

**INFLUENCE ON STUDENT ACHIEVEMENT OF
REDUNDANCY IN SELF-INSTRUCTIONAL
MATERIALS**

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Foreword

This research represents a portion of the exploratory development program of the Technical Training Branch, Training Research Division of the Behavioral Sciences Laboratory. The research is documented under Project 1710, "Human Factors in the Design of Training Systems," Task 171007, "Automated Training and Programmed Instruction." Dr. Gordon A. Eckstrand was the Project Scientist. Dr. Ross L. Morgan was Task Scientist. The research was initiated in August 1967 and was completed in February 1968.

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Abstract

Five versions of an instructional program on medical terminology were experimentally evaluated to determine the effect of redundancy or repetition on learning. The subjects (N = 440) were assigned to five groups (N = 88 for each group). A different instructional mode was administered to the subjects in each group as follows:

- Group I – 274-frame linear program
- Group II – 160-frame linear program
- Group III – 83-frame linear program
- Group IV – Narrative, typographically cued, text
- Group V – 4 by 6-inch summary card

The modes contained identical terminal behaviors and a 79-item multiple-choice test, which exhausted the population of behaviors, served as the achievement criterion. All groups studied the materials for an equal amount of time (3 hours). Groups I and II did not differ in achievement. Groups III, IV, and V also did not differ in achievement. Groups III, IV, and V all were significantly superior in achievement to Groups I and II. Therefore, for certain learning outcomes, i.e., terminology and procedure following, programmed practice and review may detract from the effectiveness of self-instructional program.

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SECTION I. Introduction

The purpose of this study was to investigate the effect of redundancy on the learning from self-instructional materials. Redundancy, as considered in this paper, refers to the use of more words, instructional frames, or support materials than are necessary to teach desired behaviors. Five instructional modes differing in degree of internal redundancy were compared in the experiment.

Many programmed texts are used to teach blocks of instruction in Air Force training programs. End-of-course critiques of these programs have indicated that some students resent the boring and "spoon feeding" aspects of small-step constructed response programs. They are especially critical of programmed materials that are not compatible with the students' threshold knowledge of the subject matter.

Of course, multiple tracks are used in linear and intrinsic programs in an effort to provide for individual differences among students. However, there is some evidence that the use of multitracks does not increase learning efficiency. Claser et al. (1964) conducted two experiments to evaluate multitracking in a linear program. Although branching seems to be a logical way to provide for individual differences, the authors found no significant differences in learning efficiency between regular linear programs and multitrack programs.

In another study, by Senter et al. (1965), records were kept of the number of "wrong answer" branches taken by 65 subjects receiving branched programmed instruction. Of the total possible "wrong" branches, only about 6% were taken by the subjects. The authors suggested that intrinsic programs may be wasteful since much of the material is never studied.

There seems to be a tendency to increase the number of small-step frames in linear programmed instruction for students of low reading ability. However, it is doubtful that the addition of more frames will result in greater learning efficiency. Instead, the programmer should give more attention to the readability of the programmed text. As Hershberger (1963) indicated, it appears to be both unnecessary and uneconomical to use the low-error rate linear programming technique just to insure readability. A better estimate of the difficulty level of programmed materials can be obtained by the use of readability formulas (Flesch, 1948; Chall, 1958; Kincaid, et al., 1967; Smith and Senter, 1967).

Studies by Hershberger (1963) and Hershberger and Terry (1965) present evidence that terse self-testing programmed instructional materials have a facilitative effect on learning. Thus, for some desired instructional outcomes, learning through the use of redundant programs may be less efficient than terse programs which provide self-test events.

It is economically unsound to develop a redundant ("fat") program if a "lean" one will suffice. An effort should be made, in the early stages of program development, to determine the number of teaching frames or operant span required to enable students of the target population to attain the desired terminal behaviors. If the instructional materials are initially programmed lean, the steps that are too large should be easily identified during the initial and group testing phases. If, however, a fat program is developed initially, the redundant material may not be noticed by the subjects of the target population nor by the programmer during the testing of the materials.

Concerning the economics of lean programming, Rummler (1965) cautioned:

“However, as I mentioned earlier, there is a problem with maintaining lean programming behavior. Often a manager will not accept a lean, well-designed pamphlet as a program. “Where are the small steps?” Likewise, there are the trainers who buy one program over another because it has more frames. Just remember you are buying a change in behavior, not frames.”

