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The ocular anatomy coloring book

Abbie M. Jordan

Pacific University

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The ocular anatomy coloring book

Abstract

Author Abbie M. Jordan combined her visual learning style with a love of anatomy to incorporate this study tool useful for optometry students. With the guidance of Dr. Lee Ann Remington the pair has written, drawn, and edited two editions of The Ocular Anatomy Coloring Book. This book illustrates a combination of anatomical structures and creative shapes involved in the study of vision. It is intended to be used as a fun and abstract visual tool to facilitate primary learning of the ocular system and its components. As an accompaniment to ocular anatomy texts and lectures, this book should help to form a mental picture of the many interconnections and relationships of anatomical structures. During the first year of distribution, 2001, the book was used by 50 members of the Class of 2004 at Pacific University College of Optometry and 25 members of the Class of 2005. With minor editing and corrections a second edition was produced and distributed to 47 students of the class of 2006. Alterations for the 2nd edition included some grammatical and spelling changes, as well as some drawing simplifications and additions. After the completion of the 2003 Ocular Anatomy course at PUCO a survey and questionnaire was given to all those that had purchased the book. Results of this survey are included in the following attachments. As shown, 97% of the students commented that they would recommend the book to incoming first year optometry students and 83% agreed the book helped them to learn ocular anatomy. Students were also asked to make comments and suggestions for the book, which are included in attachment three. The general consensus and conclusion was that the book attained its goal of helping optometry students better learn ocular anatomy. Students found it both 'simplifying' and 'helpful' with one student writing the book helped them "to get visual idea of the structures which is a good mental 'picture' to refer to when studying." The Ocular Anatomy Coloring Book will continue to be available for all incoming optometry students at PUCO. Professional publication is currently in the works to make the book available to other optometry schools across the country.

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Lee Ann Remington

Subject Categories

Optometry

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The Ocular Anatomy Coloring Book

By

Abbie M. Jordan

A Thesis Submitted to the Faculty of

College of Optometry

Pacific University

Forest Grove, Oregon

For the Degree of

Doctor of Optometry

May 2004

Advisor

Lee Ann Remington, O.D., M.S., F.A.A.O.

A handwritten signature in cursive script, reading "Abbie M. Jordan", is written over a horizontal line.

Abbie M. Jordan, Author

A handwritten signature in cursive script, reading "Lee Ann Remington", is written over a horizontal line.

Lee Ann Remington, O.D., M.S., F.A.A.O.

Advisor

Biography

Artist and author Abbie M. Jordan is a member of the graduating Class of 2004 at Pacific University College of Optometry. Jordan remained active throughout her years in optometry school as president of her class, chairperson for the 2004 graduation festivities, two-year officer of the Amigos Eye Care group, and was selected to sit on Oregon's Foundation for Vision Awareness.

Jordan earned her Bachelors Degree in Visual Science from Pacific University and has certification from the American Board of Opticianry. She began her optometric education by earning an Associates Degree in Optometric Assisting at Spokane Community College where she was named Student Body Government Senator for Health Sciences and made All-League on their collegiate golf team. She was a member of Phi Beta Kappa Honors Society and graduated with Honors, as well as first in her class, at SCC.

Abbie Jordan's plans following graduation included remaining in the Beaverton area where she and her husband of three years own their home, which they share with two dogs and a cat. Eventually Abbie wants to open her own private practice and optical.

Abstract

Author Abbie M. Jordan combined her visual learning style with a love of anatomy to incorporate this study tool useful for optometry students. With the guidance of Dr. Lee Ann Remington the pair has written, drawn, and edited two editions of The Ocular Anatomy Coloring Book.

This book illustrates a combination of anatomical structures and creative shapes involved in the study of vision. It is intended to be used as a fun and abstract visual tool to facilitate primary learning of the ocular system and its components. As an accompaniment to ocular anatomy texts and lectures, this book should help to form a mental picture of the many interconnections and relationships of anatomical structures.

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The Ocular Anatomy Coloring Book will continue to be available for all incoming optometry students at PUCO. Professional publication is currently in the works to make the book available to other optometry schools across the country.

Acknowledgements

Many thanks to Dr. Lee Ann Remington for her undivided attention and extensive anatomy knowledge throughout the duration of this project!

Attachment 1

Ocular Anatomy Coloring Book EVALUATION

Class of 2004

Choose whether you strongly agree (5) or disagree (1) with the statements below:

	5	4	3	2	1	n/a
1. Using this coloring book helped me to learn ocular anatomy.	<small>Strongly Agree</small>				<small>Disagree</small>	
2. Using this book helped me to study ocular anatomy.						
3. Coloring the structures helped me to learn ocular anatomy better.						
4. Using this book was helpful in learning about ocular diseases.						
5. I like the heavy weight, thick paper.						
6. The paper used in the book didn't matter much to me.						
7. The table of contents (added to the 2 nd edition) was helpful.						
8. This book was well worth the money.						
9. I would recommend this coloring book to incoming 1 st years.						

How did you use the Coloring Book? (to help study diseases, to study for boards, etc.)

Could you suggest any changes that would improve the book?

Attachment 2

Ocular Anatomy Coloring Book Evaluation – Distributed May 2003

Class of 2006 Results – using the book during 1st year of optometry school – 34 responses out of 50 purchases

	Question	Grade 5 "strongly agree"	Grade 4	Grade 3	Grade 2	Grade 1 "strongly disagree"	N/A
1.	Using this coloring book helped me to learn ocular anatomy.	13	12	5	4	-	-
2.	Using this book helped me to study ocular anatomy.	14	13	4	3	-	-
3.	Coloring the structures helped me to learn ocular anatomy better.	8	11	8	3	2	2
4.	Using this book was helpful in learning about ocular diseases.	5	2	10	5	4	8
5.	I liked the heavy weight, thick paper.	24	6	3	1	-	-
6.	The paper used in the book didn't matter much to me.	2	1	3	8	15	8
7.	The table of contents (added in 2 nd edition) was helpful.	10	9	10	3	2	-
8.	This book was well worth the money.	13	12	5	3	1	-
9.	I would recommend this coloring book to incoming 1 st years.	15	12	5	2	-	-

Class of 2005 Results – used the book during 1st and 2nd years of optometry school – 6 responses out of 25 purchases

	Question	Grade 5 "strongly agree"	Grade 4	Grade 3	Grade 2	Grade 1 "strongly disagree"	N/A
1.	Using this coloring book helped me to learn ocular anatomy.	4	1	1	-	-	-
2.	Using this book helped me to study ocular anatomy.	4	2	-	-	-	-
3.	Coloring the structures helped me to learn ocular anatomy better.	4	1	-	-	-	1
4.	Using this book was helpful in learning about ocular diseases.	3	-	3	-	-	-
5.	I liked the heavy weight, thick paper.	6	-	-	-	-	-
6.	The paper used in the book didn't matter much to me.	-	-	1	2	2	1
7.	The table of contents (added in 2 nd edition) was helpful.	3	-	-	-	-	3
8.	This book was well worth the money.	5	1	-	-	-	-
9.	I would recommend this coloring book to incoming 1 st years.	5	1	-	-	-	-

Class of 2004 Results – used the book during 2nd and 3rd years of optometry school – 24 responses out of 47 purchases

	Question	Grade 5 "strongly agree"	Grade 4	Grade 3	Grade 2	Grade 1 "strongly disagree"	N/A
1.	Using this coloring book helped me to learn ocular anatomy.	3	10	4	3	2	2
2.	Using this book helped me to study ocular anatomy.	6	8	6	-	2	2
3.	Coloring the structures helped me to learn ocular anatomy better.	4	7	4	1	2	6
4.	Using this book was helpful in learning about ocular diseases.	2	3	6	5	5	3
5.	I liked the heavy weight, thick paper.	14	6	2	1	-	1
6.	The paper used in the book didn't matter much to me.	3	-	1	11	7	2
7.	The table of contents (added in 2 nd edition) was helpful.	4	-	1	-	-	19
8.	This book was well worth the money.	6	7	7	1	2	1
9.	I would recommend this coloring book to incoming 1 st years.	12	7	5	-	-	-

Total of 64 Responses – Compiled Results in Percent

	Question	Grade 5 "strongly agree"	Grade 4	Grade 3	Grade 2	Grade 1 "strongly disagree"	N/A
1.	Using this coloring book helped me to learn ocular anatomy.	31%	36%	16%	11%	3%	3%
2.	Using this book helped me to study ocular anatomy.	38%	36%	16%	5%	3%	3%
3.	Coloring the structures helped me to learn ocular anatomy better.	25%	30%	19%	6%	6%	14%
4.	Using this book was helpful in learning about ocular diseases.	16%	8%	30%	16%	14%	17%
5.	I liked the heavy weight, thick paper.	69%	19%	8%	3%	-	2%
6.	The paper used in the book didn't matter much to me.	8%	2%	8%	39%	38%	13%
7.	The table of contents (added in 2 nd edition) was helpful.	27%	31%	17%	5%	3%	34%
8.	This book was well worth the money.	38%	31%	19%	6%	5%	2%
9.	I would recommend this coloring book to incoming 1 st years.	50%	31%	16%	3%	-	-

Ocular Anatomy Coloring Book Evaluation Comments – Distributed May 2003

Question #1 – How did you use the coloring book?

Quotations from the Class of 2006 – used book during 1st year:

- “The pathways & enlarged size of the pictures were really helpful!”
- “Great for pathways!”
- “To study – many for lab quizzes.”
- “Study at home especially pathways.”
- “Study for tests.”
- “Overall study for exams.”
- “Especially helpful w/ cranial nerves, embryology, as well as overall big picture.”
- “I used it to study for exams. It really simplified pathways, etc. for me and made it easier to understand and learn. I loved the thick paper. I took tons of notes on the back side of the diagrams and when I colored in pen, it didn’t got through! This is definitely worth the money and I would totally recommend it to others. Great idea and great job! Thanks!”
- “For studying I used the structures, sometimes made more sense than the structures in anatomy book.”
- “For studying, and test preparation.”
- “Used it to study for test when I had time. I used it more during lab and for lab quizzes.”
- “To study for tests.”
- “To get the big picture while reading the text book.”
- “Everything – thanks so much for pg 38. I like that the opposing page was blank.”
- “Study for tests, especially the signal pathways for sensory, parasympathetic, and sympathetic, to various structure.”
- “For tests only.”
- “Good for quizzes.”
- “First thing to look at beginning study for any exam. This helps to get a visual idea of the structures which is a good mental ‘picture’ to refer to when studying.”
- “In lab. Study for tests.”
- “To study for tests occasionally.”
- “I used it for review/studying when there was relevant info.”
- “To study for tests occasionally.”
- “Study for tests and quizzes.”
- “Study 4 tests and quizzes.”
- “Study for exams & quizzes.”
- “To study for tests.”
- “Great for pathway – but not for lecture.”
- “Wasn’t quite as useful as I hoped – some things were extremely useful while others were not.”
- “2 or 3 diagrams where very helpful everything else was not as specific as it needed to be.”

Quotations from the Class of 2005 – used book during 1st and 2nd years:

- “Brief study before tests.”
- “To study for tests!” (3)
- “I recommended it. Good job! People recommended it to me to use to study for Boards as well.”
- “During lecture: compared it to or even used it instead of some of the book diagrams. Study for tests: (lab, etc) especially for memorizing/visualizing pathways & layers. Reference: to refresh memory (in 2nd year disease class)”

Quotations from the Class of 2004 – used book during 2nd and 3rd years:

- “Refresher in quickly looking at eye anatomy.”
- “Good review before boards. Helped to take notes on the blank page opposite the picture.”
- “Boards.” (5)
- “I actually haven’t done anything with it.”
- “To color for enjoyment.”
- “Study for boards. Wrote notes in book as studying Remington’s book.”
- “More helpful as a 1st year vs. end of 2nd year.”
- “I think it would be more useful to have as a 1st year so I could have looked at it while we were learning it.”
- “Study for boards.”
- “I colored coded pictures and it helped me to study for boards! Very nice book!”
- “I didn’t use the coloring book which is why it wasn’t worth the money for me. If I had used it I probably wouldn’t feel that way. It would have been more useful to have for first year, so I would recommend it for students.”
- “I used it mostly to review for boards, especially in ocular embryology. Great job!”

Evaluation Comments – Distributed May 2003

Question #2 – Could you suggest any changes that would improve the book?

Quotations from the Class of 2006 – used the book during 1st year:

- “Nope!”
- “Good Job!”
- “Nope.”
- “Not really, nice job.”
- “The best part of the book was the boards of the limbus (pg 9) and retinal layer formation (pg 26).”
- “Nope.”
- “Using some of the diagrams we learned in class along side the drawings. (ie EOMs)”
- “Had some, but can’t remember right now – I’ll try to email if I think of it.”
- “Nope.”
- “No.”
- “No, wonderful!”
- “Study.”

- “Very few errors and typos to correct – correct ‘em.”
- “Pg 10 – there are zonules in canal of Petit too, Pg 29 – lacrimal & maxillary bones in orbit, Pg 21 – vitreous base attachment boards in orbit.”
- “Make the drawings not as boxy. First diagram should be squamous epithelium instead of cuboidal for inner layer of bv’s.”
- “Spelling errors: pg 10 Aqueous Veins of Aschner, pg20 A. Internal Limiting Membrane, Foreman vs. Foraman.”
- “Some of the skull bone pictures were unclear (pg 31). Use a different font for the structure names – one without serifs would be easier to color.”
- “There are a few errors in the book – I will leave a note in your mailbox on specifics.”
- “I found a couple of minor spelling errors you might want to fix.”
- “Drawings that looked less cartoonie and more like something we would see on a quiz would make it better.”
- “I found that I didn’t not need the coloring book, but it might be nice to have in the future.”
- “Some of the drawings were wrong.”
- “Only ¾ of diagrams were helpful, but someone else might think of replacing a different ¼ than I would – so leave it alone.”
- “It seemed like a lot of the coloring book was pretty much a repeat of the stuff from the book (not exactly, but similar). I can only think of a couple pages that were different enough to do me much good.”

Quotations from the Class of 2005 – used the book during 1st and 2nd years:

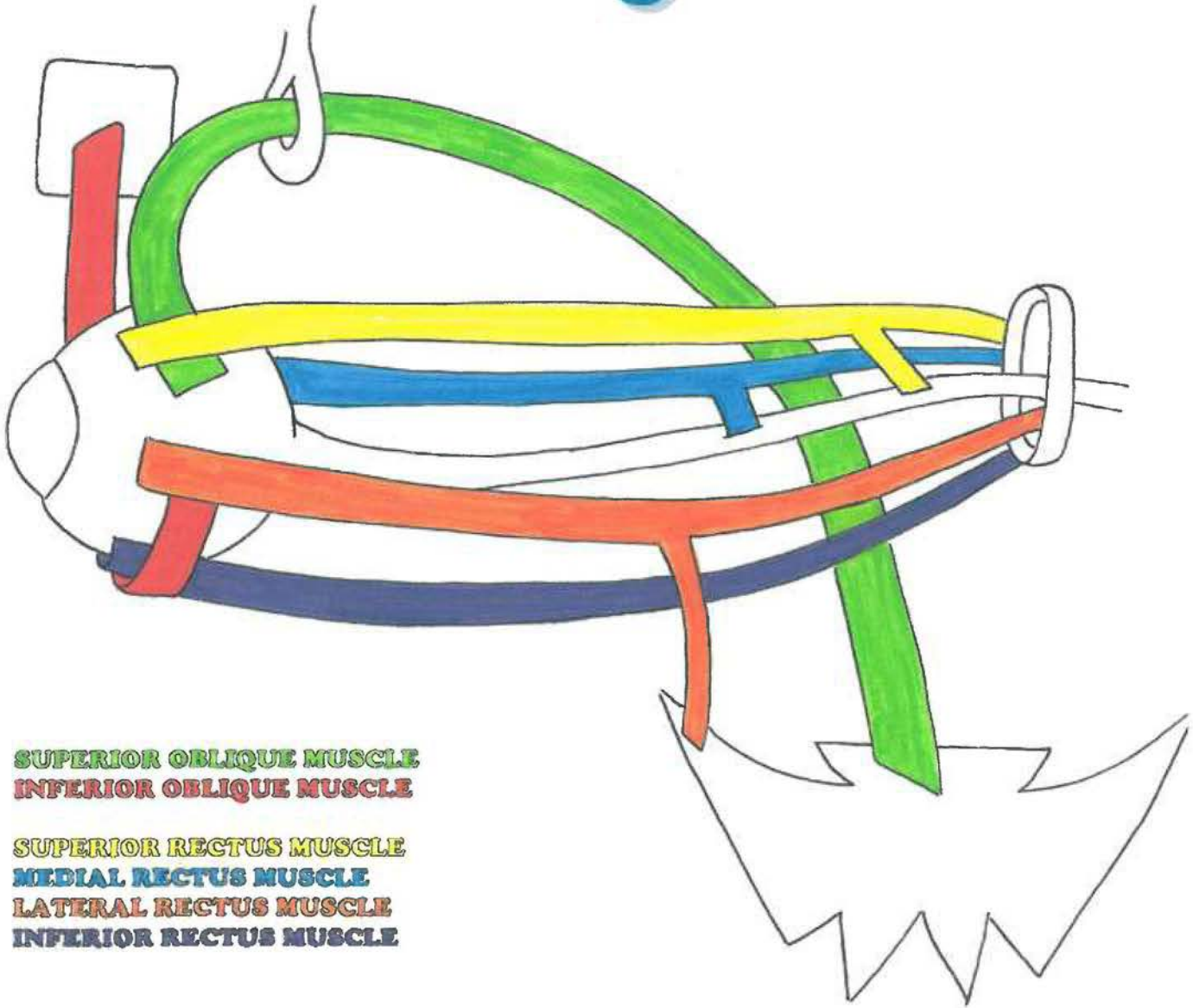
- “I used it at a review, while I studied for the tests. It’s also a great quick review guide for all other classes. It’s so easier to think pictorially!”
- “Nope.”
- “No.”
- “I haven’t seen the 2nd edition table of contents, but that was my suggestion (I actually made my own). Include branches of external carotid artery. EOM diagrams too.”

Quotations from the Class of 2004 – used the book during 2nd and 3rd years:

- “No, sorry, perfect as is.”
- “Nope – great!”
- “Not as many detailed areas to color.”
- “Make the font san serif, otherwise great help!”

