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An experimental study in Retention of Knowledge in Seventh Grade General Science

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AN EXPERIMENTAL STUDY IN
RETENTION OF KNOWLEDGE IN
SEVENTH GRADE GENERAL SCIENCE

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS OF

THE COLLEGE OF WILLIAM AND MARY

FOR THE DEGREE
MASTER OF ARTS

1951

Ruth Groves Keffer

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CHAPTER I

INTRODUCTION TO THE STUDY

Along with the growth of interest by teachers in the use of audio-visual aids in the instruction of different courses, there has arisen the problem of the inducement of retention of the facts by the pupil.¹

I. The Purpose of the Study

The purpose of the experiment was to demonstrate that, through the use of motion pictures, the amount of scientific knowledge retained was increased in certain units of study taught in a course of Seventh Grade General Science in four classes at Chelyan Junior High School, Chelyan, West Virginia.

II. Significance of the Study

Many studies have been made of the use of motion pictures in elementary and secondary schools,² but only a few studies have been made with junior high school science pupils.

In order that a pupil may meet the responsibilities and functions of modern living, it is desirable to employ the most effective teaching methods and materials. Motion pictures are teaching aids of today which have been widely and effectively publicized through channels of general education,

¹ Daniel C. Knowlton and J. Warren Tilton, Motion Pictures in History Teaching, Yale University Press, 1929, 57-64 pp.

² Loretta E. Heidgerken, "An Experimental Study to Measure the Contribution of Motion Pictures and Slide Films to Learning Certain Units in Course of Introduction to Nursing Arts", The Journal of Experimental Education, Vol. XVII, (December, 1948), 261-281 pp.

business, industry and, more recently, in the military services.³ Their position and their contributions to seventh grade general science retention have not been studied widely. Since reported studies have dealt mostly with high school pupils, there seemed to be a need for such an investigation.

A thorough search of the literature prior to this study disclosed almost no research data regarding approved standards for criteria relating to the most meaningful visual media or methods of using them. Many of the investigations in visual education have shown that visual aids do contribute to learning, but many of these research studies have been concerned with surface problems. Hoban and Dale⁴ in their review of literature indicate the insufficiency of the evidence of meaningfulness of visual aids. A call for organized, planned and better controlled experimentation is given by Carpenter⁵ in the following statement:

"... If this promising educational tool--the motion picture--is to be effectively employed, it must be known what it can and cannot do, what its strengths and weaknesses are, and what principles should be employed in the tool's construction to make it of maximum effectiveness for communicating meanings and changing behavior."

Since motion pictures have been used frequently in Chelyan Junior High School, it was believed that an experimental study might make a significant contribution.

³ John R. Miles and Charles R. Spain, Audic-Visual Aids in the Armed Services, American Council on Education, Washington, D. C., 1947, 1-93 pp.

⁴ C. F. Hoban Jr. and E. Dale, "Visual Education", Encyclopedia of Educational Research, (New York: Macmillan Co., 1940), 1324-1334 pp.

⁵ C. R. Carpenter, "A Challenge for Research", Educational Screen, XXVII, (March, 1948), 119-121 pp.

III. Scope and Limitations of the Study

It was necessary that the experiment be made on a small scale, since only pupils in one junior high school were used. It was believed that this experiment would contribute further information regarding the influence of motion pictures upon retention of knowledge. Furthermore, this study would set a precedent for other departments of Chelyan Junior High School.

Although this investigation utilized heterogeneous groups,⁶ it could lead to a study of retention in homogeneous groups.⁷ No request was made for regrouping because the heterogeneous grouping had been completed by the school administration before the study was undertaken.

The literature indicates that there is a need for many more carefully designed and statistically analyzed studies. This is necessary before the many problems related to audio-visual aids to induce retention can be solved.

IV. Preview of the Following Chapters in the Study

In the second chapter, will be presented a review of the literature of previous investigations in science and related fields. The third chapter will describe the procedures used in the investigation, and in the fourth chapter will be the presentation ^{of} findings and conclusions.

⁶ Heterogeneous groups here is used to mean groups of pupils with different Intelligent Quotients (I. Q. Ratings).

⁷ Homogeneous groups here is used to mean groups of pupils with the same Intelligent Quotients (I. Q. Ratings).

CHAPTER II

PREVIOUS INVESTIGATIONS IN SCIENCE AND RELATED FIELDS

I. Beginnings of the Motion Picture in Education

A study of research work in the field of visual education shows that the first significant educational interest was probably evidenced by Averill¹ in 1915, in an article about the possibilities of motion pictures in education. This was not a report of an experiment, but it was an article that indicated further work to be done. Wide experimental study of visual education began soon after this. One of the first investigations reported was one made by David Sumstine² in School and Society in 1918. He found that the motion pictures, still pictures and oral description were superior in instructional effectiveness to the combination of still pictures and oral description or to the lecture used alone. This study was quite limited in the light of present knowledge of methods in experimentation, but it marked the beginning of experimental studies in the field.

II. Discussion of Some Reported Studies

Utilizing Audio-Visual Aids

Since the presentation of Sumstine's³ report, many studies of audio-visual education have been made. A number of these studies have been

¹ L. A. Averill, "Educational Possibilities of the Motion Picture", Educational Review, L. (November, 1915), p. 372.

² David Sumstine, "Comparative Effectiveness of Visual Education in High School", School and Society, VII, (February, 1918), 235-238 pp.

³ Sumstine, loc. cit.

extensive; such as Wood and Freeman's,⁴ Knowlton and Tilton's,⁵ and Rulon's.⁶ Wood and Freeman's⁷ study was made in science and geography with 11,000 pupils from the fourth to the ninth grade participating in the experiment. Silent motion pictures, slides and other visual aids were used. It was found that the geography series motion picture group made a mean gain in retention of 17 per cent over the control group, and in the general science series motion picture group there was a mean gain in retention of 11 per cent over the control group. Knowlton and Tilton's⁸ investigation was made in the history field, with 500 eleventh grade pupils participating in the experiment. Silent motion pictures were used in the study. It was reported that the motion picture groups made a 19 per cent gain in learning in score points over the control groups on the immediate testing and a 12 per cent gain on the retention test. Higher gains were made by the groups when used in the normal classroom situation than when used in the auditorium. Rulon's⁹ investigation was made in the science field with 2,860 ninth grade pupils participating in the experiment. Sound motion pictures and the lecture were used in this study. It was found that the motion picture group exceeded the control group by 20 per cent on achievement tests in general, and in the items which dealt specifically with film content the pupil achievement of the ex-

⁴ B. Wood and F. Freeman, Motion Pictures in the Classroom, (New York: Houghton Mifflin Co., 1929), 392 pp.

⁵ D. C. Knowlton and J. W. Tilton, Motion Pictures in History Teaching, Yale University Press, New Haven, (1929).

⁶ P. J. Rulon, The Sound Motion Picture in Science Teaching, Harvard Studies in Education, Vol. 20, Harvard University Press, Cambridge, 1933, 236 pp.

⁷ Wood and Freeman, loc. cit.

⁸ Knowlton and Tilton, loc. cit.

⁹ Rulon, loc. cit.

perimental group exceeded that of the control group by 35 per cent. It was also reported that neither of the two above gains may be expected to be made at the expense of habits of good thinking.

III. Inadequacies of Previous Studies

The investigations in the past decade have been more helpful, even though they have their inadequacies. One of the handicaps of the first research studies was the kind of motion pictures utilized.^{10,11} Many such investigations utilized films which were not intended for educational purposes but were designed for advertising. Nevertheless, investigators reported their findings as though appropriate educational films had been utilized. As late as 1945, Stenius¹² in his report on the literature in the field of visual education said:

"Research in the field has reflected the status of the program in the schools. There has been no continuous pattern of investigation. For the most part, studies have dealt with specific problems in a rather superficial manner. It is not difficult to match every investigation that has proved that the use of visual or auditory aids resulted in increased instructional effectiveness with one that has shown no added benefits to pupils".

¹⁰ F. N. Freeman et al, Visual Education: A Comparative Study of Motion Pictures and Other Methods of Instruction, (Chicago: University of Chicago Press), 1924, 391 pp.

¹¹ J. J. Weber, Comparative Effectiveness of Some Visual Aids in Seventh Grade Instruction, (Chicago: Educational Screen, 1922), 132 pp.

¹² A. C. Stenius, "Auditory and Visual Education", Review of Educational Research, XV, (June, 1945), p. 244.

This statement of Stanius is in harmony with the criticism of research in audio-visual education made by Hoban,¹³ who found that most of the investigations have dealt only with factual materials which duplicated the same areas, and frequently revealed no new findings.¹⁴ The findings relative to percentage of increase in knowledge vary considerably in the above studies.

The utilization of motion pictures in education is another area which apparently has been given very little consideration, since only one such investigation was revealed in the literature. Keeslar¹⁵ subjected to critical analysis twenty-four of the better science films and discovered that 44.1 per cent of the scenes in these films satisfied no special purpose and made no contribution to the major objectives of science education.

The armed services used audio-visual materials extensively as training aids in their program of preparedness for war. But, in spite of the wide use of these training aids, only a small amount of research was made to evaluate and give foundation for their extensive use.¹⁶ Miles and Spain,¹⁷ in the summary of the studies that they reported, say:

¹³ C. F. Hoban Jr., "Experimental Research in Instructional Films", in Motion Pictures in Education, (New York: H. W. Wilson Co., 1938), 307-386 pp.

¹⁴ Hoban, loc. cit.

¹⁵ O. P. Keeslar, Contributions of Instructional Films to the Teaching of High School Science, Unpublished Doctoral Dissertation, University of Michigan, 1945. (Findings).

¹⁶ J. R. Miles and C. R. Spain, Audio-Visual Aids in the Armed Services; Prepared for the Commission on Implications of Armed Services Educational Programs, (Washington, D. C., American Council on Education, 1947), p. 93.