SECTION II. Problem

The problem was to compare student achievement on five programmed instructional modes to determine if a reduction in programmed redundancy would adversely affect learning of desired terminal behaviors. It was hypothesized that learning which involves terminology, nomenclature, or procedure following is not facilitated by redundant verbal or other support materials.

SECTION III. Method

INSTRUCTIONAL MATERIAL. The prefixes, roots, and suffixes of medical terminology considered to be useful in all airman medical specialties, are taught by programmed instruction in the Medical Service School (MSS) at Sheppard Air Force Base, Texas. The students take the programmed medical terminology text in the Medical Helper Course, AQR90010. The class time allotted for completion of the program is three hours. All airmen selected for the medical services career field attend the Medical Helper Course. Upon graduation from this course, they are either enrolled in a specialized course, or they are sent to the field as Directed Duty Assignees (DDAs) where they are given on-the-job training in a given medical services specialty.

For comparison purposes in this experiment four additional modes of instruction in descending order of redundancy were prepared and each contained the same terminal behaviors, as the programmed text used in the regular course of instruction. In the experiment, the five instructional modes were evaluated in terms of achievement on a test designed to measure achievement of the instructional objectives. The Medical Service School (MSS) modes of instruction were identified as follows:

a. MSS-1: A linear programmed text, consisting of 274 instructional frames. The program is used to teach the regular medical terminology block of instruction in the Medical Helper Course. A sample of the program is contained in Appendix I.

b. MSS-2: An experimental linear programmed text similar to MSS-1, except that the number of instructional frames are reduced to 160. The reduction in frames was accomplished by eliminating from MSS-1 any review 10 or more frames from the introduction of a term. A sample of the program is contained in Appendix II.

c. MSS-3: An experimental programmed text similar to MSS-1 and MSS-2 except that the instructional frames are further reduced to 83. With the exception of 5 introductory frames, each criterion item is the subject of only one instructional frame. Redundancy in this program was figuratively "cut to the bone."

d. MSS-4: An experimental terse narrative text using a typographically cued response mode (underlined important words). A sample of the narrative text is contained in Appendix III.

e. MSS-5: All regular course medical terminology information is presented on a 4 by 6-inch summary card. Both sides of the card are used for this purpose. A sample card is shown in Appendix IV.

SUBJECTS. The subjects (N = 440) were airmen (E-2) enrolled in the Medical Helper Course, Medical Service School, Sheppard Air Force Base, Texas. They were recent graduates of the Basic Military Training Program, Lackland Air Force Base, Texas and their average age was 19. They were assigned to five groups as shown below:

<u>Group I</u>	<u>Group II</u>	<u>Group III</u>	<u>Group IV</u>	<u>Group V</u>
MSS-1	MSS-2	MSS-3	MSS-4	MSS-5
N = 88	N = 88	N = 88	N = 88	N = 88

The groups were equated to the lowest N (88) by random selection.

The subjects were not matched prior to assignment to the various groups. However, an analysis of variance was made to determine if any significant differences existed among the groups as measured by the Otis Self-Administering Tests of Mental Ability (Higher Examination). The time limit used for the test was 30 minutes.

SECTION IV. Procedure

A 79-item multiple-choice (4 alternative) master validation examination designed to measure achievement of each expected terminal behavior of the medical terminology block of instruction served as the criterion test for all five instructional modes. The average time required to complete the test was one hour. Since the class schedules for the medical terminology block of instruction was based upon the average completion times which did not include a total two hours for pre- and post-testing, it was decided only to measure achievement by the post-test. However, an estimate of the familiarity of the subjects with the content of the block of instruction was obtained by administering the criterion test to 113 comparable subjects prior to their exposure to the instructional material. The obtained mean of 20 indicates little, if any, familiarity with the content of the subject matter.

The various modes of instruction were administered by the course instructors during the scheduled class period. Group I, Group II, and Group III subjects were instructed to make overt responses to the program stimuli and to complete the self-test at the end of the text. Group IV subjects were instructed to read the textural material and to pay particular attention to the underlined information. They were also instructed to complete the self-test at the end of the text. Group V subjects were issued the 4 by 6-inch cards and they were informed that the cards contained all of the information needed to successfully complete the block of instruction. They were instructed to study the information presented on both sides of the cards and to complete the separate self-test when they were sure they had mastered the information.