Ocular Anatomy

Coloring Book



SUPERIOR OBLIQUE MUSCLE
INFERIOR OBLIQUE MUSCLE

SUPERIOR RECTUS MUSCLE
MEDIAL RECTUS MUSCLE
LATERAL RECTUS MUSCLE
INFERIOR RECTUS MUSCLE

A Thesis Project by *Abbie Marie Jordan*
Advised by *Dr. Lee Ann Remington*

2nd edition, edited by Abbie Jordan & Dr. Lee Ann Remington
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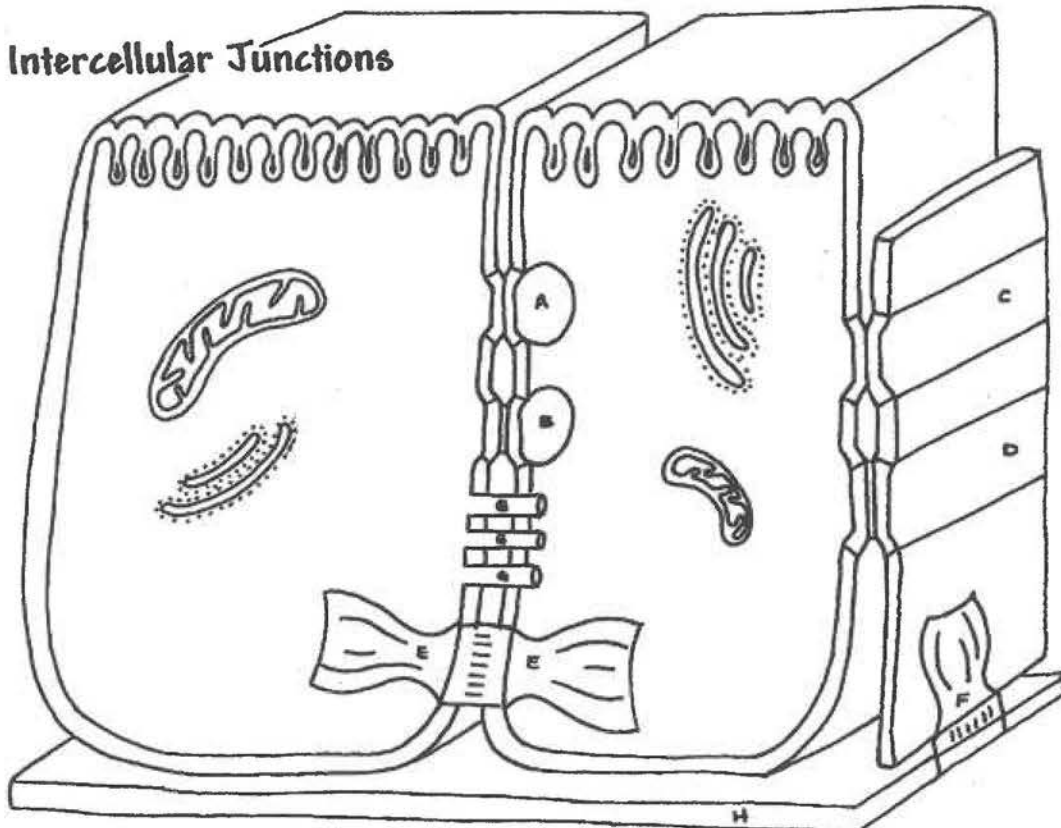
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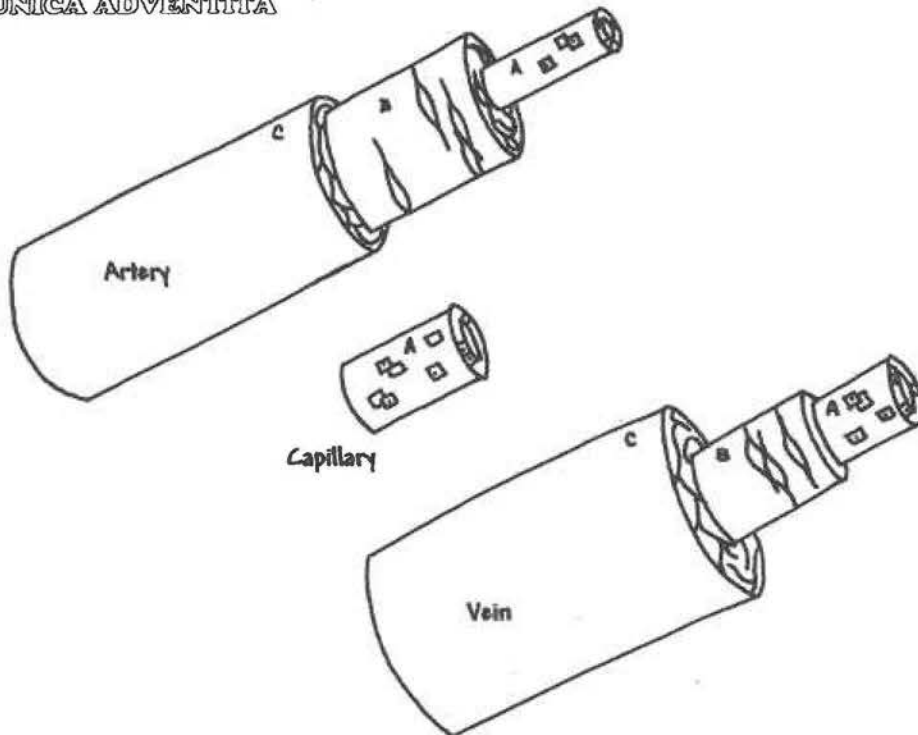
Intercellular Junctions



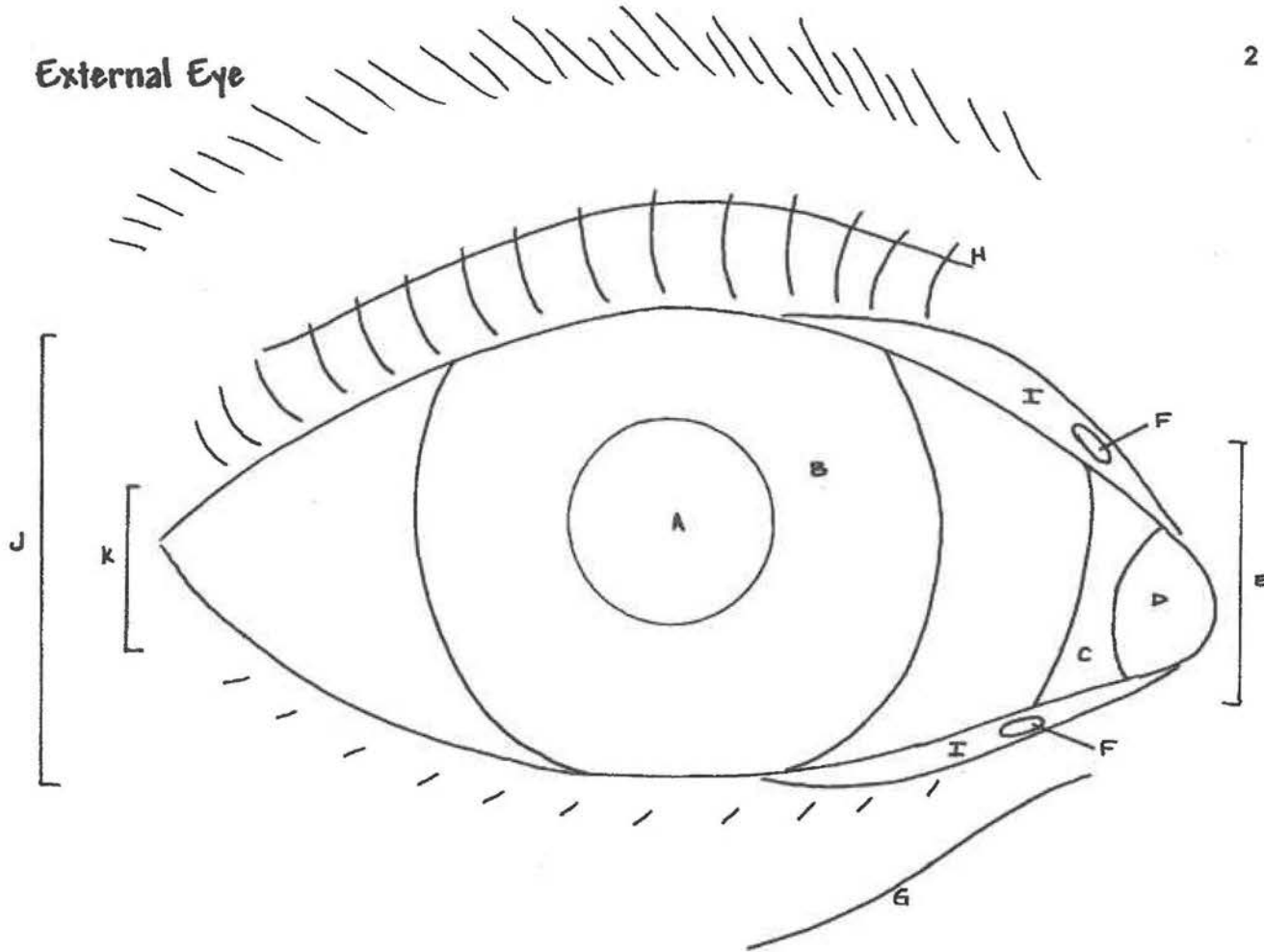
- A. MACULAR OCCLUDING
- B. MACULAR ADHERING
- C. ZONULAR OCCLUDING
- D. ZONULAR ADHERING
- E. DESMOSOMES
- F. HEMI-DESMOSOMES
- G. GAP JUNCTIONS
- H. BASEMENT MEMBRANE

Structural Organization of Vascular Tissue

- A. TUNICA INTIMA
- B. TUNICA MEDIA
- C. TUNICA ADVENTITIA



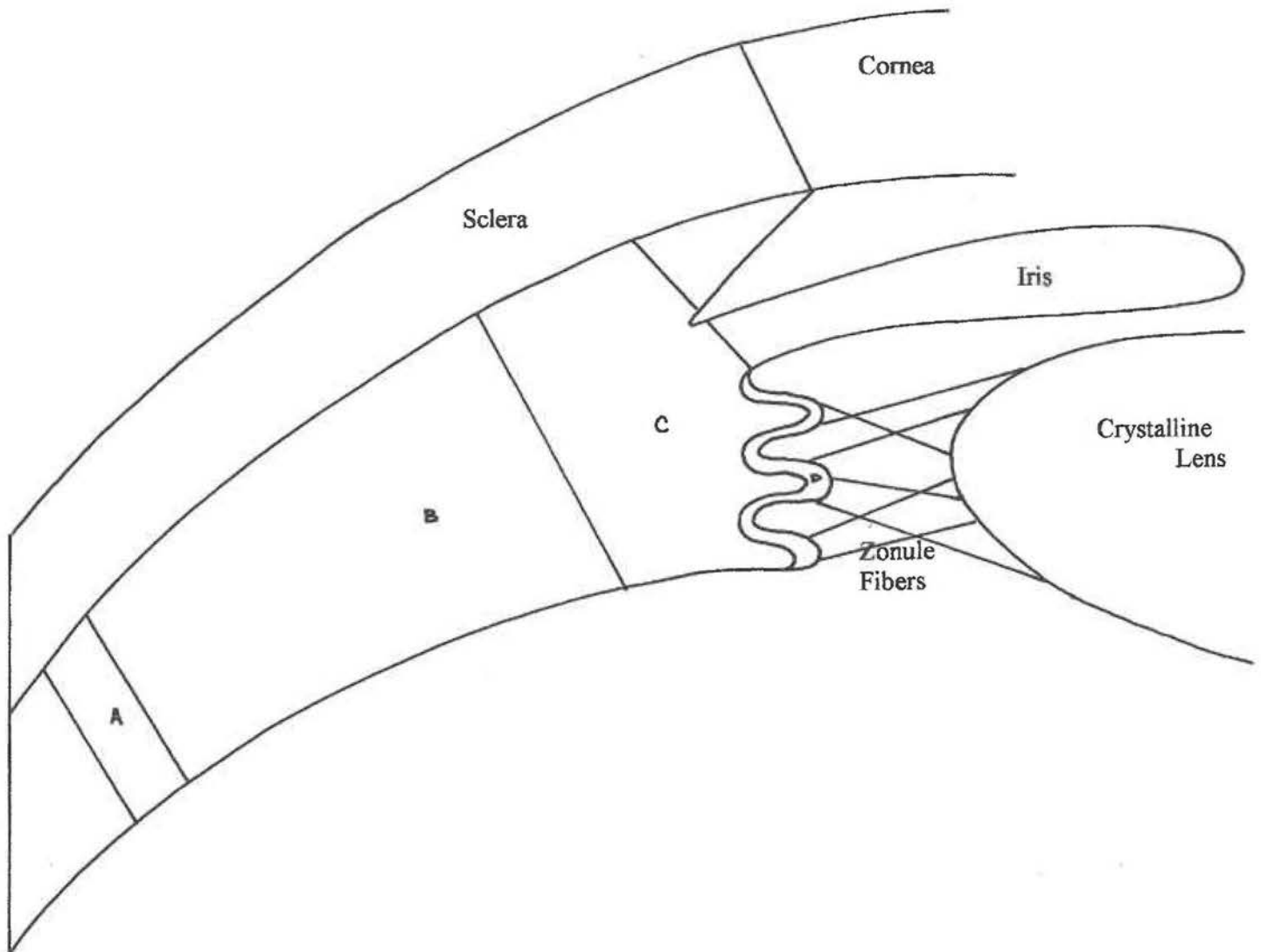
External Eye



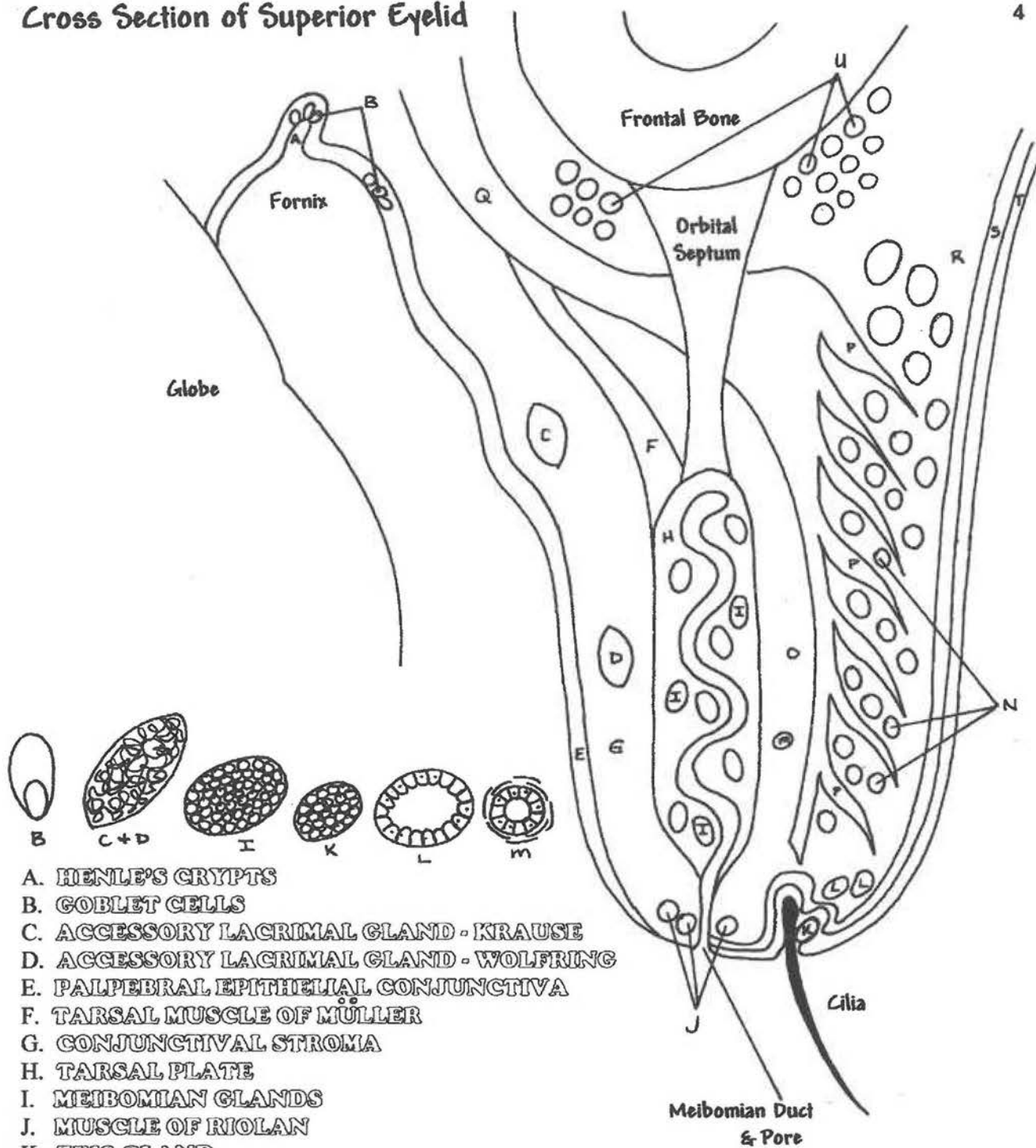
- A. PUPIL
- B. IRIS
- C. PLICA SEMILUNARIS
- D. CARUNCLE
- E. MEDIAL CANTHUS
- F. PUNCTA
- G. INFERIOR PALPEBRAL SULCUS
- H. SUPERIOR PALPEBRAL SULCUS
- I. PAPILLA
- J. PALPEBRAL FISSURE
- K. LATERAL CANTHUS

Four Structures of the Ciliary Body

- A. ORA SERRATA
- B. PARS PLANA
- C. PARS PlicATA
- D. CILIARY PROCESSES

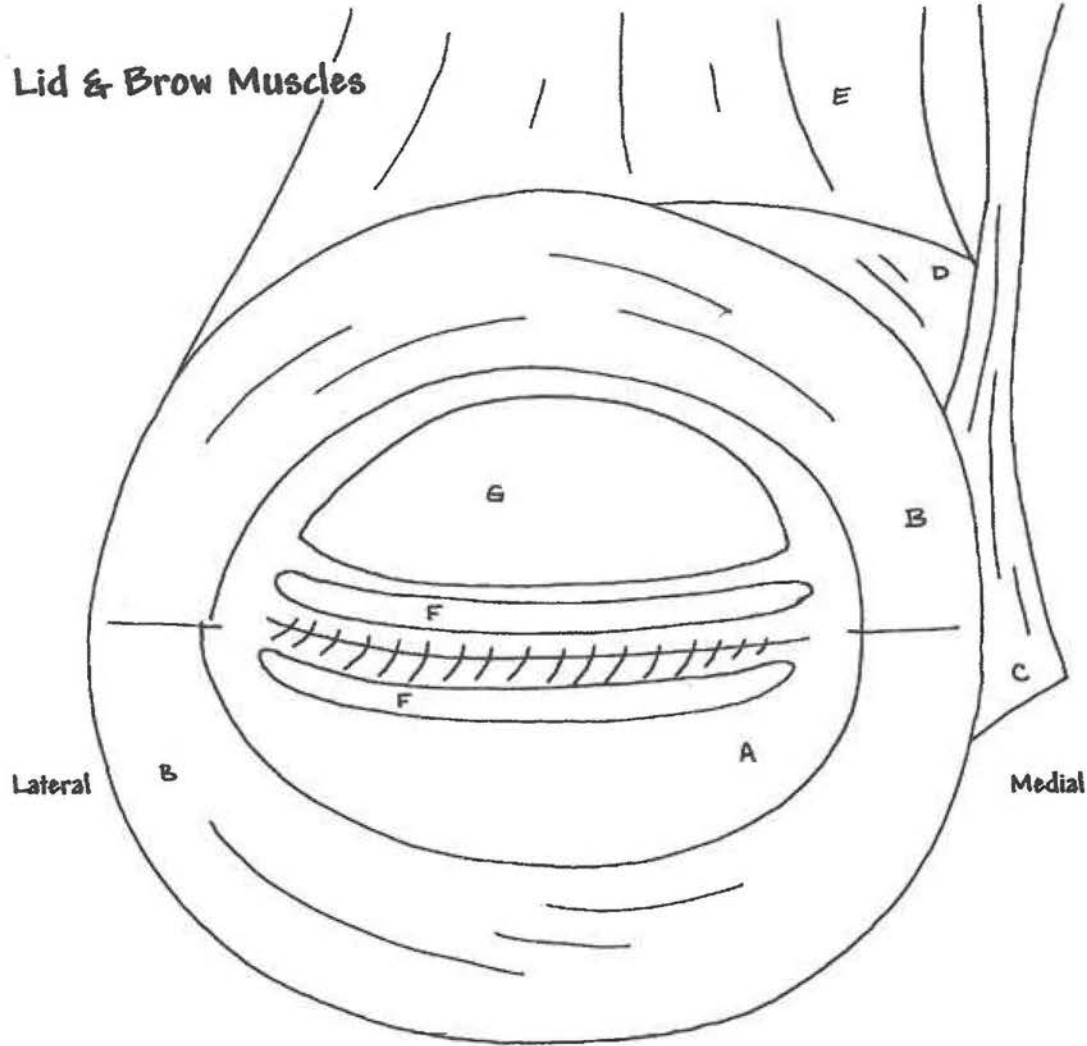


Cross Section of Superior Eyelid



- A. HENLE'S CRYPTS
- B. GOBLET CELLS
- C. ACCESSORY LACRIMAL GLAND - KRAUSE
- D. ACCESSORY LACRIMAL GLAND - WOLFRING
- E. PALPEBRAL EPITHELIAL CONJUNCTIVA
- F. TARSAL MUSCLE OF MÜLLER
- G. CONJUNCTIVAL STROMA
- H. TARSAL PLATE
- I. MEIBOMIAN GLANDS
- J. MUSCLE OF RIOLAN
- K. ZEIS GLAND
- L. GLANDS OF MOLL
- M. BLOOD VESSEL
- N. ORBICULARIS MUSCLE
- O. SUBMUSCULAR CONNECTIVE TISSUE
- P. PALPEBRAL APONEUROSIS OF LEVATOR MUSCLE
- Q. LEVATOR PALPEBRAE
- R. SUBCUTANEOUS CONNECTIVE TISSUE
- S. DERMIS
- T. EPIDERMIS
- U. ADIPOSE TISSUE