¹⁷ Miles and Spain, loc. cit.

"Studies reviewed support the contention that films can and do affect emotional attitudes in the direction predetermined to be desirable. Furthermore, such attitudes tend to persist for a considerable time. Films also definitely increase factual knowledge, and such knowledge also remains with the trainee for a considerable period of time....."

"....the majority of instructors prefer movies to filmstrips. Instructors further believe that movies and filmstrips shorten training time, result in greater learning, and stimulate interest and motivation. Finally returned veterans now in colleges and public schools overwhelmingly endorse a greater use of audio-visual aids than is now characteristic of civilian education."

In an investigation of techniques for using filmstrips and motion pictures, Hoban¹⁸ reported as much as 19 per cent gain in retention as a result of the proper use of filmstrips and motion pictures. The subject material used involved elementary map reading. The teaching technique and presentation of material used in Hoban's study was comparable to that of high school level.

IV. Summary

There was general agreement among the investigations to indicate that the use of motion pictures and other visual aids were superior with regard to retention to the use of verbal material alone or the unorganized utilization of other visual aids, even though there were weaknesses and inadequacies in many of the studies.

¹⁸ C. F. Hoban Jr., Movies That Teach, (New York: Dryden Press, 1946), p. 189.

CHAPTER III

PROCEDURES USED IN THE INVESTIGATION

I. Setting of the Study

The classes chosen for this study contained 131 regular pupils of the Seventh Grade of Chelyan Junior High School, Chelyan, West Virginia, for the session 1950-51. The seventh grade general science classes were selected because they were the only classes taught by the author in which a constant membership was maintained during the entire school year.

In general the program of studies is the same for all seventh grade general science pupils in the State of West Virginia since the program of studies is outlined in the State Course of Study of West Virginia. A complementary Course of Study and Lesson Guide, prepared at the county level, does allow some variation because the sequence of the different units of study is not fixed.

The two units of study selected for this experiment were: (1) Bones, Muscles, Teeth, Nerves and Skin of the Human Body, and (2) Respiration, Excretion, Circulation, Digestion and Growth in the Human Body. The above units were chosen because it was believed by the investigator that these would be desirable for such an experiment since emphasis had been placed on the study of the human body in the pupils' previous science courses.

A single book,¹ Science Problems Book 1, was designated as the text-

¹ Wilbur L. Beauchamp, John C. Mayfield and Joe Young West, Science Problems Book 1, Scott, Foresman and Company, New York, N. Y., 1938 and 1946, p. 432.

book for the course; but this was supplemented by several copies of the latest General Science textbooks,² along with pamphlets, pictures, charts, exhibits, demonstrations, experiments, discussions, experiences of others, lectures and committee work. Motion pictures were used as variables with the experimental groups.

Three silent motion pictures, "Muscles", "Digestion" and "Action of the Human Heart" along with three sound motion pictures, "The Skin", "Mechanisms of Breathing" and "Body Defense Against Disease" were used in the study. These motion pictures were selected because it was believed from previous use of the films, that they would be desirable.

II. Development of Tests for Study

In the previous year, 1949-50, the investigator had taught these units in a regular class of 34 pupils in the seventh grade in science at Chelyan Junior High School (the same school in which the study was made in 1950-51). At the beginning of the two study units a test³ of 120 multiple choice items was given to the class. The test on the first unit, Bones, Muscles, Teeth, Nerves and Skin of the Human Body, was designated as Test A and the test on the second unit, Respiration, Excretion, Circulation, Digestion and Growth in the Human Body, as Test B.

After these diagnostic testings the papers were scored and the questions equated. The equating was made on the basis that no question would

² See Bibliography for list of science textbooks.

³ See Appendix A for Initial Tests A and B.

be selected that had been answered incorrectly in the diagnostic testings by eleven or more pupils; this was about 29 per cent of the pupils in the class. In this manner Test A⁴ was cut to fifty multiple choice items and Test B⁴ was cut to fifty-two multiple choice items.

III. Setting up of Groups

For the two units of study the investigator's four seventh grade science classes were designated as Class A, Class B, Class C and Class D. For the first unit of work Classes A, B and D were the experimental groups and Class C was the control group. In the second unit of study, Classes A, C and D were the experimental groups and Class B was the control group. In the first unit of study, Classes A and B, two of the experimental groups, were held in the morning while Class C, the control group, and Class D, the third experimental group, were in the afternoon. For the second unit of study, Class A, one of the experimental groups, and Class B, the control group, were held in the morning, while Classes C and D, the other experimental groups, were held in the afternoon. The element of fatigue was partially accounted for by the rotation of the experimental and control groups in the above manner.

IV. Discussion of Unit Studies and Testing Plan

At the beginning of each unit of work there was a teacher-pupil planning period. In this period the activities for the units to be studied were planned carefully. They were based on the previous experiences of the pupils,

⁴ See Appendix B for Final Tests.

their interests in different problems concerning the units, and allowance was made for other questions to arise during the period of instruction. The instruction proceeded as planned utilizing the textbook, other late General Science textbooks, pictures, pamphlets, demonstrations, charts, exhibits, experiments, experiences of others, discussions, committee work and lectures; with the variable of motion pictures added to the above list for the experimental groups. The films were shown to the experimental groups only once during the period of instruction and were not shown at any other time after the testing period began.

The two units of work were completed in thirty-two days; that is, sixteen days for the groups on the first unit of study and sixteen days for the groups on the second unit of work.

Test A, the fifty item test, was administered to the groups who had had instruction in the first unit of work, the next day after the completion of the unit study. This was used as immediate recall ^{of} subject matter covered. Without further instructions on the unit, the same test was given for retention testings at intervals of three, six and nine weeks following the immediate recall test. The pupils who studied the second unit were given the test of fifty-two items, Test B, in a similar manner.

All of the tests were scored and treated statistically to show whether increased retention was induced by the motion pictures.

CHAPTER IV

PRESENTATION OF FINDINGS AND CONCLUSIONS

I. Findings

The raw scores obtained from the four Seventh Grade General Science Classes, Groups A, B, C and D, for the four testing periods (immediate recall, and the retention tests given at intervals of three, six and nine weeks after the completion of the two units of study) are presented in Tables I, II, III, and IV. These tables were constructed in the following manner: the number of the pupil from the teacher's alphabetical class record is given in the first column at the left of the table; and under sections marked Test A and Test B his raw scores for the immediate recall tests and the three, six and nine weeks tests on the two units of study. The tables are as follows:

TABLE I
 RAW SCORES OBTAINED BY GROUP A
 ON TESTS A AND B

Pupils	TEST A				TEST B			
	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks
1	42	32	30	28	51	46	45	42
2	44	43	41	40	51	49	48	46
3	46	46	45	44	50	44	41	40
4	43	43	42	41	49	47	46	46
5	44	43	43	41	44	42	41	39
6	49	46	47	46	51	41	40	40
7	40	40	40	40	50	50	47	44
8	43	42	42	41	46	42	42	40
9	46	43	44	43	43	42	40	40
10	45	43	43	42	42	40	39	38
11	39	39	39	39	45	42	40	40
12	36	36	35	35	51	48	46	44
13	39	39	38	37	48	41	40	40
14	40	40	40	40	49	42	42	41
15	31	31	30	31	51	45	43	42
16	36	36	36	36	52	46	45	44
17	38	37	38	37	50	49	47	46
18	39	39	39	38	44	42	42	40
19	42	41	40	40	49	44	44	43
20	50	49	49	50	46	45	43	42
21	41	40	40	41	50	46	45	44
22	38	36	37	38	50	46	45	44
23	37	37	36	37	51	47	46	45
24	37	36	37	37	48	48	47	46
25	34	34	34	34	51	46	39	39
26	32	31	30	32	51	50	43	41
27	34	34	34	34	51	45	42	40
28	39	39	38	39	46	43	41	40
29	41	40	40	41	51	50	50	49
30	37	36	36	37	51	49	47	47
31	50	43	43	44	45	44	42	41

TABLE II
 RAW SCORES OBTAINED BY GROUP B
 ON TESTS A AND B

Pupils	TEST A				TEST B			
	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks
1	44	44	41	42	34	33	34	33
2	40	39	38	37	40	40	40	40
3	44	43	42	40	39	38	36	35
4	41	39	38	38	31	34	31	30
5	41	40	39	38	30	32	30	30
6	40	38	36	36	32	32	31	31
7	43	40	39	37	33	33	32	33
8	45	43	40	40	39	38	37	40
9	44	42	41	40	40	40	40	39
10	43	42	41	41	32	30	30	30
11	43	40	38	38	33	31	31	30
12	39	38	38	37	39	38	36	36
13	34	32	32	32	32	36	35	38
14	44	39	38	39	34	34	33	34
15	39	38	36	36	35	34	34	35
16	50	48	46	46	38	36	34	35
17	49	47	45	45	40	40	29	14
18	44	39	38	39	39	40	26	11
19	42	38	34	35	38	39	29	12
20	42	37	35	35	36	38	39	40
21	36	36	34	34	40	40	41	40
22	40	40	38	39	36	35	38	36
23	39	39	37	38	33	31	32	32
24	38	37	35	36	31	26	33	33
25	42	42	38	38	32	32	31	30
26	38	37	36	37	21	30	30	31
27	38	37	35	35	39	36	36	35
28	40	39	40	40	42	40	40	38
29	42	40	40	40	40	39	39	38
30	45	45	45	45	41	38	36	38
31	34	33	34	34	38	36	35	35
32	49	47	48	48	36	35	35	35
33	34	33	33	34	33	32	31	30