The self-test contained all the medical terminology studied by the students. A matching format was used in which the student matched the medical terminology in Column A with the lay terminology in Column B. A sample of the self-test is shown in Appendix V. All subjects taking the five instructional modes were permitted to review the material if desired.

SECTION V. Results and Discussion

RESULTS. Bartlett's test for homogeneity of the treatment (k) variances was made to determine if the separate variance estimates of the treatment (k) samples were all estimates of the same population variance. The test results, as shown in Table I, indicated that the five treatment variances were homogeneous.

TABLE I
BARTLETT'S TEST OF HOMOGENEITY OF VARIANCE FOR (k) VARIANCES
WITH EQUAL DEGREES OF FREEDOM

<i>Treatment</i>	<i>d.f.</i>	<i>xk</i>	<i>sk</i>	<i>log sk</i>
1	87	8790.44	101.04	2.00448
2	87	9842.99	113.14	2.05361
3	87	8417.72	96.75	1.98565
4	87	6303.62	72.45	1.86004
5	87	8057.44	92.61	1.96666
			475.99	9.87044
			$X^2 = 4.510^*$	
			*Not significant	

An analysis of variance, as shown in Table II, yielded no significant differences among the groups as measured by the Otis Self-Administering Tests for Mental Ability (higher examination). Therefore, the five groups were considered to be homogeneous.

TABLE II
ANALYSIS OF VARIANCE FOR THE OTIS SELF-ADMINISTERING TESTS
OF MENTAL ABILITY (HIGHER EXAMINATION)

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between	622.9	4	155.71	1.63*
Within	41412.2	435	95.21	
			*Not significant	

The Otis scores and the criterion scores were correlated for the five groups. The results are shown in Table III.

TABLE III
CORRELATIONS OF OTIS SCORES vs. CRITERION SCORES

<i>Treatment</i>	<i>N</i>	<i>Otis Mean</i>	<i>Otis SD</i>	<i>Criterion Mean</i>	<i>Criterion SD</i>	<i>r</i>
Group I	88	109.1	10.1	67.5	8.4	.44
Group II	88	109.0	10.6	67.9	10.6	.44
Group III	88	110.2	9.8	71.9	6.4	.38
Group IV	88	109.8	8.5	71.7	5.4	.27
Group V	88	112.4	9.6	70.4	8.0	.42

The relatively low correlations obtained may raise doubt as to the appropriateness of using the Otis as an indicator of success for the treatments in this experiment. The forecasting efficiency of the highest correlation coefficient (.44) is 10 per cent while the lowest (.27) is only about 4 per cent. However, for the purpose of this study, the Otis probably was as effective as any other general predictor of student achievement.

As described previously, class scheduling precluded the administration of a pre-test. However, the mean score (109.85) obtained on the Otis test for the sample 113 subjects who took the pre-test compared favorably with the subjects in the five treatments.

An analysis of variance for the five treatments was accomplished. The results are shown in Table IV.

TABLE IV.
ANALYSIS OF VARIANCE FOR FIVE TREATMENTS

<i>Sources of Variance</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>
Between	1493.62	4	373.405	5.942*
Within	27332.70	435	62.833	

*Significant at the .005 level

Since the analysis of variance for the five treatments showed a significant difference, t tests were made to determine which treatments were significantly different. The results are shown in Table V.

TABLE V.
RESULTS OF *t* TESTS FOR FIVE MEDICAL TERMINOLOGY
INSTRUCTIONAL MODES

<u>Group I vs:</u>	<u>t</u>	<u>Level of Confidence</u>
Group II	.29	Not significant
Group III	3.63	.005
Group IV	3.47	.005
Group V	2.39	.05
 <u>Group II vs:</u>		
Group III	3.34	.005
Group IV	3.18	.005
Group V	2.10	.05
 <u>Group III vs:</u>		
Group IV	.16	Not significant
Group V	1.24	Not significant
 <u>Group IV vs:</u>		
Group V	1.07	Not significant
 <u>KEY</u>		
<u>Treatment</u>	<u>\bar{X}</u>	<u>SD</u>
Group I = 274 frames	67.5	8.4
Group II = 160 frames	67.9	10.6
Group III = 83 frames	71.9	6.4
Group IV = Narrative review	71.7	5.4
Group V = 4 by 6-inch	70.4	8.0

Groups I and II did not differ in achievement. Groups III, IV, and V, also did not differ in achievement. Groups III, IV, and V were significantly superior in achievement to Groups I and II.