Lid & Brow Muscles

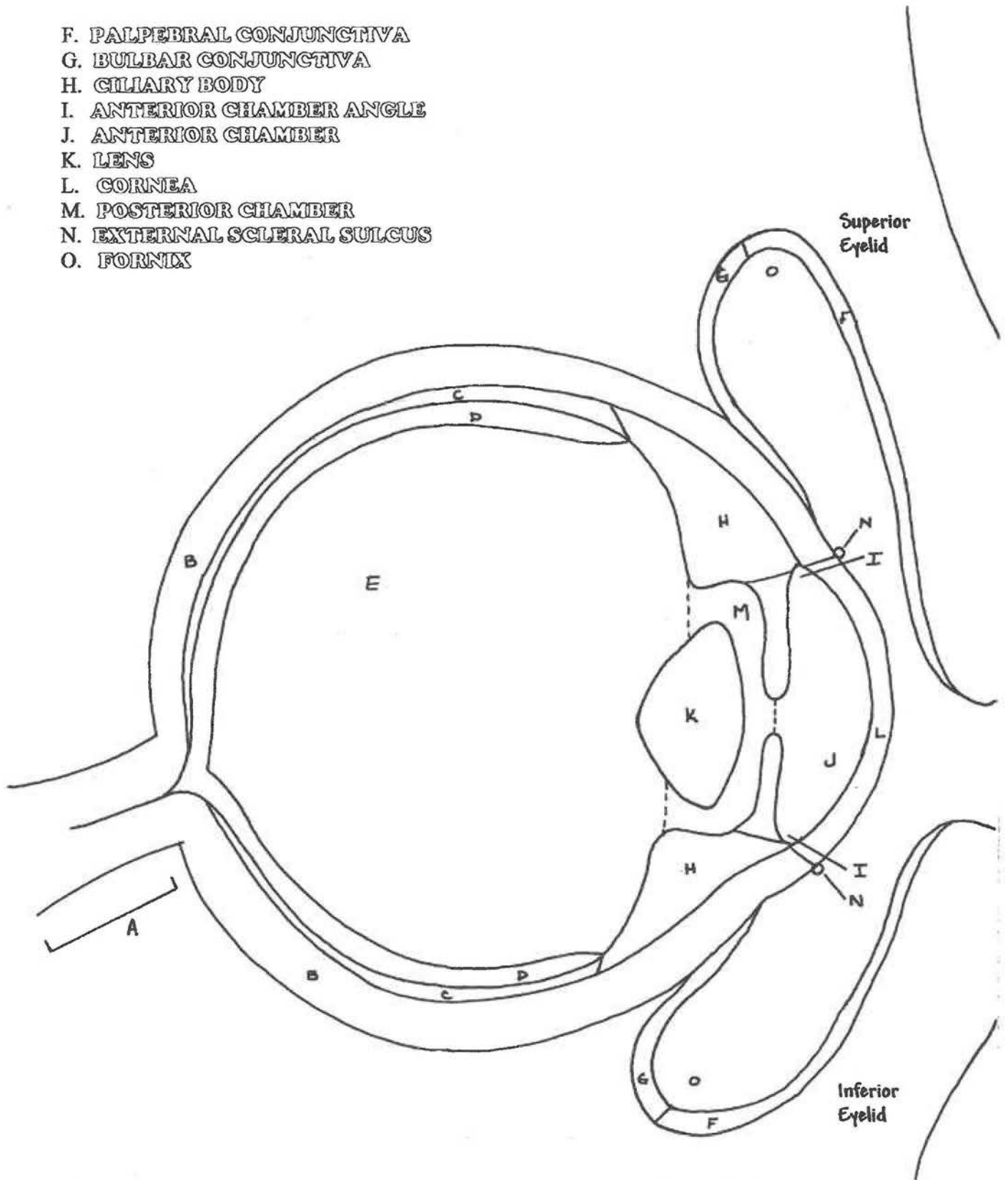


- A. PALPEBRAL ORBICULARIS MUSCLE
- B. ORBITAL ORBICULARIS MUSCLE
- C. PROCERUS MUSCLE
- D. CORRUGATOR MUSCLE
- E. FRONTALIS MUSCLE

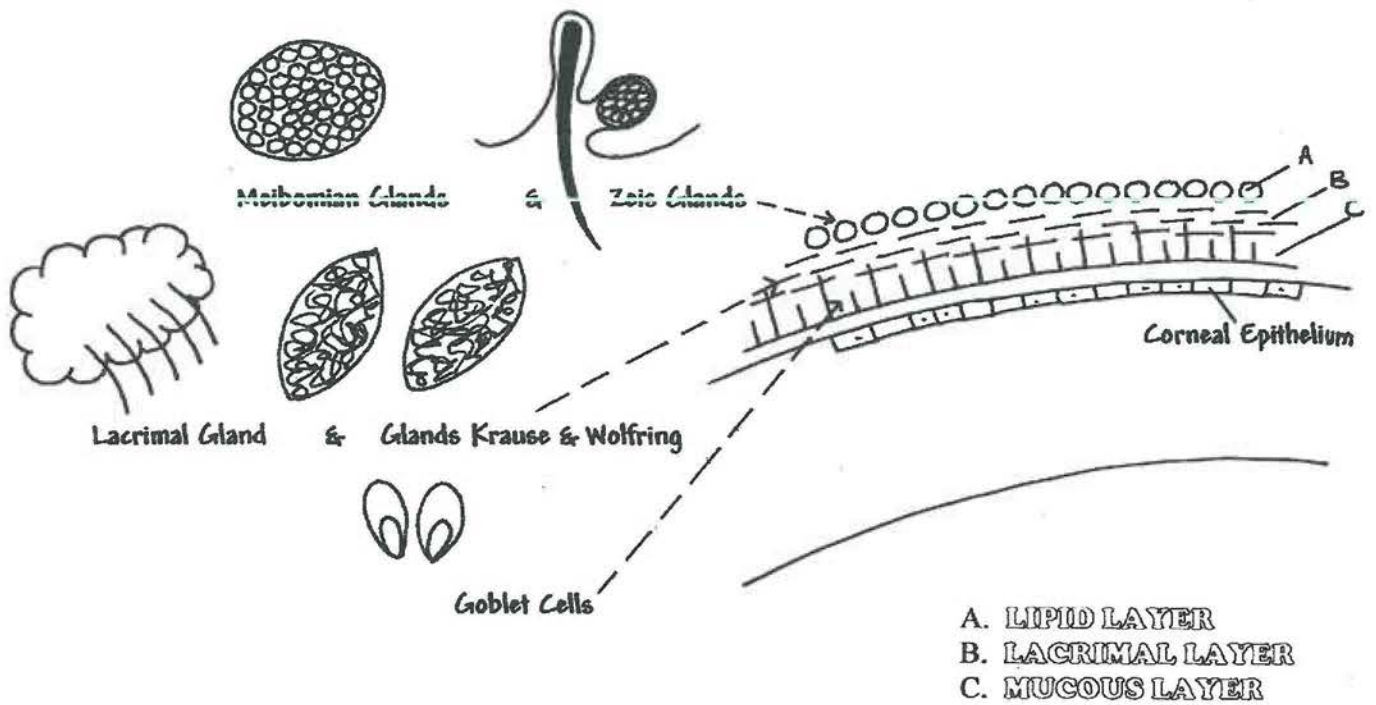
- F. MUSCLE OF RIOLAN, CILIARY PORTION
- G. TARSAL PLATE

Globe Cross Section

- A. OPTIC NERVE
- B. SCLERA
- C. CHOROID
- D. RETINA
- E. VITREOUS
- F. PALPEBRAL CONJUNCTIVA
- G. BULBAR CONJUNCTIVA
- H. CILIARY BODY
- I. ANTERIOR CHAMBER ANGLE
- J. ANTERIOR CHAMBER
- K. LENS
- L. CORNEA
- M. POSTERIOR CHAMBER
- N. EXTERNAL SCLERAL SULCUS
- O. FORNIX

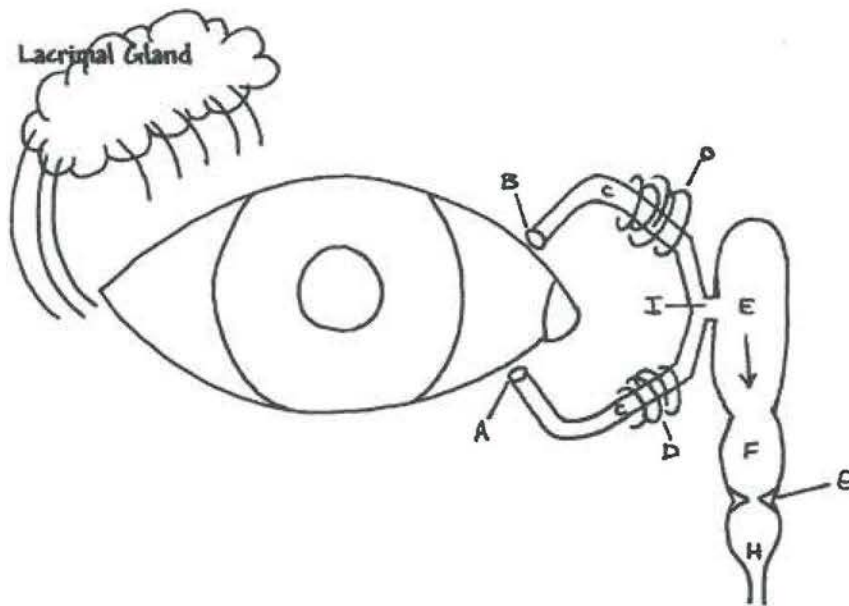


Three Layers of the Tear Film

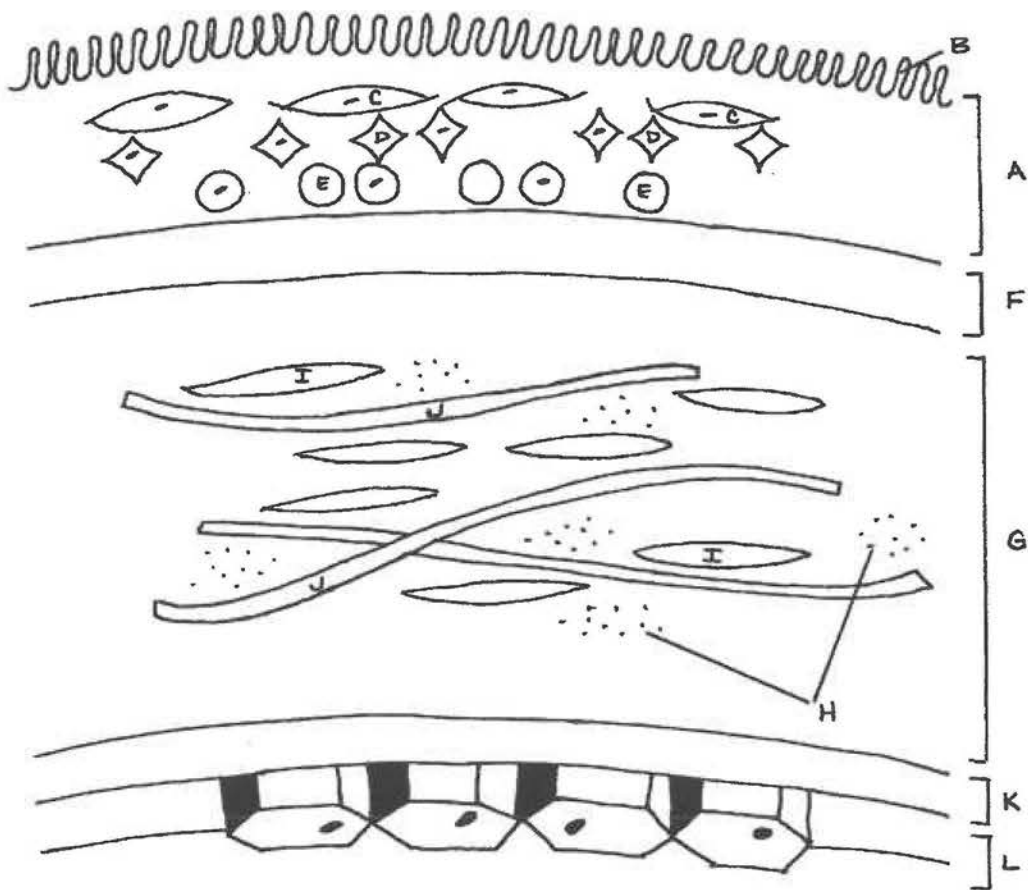


Tear Drainage

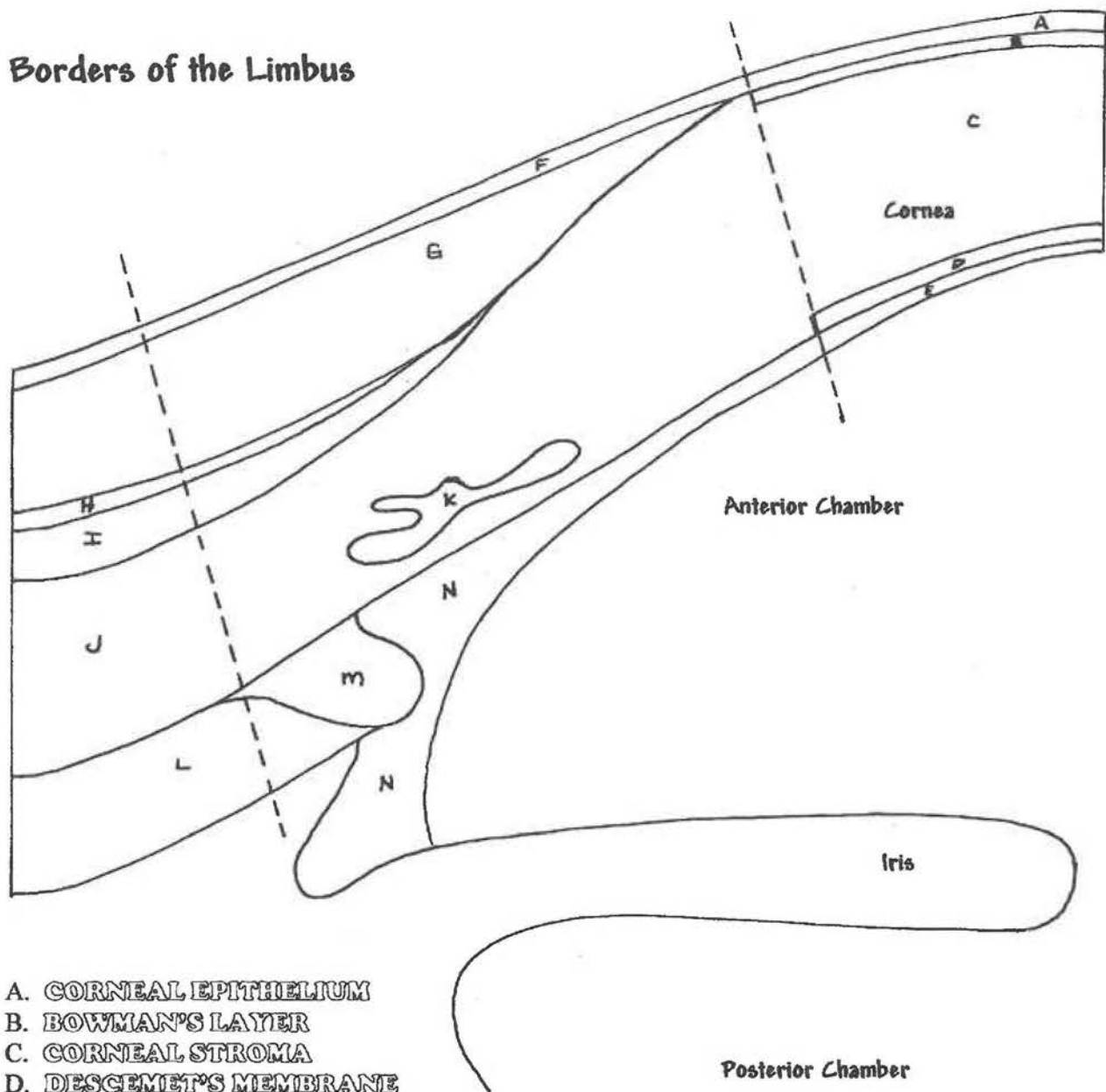
- A. INFERIOR LACRIMAL PUNCTUM
- B. SUPERIOR LACRIMAL PUNCTUM
- C. CANALICULUS
- D. MUSCLE OF HORNER
- E. LACRIMAL SAC
- F. NASOLACRIMAL DUCT
- G. VALVE OF HASNER
- H. INFERIOR MEATUS IN NASAL CAVITY
- I. COMMON CANALICULI or SINUS OF MAIER



- A. CORNEAL EPITHELIUM
- B. MICROVILLI
- C. SURFACE LAYER
- D. WING CELLS
- E. BASAL CELLS
- F. BOWMAN'S LAYER
- G. CORNEAL STROMA
- H. GROUND SUBSTANCE
- I. FIBROBLAST CELLS,
CALLED KERATOCYTES
- J. COLLAGEN FIBRILS,
CALLED LAMELLAE
- K. DESCEMET'S MEMBRANE
- L. CORNEAL ENDOTHELIUM