TABLE III
RAW SCORES OBTAINED BY GROUP C
ON TESTS A AND B

Pupils	TEST A				TEST B			
	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks
1	34	33	33	32	45	43	42	42
2	41	39	37	35	43	43	43	43
3	40	40	39	36	49	48	48	47
4	31	30	30	29	50	48	48	47
5	32	31	30	30	51	50	50	49
6	33	32	30	31	52	50	49	48
7	40	40	40	39	50	50	49	49
8	42	40	40	40	50	48	45	44
9	39	39	39	39	50	49	44	46
10	33	33	34	33	48	48	46	44
11	39	38	38	38	46	47	45	44
12	32	32	32	32	46	46	45	45
13	35	34	29	32	47	47	45	45
14	38	38	37	36	48	48	46	46
15	41	40	38	36	49	49	49	48
16	38	38	36	34	47	48	48	47
17	31	31	30	28	46	46	45	43
18	40	40	29	32	43	42	40	39
19	31	30	30	30	49	47	46	46
20	33	33	33	33	46	46	45	45
21	37	36	36	36	49	49	48	47
22	32	31	32	32	50	50	47	44
23	38	37	37	36	43	42	42	41
24	39	38	37	36	42	43	43	42
25	41	40	40	39	41	41	40	40
26	41	41	40	39	50	50	49	49
27	38	37	36	37	39	39	39	38
28	39	38	36	35	38	40	39	37
29	33	33	32	31	52	51	49	47
30	36	35	36	35	51	50	48	46
31	35	35	36	36	48	47	46	45
32	37	36	40	40	47	46	46	45
33	42	41	40	40	46	45	44	43
34	39	40	40	40	45	44	44	43
35	33	32	33	33	45	46	43	42
36	42	40	40	39	46	45	44	41

TABLE IV
 RAW SCORES OBTAINED BY GROUP D
 ON TESTS A AND B

Pupils	TEST A				TEST B			
	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks
1	48	48	45	45	43	43	42	42
2	40	40	40	40	49	48	47	48
3	47	46	44	43	50	49	50	48
4	48	47	45	42	51	51	50	50
5	48	47	46	40	52	51	50	49
6	50	49	48	47	50	50	50	49
7	47	46	46	46	50	49	49	48
8	50	47	46	45	50	50	50	42
9	47	47	46	46	48	48	46	45
10	45	45	44	45	46	46	45	44
11	42	41	40	40	46	46	45	43
12	40	40	39	39	47	47	46	44
13	42	41	41	41	48	48	47	46
14	48	46	47	46	49	49	49	49
15	44	43	43	44	42	41	41	41
16	46	45	45	45	43	43	42	42
17	46	46	45	46	49	47	46	43
18	48	48	48	47	46	46	45	43
19	43	43	43	42	49	47	46	44
20	50	50	49	47	50	49	49	49
21	44	44	43	44	52	51	50	46
22	41	40	40	40	50	50	50	45
23	46	45	44	44	51	49	48	44
24	47	46	45	44	50	48	47	46
25	48	48	47	45	51	46	47	45
26	46	46	46	44	50	50	43	42
27	49	47	47	46	46	45	43	42
28	47	46	46	45	42	41	40	40
29	50	49	47	47	44	43	41	41
30	43	42	40	41	43	44	43	42
31	46	45	40	40	39	40	40	39

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Tables V and VI below show the Mean Scores made by pupils on Test A and Test B during the four testing periods (immediate recall, and testing intervals of three, six and nine weeks) are presented as a summary of raw scores found in Tables I, II, III and IV. The mean scores in Table V were arrived at by taking the sum of all the scores of the experimental groups for the particular testing period (immediate recall, three, six or nine weeks) and dividing it by the number of pupils in the groups; and by taking the sum of all the scores of the control group for the particular testing period (immediate recall, three, six or nine weeks) and dividing it by the number of pupils in the group. The mean scores in Table VI were calculated in the same manner. The tables were constructed as follows: the groups are listed in the first column at the left. Under the headings of immediate recall, three weeks, six weeks and nine weeks are found the mean scores for the experimental groups and the control group.

TABLE V
MEAN SCORES MADE BY PUPILS ON TEST A

GROUPS	MEAN SCORES			
	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks
Experimental Groups	42.56	41.37	40.52	40.29
Control Group	36.81	36.14	35.42	34.97

TABLE VI

MEAN SCORES MADE BY PUPILS ON TEST B

GROUPS	MEAN SCORES			
	Immediate Recall	Three Weeks	Six Weeks	Nine Weeks
Experimental Groups	43.57	41.03	44.94	43.79
Control Group	35.64	35.33	34.06	32.64

The above tables show that in every period of testing the experimental groups scored uniformly higher than the control groups. On Test A the average range of difference between the experimental groups and the control group is 5.35 in mean scores in favor of the experimental groups. On Test B the average range of difference between the experimental groups and the control group is 8.92 in mean scores in favor of the experimental groups. This would seem to indicate that in each instance the gain is significant.

Analysis of variance¹ was the method used for the treatment of the

¹ E. F. Lindquist, Statistical Analysis in Educational Research, Houghton Mifflin Company, New York, N. Y., 1940, p. 91, presents the following as "the essentials of the logic involved in general in the methods of the analysis variance": "The basic proposition is that from any set of r groups of n cases each, we may on the hypothesis that all groups are random samples from the same population, derive two independent estimates of the population variance, one of which is based on the variance of group means, the other on the average variance within groups. The test of this hypothesis then consists of determining whether or not the ratio (F) between these estimates lies below the value in the table for F that corresponds to the selected level of significance."

data, because the investigation utilized heterogeneous groups. Further, the experimental and control groups were not exactly comparable. In each instance variance between methods was obtained by grouping all experimental groups as one method and the control group as the other method. The Tables VII through XIV were constructed in this manner: the source of variance was listed on the left, followed by the type of group (experimental or control), the degrees of freedom allowed, the sum of the squares, the variance and the F ratio. The data obtained from the analysis are presented in the following tables:

TABLE VII

IMMEDIATE RECALL TEST A

Source of Variance	Groups	Degrees of Freedom	Sum of Squares	Variance	F
Methods	Control	1	7817.12	7817.12	
Within Groups	Experimental	129	2547.11	19.75	
TOTALS		130	10364.23		395.80

TABLE VIII

THREE WEEKS TEST A

Source of Variance	Groups	Degrees of Freedom	Sum of Squares	Variance	F
Methods	Control	1	6848.68	6848.68	
Within Groups	Experimental	129	13985.76	108.42	
TOTALS		130	20834.44		63.17

TABLE IX

SIX WEEKS TEST A

Source of Variance	Groups	Degrees of Freedom	Sum of Squares	Variance	F
Methods	Control	1	9279.42	9279.42	
Within Groups	Experimental	129	19969.02	154.799	
TOTALS		130	29248.44		59.95

TABLE X

NINE WEEKS TEST A

Source of Variance	Groups	Degrees of Freedom	Sum of Squares	Variance	F
Methods	Control	1	6833.54	6833.54	
Within Groups	Experimental	129	22696.65	175.943	
TOTALS		130	29530.19		38.84

TABLE XI

IMMEDIATE RECALL TEST B

Source of Variance	Groups	Degrees of Freedom	Sum of Squares	Variance	F
Methods	Control	1	12240.48	12240.48	
Within Groups	Experimental	129	8661.46	67.143	
TOTALS		130	20901.94		182.32

TABLE XII

THREE WEEKS TEST B

Source of Variance	Groups	Degrees of Freedom	Sum of Squares	Variance	F
Methods	Control	1	8136.75	8136.75	
Within Groups	Experimental	129	17159.59	133.02	
TOTALS		130	25296.34		61.17

TABLE XIII

SIX WEEKS TEST B

Source of Variance	Groups	Degrees of Freedom	Sum of Squares	Variance	F
Methods	Control	1	17843.20	17843.20	
Within Groups	Experimental	129	1736.80	13.463	
TOTALS		130	19580.00		132.53

TABLE XIV

NINE WEEKS TEST B

Source of Variance	Groups	Degrees of Freedom	Sum of Squares	Variance	F
Methods	Control	1	17891.21	17891.21	
Within Groups	Experimental	129	13862.83	107.46	
TOTALS		130	31754.04		166.49

Table XV of F ratios for the various testing periods of Tests A and B is presented on the following page as a summary of F ratios obtained in Tables VII-XIV, inclusive. Table XV is constructed in this manner: the testing period is listed followed by the F ratio as calculated for that period of testing.

TABLE XV

SUMMARY OF F RATIOS OBTAINED IN TABLES VII-XIV

Testing Period	F Ratio
Immediate Recall Test A	395.80
Three Weeks Test A	63.17
Six Weeks Test A	59.95
Nine Weeks Test A	38.84
Immediate Recall Test B	182.32
Three Weeks Test B	61.17
Six Weeks Test B	132.53
Nine Weeks Test B	166.49

Tables VII through XIV, indicate that the F ratio is significant to one degree level of confidence according to G. W. Snedecor's table as reproduced in Lindquist's² book, Statistical Analysis in Educational Research. According to Snedecor's table an F ratio is significant for 125 degrees of freedom within groups if it is as large as 6.84, and for 150 degrees of freedom within groups if the F ratio is as large as 6.81. The degrees of freedom within groups used in this investigation was 129, a number between the degrees of freedom as listed in Snedecor's table. As summarized in Table XV all of the F ratios exceed 6.84. This significance was tentatively indicated in the summary of mean scores and it is borne out statistically by analysis of variance.

² Ibid. p. 65.

II. Conclusions

The following conclusions, based on findings, are made concerning the investigation:

(1) The amount of scientific knowledge retained was increased as demonstrated through the use of motion pictures. This increased retention was shown tentatively by the 5.35 average range of difference in mean scores made by the experimental and control groups on the first unit of study, and by the 8.92 average range of difference in mean scores between the groups on the second unit of study. These average ranges of difference in mean scores for both units favored the experimental groups over the control groups. This increased retention is indicated positively by the F ratios as calculated by analysis of variance. To be considered significant, the F ratios must be as large as 6.84 for 125 degrees of freedom within groups (See p. 25). The investigator was allowed 129 degrees of freedom within groups, so all the F ratios must exceed 6.84. All the F ratios (as summarized in Table XV) do exceed 6.84; therefore, the results are statistically significant.