DISCUSSION. Eliminating the usual redundancy in a linear instructional program significantly increased students' achievement. Equivalent achievement was attained by students using (1) a minimally redundant linear program, (2) a brief narrative coverage of the same information, and (3) a study card which presented all essential behaviors. The desired terminal behaviors were the same for each instructional mode in the experiment.

For some instructional goals, programmed practice or review may detract from the effectiveness of a self-instructional program. Lean programs are, therefore, more economical and efficient than programs which contain redundant verbal or other unnecessary support materials.

APPENDIX I.

MSS-1 Program Sample

143. (b, c) Myo is the medical term for muscle. Myocardium is a/an
a. arm muscle
b. neck muscle
c. heart muscle
d. head muscle
144. (c) A cell of the muscular tissue is called
a. myocardium
b. myocyte
145. (b) Ren and nephr both mean kidney. Nephr is used most often. Which of the words below pertain to the kidney or heart?
both_____, a_____, b_____, neither_____
a. nephrocardiac
b. renicardiac
146. (both) The most common form for kidney is
a. ren
b. nephr
147. (b) Intrarenal means
a. within the kidney
b. inside the kidney
c. upon the kidney
148. (a-b) Around the kidney is
a. peribrachial
b. pericostal
c. perirenal
d. pericardial
149. (c) Endonephritis, renal, intrarenal, perirenal, nephrectomy.
Looking at the words above, select the correct statement or statements that tell how and when ren and nephr are used.
a. Ren is always used as a word ending.
b. Nephr is always used as a word beginning.
c. Ren is never used as a word beginning.
d. Nephr is never used as a word ending.
e. Ren is usually used as a word ending with the suffix al.
150. (d, e) Oste is the medical term for bone. Removing a bone is accomplished through a/an
a. cardiectomy
b. pneumonectomy
c. nephrectomy
d. ostectomy
151. (d) Ostealgia would be a
a. headache
b. pain in the arm
c. pain in the bone
d. pain in the neck
152. (c) Osteopathy is a
a. disease of the skin
b. disease of the arm
c. disease of the bone
153. (c) Neuro is the medical term for nerve. A neurocyte would be a
a. muscle cell
b. blood cell
c. clotting cell
d. nerve cell

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154. (d) Within a nerve is
a. subneural
b. adneural
c. endoneural
d. epineural
155. (c) Subneural means
a. around an arm
b. upon a nerve
c. upon an arm
d. under a nerve
156. (d) Thrombo is the medical term for clot. A thrombocyte is a blood platelet or
a. red cell
b. white cell
c. clotting cell
157. (c) A blood clot within the heart is
a. thrombo-endarteritis
b. thrombocytopenia
c. thrombo-embolism
d. thrombo-endocarditis
158. (d) Producing a clot is
a. thrombogenic
b. thrombocyte
159. (a) You have learned many words. To help you retain this knowledge, the next four frames consist of a review. Column A contains medical terminology and Column B contains lay terminology. Match the medical term with the correct lay term.

A	B
1. extension.....	a. a study of the functions of the body
2. anatomy.....	b. an imaginary plane which divides the body into equal right and left halves
3. physiology.....	c. an imaginary plane which divides the body into a front and back section
4. normal anatomical position.....	d. a study of the structures of the body
5. mid-sagittal plane.....	e. movement toward the mid-line
6. transverse plane.....	f. lengthening of an angle
7. coronal plane.....	g. movement away from the mid-line
8. abduction.....	h. the position of attention with the palms facing forward
9. adduction.....	i. the shortening of an angle
10. flexion.....	j. an imaginary plane which divides the body into a top and bottom section

160. (1-f, 2-d, 3-a, 4-h, 5-b, 6-j, 7-c, 8-g, 9-e, 10-i) Continue as in the preceding frame.
- | | |
|--------------------|--|
| 1. medial..... | a. above the transverse plane |
| 2. lateral..... | b. in front of the coronal plane |
| 3. superior..... | c. closest to the point of origin |
| 4. inferior..... | d. pertaining to or affecting but one side |
| 5. anterior..... | e. pertaining to or affecting both sides |
| 6. posterior..... | f. nearest to the mid-line |
| 7. proximal..... | g. farthest from the point of origin |
| 8. distal..... | h. below the transverse plane |
| 9. unilateral..... | i. in back of the coronal plane |
| 10. bilateral..... | j. farthest from the mid-line |