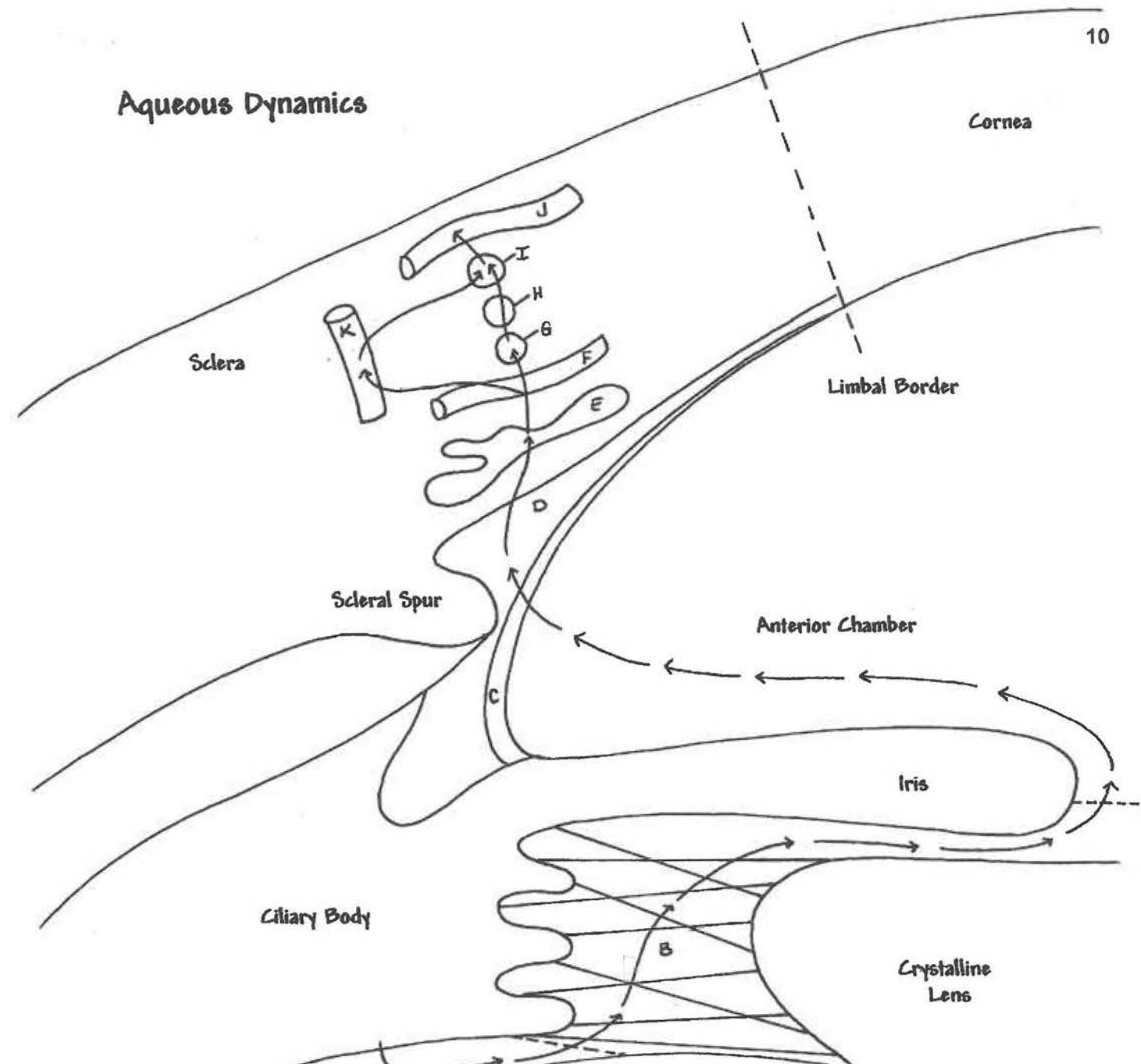
Borders of the Limbus



- A. CORNEAL EPITHELIUM
- B. BOWMAN'S LAYER
- C. CORNEAL STROMA
- D. DESCMET'S MEMBRANE
- E. CORNEAL ENDOTHELIUM

- F. CONJUNCTIVAL EPITHELIUM
- G. CONJUNCTIVAL STROMA
- H. TENON'S
- I. EPISCLERA
- J. SCLERA
- K. SCHLEMM'S CANAL
- L. CILIARY MUSCLE
- M. SCLERAL SPUR
- N. TRABECULAR MESHWORK

Aqueous Dynamics



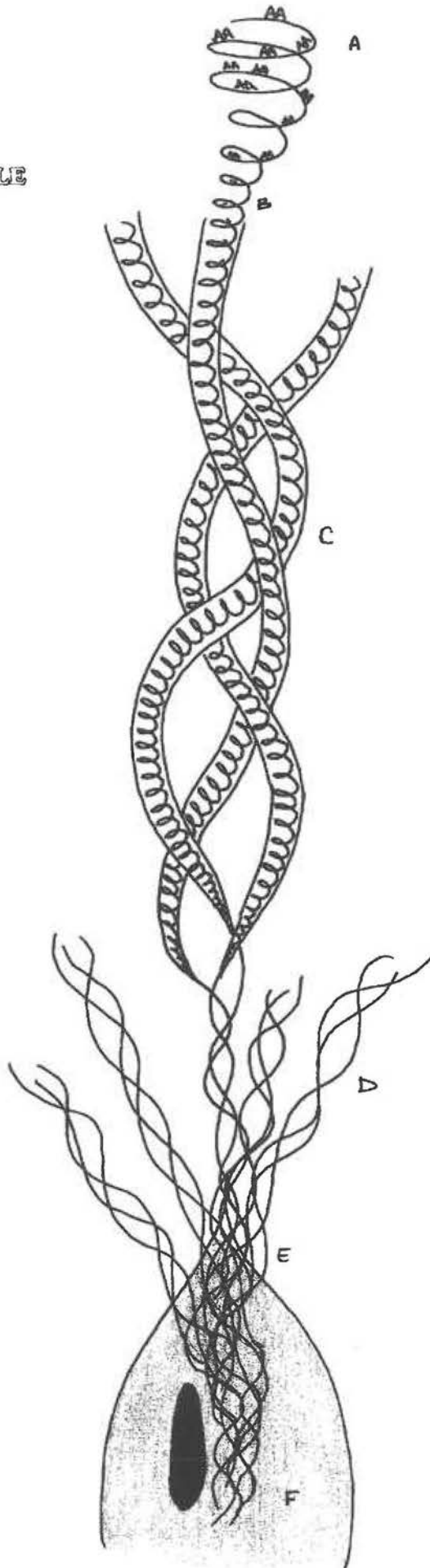
Ciliary Body

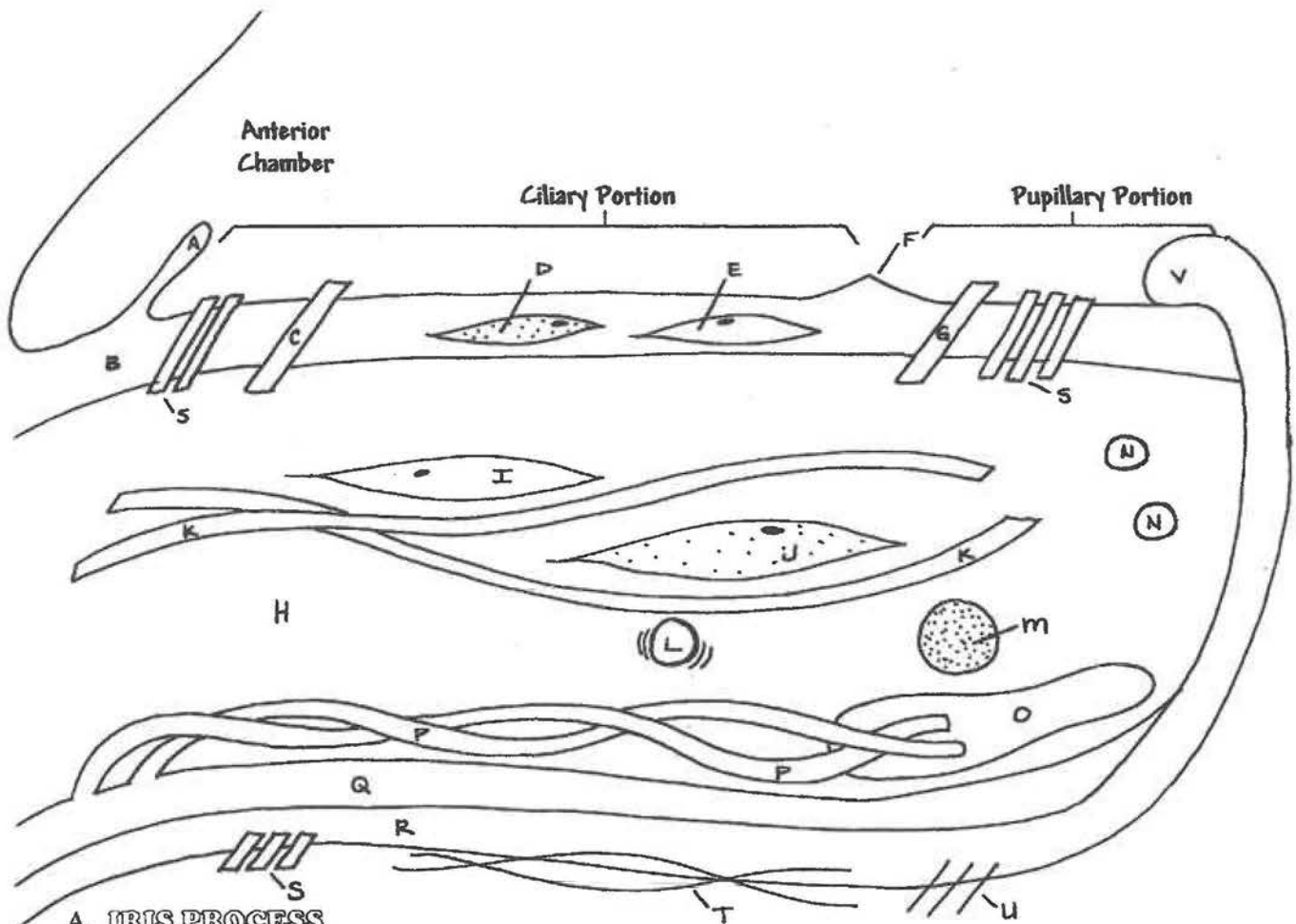
Vitreous

- A. CANAL OF PETIT OF POSTERIOR CHAMBER
- B. CANAL OF HANNOVER OF POSTERIOR CHAMBER
- C. UVEAL MESHWORK OF TRABECULAR MESHWORK
- D. CORNEOSCLERAL MESHWORK OF TRABECULAR MESHWORK
- E. SCHLEMM'S CANAL
- F. EXTERNAL COLLECTOR CHANNELS
- G. DEEP SCLERAL PLEXUS
- H. INTRASCLERAL PLEXUS
- I. EPISCLERAL PLEXUS
- J. CONJUNCTIVAL VEINS
- K. AQUEOUS VEINS OF ASCHNER

Make Up of Collagen

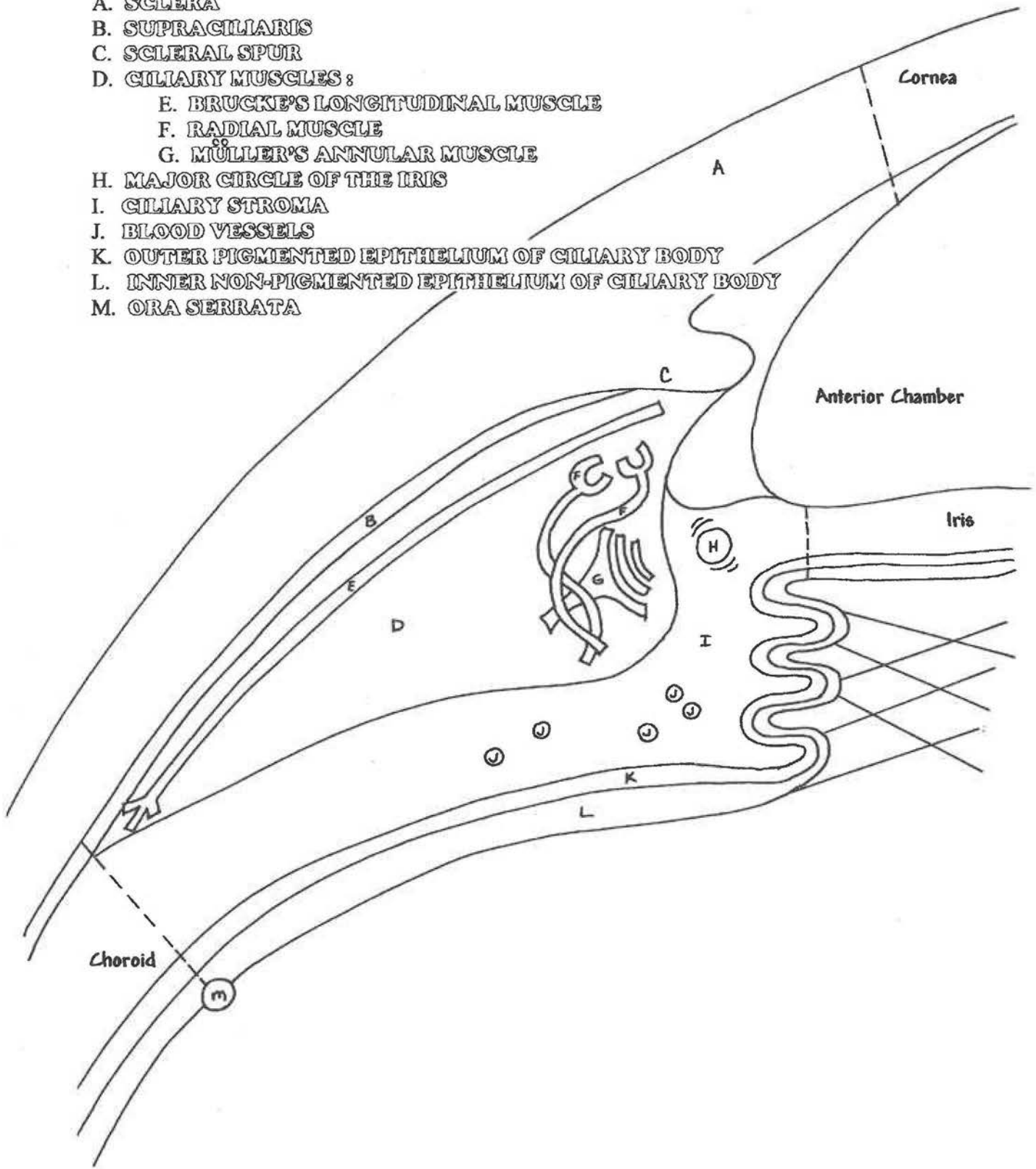
- A. AMINO ACIDS
- B. SUBUNITS
- C. TROPICOLLAGEN MOLECULE
- D. COLLAGEN FIBRIL
- E. COLLAGEN FIBER
- F. LAMELLAE

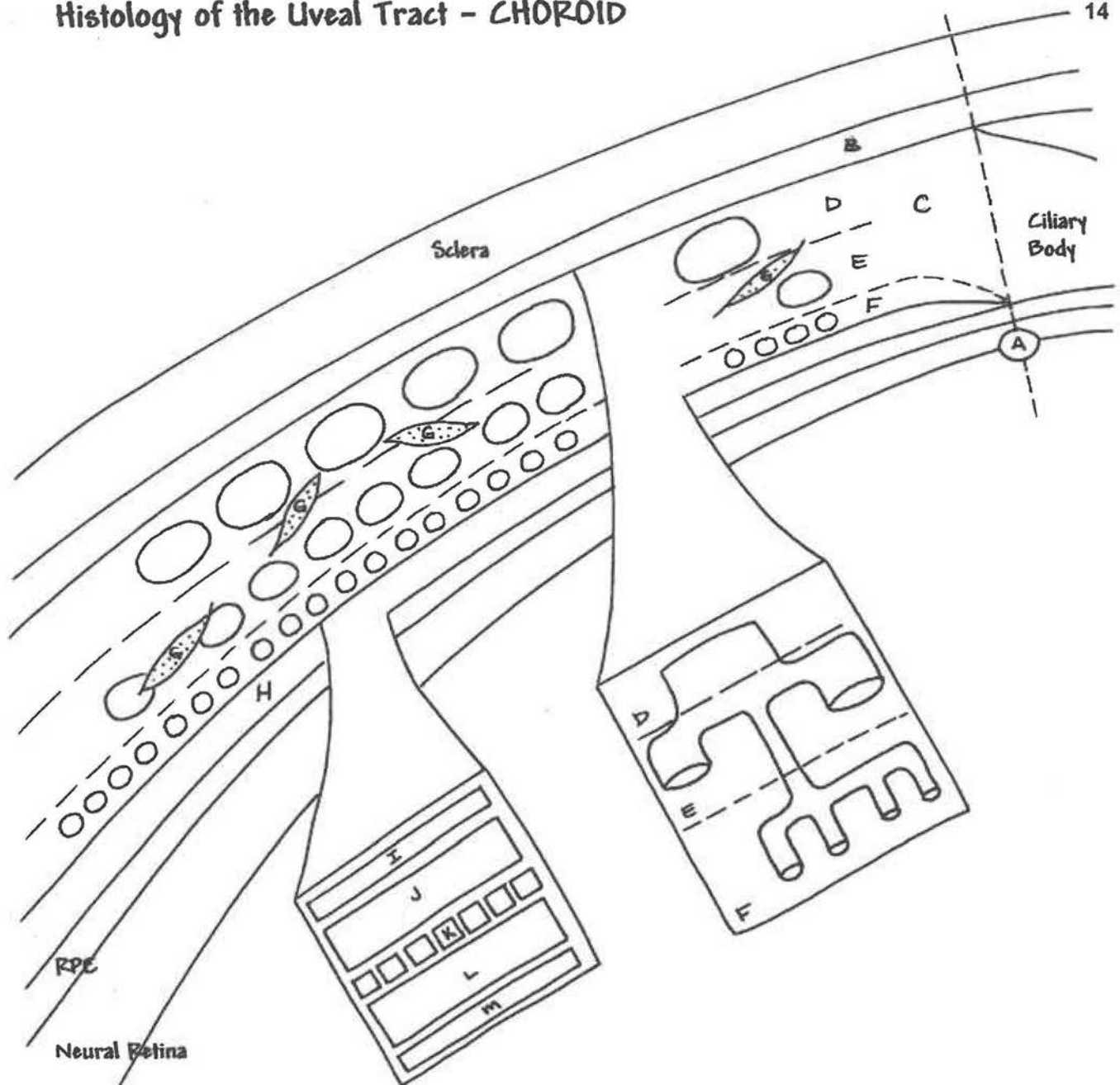




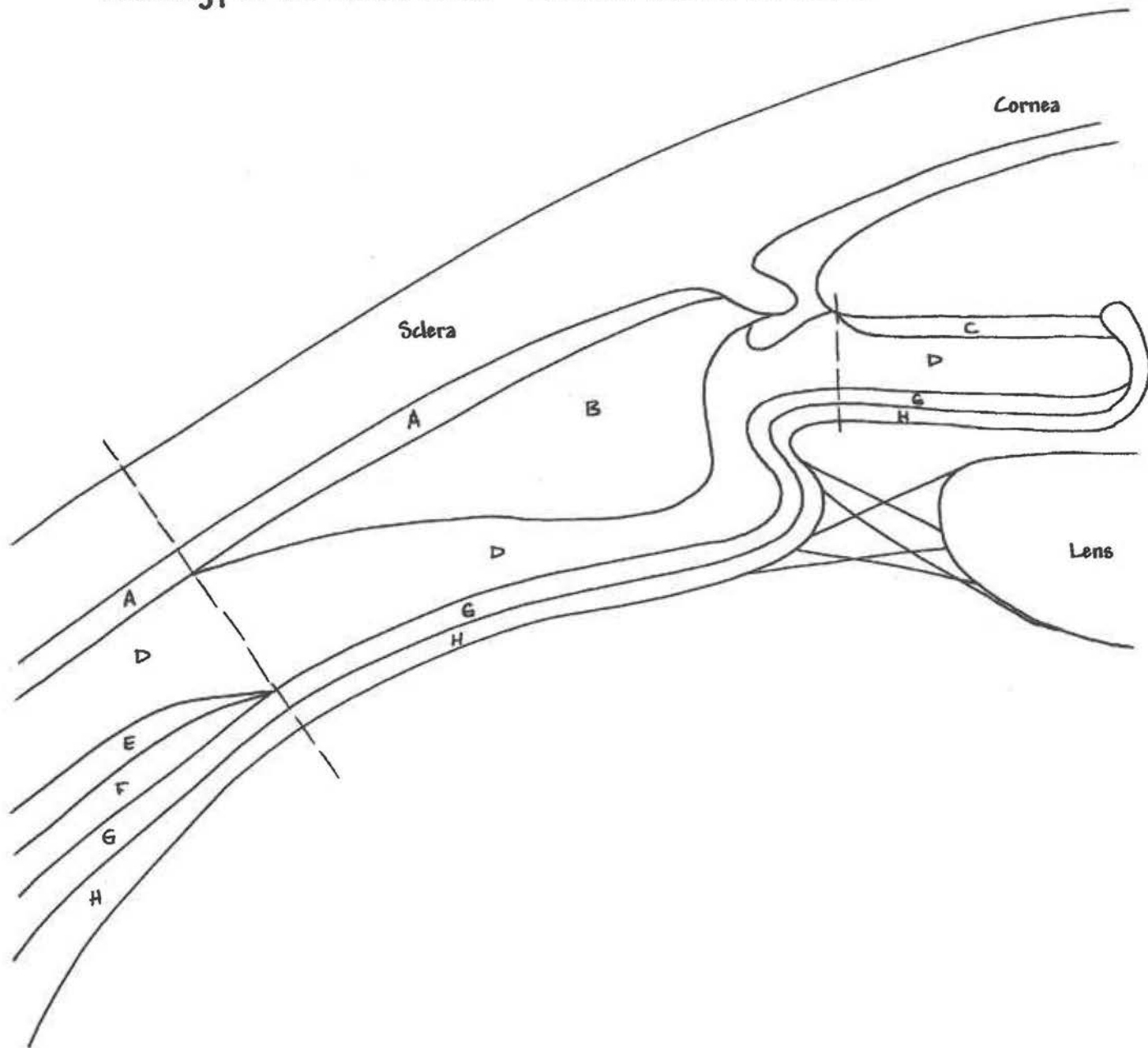
- A. IRIS PROCESS
- B. ANTERIOR BORDER LAYER OF THE IRIS
- C. PERIPHERAL CRYPTS
- D. MELANOCYTES OF ANTERIOR IRIS
- E. FIBROBLASTS OF ANTERIOR IRIS
- F. COLLERETTE
- G. CRYPTS OF FUCH
- H. IRIS STROMA
- I. FIBROBLASTS OF IRIS STROMA
- J. MELANOCYTES OF IRIS STROMA
- K. COLLAGEN FIBRILS
- L. MINOR CIRCLE OF THE IRIS
- M. CLUMP CELL
- N. BLOOD VESSELS
- O. SPHINCTER MUSCLE
- MYOEPIETHELIUM:
 - P. DILATOR MUSCLE
 - Q. ANTERIOR EPITHELIUM OF IRIS
 - R. POSTERIOR EPITHELIUM OF IRIS
 - S. CIRCULAR CONTRACTION FOLDS
 - T. STRUCTURAL FURROWS
 - U. RADIAL CONTRACTION FURROWS
 - V. PUPILLARY RUFF