In view of the above results the following recommendations are made concerning the problem of developing increased retention of knowledge:

(1) That the two units of study with motion pictures become a part of the regular Seventh Grade General Science Program at Chelyan Junior High School, Chelyan, West Virginia.

(2) That this study be accepted as a beginning in the study of retention of knowledge in Seventh Grade General Science at Chelyan Junior High School and as an indication for further work to be done.

(3) That further investigations in retention of knowledge be made

utilizing classes in two or more schools.

(4) That future investigators in retention of knowledge use homogeneous class groups in their investigations in order to determine the influence of motion pictures upon retention in such groups.

(5) That studies be made of problems closely related to the present one, such as: attitudes of pupils toward the use of motion pictures, attitudes of teachers toward the use of motion pictures; and types of motion pictures which prove most effective in inducing retention.

(6) That further studies be made to determine whether increased retention through the use of motion pictures is made at the expense of habits of good thinking.

(7) That additional research be undertaken to determine whether initial retention drops off when the educational motion picture ceases to be a novelty in the classroom.

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Action of the Human Heart, silent; type B & W; length, 5 min., No cost.

Body Defense Against Disease, sound; type B & W; length, 14 min., No cost.

Digestion, silent; type B & W; length, 16 min., No cost.

Mechanisms of Breathing, sound; type B & W; length, 10 min., No cost.

Miscles, silent; type B & W; length, 15 min., Free.

The Skin, sound; type B & W; length, 1 reel; No cost.

APPENDIX

APPENDIX A

Initial Tests A and B

Seventh Grade Science Test Test A

Name _____

Bones, Muscles, Teeth, Nerves and Skin of the Human Body

Directions: Read the statement carefully and underline the correct answer.

1. Energy from carbohydrate foods is used by the muscle cells to make 1-the body feel pain, 2-the body move, 3-the body temperature rise, 4-the body weak.
2. The word skeleton came from the early 1-Athenians, 2-Greeks, 3-Romans, 4-Norwegians.
3. The bones make up the framework of the 1-nerves, 2-heart, 3-muscles, 4-body.
4. The bones of our body were made from the 1-digestive system, 2-muscles, 3-nerves, 4-cartilage.
5. The food energy stored up for the muscles is called 1-glucose, 2-lactose, 3-glycogen, 4-pancreatic juice.
6. The parts of the body are moved by 1-the pancreas, 2-nerves, 3-neurons, 4-muscles.
7. The longest part of a nerve cell is the 1-dendrites, 2-nucleus, 3-axon, 4-epidermis.
8. Muscles that we can control are 1-voluntary, 2-regulator, 3-involuntary, 4-cardiac.
9. The skin serves as a 1-cartilage for the body, 2-muscle for the body, 3-protective coating for the body, 4-the largest cell in the body.
10. The largest aggregate of nerves in the body is the 1-aorta, 2-spinal cord, 3-neuron, 4-sacral nerve.
11. When a muscle makes itself shorter by tightening and drawing its ends together, we call it 1-expansion, 2-contraction, 3-circulation, 4-respiration.
12. Bones have in common their composition, power to increase in size and shape, 1-strength, 2-surface smoothness, 3-joint structure, 4-power to repair themselves.
13. The carpal bones are 1-in the chest, 2-in the ankle, 3-in the neck, 4-in the wrist.
14. The sternum is the 1-large bone of the leg, 2-knee-cap, 3-cranium, 4-breast bone.
15. The hip bone is the 1-sternum, 2-clavicle, 3-ulna, 4-femur.

16. Another name for the bones in the fingers is 1-phalanges, 2-tarsus, 3-patella, 4-radius.
17. The mineral matter in a bone makes up about 1-one-half of the bone's weight, 2-two-thirds of the bone's weight, 3-all of the bone's weight, 4-one-fourth of the bone's weight.
18. The mineral matter of the bones is principally 1-calcium phosphate and calcium carbonate, 2-fat and energy, 3-hydrochloric acid and common salt, 4-pepsin and iron sulfide.
19. Cartilage is a 1-gristle-like material, 2-rib, 3-mineral substance, 4-vitamin.
20. Movable joints give 1-the body a better digestive system, 2-the body free motion, 3-the body an extra supply of energy, 4-the body a faster growth rate.
21. Joints in the elbow, knee and finger are designed to 1-bend in one direction, 2-bend in two directions, 3-allow the body less movement, 4-not bend.
22. Joints in the wrist, ankle and backbone can move 1-in only one direction, 2-in two directions, 3-backward, forward and can twist in a circular motion, 4-forward, to the side, but not backward.
23. Bones which lack proper amounts of calcium are apt to break more easily than 1-well-nourished bones, 2-cartilage, 3-ligaments, 4-soft bones.
24. The humerus is the large bone of the 1-ankle, 2-wrist, 3-leg, 4-upper arm.
25. Another name for the shoulder blade is 1-clavicle, 2-tibia, 3-scapula, 4-cranium.
26. Nerve cells differ from the other cells in the body in that they are 1-smaller, 2-disc-shaped, 3-much larger and have several branches, 4-not branched.
27. A neuron is 1-a digestive organ, 2-the simple unit of the nervous system, 3-a section of muscle cell, 4-an impulse.
28. The spinal cord is enclosed in the 1-spinal column, 2-aorta, 3-lungs, 4-liver.
29. There are 1-four, 2-five, 3-thirty-one, 4-twenty-one, pairs of spinal nerves leading from the spinal column to all parts of the body.
30. 1-White, 2-black, 3-colorless, 4-yellow, nerve fibers make up the outside of the spinal cord which carry messages up and down.
31. The inside portion of the spinal cord consists of 1-white nerve cells, 2-yellow nerve cells, 3-gray nerve cells, 4-colorless nerve cells.

32. The upper end of the spinal cord, just inside the head, is enlarged and is called the 1-axon, 2-heart, 3-medulla oblongata, 4-cerebrum.
33. The two divisions of the brain are 1-cerebrum and cerebellum, 2-auricle and ventricle, 3-axon and neuron, 4-palate and esophagus.
34. The cerebrum is 1-larger, 2-smaller, 3-lighter in weight, 4-divided into fewer parts, than the cerebellum.
35. Every movement of a muscle, every response of the five senses is controlled by some action in the 1-digestive system, 2-circulatory system, 3-nervous system, 4-skeletal system.
36. The nerve which carries the light impulses from the eye to the brain is the 1-optic nerve, 2-olfactory nerve, 3-pelvic nerve, 4-auditory nerve.
37. The cerebellum is known to control 1-the beat of the heart, 2-digestion in the body, 3-the action of the pancreas, 4-the proper balance of the body.
38. Reflex action is controlled by 1-the medulla, 2-the auditory nerve, 3-the olfactory nerve, 4-the spinal cord.
39. The short branches of a nerve cell are 1-the dendrites, 2-the arteries, 3-the carpals, 4-the rays.
40. The cerebrum makes up about 1-20%, 2-30%, 3-50%, 4-80% of the weight of the brain.
41. The brain is located in the 1-pectoral cavity, 2-thoracic cavity, 3-pelvic cavity, 4-cranial cavity.
42. The nerve which carries impulses of sound from the ear to the brain is called 1-sciatic nerve, 2-auditory nerve, 3-optic nerve, 4-pelvic nerve.
43. The central nervous system is made up of the 1-the brain and spinal cord, 2-the optic nerve with its fibers, 3-the olfactory nerve and dendrites, 4-all the neurons with stimuli.
44. The function of the neuron is 1-to receive nerve impulses and carry them to other cells, 2-just to allow the body organs to feel pain, 3-to stimulate the muscles of the eye, 4-to decrease the size of the cranial cavity.
45. The bodies of nerve cells 1-never change, 2-vary greatly, 3-always get larger, 4-never decrease in size.
46. Nerve cells are called 1-neurons, 2-motor cells, 3-arteries, 4-veins.
47. A collection of nerve cells outside the central nervous system is called 1-a ganglion, 2-a vein, 3-an unused group of tissues, 4-a single nerve fiber.

48. A nerve fiber consists of 1-a nerve fiber bundle, 2-an axis cylinder with its coverings, 3-a small axon and vein, 4-tiny disc-like cells.
49. Two causes of fatigue of nerve cells are 1-too much mental and muscular work, 2-nerve cells are small and all shaped alike, 3-too many ganglia and nerve centers, 4-no serious thinking.
50. The parts of the nervous system may be classified 1-in two ways, 2-in three ways, 3-in one way, 4-in many ways.
51. Muscles not only move the bones of the skeleton but also 1-hold them in position, 2-causes them to increase in size, 3-causes them to decrease in size, 4-allows them less movement.
52. The biceps muscle is located in 1-the leg, 2-the arm, 3-the chest, 4-the head.
53. The chief muscle of the head may be divided into 1-three muscles, 2-four muscles, 3-six muscles, 4-two muscles.
54. Muscles may be classified into 1-two groups, 2-three groups, 3-four groups, 4-five groups.
55. The function of the body muscles is 1-to operate the bones of the body, producing motion, 2-to increase flow of oxygen to lungs, 3-to slow down respiration, 4-to increase power of optic nerve.
56. The voluntary muscles have 1-stripes, 2-no enclosing membrane, 3-no fibers, 4-an appearance like the involuntary muscles.
57. Unstriated muscles are 1-disc-shaped cell structures, 2-rough muscles of spindle-shaped cells, 3-smooth muscles, 4-voluntary muscles.
58. The muscles are stimulated by the 1-ears, 2-nerve, 3-arteries, 4-digestive organs.
59. Muscles which are used regularly become 1-weak and limp, 2-firm and strong, 3-fixed, 4-ill-shaped.
60. The triceps muscle is found in the 1-leg, 2-hip, 3-head, 4-arm.
61. The largest tendon of the body is the 1-tendon of Artemis, 2-tendon of Aristotle, 3-tendon of Aristarchus, 4-tendon of Achilles.
62. A person will recover from his tired feeling when the lactic acid in his muscles is changed back into 1-glycogen, 2-water, 3-hydrogen, 4-carbon dioxide.
63. As a muscle becomes tired from too much work we have formed in it 1-oxygen, 2-carbon monoxide, 3-water, 4-lactic acid.
64. When a muscle becomes flabby we say it has lost its 1-size, 2-strength, 3-weight, 4-tone.