Contrails

161. (1-f, 2-j, 3-a, 4-h, 5-b, 6-i, 7-c, 8-g, 9-d, 10-e) Continue as in the preceding frame.
- | | |
|-----------------------|--|
| 1. abrachial..... | a. situated upon a rib |
| 2. anerythrocyte | b. red blood cell |
| 3. adneurial..... | c. within the heart |
| 4. epicostal..... | d. white blood cell |
| 5. erythrocyte..... | e. around the kidney |
| 6. interrenal..... | f. without hemoglobin in the red cells |
| 7. leukocyte..... | g. to a nerve |
| 8. intracardiac..... | h. behind the heart |
| 9. perinephric..... | i. without arms |
| 10. retrocardiac..... | j. between the kidneys |
162. (1-i, 2-f, 3-g, 4-a, 5-b, 6-j, 7-d, 8-c, 9-e, 10-h) Continue as in the preceding frame.
- | | |
|---------------------------|--|
| 1. endocardial..... | a. destructive to living organisms |
| 2. bilateral..... | b. excess in the number of white blood cells |
| 3. biocidal..... | c. under the rib |
| 4. hematology..... | d. pertaining to the heart and lungs |
| 5. hyperleukocytosis..... | e. inside the heart |
| 6. hypoleukocytosis..... | f. a nerve cell |
| 7. subcostal..... | g. deficiency of white blood cells |
| 8. pneumocardial..... | h. a blood platelet (clotting cell) |
| 9. neurocyte..... | i. a study of blood |
| 10. thrombocyte..... | j. pertaining to both sides |
163. (1-e, 2-j, 3-a, 4-i, 5-b, 6-g, 7-c, 8-d, 9-f, 10-h) Hepat is a root meaning liver. A patient with an inflamed liver would have
- | | |
|-------------|--------------|
| a. neuritis | b. hepatitis |
| c. carditis | d. nephritis |
164. (b) Any disease of the liver would be
- | | |
|----------------|---------------|
| a. hepatopathy | b. osteopathy |
|----------------|---------------|
165. (a) A removal of a portion of the liver would require a
- | | |
|----------------|----------------|
| a. hepatopathy | b. cardiectomy |
| c. hepatectomy | d. ostectomy |

APPENDIX II.

MSS-2 Program Sample

42. (b, c) Myo is the medical term for muscle. Myocardium is a/an
- a. arm muscle
 - b. heart muscle
 - c. neck muscle
 - d. head muscle
43. (b) Ren and Neph both mean kidney. Neph is used most often. Endonephritis, renal, intrarenal, perirenal, nephrectomy.
Looking at the words above, select the correct statement or statements that tell how and when ren and nephro are used.
- a. Ren is always used as a word ending.
 - b. Neph is always used as a word beginning.
 - c. Ren is never used as a word beginning.
 - d. Neph is never used as a word ending.
 - e. Ren is usually used as a word ending.
44. (d, e) Oste is the medical term for bone. Removing a bone is accomplished through a/an
- a. cardiectomy
 - b. nephrectomy
 - c. pneumonectomy
 - d. ostectomy
45. (d) Neuro is the medical term for nerve. Ben Casey is a neurosurgeon; this means he operates on
- a. the arm
 - b. the heart
 - c. the kidneys
 - d. the nerves
46. (d) Thrombo is the medical term for clot. A thrombocyte is a blood platelet or
- a. red cell
 - b. clotting cell
 - c. white cell
47. (b) Hepat is a root meaning liver. A patient with an inflamed liver would have
- a. neuritis
 - b. carditis
 - c. hepatitis
 - d. nephritis
- (c) By adding the correct root word, make each medical term below mean what the lay term indicates.
48. (white blood cell) leuko.....
(leukocyte)
49. (heart muscle)cardium
(myocardium)
50. (around the kidney) peri.....
(perirenal)
51. (disease of the bone)pathy
(osteopathy)
52. (under a nerve) sub.....
(subneural)