- A. SCLERA
- B. SUPRACILIARIS
- C. SCLERAL SPUR
- D. CILIARY MUSCLES :
 - E. BRUCKE'S LONGITUDINAL MUSCLE
 - F. RADIAL MUSCLE
 - G. MÜLLER'S ANNULAR MUSCLE
- H. MAJOR CIRCLE OF THE IRIS
- I. CILIARY STROMA
- J. BLOOD VESSELS
- K. OUTER PIGMENTED EPITHELIUM OF CILIARY BODY
- L. INNER NON-PIGMENTED EPITHELIUM OF CILIARY BODY
- M. ORA SERRATA

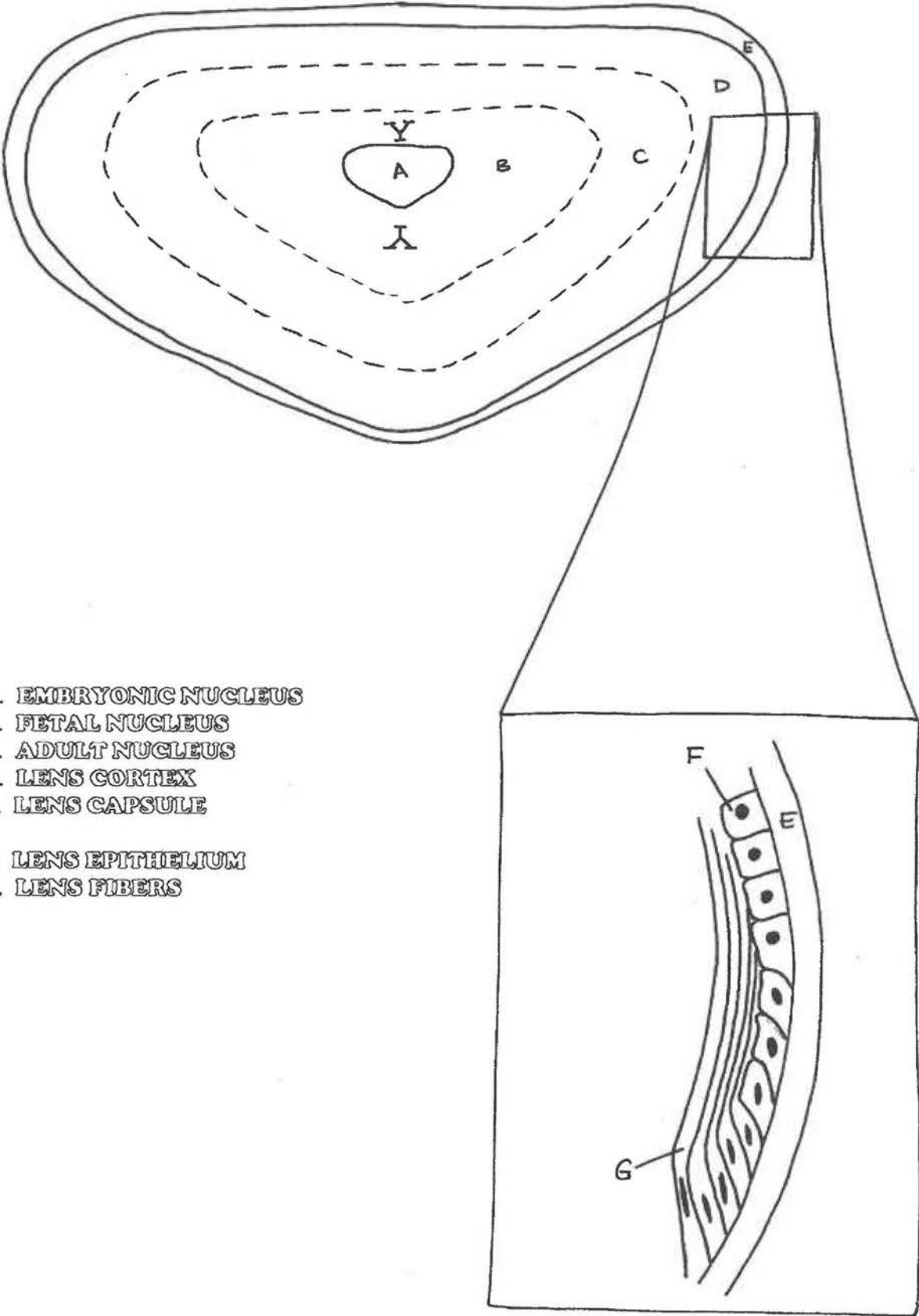




- A. ORA SERRATA
- B. SUPRACHOROID
- C. CHOROIDAL STROMA:
 - D. HALLER'S BLOOD VESSEL LAYER
 - E. SATTLER'S BLOOD VESSEL LAYER
 - F. CHORIOCAPILLARIS
- G. MELANOCYTES
- H. BRUCH'S MEMBRANE:
 - I. BASEMENT MEMBRANE OF CHORIOCAPILLARIS
 - J. OUTER COLLAGENOUS ZONE
 - K. ELASTIC LAYER
 - L. INNER COLLAGENOUS ZONE
 - M. BASEMENT MEMBRANE OF RPE

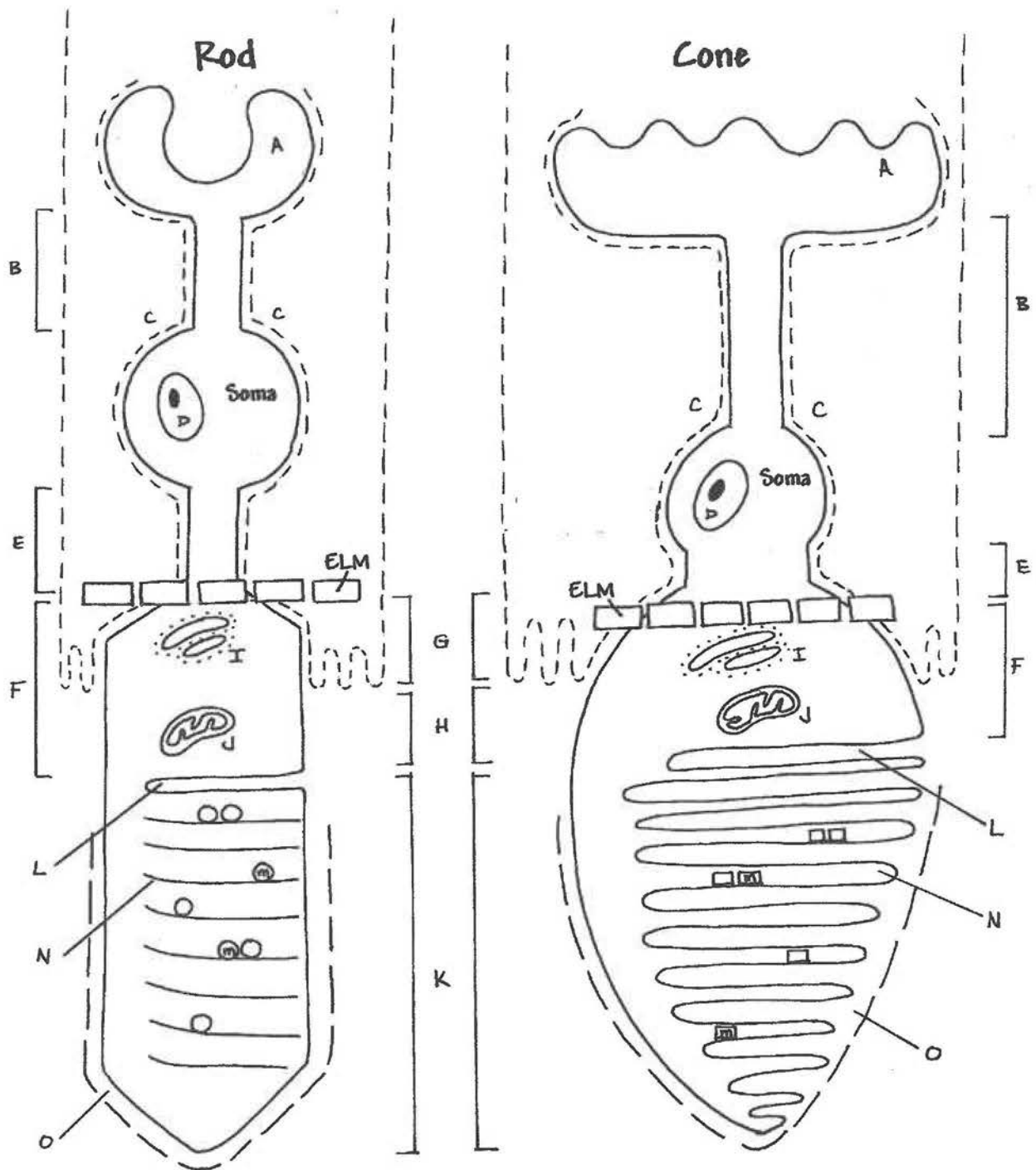


- A. SUPRACILIARIS & SUPRACHOROID
- B. CILIARY MUSCLE
- C. ANTERIOR BORDER LAYER OF THE IRIS
- D. IRIS STROMA,
CILIARY STROMA, &
CHOROIDAL STROMA
- E. CHORIOCAPILLARIS
- F. BRUCH'S MEMBRANE
- G. ANTERIOR IRIS EPITHELIUM,
OUTER PIGMENTED EPITHELIUM OF THE CILIARY BODY,
& RETINAL PIGMENTED EPITHELIUM
- H. POSTERIOR IRIS EPITHELIUM,
INNER NON-PIGMENTED EPITHELIUM OF THE CILIARY BODY,
& NEURAL RETINA



- A. EMBRYONIC NUCLEUS
- B. FETAL NUCLEUS
- C. ADULT NUCLEUS
- D. LENS CORTEX
- E. LENS CAPSULE

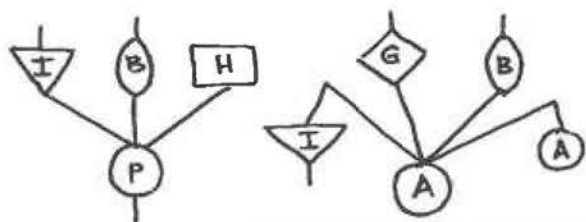
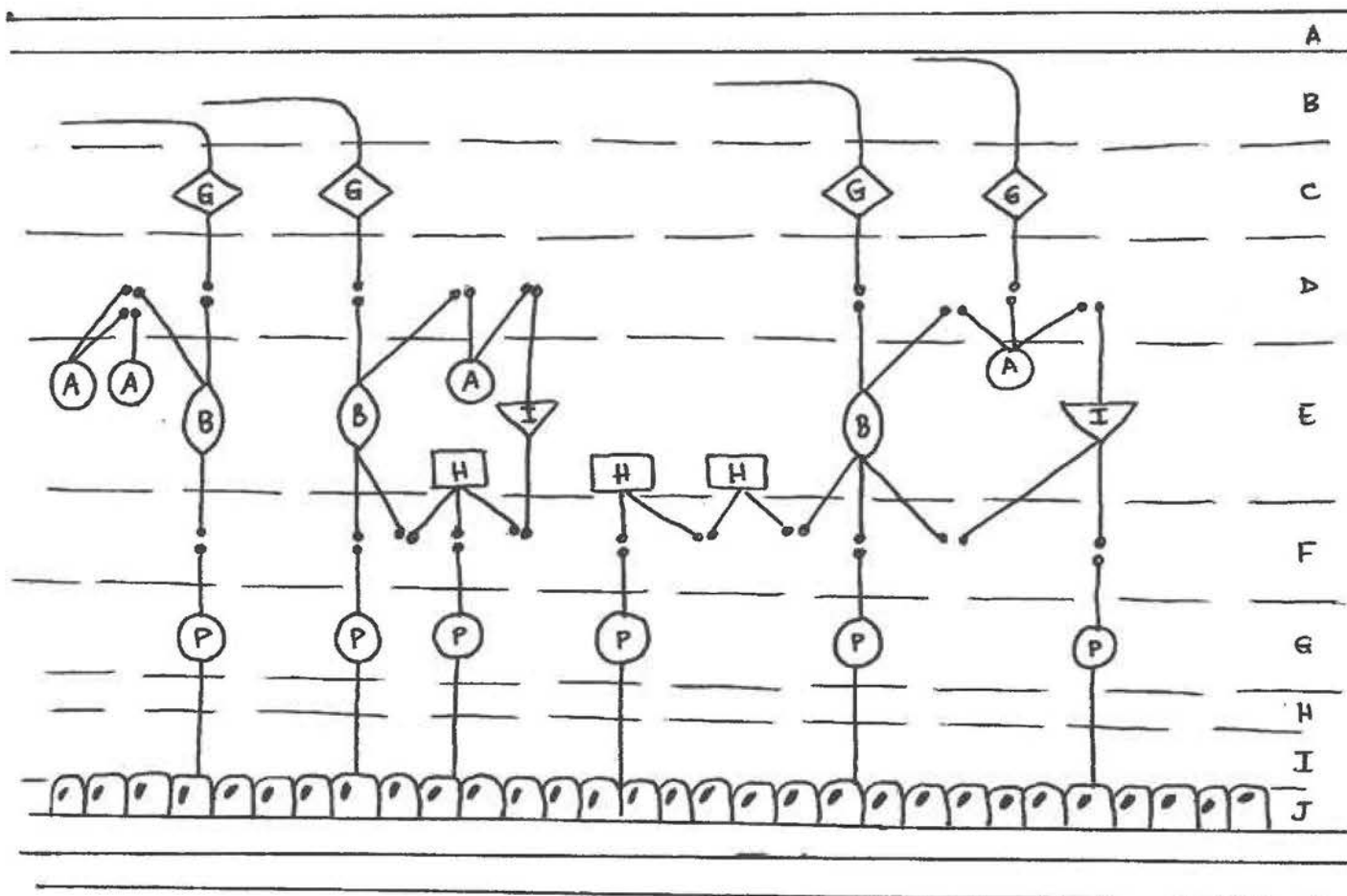
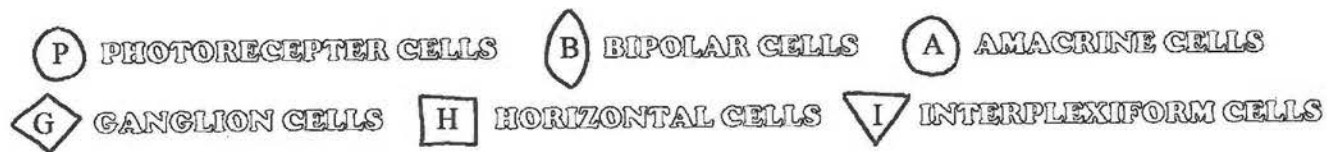
- F. LENS EPITHELIUM
- G. LENS FIBERS



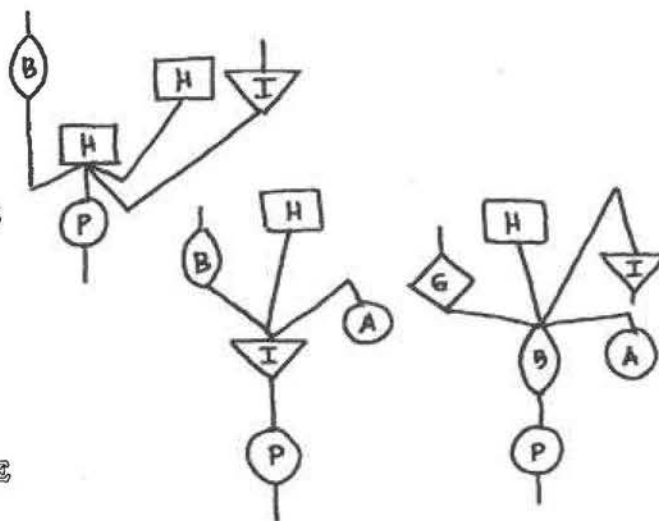
- A. SPHERE ON ROD,
PEDICLE ON CONE
- B. INNER FIBER
- C. MÜLLER CELL
- D. NUCLEUS
- E. OUTER FIBER
- F. INNER SEGMENT :
 - G. MYLOID PORTION
 - H. ELLIPSOID PORTION

- I. GOLGI APPARATUS
- J. MITOCHONDRIA
- K. OUTER SEGMENT
- L. CILIUM
- M. RHODOPSIN IN ROD,
IODOPSIN IN CONE
- N. DISCS
- O. INTERPHOTORECEPTOR
MATRIX