65. The stored up food energy for the muscles is called 1-plasma, 2-water, 3-oxygen, 4-glycogen.
66. A muscle cell is 1-like, 2-quite different from, 3-disc-shaped like, 4-not a necessity like, a nerve cell.
67. Muscles which we do not have control over are 1-common, 2-unusual, 3-involuntary, 4-arm muscles.
68. The gas which a muscle gives off while in action is called 1-chlorine, 2-carbon monoxide, 3-carbon dioxide, 4-helium.
69. Muscle tissue makes up 1-30-35%, 2-40-50%, 3-60-70%, 4-80-90% of the human body weight.
70. Cardiac muscle tissue forms the 1-heart, 2-liver, 3-lungs, 4-stomach walls.
71. The orbit for the eyeball contains 1-five muscles, 2-eight muscles, 3-six muscles, 4-seven muscles.
72. The eyeball is held in place by 1-two muscles, 2-four muscles, 3-five muscles, 4-six muscles.
73. Our chewing muscle is the 1-biceps, 2-triceps, 3-masseter, 4-esophagus.
74. In the human body, the muscle fibers lie closely packed forming 1-primary bundles, 2-spiral colonies, 3-spindle-shaped clumps, 4-cylindrical nerve groups.
75. The white cord that extends beyond the muscle fibers is 1-a vein, 2-a tendon, 3-an artery, 4-a ligament.
76. As in bones, calcium forms an important part of the mineral substance of 1-the eye, 2-teeth, 3-ears, 4-muscles.
77. Teeth are the hardest parts of the 1-neck, 2-chest, 3-arms, 4-body.
78. The very sensitive inner portion of a tooth is the 1-enamel, 2-pulp cavity, 3-crown, 4-dentine.
79. The bonelike shield, in a tooth, which surrounds the pulp cavity is called 1-crown, 2-neck, 3-dentine, 4-enamel.
80. The hard substance that covers the dentine on the chewing surface of a tooth is called 1-the nerve, 2-the enamel, 3-the pulp cavity, 4-the neck.
81. The thin layer of bone that covers the outer surface of the dentine where it is not covered by enamel is the 1-crown, 2-neck, 3-root, 4-cement.
82. The enamel, dentine, and cement are made of mineral salts, which consists mostly of 1-hydrochloric acid, 2-pepsin, 3-common table salt, 4-calcium phosphate.

83. The pulp cavity is filled with pulp, made up mostly of 1-enamel, cement and nerves, 2-connective tissue, blood cells and nerve cells, 3-pepsin, vitamins and cement, 4-water, salt and cement.
84. The elastic, hard dentine of a tooth is attached to the enamel by many threads of 1-capillaries, 2-cement, 3-connective tissue, 4-bone.
85. During his lifetime everyone has 1-one set, 2-three sets, 3-two sets, 4-four sets, of teeth.
86. Teeth do not change their 1-size, 2-color, 3-condition, 4-appearance, like other parts of our growing bodies do.
87. In the temporary or first set of teeth there are 1-ten teeth in each jaw, 2-fifteen teeth in each jaw, 3-five teeth in each jaw, 4-eight teeth in each jaw.
88. The normal loss of the temporary teeth begins when a child is about 1-five years old, 2-six years old, 3-seven years old, 4-eight years old.
89. The normal loss of temporary teeth is 1-extremely slow, 2-rapid, 3-gradual, 4-very fast.
90. As the permanent teeth form temporary teeth are gradually 1-pulled out, 2-set aside, 3-moved over, 4-pushed out.
91. In the normal permanent set of teeth there are 1-eight teeth in each jaw, 2-sixteen teeth in each jaw, 3-ten teeth in each jaw, 4-nine teeth in each jaw.
92. The last four of the permanent teeth to enter the mouth sometimes do not appear until a person is 1-ten years old, 2-twelve years old, 3-fifteen years old, 4-twenty-five years old.
93. The six year molars are really 1-permanent teeth, 2-temporary teeth, 3-not teeth, 4-undeveloped teeth.
94. Our bodies have over 1-500, 2-300, 3-650, 4-700, muscles and each of them has some special work to do.
95. The substance which fills the cavities inside the bones is 1-the nerves, 2-marrow, 3-the brain, 4-the lymph.
96. The two groups of muscles that we have, named according to the kind of work they do, are 1-artery and vein, 2-skeletal and visceral, 3-brain and throat, 4-neck and wrist.
97. A pair of names for the muscles which represents differences in marking is 1-striated and unstriated, 2-similar and different, 3-colored and colorless, 4-white and black.
98. The supply lines for the circulatory system are 1-arteries, vertebrae, femur, 2-arteries, veins, capillaries, 3-bones, muscles, nerves, 4-atria, ventricle, nerves.

99. Your heart pumps about 1-50 times a minute, 2-30 times a minute, 3-12 times a minute, 4-72 times a minute.
100. The big brain is the 1-cerebellum, 2-cerebrum, 3-liver, 4-lungs.
101. The little brain is the 1-nerves, 2-muscles, 3-cerebellum, 4-heart.
102. The great aggregate of nerves is the 1-sciatic nerve, 2-sacral nerve, 3-nerve of the eye, 4-spinal cord.
103. The place where bones come together in the body is a 1-cap, 2-nail, 3-skin, 4-joint.
104. Voluntary muscles are controlled by our 1-hopes, 2-wills, 3-fears, 4-habits.
105. An example of the work of involuntary muscles is 1-blinking the eye, 2-throwing a ball, 3-shoveling snow, 4-walking.
106. Corpuscles that can leave the blood vessels are the 1-red cells, 2-dead cells, 3-white cells, 4-nerves.
107. The skin is the organ of sensations like 1-pain, 2-hunger, 3-taste, 4-sound.
108. Of the following sensations, the skin is quickest to feel 1-pain, 2-pressure, 3-heat, 4-cold.
109. The nerves of touch end in the 1-epidermis, 2-dermis, 3-oil glands, 4-pores.
110. Our bones could not help us do work if they did not have 1-dentine, 2-crowns, 3-joints, 4-enamel.
111. Most bones in the body form simple machines called 1-screws, 2-pulleys, 3-wedges, 4-levers.
112. The principal mineral in teeth is 1-iron, 2-cement, 3-calcium, 4-magnesium.
113. The part of the tooth useful in chewing is 1-dentine, 2-enamel, 3-root, 4-crown.
114. The part of the tooth which has little living matter is 1-pulp, 2-enamel, 3-dentine, 4-cement.
115. The purpose of the bones in the skull is to give the brain 1-protection, 2-support, 3-shape, 4-weight.
116. The lower passages of the nose are 1-smooth, 2-dry, 3-scaly, 4-hairy.
117. Our nerves are 1-not important to the body, 2-not necessary in the body, 3-useless in the body, 4-very important to the body.

118. The bones of the face make up the group of 1-facial bones, 2-cranial bones, 3-pelvic bones, 4-leg bones.

119. The "wisdom" teeth are really 1-incisors, 2-canines, 3-premolars, 4-molars.

120. The spinal cord is 1-not used in the body, 2-an aggregate of nerves, 3-a voluntary muscle, 4-heart muscle.

Seventh Grade Science Test Test B

Name _____

Respiration, Excretion, Circulation, Digestion and Growth in the Human Body.**Directions:** Read each statement carefully and underline the correct answer.

1. An outstanding life function which animals have that plants cannot carry out is 1-digestion, 2-respiration, 3-growth, 4-movement.
2. The pancreas manufactures 1-blood, 2-bile, 3-protoplasm, 4-pancreatic juice.
3. When dissolved food soaks through the lining of the digestive system, it passes into 1-tiny digestive glands, 2-the arms, 3-the blood, 4-the respiratory system.
4. In the lining of the stomach are tiny glands that manufacture digestive 1-foods, 2-parts, 3-juices, 4-cells.
5. Most of the digestion takes place in the 1-pancreas, 2-esophagus, 3-liver, 4-small intestine.
6. In digestion the food you eat is made into 1-fat, 2-protein, 2-a solution, 4-a hard, solid substance.
7. The lungs are a part of the 1-digestive system, 2-nervous system, 3-skeletal system, 4-respiratory system.
8. The development of the bones and organs of the body is 1-digestion, 2-circulation, 3-growth, 4-excretion.
9. The body gets oxygen in the process of 1-respiration, 2-excretion, 3-digestion, 4-mastication.
10. Complete use of the lungs helps 1-to build strong bones, 2-to ward off disease, 3-to enlarge the liver, 4-bones to develop very rapidly.
11. Good exercise stimulates 1-deep breathing, 2-the growth of the brain, 3-only the largest nerve in the body, 4-the circulatory system, alone.
12. One may become hollow chested by 1-eating too many solid foods, 2-not exercising the chest muscles sufficiently in breathing, 3-taking some real deep breaths each day, 4-drinking too much water.
13. By regular practice of deep, strong uniform breathing, one may 1-obtain a sufficient supply of oxygen, 2-make the bones develop rapidly, 3-cause the heart to beat slower, 4-cause the chest cavity to get smaller.
14. By careful attention to and practice of breathing and exercise 1-serious lung disease may possibly be prevented, 2-the chest measurement may be decreased several inches, 3-colds will come often, 4-respiratory organs will decrease in size.