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53. (clotting cell) _____cyte
(thrombocyte)
54. (inflamed liver) _____itis
(hepatitis)
55. Cephal means head. Medically speaking, if you had a headache you would have
- | | |
|----------------|---------------|
| a. neuralgia | c. cardialgia |
| b. cephalalgia | d. myalgia |
56. (b) Chondri is a root meaning cartilage. Under the cartilage is
- | | |
|-------------------|----------------------|
| a. hypochondrium | c. hypochondroplasia |
| b. intrachondrial | d. subchondral |
57. (d) The root for stomach is gastr. An inflammation of the stomach is
- | | |
|---------------|--------------|
| a. nephritis | c. gastritis |
| b. cephalitis | d. neuritis |
58. (c) Arter means artery. Arteriorenal would be an _____ of the _____.
(artery – kidney)

APPENDIX III.
MSS-4 Narrative Review Sample

Unit IV

Neuro means nerve. Neurology is the study of the nervous system; neuralgia is a pain in a nerve; a neurosis is a functional nervous disease or emotional disorder; a neurosurgeon operates on the nerves.

Thrombo is the medical term for clot. Thrombosis is the clotting of blood in any part of the circulatory system. A thrombocyte is a clotting cell; producing a clot is thrombogenic.

A root meaning liver is hepat. Someone who has an inflamed liver would have hepatitis. If part of the liver is removed, this would be called a hepatectomy; any disease of the liver would be hepatopathy.

If you have a headache by now, you may be suffering from cephalalgia; cephal is the root meaning head. A disease of the head would be classified under cephalopathy; encephalitis is an inflammation of the brain.

Chondri is a root meaning cartilage. A chondrocyte is a cartilage cell; under the cartilage is subchondral; chondrology is a study of the cartilage.

Gastronomy is the art of preparing good food; the root meaning stomach is gastr. Inflammation of the stomach is gastritis; if you are talking about both the heart and the stomach, the word is gastrocardiac.

An arterial highway is a through or main highway (or artery); the root arter means artery. Arteritis would be an inflammation of the arteries; arteriostenosis means a narrowing of the arteries; stenosis means narrowing. The frequently heard term arteriosclerosis indicates a thickening of the blood vessels.


Crani or cranium means skull. A craniectomy would be a surgical removal of the skull. Cranoscopy is an examination of the skull. Craniopathy deals with diseases of the skull; pathy means disease.

You have learned that hypodermic is under the skin; derma or dermat-o means skin. A dermatologist treats diseases of the skin; dermatitis is an inflammation of the skin.

The root meaning gland is aden. A gland can be removed by an adenectomy. A condition of enlarged glands would be hyperadenosis.

APPENDIX IV. MSS-5 4- by 6-inch Cards


MEDICAL TERMINOLOGY



The mid-sagittal plane is the plane which extends the length of the body and divides it into equal portions.

lateral - If a part is farther from mid-sagittal plane than another part it is lateral. (Example: ear is lateral to eye)


medial - If a part is closer to mid-sagittal plane than another part it is medial. (Example: eye is medial to ear)



A coronal (frontal) plane is any plane which extends the length of the body separating the front from the rear.

anterior (front)
(Example: nose is anterior to the back of the head)


posterior (back)
(Example: back of the head is posterior to the forehead)




A transverse plane is any plane which extends the width of any section of the body and divides the body into a top and bottom section.

superior (above)
(Example: nose is superior to chin)


inferior (below)
(Example: foot is inferior to knee)




The normal anatomical position has the body at the position of attention with the palms facing forward.




Adduction
(movement toward the mid-line)



Abduction
(movement away from the mid-line)



Flexion
(shortening or closing of an angle)



Extension
(lengthening or opening of an angle)