10 Layers, Cells, & Synapses of the Retina

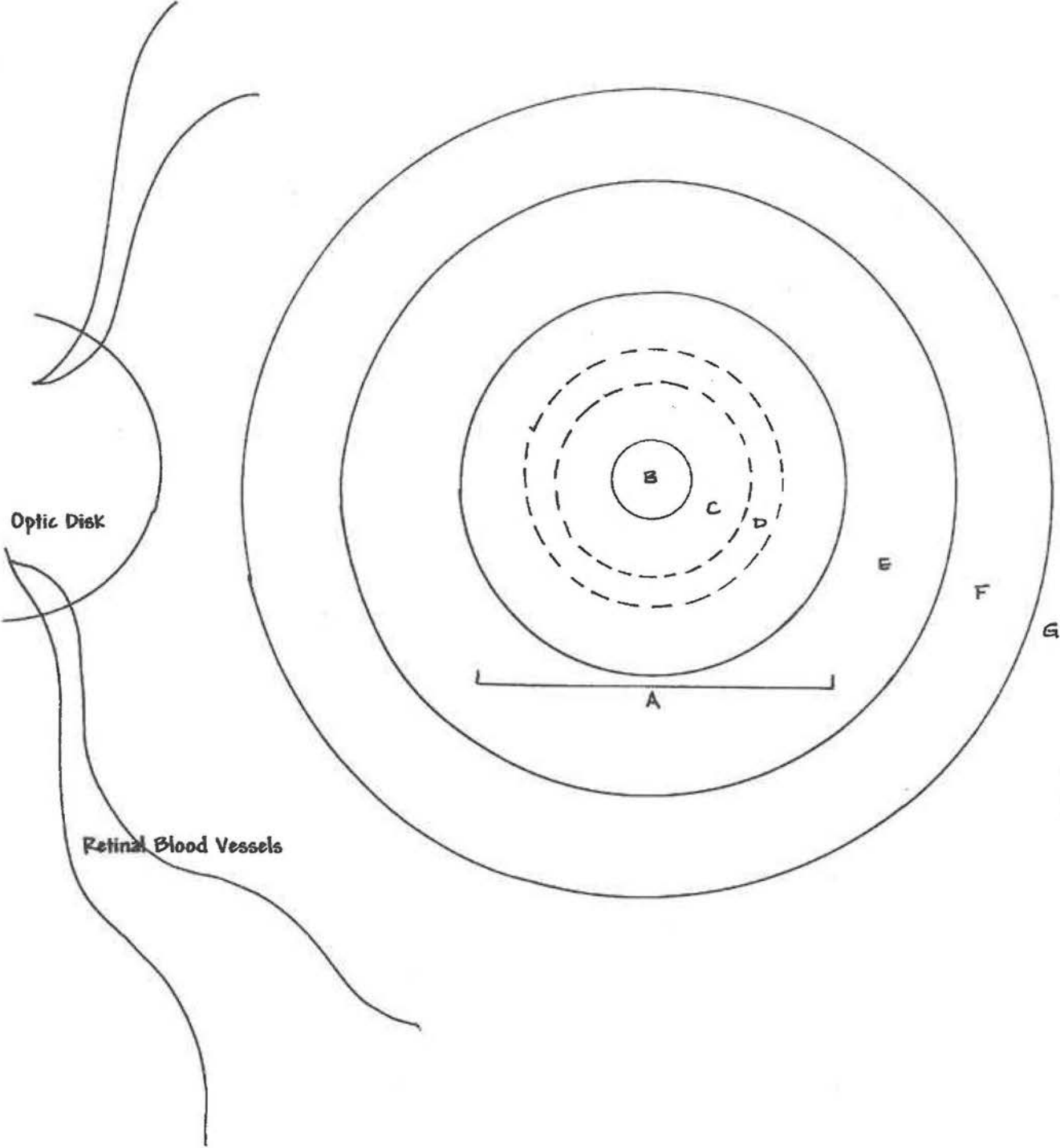


- A. INTERNAL LIMITING MEMBRANE
- B. NERVE FIBER LAYER
- C. GANGLION CELLS LAYER
- D. INNER PLEXIFORM LAYER
- E. INNER NUCLEAR LAYER
- F. OUTER PLEXIFORM LAYER
- G. OUTER NUCLEAR LAYER
- H. EXTERNAL LIMITING MEMBRANE
- I. PHOTORECEPTOR LAYER
- J. RETINAL PIGMENTED EPITHELIUM



Regions of the Retina

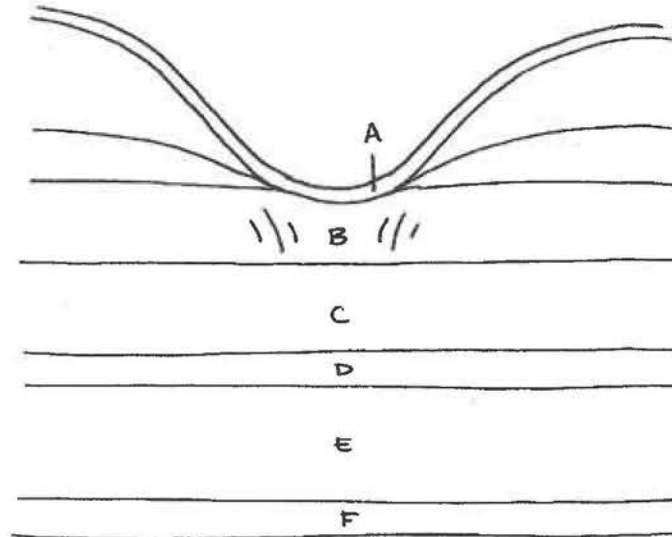
- A. FOVEA
- B. FOVEOLA
- C. CAPILLARY FREE ZONE
- D. ROD FREE ZONE
- E. PARAFOVEAL
- F. PERIFOVEAL
- G. PERIPHERAL RETINA



Layers of the Foveola

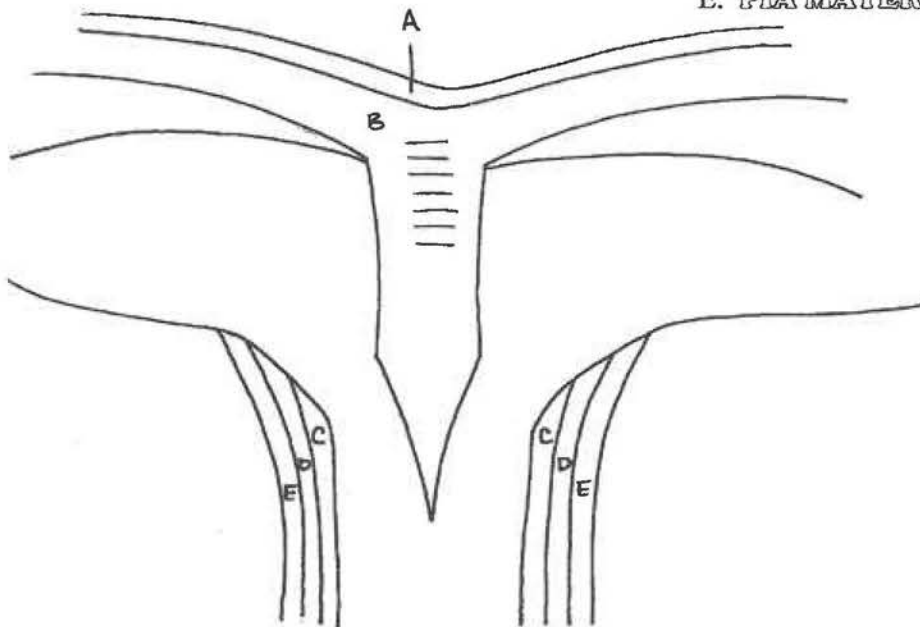
20

- A. INNER LIMITING MEMBRANE
- B. HENLE'S FIBER LAYER
- C. OUTER NUCLEAR LAYER
- D. EXTERNAL LIMITING MEMBRANE
- E. PHOTORECEPTOR LAYER
- F. RETINAL PIGMENTED EPITHELIUM

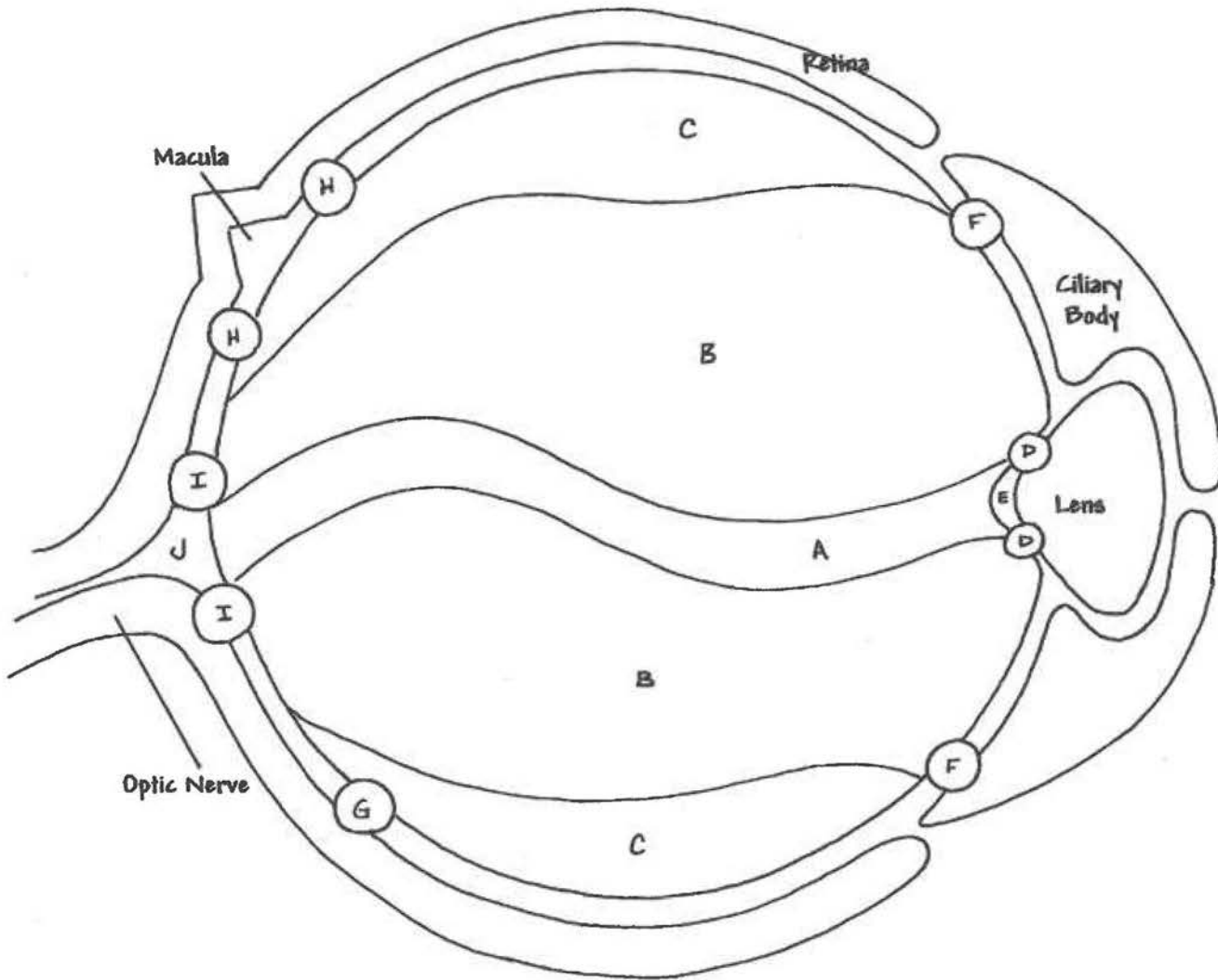


Optic Disc Area

- A. INNER LIMITING MEMBRANE
- B. NERVE FIBER LAYER
- C. DURA MATER MENINGEAL SHEATH
- D. ARACHNOID MENINGEAL SHEATH
- E. PIA MATER MENINGEAL SHEATH



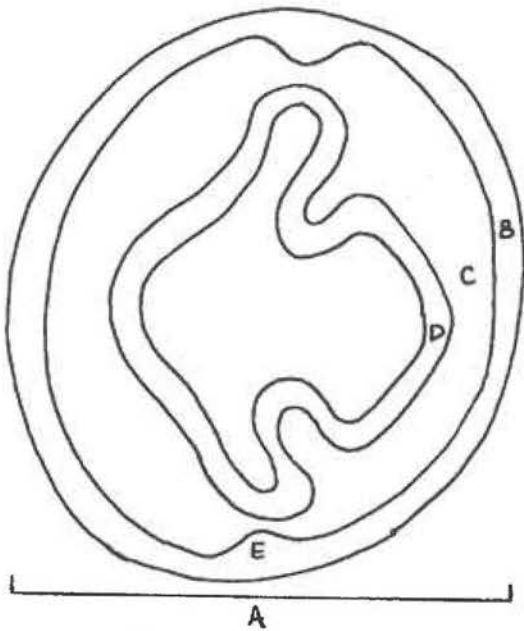
- A. CLOQUET'S OR HYALOID CANAL
- B. INTERMEDIATE ZONE
- C. CORTEX
- D. HYALOIDEOCAPSULAR LIGAMENT OF WEIGER ATTACHMENT
- E. RETROLENTAL SPACE OF BERGER
- F. VITREOUS BASE ATTACHMENT
- G. ATTACHMENT AROUND LARGE VESSELS
- H. PERIMACULAR ATTACHMENT
- I. PERIPAPILLARY ATTACHMENT
- J. AREA OF MARTEGIONI



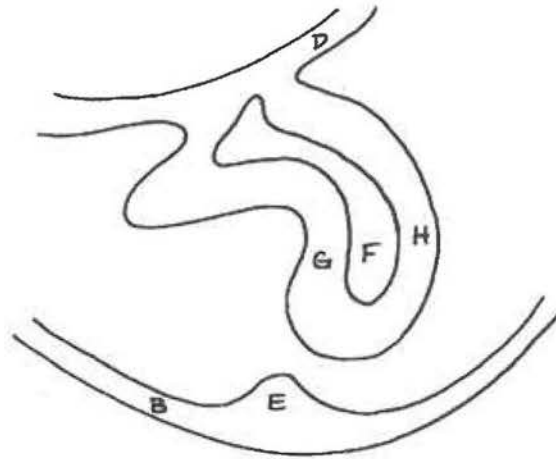
Embryology Lab Slides

Sequence of 6 slides showing the developing eye. Labels A through K continue to slides 5 & 6 on the next page.

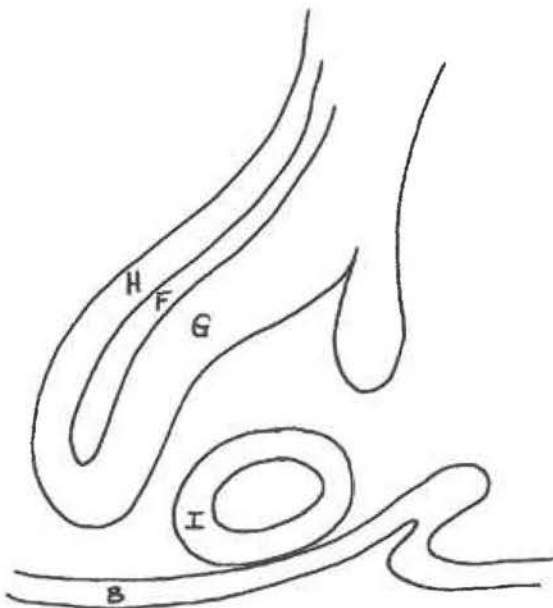
- A. NEURAL TUBE
- B. SURFACE ECTODERM
- C. MESENCHYME
- D. NEURAL ECTODERM
- E. LENS PLACODE/PLATE
- F. INTRARETINAL SPACE
- G. INNER OPTIC CUP LAYER
- H. OUTER OPTIC CUP LAYER
- I. LENS VESICLE
- J. BEGINNINGS OF HYALOIOD VESSEL SYSTEM
- K. PIGMENT PRESENT IN THE OUTER LAYER OF THE OPTIC CUP



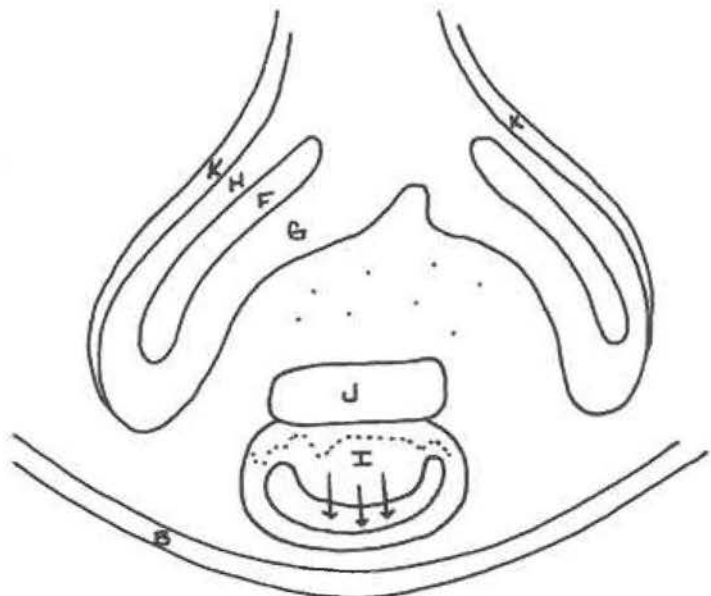
Slide 1 - 6mm pig embryo



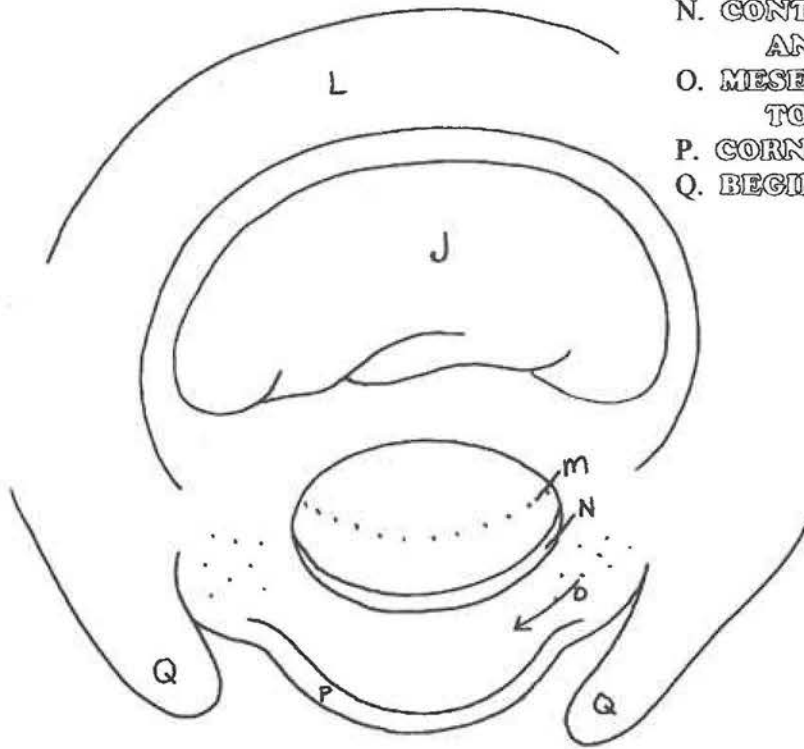
Slide 2 - 8mm pig embryo



Slide 3 - 10mm pig embryo



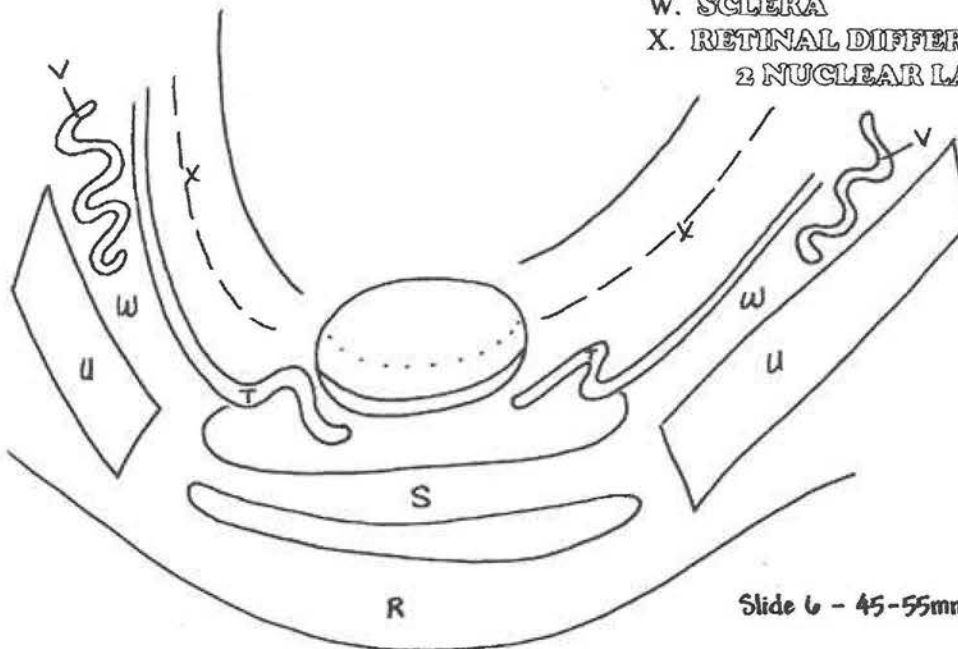
Slide 4 - 15mm pig embryo



- L. OPTIC CUP
- M. LENS BOW
- N. CONTINUED PRESENCE OF ANTERIOR LENS EPITHELIUM
- O. MESENCHYME MOVING FORWARD TO FORM CORNEAL STROMA
- P. CORNEAL EPITHELIUM
- Q. BEGINNINGS OF EYELIDS