15. Breathing is the method 1-by which solid waste material is eliminated from the body, 2-by which blood circulates through the body, 3-by which the body repairs injured cells, 4-by which oxygen is brought into the lungs to the blood and waste carbon dioxide gas is given off.
16. Every boy and girl should know by actual practice how to produce artificial respiration, for it 1-may be the means of saving a life, 2-may speed up our breathing, 3-may cause someone to breathe slower, 4-may develop our nerve cells.
17. The passages of the nose are lined with small hairs so that 1-most dust is prevented from passing along with the air to the lungs, 2-we may learn to breath through the mouth, 3-we may know how the blood is purified, 4-we will form the habit of breathing through the nose.
18. The winding passages of the nose 1-prevent mouth breathing, 2-lower the body temperature, 3-warms the air nearly to body temperature before it reaches the lungs, 4-stimulate body impulses.
19. Mouth breathing does not allow enough time 1-for the brain to get a good control over the body muscles, 2-for good nerve control, 3-for the air to be warmed before it reaches the lungs, 4-for digestion in the body.
20. When a large amount of dry air is taken into the lungs, 1-the delicate tissues wither, 2-digestion slows down, 3-new cells are made more rapidly, 4-circulation stops within the body.
21. Severe cases of adenoids cause 1-deep breathing, 2-short, quick breathing, 3-mouth-breathing, 4-proper breathing.
22. Adenoids are obstructing growths found at the end of the 1-lungs, 2-liver, 3-brain, 4-nasal passages.
23. Adenoids may affect hearing as well as 1-circulation, 2-digestion, 3-breathing, 4-sight.
24. Diseases connected with the organs of breathing are called 1-circulatory diseases, 2-growth diseases, 3-digestive diseases, 4-respiratory diseases.
25. Mucus is a somewhat sticky fluid which coats the walls of the 1-nerve cells, 2-muscle tissues, 3-air passages, 4-heart.
26. The heart is 1-a single pump, 2-a single force pump, 3-a double, self-acting pump, 4-a double pump with a single chamber.
27. The heart consists of 1-two chambers, 2-a single chamber, 3-three chambers, 4-four chambers.
28. The capillaries supply every part of the body with 1-air, 2-lubricating hormones, 3-food and oxygen-laden blood, 4-fresh water.

29. The blood is carried from the heart to different parts of the body by 1-veins, 2-intestines, 3-arteries, 4-nerves.

30. After the blood has given up its useful materials and taken on waste materials, it returns to the heart by capillaries, leading into 1-the stomach, 2-the liver, 3-the brain, 4-veins.

31. The color of the blood is due to the 1-white corpuscles, 2-the plasma, 3-veins, 4-red corpuscles.

32. The liquid of the blood is colorless and contains about 1-70%, 2-60%, 3-50%, 4-80% of water.

33. The colorless liquid in the blood is called 1-pancreatic juice, 2-insulin, 3-plasma, 4-nerve fluid.

34. The red corpuscles in the blood are shaped like 1-circular discs, 2-spindles, 3-spiral loops, 4-cylinders.

35. The red substance in the red corpuscles of the blood is called 1-haemoglobin, 2-carbon dioxide, 3-lymph, 4-plasma.

36. The colorless fluid that surrounds and bathes the cells in the body is 1-hydrochloric acid, 2-pepsin, 3-lymph, 4-water.

37. There is a right and left atrium in the heart and a right and left 1-ventricle, 2-artery, 3-nerve, 4-tributary.

38. Alcohol has a depressing or paralyzing action on the heart 1-blood-vessel muscles, 2-hands, 3-feet, 4-ears.

39. The arteries are in the 1-digestive system, 2-respiratory system, 3-reproductive system, 4-circulatory system.

40. A single drop of blood contains 1-several million, 2-an hundred, 3-four thousand, 4-a million, red corpuscles.

41. White corpuscles 1-are all oval in shape, 2-are all spindle-shaped, 3-are all small, flat discs, 4-change their shape constantly.

42. White corpuscles vary in size and they can destroy 1-the red corpuscles, 2-the nervous system, 3-certain foreign materials, in the blood, including some germs, 4-their cell walls.

43. White corpuscles are living cells but they have no 1-shape, 2-nuclei, 3-cell walls, 4-means for destroying foreign materials in the blood.

44. The Vena Cava is in the 1-digestive system, 2-skeletal system, 3-nervous system, 4-circulatory system.

45. The continued flow of blood from the heart to the tissues of the body as pure blood and the return of the blood to the heart carrying waste products to be expelled from the body is called 1-digestion, 2-muscular action, 3-circulation, 4-a nervous reaction.
46. In appearance the white blood cell looks like a single animal called 1-an amoeba, 2-a bacterium, 3-a fish, 4-a crab.
47. The volume of blood in the average person is about 1-two quarts, 2-four quarts, 3-six pints, 4-six quarts.
48. A vessel which carries pure, clean blood away from the heart is 1-a vein, 2-a lymph duct, 3-an artery, 4-a nerve.
49. The walls of the arteries are 1-thinner than veins, 2-thicker than veins, 3-filled with more fat substances, 4-the same size as veins.
50. The discharge of blood rapidly from a ruptured blood vessel is known as 1-hemoglobin, 2-a vaccination, 3-hemorrhage, 4-an infusion.
51. The digestive organs of man would compare closely to that of a 1-fish, 2-snake, 3-butterfly, 4-rabbit.
52. The saliva contains an enzyme known as 1-carbon dioxide, 2-pepsin, 3-oxygen, 4-ptyalin.
53. The three most important elements in the human body are 1-oxygen, hydrogen, calcium, 2-carbon, iron, nickel, 3-carbon, hydrogen, oxygen, 4-gold, silver, copper.
54. Our digestive organs are divided into 1-two groups, 2-six groups, 3-three groups, 4-five groups.
55. The type of food that saliva acts upon is 1-sugars, 2-fats, 3-starches, 4-proteins.
56. The complete food canal in the body is called the 1-alimentary canal, 2-pelvic canal, 3-digestive canal, 4-respiratory canal.
57. The tube which carries food and is found leading from the back part of the throat to the stomach is called 1-the esophagus, 2-left atrium, 3-hydrogen tube, 4-circulation tube.
58. The back part of the throat is called the 1-esophagus, 2-lungs, 3-palate, 4-pharynx.
59. The pharynx is shaped like a funnel and contains 1-one opening, 2-two openings, 3-three openings, 4-four openings.

60. The stomach of an average person will hold about 1-one pint, 2-two pints, 3-three pints, 4-four pints.
61. The first ten inches of the small intestine is the 1-appendix, 2-largest vein in the body, 3-ileum, 4-duodenum.
62. The name of digestive juice that is secreted in the mouth is 1-pepsin, 2-bile, 3-saliva, 4-hydrochloric acid.
63. The digestive juice found in the stomach acts on the 1-minerals, 2-vitamins, 3-sugars, 4-proteins.
64. The small intestine is in the 1-respiratory, 2-digestive, 3-circulatory, 4-excretory system.
65. The small intestine of an average person is about 1-five feet long, 2-twenty feet long, 3-seven feet long, 4-twenty-four feet long.
66. The acid found in the digestive juice of the stomach is 1-sulfuric, 2-hydrochloric, 3-lactic, 4-acetic.
67. The digestive juice, bile, is manufactured in the 1-lungs, 2-stomach, 3-heart, 4-liver.
68. The hair-like fingers which absorb liquid food in the small intestine are known as 1-nerve endings, 2-arteries, 3-villi, 4-tubes.
69. The pancreas makes a digestive juice which will act 1-just on fats, 2-just on starches, 3-on starches, proteins and fats, 4-just on proteins.
70. In length the large intestine will measure about 1-five feet, 2-six feet, 3-seven feet, 4-eight feet.
71. The largest gland in the body is the 1-heart, 2-spleen, 3-pancreas, 4-liver.
72. The process by which the liquid foods pass through the walls of the intestines is 1-osmosis, 2-contraction, 3-photosynthesis, 4-expansion.
73. The type of food that furnishes most of the energy for the body is the 1-water, 2-carbohydrates, 3-proteins, 4-minerals.
74. The digestive juice from the pancreas enters the digestive tract at 1-the stomach, 2-the large intestine, 3-the small intestine, 4-the esophagus.
75. The stomach is an organ in the 1-respiratory system, 2-circulatory system, 3-nervous system, 4-digestive system.
76. One of the most important processes taking place in the life of a child is 1-physical growth, 2-joint contraction, 3-regulating of tendon expansion, 4-increase in the amount of food to be taken into the body each day.

77. The right amount of calcium in the body is very important for 1-respiration, 2-nervous reactions, 3-normal bone growth or development, 4-normal circulation.
78. Growing children should have plenty of milk to drink because 1-it contains special salt compounds that the body needs, 2-it contains calcium which is necessary in normal bone development, 3-it contains large amounts of pure oxygen, 4-it contains solid substances which the body uses in nerve control.
79. Good muscle development depends upon 1-the right amounts and kinds of food, exercise and rest, 2-plenty of muscle strain, 3-lack of rest, 4-lack of proper food.
80. When you grow 1-the cells of the body get larger and new cells are made, 2-excretions from the body decrease, 3-the whole circulatory system is thrown out of order, 4-the nerves of the body are not working.
81. The new materials that the cells of the body need must come from 1-the air, 2-the food we eat, 3-the digestive juice in the mouth, 4-the nervous system.
82. In the cells, such foods as meat, milk, potatoes, etc., are made into 1-oxygen, 2-hydrogen, 3-carbon, 4-bone, muscle hair and other parts of the body.
83. Worn out parts of the body are repaired by a process of 1-growing new cells from materials taken into the body in food, 2-excretions, 3-respiration, 4-nervous strain.
84. A broken bone will grow back together 1-when the cells of the body build new protoplasm and cells to fasten the ends together, 2-when the right amount of water is taken into the body, 3-when the body is clean, 4-when harmful bacteria are allowed to develop at the place of the broken bone.
85. In addition to the different classes of food that our body uses, we also need proper amounts of 1-nitric acid and pure sulfur, 2-sulfuric acid and gold, 3-minerals and vitamins, 4-silver and natural gas.
86. If our bodies are to grow properly 1-every within our body must do its work well, 2-the muscles must cease their movement, 3-the veins will have to carry the blood from the heart, 4-the respiratory system will have to decrease its activity.
87. Calcium and phosphorus compounds are needed for bone and teeth 1-growth and repair, 2-decay, 3-mis-shaping, 4-muscles.
88. Normal elimination of waste products is necessary to a 1-health, growing body, 2-case of lazy digestion, 3-decrease in body circulation, 4-decrease in the action of the respiratory system.
89. Proper food, plenty of water, exercise and rest promote 1-proper exercise, 2-proper elimination, 3-promote use of all necessary health rules, 4-bad health habits.