FRONT

MEDICAL TERMINOLOGY

Location	(Example)	MEDICAL TERMINOLOGY		Word Endings Used to Form Various Parts of Speech
ad to, at	antefebri	stasis standing	hemostasis still	1) Noun - <u>um</u> or <u>ium</u> - (Words not ending in a vowel use <u>um</u> ; Example: gastrum. Words ending in a vowel use <u>um</u> ; Example: cardium).
ante before	antefebri	stenosis narrowing	arteriostenosis	
endo inside/	endocranial	tomy surgical		
epi within	epidermal	incision	cystotomy	
hyper on, upon	hypertension	Anatomical Parts (Example)		2) Adjective - <u>al</u> - (Example: cardiac). 3) Noun ending for a verb or a noun suffix - <u>ion</u> - (Example: adduction).
hypo above	hypodermic	aden gland	adenectomy	
inter under	intercostal	adip fat	adipositis	
intra between	intrarenal	arter artery	arterectomy	
peri within	pericardial	brachi arm	abrachial	4) Pertaining to - <u>ac</u> - (Adjective or noun depending on use. Example: cardiac).
retro around	retrocardiac	cardi heart	cardialgia	
sub behind	subcostal	cephal head	cephalitis	
Condition	(Example)	chondri cartilage	subchondrial	
a, an without	anemia	cost rib	subcostal	Definitions Anatomy is a study of the structures of the human body. Physiology is a study of the functions of the human body. Unilateral refers to an anatomical part that is related to only one side of the body (heart, liver). Bilateral refers to an anatomical part that is related to both sides of the body (arms, legs). A point of origin is where the extremities (arms and legs) leave the body; terms of location associated with these points are: proximal (closest to) and distal (farthest from); the elbow is closer to the shoulder than the hand, therefore, the elbow is proximal to the hand; the hand is distal to the elbow.
algia pain	neuralgia	cran/ cranium	skull	
bi two	bilateral	cyst bladder	cell	
blast life	biology	derma/ dermat/o	skin	
forming cell	erythroblast	duct	passage	dermatology
surgical removal of a part	lobectomy	gastr stomach	tube	oviduct
condition of blood	anemia	hem/o/ hemat	stomach	gastritis
produce	avigenetic	blood		hematology
inflammation		liver		hepatitis
study of condition	cytitis	muscle		myocardium
disease	neurosis	neuro nerve		neurocyte
visual	cranioptathy	ophthalm eye		ophthalmology
exam of	endoscopy	oste bone		osteotomy
		ot/o ear		otocopy
		ov/i egg		ovocyte
		rean/ reanr		intrarenal

BACK

APPENDIX V. Self-Test Sample

The following is a review of all the words you have learned. You should be able to translate all the medical terminology into lay terminology with little difficulty. Match the terminology in column A with the lay term in column B.

Column A

1. erythroblastosis.....
2. gastrotomy.....
3. hyperemia.....
4. pericardectomy.....
5. osteochondrosis.....
6. erythrodermatitis.....
7. hematocytoblast.....

Column B

- a. excessive blood
- b. inflammation of the skin with redness
- c. a condition of red forming cells
- d. a condition of the cartilage and bone
- e. forming blood cell
- f. surgical removal of the sac around the heart
- g. cutting into the stomach

(1-c, 2-g, 3-a, 4-f, 5-d, 6-b, 7-e) Continue with the following words.

8. hypochondrium.....
9. subdermal.....
10. pneumocardial.....
11. periophthalmitis.....
12. brachiocephalic.....
13. anhepatogenic.....
14. athrombosis.....

- a. pertaining to the lungs and the heart
- b. pertaining to the arms and head
- c. under the cartilage (ribs)
- d. not originating in the liver
- e. an inflammation of the tissues around the eye
- f. a condition in which the blood does not clot
- g. under the skin

(8-c; 9-g; 10-a; 11-e; 12-b; 13-d; 14-f) Continue with the following words.

15. endoneural.....
16. perinephritis.....
17. retro-ocular.....
18. bilateral ophthalmitis.....
19. biology.....
20. subhepatic.....
21. hepatoscopy.....
22. hemostasis.....

- a. inflammation of both eyes
- b. study of life
- c. inflammation of the sac around the kidney
- d. beneath the liver
- e. situated within a nerve
- f. stopping bleeding
- g. examination of the liver
- h. behind the eye

(15-e, 16-c, 17-h, 18-a, 19-b, 20-d, 21-g, 22-f) Continue with the following words.

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13. ABSTRACT Five versions of an instructional program on medical terminology were experimentally evaluated to determine the effect of redundancy or repetition on learning. The subjects (N = 440) were assigned to five groups (N = 88 for each group). A different instructional mode was administered to the subjects in each group as follows: Group I - 274-frame linear program; Group II - 160-frame linear program; Group III - 83-frame linear program; Group IV - Narrative, typographically cued, text; Group V - 4 by 6-inch summary card. The modes contained identical terminal behaviors and a 79-item multiple-choice test, which exhausted the population of behaviors, served as the achievement criterion. All groups studied the materials for an equal amount of time (3 hours). Groups I and II did not differ in achievement. Groups III, IV, and V also did not differ in achievement. Groups III, IV, and V all were significantly superior in achievement to Groups I and II. Therefore, for certain learning outcomes, i.e., terminology and procedure following, programmed practice and review may detract from the effectiveness of self-instructional program.		

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