Slide 5 - 25mm pig embryo

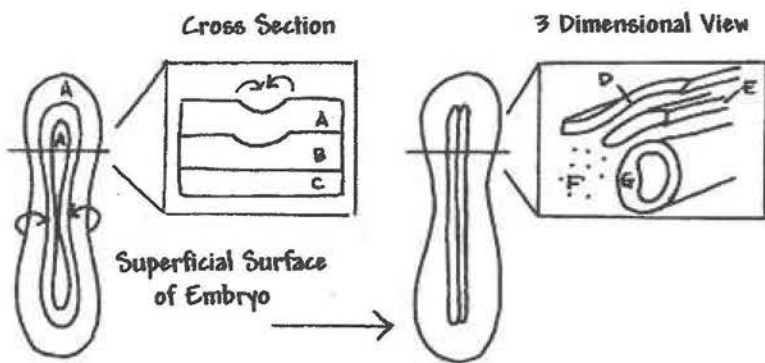
- R. EYELIDS ARE FUSED TOGETHER
- S. CORNEA
- T. IRIS IS BEGINNING TO ADVANCE ANTERIOR TO THE LENS
- U. EXTRAOCULAR MUSCLES
- V. CHOROIDAL VESSELS MAY BE EVIDENT
- W. SCLERA
- X. RETINAL DIFFERENTIATION INTO 2 NUCLEAR LAYERS



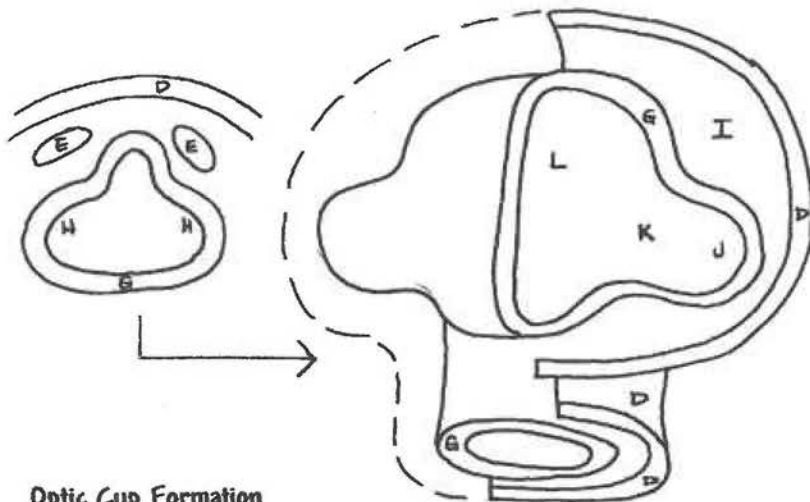
Slide 6 - 45-55mm pig embryo

Embryology of the Visual System

Labels A-Z include embryology on this page and continue onto the next page.

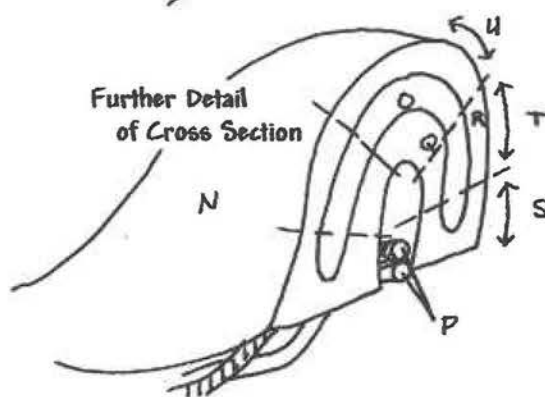
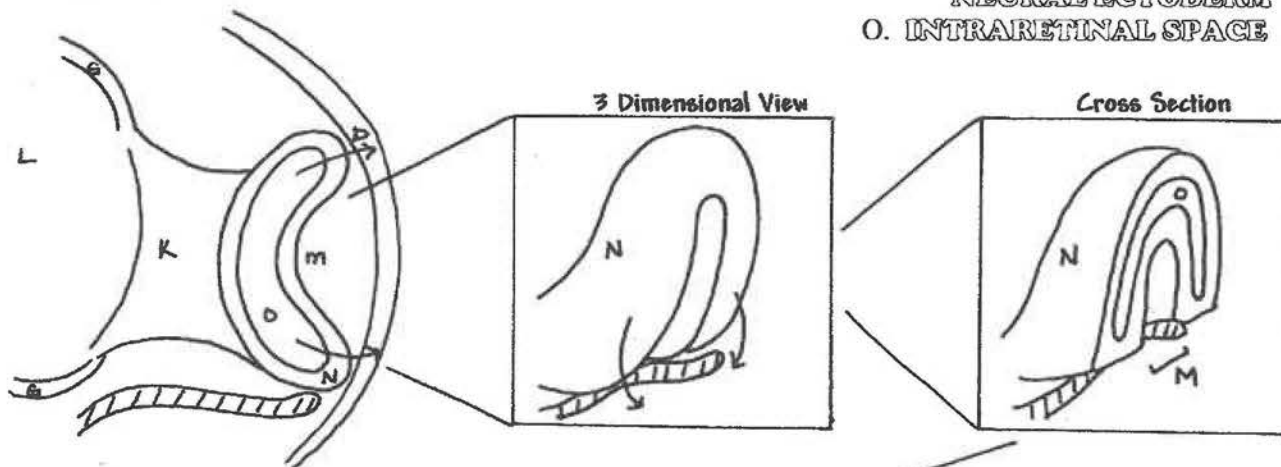


- A. ECTODERM
- B. MESODERM
- C. ENDODERM
- D. SURFACE ECTODERM
- E. NEURAL CREST CELLS
- F. MESODERM
- G. NEURAL TUBE MADE OF NEURAL ECTODERM
- H. OPTIC PITS

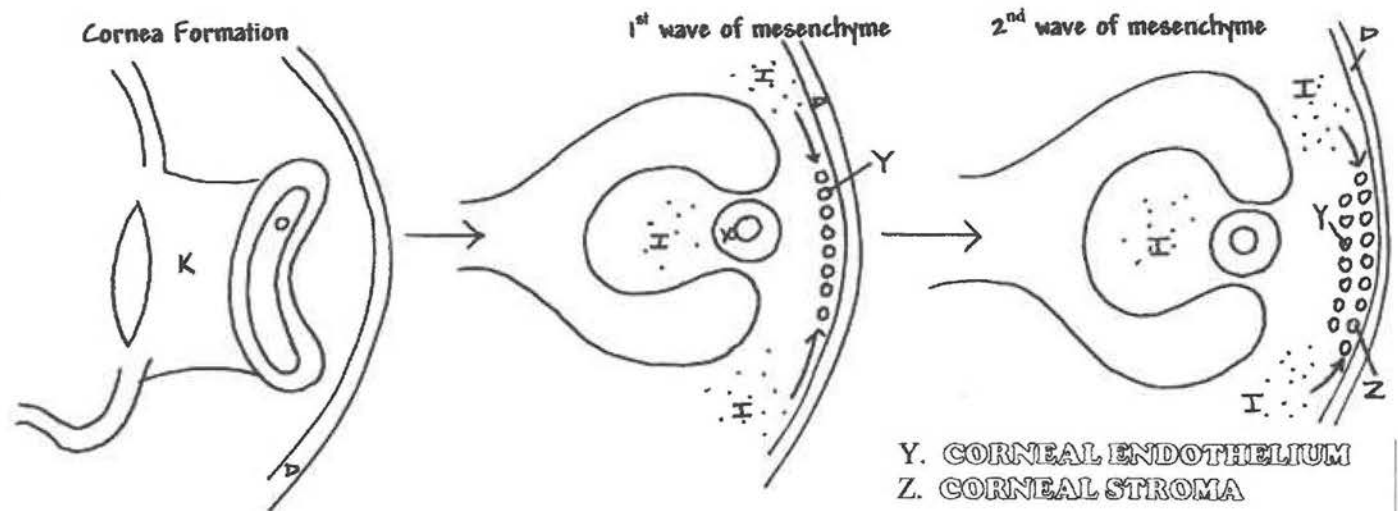
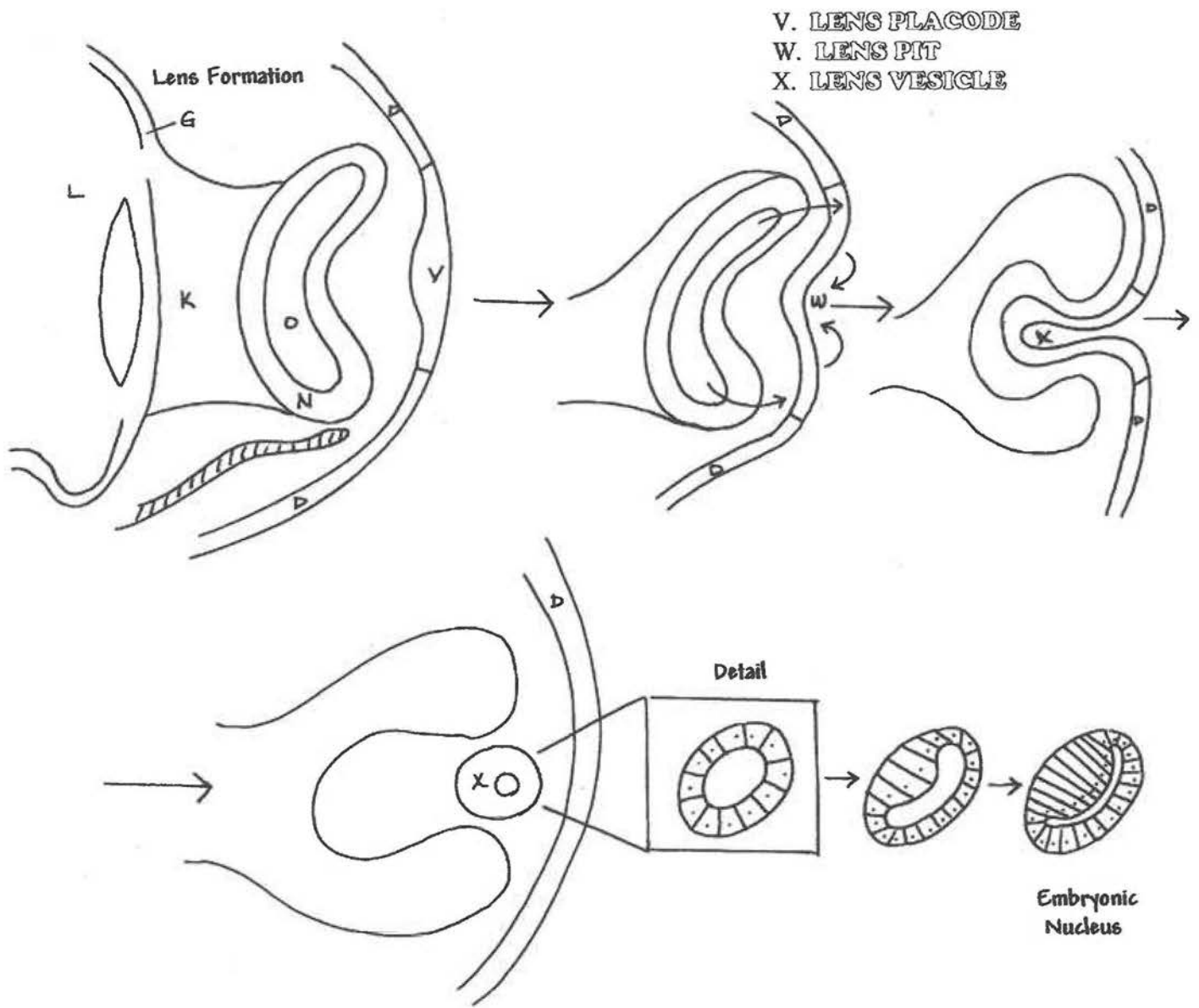


- I. MESENCHYME (MESODERM & NEURAL CREST CELLS)
- J. OPTIC VESICLE
- K. OPTIC STALK
- L. 3RD VENTRICLE
- M. OPTIC FISSURE
- N. OPTIC CUP MADE OF NEURAL ECTODERM
- O. INTRARETINAL SPACE

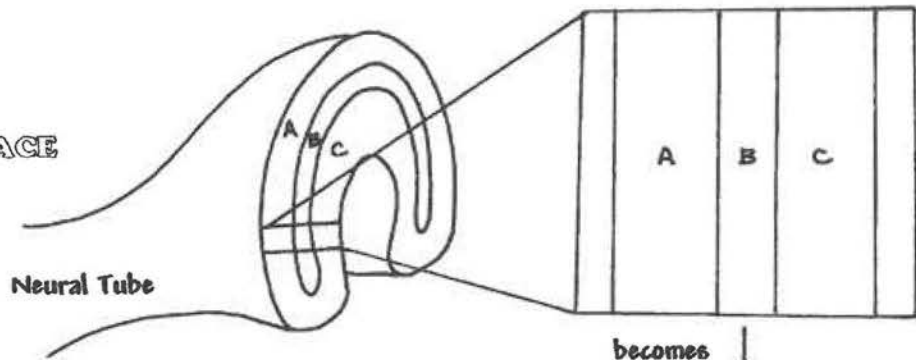
Optic Cup Formation



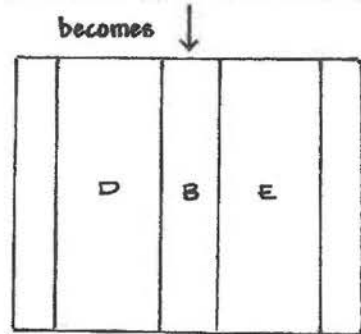
- P. HYALOID ARTERY & VEIN
- Q. INNER OPTIC CUP
- R. OUTER OPTIC CUP
- S. WILL BECOME IRIS
- T. WILL BECOME CILIARY BODY EPITHELIUM
- U. WILL BECOME RETINA



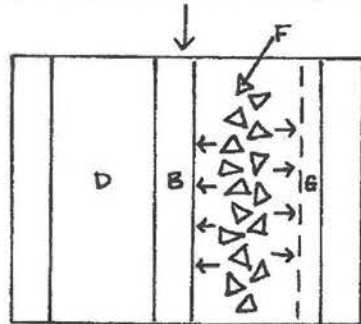
- A. OUTER OPTIC CUP
- B. INTRARETINAL SPACE
- C. INNER OPTIC CUP



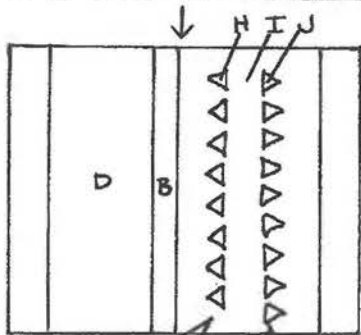
- D. RETINAL PIGMENTED EPITHELIUM
- E. NEURAL RETINA



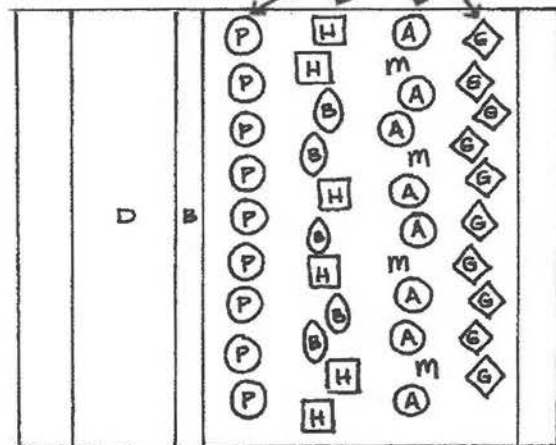
- F. PROLIFERATIVE ZONE
- G. MARGINAL ZONE OF HIS



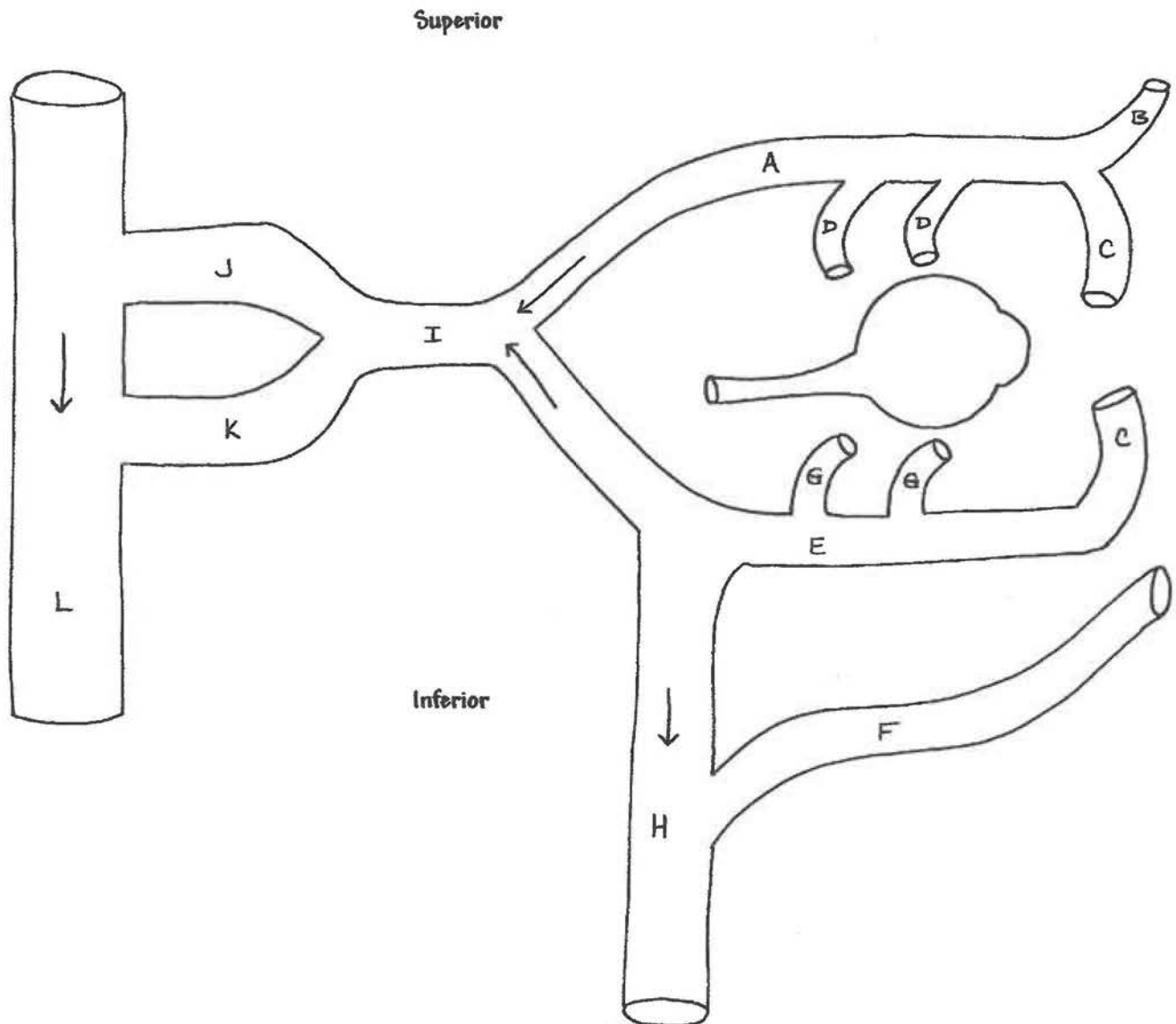
- H. OUTER NEUROBLASTIC LAYER
- I. TRANSIENT LAYER OF CHIVITZ
- J. INNER NEUROBLASTIC LAYER