90. The skin serves as an organ of 1-the nervous system, 2-the circulatory system, 3-excretion, 4-the glandular system.
91. In the human body there are 1-four, 2-five, 3-six, 4-two kidneys.
92. The kidneys are 1-bean-shaped, 2-heart-shaped, 3-needle-shaped, 4-oval in shape.
93. Two waste products of the body are 1-carbon dioxide and water, 2-vitamins and new mineral substances, 3-teeth and bones, 4-nerves and arteries.
94. Digestion means 1-to increase blood pressure, 2-to speed up the beat of the heart, 3-to make soluble, 4-to manufacture solid materials.
95. To exhale is to 1-breathe out, 2-move the arms, 3-breathe in, 4-push the air from the lungs.
96. The nasal passages are 1-water ducts in the body, 2-veins, 3-arteries, 4-air passages reaching from the nostrils to the throat.
97. The nostrils are openings ¹in the liver, 2-in the kidneys, 3-in the heart, 4-in the nose through which air passes.
98. Each living cell in our bodies has a central portion called the 1-nucleus, 2-nervous system, 3-cell wall, 4-connective tissue.
99. Carbon dioxide is not needed in the body except in 1-grains, 2-solid form, 3-small amounts, 4-the lungs.
100. When the oxidation of food takes place in the cells, the products obtained are 1-vitamins and pepsin, 2-carbon dioxide and water, 3-carbon monoxide and pepsin, 4-iron sulfide and chlorine.
101. The carbon dioxide made in the body by the oxidation of food in the cells is got rid of by 1-the stomach, 2-the lungs, 3-the pancreas, 4-the heart.
102. Perspiration on the surface of the skin is more than water seeping out through the pores; it contains 1-blood, 2-salts of various kinds, 3-nerve tissue, 4-hydrochloric acid.
103. The energy producing foods are 1-vitamins, sulfur and chlorine, 2-starches, sugars and fats, 3-nicotine, coffee and tea, 4-sulfuric acid, tea and pepsin.
104. Oxidation of food material takes place in each body cell and produces 1-pepsin, 2-veins, 3-arteries, 4-heat.
105. Proteins are 1-tissue-building foods, 2-energy producing foods, 3-foods that never should be eaten, 4-foods that the body needs in excess.
106. In the body the right kidney is a little 1-heavier, 2-lower, 3-lighter, 4-higher, than the left kidney.

107. Each kidney is covered by rather tough, fibrous 1-tissue, 2-bone, 3-layer of iron, 4-layer of copper.
108. The kidneys are supplied with blood by the 1-renal vein, 2-renal artery, 3-renal capillary, 4-aorta.
109. The circulation of blood in the kidney is controlled by 1-the stomach, 2-the nerves, 3-the liver, 4-the esophagus.
110. The pancreas is in the 1-cranial cavity, 2-abdominal cavity, 3-the upper arm, 4-the pelvic region.
111. The flow of blood through the skin tends to raise 1-skin absorption, 2-skin temperature, 3-the weight of the skin, 4-the thickness of the skin.
112. The blood that carries dissolved materials from one part of the body of another is 1-20%, 2-60%, 3-40%, 4-81%, water.
113. Water helps to keep the body 1-cool, 2-hot, 3-warm, 4-balanced by evaporation when it is poured on the skin by the sweat glands.
114. Protoplasm is made almost entirely of 1-fats and gases, 2-protein and water, 3-energy and gas, 4-sugars and acids.
115. Most people get all the mineral elements necessary in their food except 1-calcium, phosphorus, iron and iodine, 2-chlorine, copper, gold and silver, 3-sulfur, gold, lead and aluminum, 4-oxygen, chromium, lead and zinc.
116. An artery is 1-larger than, 2-smaller than, 3-the same size as, 4-the same as, a capillary.
117. The average heart rate of a man at rest is 1-70-72 beats per minute, 2-80-85 beats per minute, 3-95-100 beats per minute, 4-65-75 beats per minute.
118. Muscular exercise 1-increases, 2-decreases, 3-stops, 4-slows down, the heart rate.
119. Starch is a kind of food made by 1-animals, 2-plants, 3-vitamins, 4-the lung.
120. To inhale is to 1-breathe out, 2-move the arms, 3-breathe in, 4-push the air from the lungs.

APPENDIX B

Final Tests A and B

Seventh Grade Science Test Test A Name _____

Bones, Muscles, Teeth, Nerves and Skin of the Human Body

Directions: Read the statement carefully and underline the correct answer.

1. Energy from carbohydrate foods is used by the muscle cells to make 1-the body feel pain, 2-the body move, 3-the body temperature rise, 4-the body weak.
2. The bones make up the framework of the 1-nerves, 2-heart, 3-muscles, 4-body.
3. The parts of the body are moved by 1-the pancreas, 2-nerves, 3-neurons, 4-muscles.
4. The skin serves as a 1-cartilage for the body, 2-muscle for the body, 3-protective coating for the body, 4-the largest cell in the body.
5. The largest aggregate of nerves in the body is the 1-aorta, 2-spinal cord, 3-neuron, 4-sacral nerve.
6. When a muscle makes itself shorter by tightening and drawing its ends together, we call it 1-expansion, 2-contraction, 3-circulation, 4-respiration.
7. The sternum is the 1-large bone of the leg, 2-knee-cap, 3-cranium, 4-breast-bone.
8. The mineral matter of the bones is principally 1-calcium phosphate and calcium carbonate, 2-fat and energy, 3-hydrochloric acid and common salt, 4-pepsin and iron sulfide.
9. Cartilage is a 1-gristle-like material, 2-rib, 3-mineral substance, 4-vitamin.
10. Movable joints give 1-the body a better digestive system, 2-the body free motion, 3-the body an extra supply of energy, 4-the body a faster growth rate.
11. Joints in the elbow, knee and finger are designed to 1-bend in one direction, 2-bend in two directions, 3-allow the body less movement, 4-not bend.
12. Joints in the wrist, ankle and backbone can move 1-in only one direction, 2-in two directions, 3-backward, forward, and can twist in a circular motion, 4-forward, to the side, but not backward.
13. Bones which lack proper amounts of calcium are apt to break more easily than 1-well-nourished bones, 2-cartilage, 3-ligaments, 4-soft bones.
14. The humerus is the large bone of the 1-ankle, 2-wrist, 3-leg, 4-upper arm.
15. A neuron is 1-a digestive organ, 2-the simple unit of the nervous system, 3-a section of muscle cell, 4-an impulse.

16. The spinal cord is enclosed in the 1-spinal column, 2-aorta, 3-lungs, 4-liver.
17. The upper end of the spinal cord, just inside the head is enlarged and is called the 1-axon, 2-heart, 3-medulla oblongata, 4-cerebrum.
18. Two divisions of the brain are 1-cerebrum and cerebellum, 2-auricle and ventricle, 3-axon and neuron, 4-palate and esophagus.
19. The brain is located in the 1-pectoral cavity, 2-thoracic cavity, 3-pelvic cavity, 4-cranial cavity.
20. The nerve which carries impulses of sound from the ear to the brain is called 1-sciatic nerve, 2-auditory nerve, 3-optic nerve, 4-pelvic nerve.
21. Nerve cells are called 1-neurons, 2-motor cells, 3-arteries, 4-veins.
22. Two causes of fatigue of nerve cells are 1-too much mental and muscular work, 2-nerve cells are small and all shaped alike, 3-too many ganglia and nerve centers, 4-no serious thinking.
23. The parts of the nervous system may be classified 1-in two ways, 2-in three ways, 3-in one way, 4-in many ways.
24. Muscles not only move the bones of the skeleton but also 1-hold them in position, 2-causes them to increase in size, 3-causes them to decrease in size, 4-allows them less movement.
25. The chief muscle of the head may be divided into 1-three muscles, 2-four muscles, 3-six muscles, 4-two muscles.
26. Muscles which are used regularly become 1-weak and limp, 2-firm and strong, 3-fixed, 4-ill-shaped.
27. The largest tendon of the body is the 1-tendon of Artemis, 2-tendon of Aristotle, 3-tendon of Aristarchus, 4-tendon of Achilles.
28. Cardiac muscle tissue forms the 1-heart, 2-liver, 3-lungs, 4-stomach walls.
29. As in bones, calcium forms an important part of the mineral substance of 1-eye, 2-teeth, 3-ears, 4-muscles.
30. Teeth are the hardest parts of the 1-neck, 2-chest, 3-arms, 4-body.
31. The hard substance that covers the dentine on the chewing surface of a tooth is called 1-the nerve, 2-the enamel, 3-the pulp cavity, 4-the neck.
32. The elastic, hard dentine of a tooth is attached to the enamel by many threads of 1-capillaries, 2-cement, 3-connective tissue, 4-bone.

