food and Its Adulteration.        | *Coal Tar Dyes.                 |
| *Color in Foods.                   | Other Dye Tests.                |
| Coffee and Its Relation to Health. | *Coffee Tests.                  |
| *Milk and Butter.                  | *Butter Tests.                  |
| *Eggs.                             | *Babcock Milk Test.             |
| Food Preservatives.                | Preservatives in Milk.          |
| *Flavoring Extracts.               | Pasturized Milk.                |
| Science and the Food Supply.       | Ice Cream.                      |
| Food and Health.                   | *Study of Eggs.                 |
|                                    | *Making Flavoring Extracts.     |
|                                    | Preparation and Test of Starch. |
|                                    | Starch and Sugar in Foods.      |

## THE HOUSES WE LIVE IN

- |                                |                                     |
|--------------------------------|-------------------------------------|
| The Forest and Its Products.   | *Carbon Dioxide In Air.             |
| Clay and Bricks.               | *Testing the Ventilation of a Room. |
| Cement and Concrete.           | *Cost of Some Fuels.                |
| Wood Through a Microscope.     | *The Hot Water Tank.                |
| *Ventilation of the House.     | *Our Home Heater.                   |
| *Heat in the Home.             | Our Refrigerator.                   |
| *Fires and Fire Extinguishers. | Ice Cream Freezers.                 |
| *Home Lighting.                | *The Fireless Cooker.               |
| Science and Decoration.        | Testing Lights.                     |

## KEEPING WELL

- |                         |                                |
|-------------------------|--------------------------------|
| The Sanitary Home.      | *Test of Tooth Preparations.   |
| Personal Hygiene.       | Making Tooth Powders & Pastes. |
| *Tooth Preparations.    | Test of Headache Preparations. |
| *Headache Preparations. | *Toilet Preparations.          |
| *Patent Medicines.      | *Moulds.                       |
| *Habit Forming Drugs.   | *Growing Bacteria.             |
| *Preventable Diseases.  |                                |

*Note*:—Constant reference will be made to matters of health and hygiene in connection with other work of the course.

## CLEANSING AND DYEING

- |                                 |                            |
|---------------------------------|----------------------------|
| *Physical and Chemical Changes. | *Litmus Tests.             |
| *Soap and Its Uses.             | *Making Soap.              |
| Removal of Stains.              | *Tests of Ink Eradicators. |
| Bleaching.                      | Javelle Water.             |
| *A Trip Through a Laundry.      | *Removing Common Stains.   |
| Dyeing at Home.                 | Tests of Washing Powders.  |
| Where Do We Get Our Dyes?       | Tests of Cleansing Fluids. |
|                                 | *Dyeing Tests.             |
|                                 | Inks.                      |

## HOUSEHOLD ELECTRICAL APPLIANCES

- |  |   |
|--|---|
| *The Story of Electricity.                 | The Electric Bell.                      |
| *Heat and Light From Electricity.          | Bell Wiring Problems.                   |
| Other Electrical Effects.                  | *Tests of Household Electrical Devices. |
| *How Electricity Is Produced and Measured. | *Lamp Tests.                            |
| *Electricity In The Home.                  |   |



## THE WEATHER

- \*Our Atmosphere.
- \*Air In Motion.
- \*Clouds, Fog, Mist, Rain, Dew and Snow.
- Work of the United States Weather Bureau.
- Effects Produced by Weather.
- Water Power in New England.
- Testing Air for Oxygen and Nitrogen.
- \*Temperature Graphs.
- Dew Point and Humidity.
- \*Weather Record.
- Making a Weather Map.
- \*Almanac Weather Predictions.
- \*Rainfall and Forests.
- Water Power Map of New England.

*Note:*—The study of the weather, particularly the keeping of records and notes on special conditions, should be continued throughout the semester.

## OUR NEIGHBORS IN SPACE

- \*Astronomy of Everyday Life.
- \*The Moon, Our Nearest Neighbor.
- \*The Sun, Our Distant Neighbor.
- \*The Planet Mars, Our Sister World.
- \*Comets and Meteors.
- \*The Stars, Our Very Distant Neighbors.
- \*Finding a Meridian.
- \*Monthly Record of the Moon.
- \*Sunrise and Sunset Graphs.
- \*Heat From the Sun at Different Angles.
- \*Constellations.
- Latitude by Altitude of Polaris, or by Gnomon.

## WHAT TIME IS IT?

- \*Local and Standard Time.
- \*How Time Is Kept.
- Ancient.
- Modern.
- \*The Calendar.
- \*Map of Time Belts.
- \*Rotation of the Earth and Its Effects.
- Longitude of Springfield.
- Time Signals.

## SPRINGFIELD'S WATER SUPPLY

- \*Growth of Our Water System.
- \*Reservoirs and Their Location.
- \*Purification of Water.
- Conserving the Supply.
- \*Water Pressure.
- \*Water Tests.
- \*Charcoal as a Filter.
- \*Household Filters.
- Hard and Soft Water.

**TEXT BOOKS.**—Text books should be used mainly for reference purposes, and not as an outline of a course. It is desirable, therefore to have at hand a number of different texts, and those already in use in the several high schools should be turned over to the Junior High School as soon as practicable.

Leaflets, each dealing with some particular project, and prepared especially for local use, make the best text book in the commonly accepted meaning of that term. They should be prepared largely by those in charge of the work and printed, if possible, by the Practical Arts classes in the various schools. The use of such leaflets relieves the pupil of the somewhat arduous task of writing up reports of lectures, and serves the purpose equally well.

**LABORATORY MANUALS.**—The laboratory manual, like the text-book, should be made to fit our own particular needs. The various exercises should be printed. The teacher can give directions, when these are needed, more easily and clearly, and as the time sometimes wasted in dictation is saved, more real work can be done in a given number of lessons. The pupil escapes the purely mechanical work of recording results, a task which too frequently causes him to miss the real point of the exercise which he has performed. This in no way lessens the training in orderly arrangement of material, and will often prevent the pupil from becoming discouraged. The production of an elaborate system of notes is not one of the purposes of the course. The note book should be considered a means rather than an end.

The foregoing represents the last stage, to date, of the "Springfield Plan." We do not accept it as final. It is not even our ideal. We are looking for improvement, but it seems to be, *for us*, the best solution of our present problem, and that, after all, is about the only qualification that we can absolutely demand of a course in general science.

### History of the General Science Movement<sup>1</sup>

GEORGE D. VON HOFÉ, JR., Teachers College, Columbia University.

The story of the General Science Movement traces itself through many years, but not until recently has it become significant in aiding the science teacher to meet the demand for an improvement in science instruction. The history of the teaching of general science is still to be made. It had a beginning that was curtailed fifty years ago, and the revival is just appearing. Since the break, as far as the writer is aware real general science, the kind that is discussed by Professor Woodhull in his "Science Teaching by Projects"<sup>2</sup>, has not been prominent in any school. All we can trace is the history of the opposition to, and the breaking away from methods which are a check on the pupil's natural progress.

<sup>1</sup> Abstract of an address delivered at Teachers College Science Round Table.

<sup>2</sup> School Science and Mathematics, March, 1915.