33. During his lifetime everyone has 1-one set, 2-three sets, 3-two sets, 4-four sets, of teeth.
34. As the permanent teeth form temporary teeth are gradually 1-pulled out, 2-set aside, 3-moved over, 4-pushed out.
35. The six year molars are really 1-permanent teeth, 2-temporary teeth, 3-not teeth, 4-undeveloped teeth.
36. Your heart pumps about 1-50 times a minute, 2-30 times a minute, 3-12 times a minute, 4-72 times a minute.
37. The big brain is the 1-cerebellum, 2-cerebrum, 3-liver, 4-lungs.
38. The little brain is the 1-nerves, 2-muscles, 3-cerebellum, 4-heart.
39. The place where bones come together in the body is a 1-cap, 2-nail, 3-skin, 4-joint.
40. The skin is the organ of sensation like 1-pain, 2-hunger, 3-taste, 4-sound.
41. Of the following sensations, the skin is quickest to feel 1-pain, 2-pressure, 3-heat, 4-cold.
42. Our bones could not help us do work if they did not have 1-dentine, 2-crowns, 3-joints, 4-enamel.
43. Most bones in the body form simple machines called 1-screws, 2-pulleys, 3-wedges, 4-levers.
44. The principal mineral in teeth is 1-iron, 2-cement, 3-calcium, 4-magnesium.
45. The purpose of the bones in the skull is to give the brain 1-protection, 2-support, 3-shape, 4-weight.
46. The lower passages of the nose are 1-smooth, 2-dry, 3-scaly, 4-hairy.
47. Our nerves are 1-not important to the body, 2-not necessary in the body, 3-useless in the body, 4-very important to the body.
48. The bones of the face make up the group of 1-facial bones, 2-cranial bones, 3-pelvic bones, 4-leg bones.
49. The wisdom teeth are really 1-incisors, 2-canines, 3-premolars, 4-molars.
50. The spinal cord is 1-not used in the body, 2-an aggregate of nerves, 3-a voluntary muscle, 4-heart muscle.

Seventh Grade Science Test Test B

Name _____

Respiration, Excretion, Circulation, Digestion and Growth in the Human Body

Directions: Read each statement carefully and underline the correct answer.

1. The development of the bones and organs of the body is 1-digestion, 2-circulation, 3-growth, 4-excretion.
2. The body gets oxygen in the process of 1-respiration, 2-excretion, 3-digestion, 4-mastication.
3. One may become hollow chested by 1-eating too many solid foods, 2-not exercising the chest muscles sufficiently in breathing, 3-taking some real deep breaths each day, 4-drinking too much water.
4. By regular practice of deep, strong, uniform breathing, one may 1-obtain a sufficient supply of oxygen, 2-make the bones develop rapidly, 3-cause the heart to beat slower, 4-cause the chest cavity to get smaller.
5. By careful attention to and practice of breathing and exercise 1-serious lung disease may possibly be prevented, 2-the chest measurement may be decreased several inches, 3-colds will come often, 4-respiratory organs will decrease in size.
6. Breathing is the method 1-by which solid waste material is eliminated from the body, 2-by which blood circulates through the body, 3-by which the body repairs injured cells, 4-by which oxygen is brought into the lungs to the blood and waste carbon dioxide gas is given off.
7. Every boy and girl should know by actual practice how to produce artificial respiration, for it 1-may be the means of saving a life, 2-may speed up our breathing, 3-may cause someone to breathe slower, 4-may develop our nerve cells.
8. The passages of the nose are lined with small hairs so that 1-most dust is prevented from passing along with the air to the lungs, 2-we may learn to breathe through the mouth, 3-we may know how the blood is purified, 4-we will form the habit of breathing through the nose.
9. Mouth breathing does not allow enough time 1-for the brain to get a good control over the body muscles, 2-for good nerve control, 3-for the air to be warmed before it reaches the lungs, 4-for digestion in the body.
10. Severe cases of adenoids cause 1-deep breathing, 2-short, quick breathing, 3-mouth-breathing, 4-proper breathing.
11. Adenoids are obstruction growths found at the end of the 1-lungs, 2-liver, 3-brain, 4-nasal passages.

12. Adenoids may affect hearing as well as 1-circulation, 2-digestion, 3-breathing, 4-sight.
13. Diseases connected with the organs of breathing are called 1-circulatory, diseases, 2-growth diseases, 3-digestive diseases, 4-respiratory diseases.
14. The capillaries supply every part of the body with 1-air, 2-lubricating hormones, 3-food and oxygen-laden blood, 4-fresh water.
15. The color of the blood is due to the 1-white corpuscles, 2-the plasma, 3-veins, 4-red corpuscles.
16. Alcohol has a depressing or paralyzing action on the heart 1-blood-vessel muscles, 2-hands, 3-feet, 4-ears.
17. The arteries are in the 1-digestive system, 2-respiratory system, 3-re-productive system, 4-circulatory system.
18. A single drop of blood contains 1-several million, 2-an hundred, 3-four thousand, 4-a million red corpuscles.
19. The Vena Cava is in the 1-digestive system, 2-skeletal system, 3-nervous system, 4-circulatory system.
20. The discharge of blood rapidly from a ruptured blood vessel is known as 1-hemoglobin, 2-a vaccination, 3-a hemorrhage, 4-an infusion.
21. The digestive organs of man would compare closely to that of a 1-fish, 2-snail, 3-butterfly, 4-rabbit.
22. The saliva contains an enzyme known as 1-carbon dioxide, 2-pepsin, 3-oxygen, 4-ptyalin.
23. The tube which carries food and is found leading from the back part of the throat to the stomach is called 1-the esophagus, 2-left atrium, 3-hydrogen tube, 4-circulation tube.
24. The back part of the throat is called the 1-esophagus, 2-lungs, 3-palate, 4-pharynx.
25. The name of the digestive juice that is secreted in the mouth is 1-pepsin, 2-bile, 3-saliva, 4-hydrochloric acid.
26. The digestive juice found in the stomach acts on the 1-minerals, 2-vitamins, 3-sugars, 4-proteins.
27. The hairlike fingers which absorb liquid food in the small intestine are known as 1-nerve endings, 2-arteries, 3-villa, 4-tubes.
28. The pancreas makes a digestive juice which will act 1-just on fats, 2-just on starches, 3-on starches, proteins and fats, 4-just on proteins.

29. The stomach is an organ in the 1-respiratory system, 2-circulatory system, 3-nervous system, 4-digestive system.

30. One of the most important processes taking place in the life of a child is 1-physical growth, 2-joint contraction, 3-regulating of tendon expansion, 4-increase in the amount of food to be taken into the body each day.

31. The right amount of calcium in the body is very important for 1-respiration, 2-nervous reactions, 3-normal bone growth or development, 4-normal circulation.

32. Growing children should have plenty of milk to drink because 1-it contains special salt compounds that the body needs, 2-it contains calcium which is necessary in normal bone development, 3-it contains large amounts of pure oxygen, 4-it contains solid substances which the body uses in nerve control.

33. Good muscle development depends upon 1-the right amounts and kinds of food, exercise and rest, 2-plenty of muscle strain, 3-lack of rest, 4-lack of proper food.

34. When you grow 1-the cells of the body get larger and new cells are made, 2-excretions from the body decrease, 3-the whole circulatory system is thrown out of order, 4-the nerves of the body are not working.

35. The new materials that the cells of the body need must come from 1-the air, 2-the food we eat, 3-the digestive juice in the mouth, 4-the nervous system.

36. In the cells, such foods as meat, milk, potatoes, etc., are made into 1-oxygen, 2-hydrogen, 3-carbon, 4-bone, muscle, hair and other parts of the body.

37. Worn out parts of the body are repaired by a process of 1-growing new cells from materials taken into the body in food, 2-excretions, 3-respiration, 4-nervous system.

38. A broken bone will grow back together 1-when the cells of the body build new protoplasm and cells to fasten the ends together, 2-when the right amount of water is taken into the body, 3-when the body is clean, 4-when harmful bacteria are allowed to develop at the place of the broken bone.

39. In addition to the different classes of food that our body uses, we also need proper amounts of 1-nitric acid and pure sulfur, 2-sulfuric acid and gold, 3-minerals and vitamins, 4-silver and natural gas.

40. If our bodies are to grow properly 1-every organ within our body must do its work well, 2-the muscles must cease their movement, 3-the veins will have to carry the blood from the heart, 4-the respiratory system will have to decrease its activity.

41. Calcium and phosphorus compounds are needed for bone and tooth 1-growth and repair, 2-decay, 3-mis-shaping, 4-muscles.

42. Normal elimination of waste products is necessary to a 1-healthy, growing body, 2-case of lazy digestion, 3-decrease in body circulation, 4-decrease in the action of the respiratory system.
43. In the human body there are 1-four, 2-five, 3-six, 4-two kidneys.
44. The kidneys are 1-bean shaped, 2-heart-shaped, 3-spindle-shaped, 4-oval in shape.
45. To exhale is to 1-breathe in, 2-breathe out, 3-move the eyelids, 4-close the mouth.
46. To inhale is to 1-breathe out, 2-move the arms, 3-breathe in, 4-push the air from the lungs.
47. The nasal passages are 1-water ducts in the body, 2-veins, 3-arteries, 4-air passages reaching from the nostrils to the throat.
48. The nostrils are openings 1-in the liver, 2-in the kidneys, 3-in the heart, 4-in the nose through which air passes.
49. Perspiration on the surface of the skin is more than water seeping out through the pores; it contains 1-blood, 2-salts of various kinds, 3-nerve tissue, 4-hydrochloric acid.
50. Each kidney is covered by a rather tough, fibrous 1-tissue, 2-bone, 3-layer of iron, 4-layer of copper.
51. Most people get all the mineral elements necessary in their food except 1-calcium, phosphorus, iron and iodine, 2-chlorine, copper, gold and silver, 3-sulfur, gold, lead and aluminum, 4-oxygen, chromium, lead and zinc.
52. Muscular exercise 1-increases, 2-decreases, 3-stops, 4-slows down, the heart rate.

VITA

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