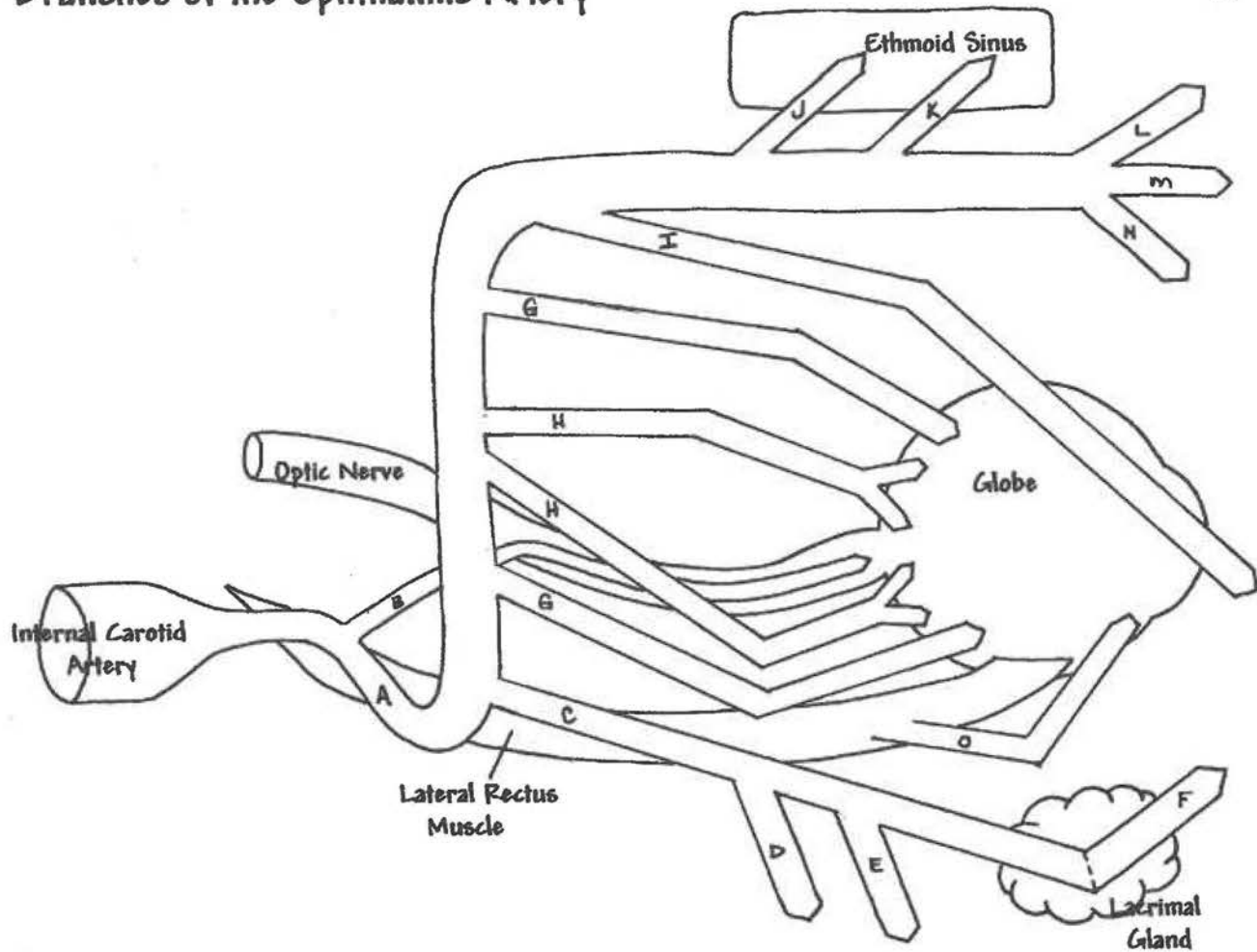


- (P) PHOTORECEPTOR CELLS
- (H) HORIZONTAL CELLS
- (B) BIPOLAR CELLS
- (A) AMACRINE CELLS
- (M) MÜLLER CELLS
- (G) GANGLION CELLS



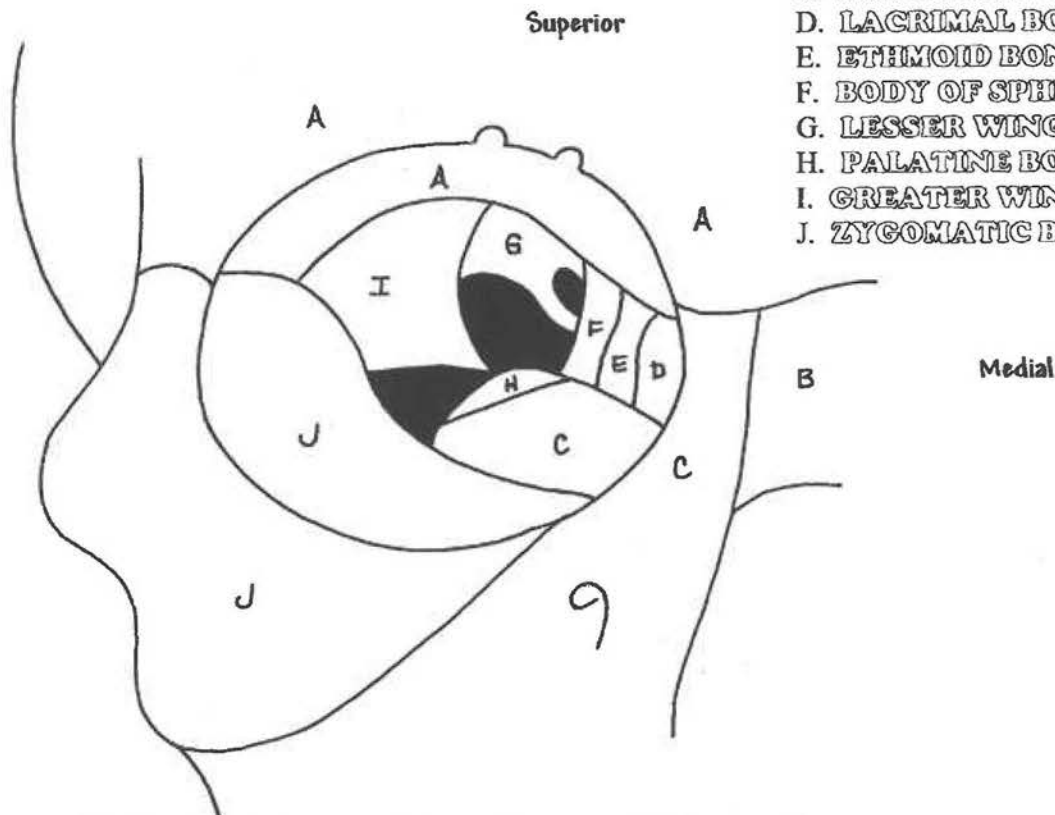
- A. SUPERIOR OPHTHALMIC VEIN
- B. SUPRAORBITAL VEIN
- C. ANGULAR VEIN
- D. SUPERIOR VORTEX VEINS
- E. INFERIOR OPHTHALMIC VEIN
- F. INFRAORBITAL VEIN
- G. INFERIOR VORTEX VEINS
- H. PTERGOID VENOUS PLEXUS
- I. CAVERNOUS SINUS
- J. SUPERIOR PETROSAL SINUS
- K. INFERIOR PETROSAL SINUS
- L. INTERNAL JUGULAR VEIN



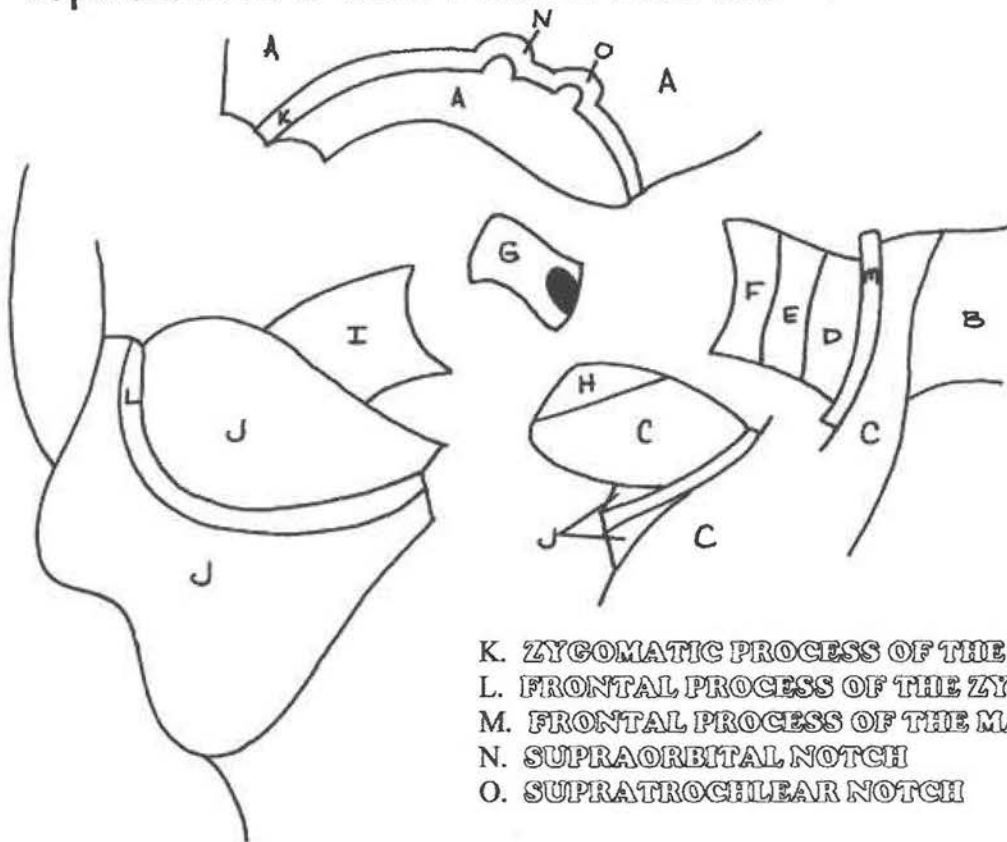


- A. OPHTHALMIC ARTERY
- B. CENTRAL RETINAL ARTERY
- C. LACRIMAL ARTERY
 - D. ZYGOMATICOFACIAL ARTERY
 - E. ZYGOMATICOTEMPORAL ARTERY
 - F. LATERAL PALPEBRAL ARTERY
- G. LONG POSTERIOR CILIARY ARTERIES
- H. SHORT POSTERIOR CILIARY ARTERIES
- I. SUPRAORBITAL ARTERY
- J. POSTERIOR ETHMOID ARTERY
- K. ANTERIOR ETHMOID ARTERY
- L. SUPRATROCHLEAR ARTERY
- M. DORSONASAL ARTERY
- N. MEDIAL PALPEBRAL ARTERY
- O. ANTERIOR CILIARY ARTERIES

- A. FRONTAL BONE
- B. NASAL BONE
- C. MAXILLARY BONE
- D. LACRIMAL BONE
- E. ETHMOID BONE
- F. BODY OF SPHENOID
- G. LESSER WING OF SPHENOID
- H. PALATINE BONE
- I. GREATER WING OF SPHENOID
- J. ZYGOMATIC BONE



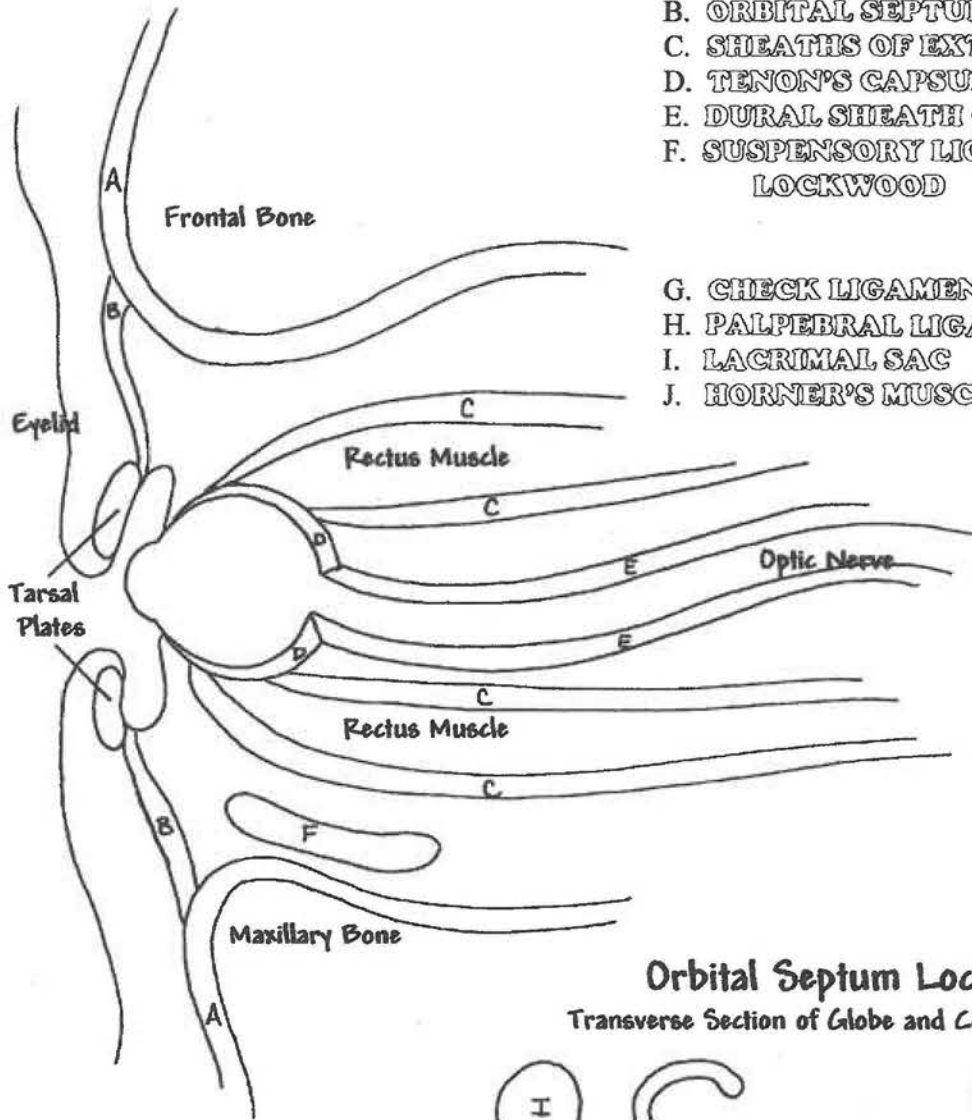
Exploded Orbit to Show Bones of Each Wall



- K. ZYGOMATIC PROCESS OF THE FRONTAL BONE
- L. FRONTAL PROCESS OF THE ZYGOMATIC BONE
- M. FRONTAL PROCESS OF THE MAXILLARY BONE
- N. SUPRAORBITAL NOTCH
- O. SUPRATROCHLEAR NOTCH

Orbital Connective Tissue

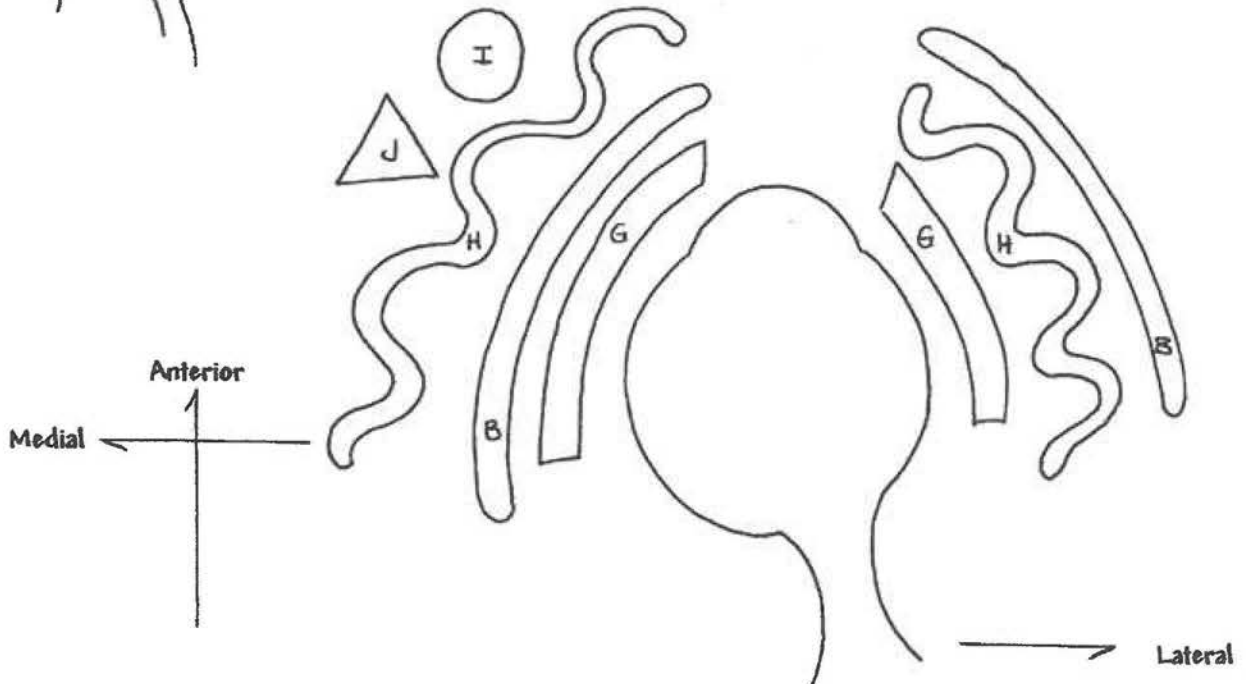
Sagittal Section of Globe and Connective Tissue



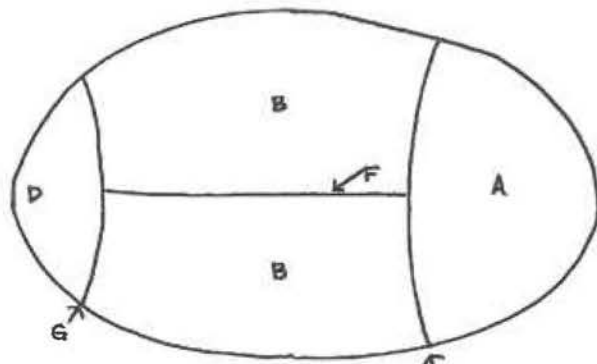
- A. PERIORBITA
- B. ORBITAL SEPTUM
- C. SHEATHS OF EXTRAOCULAR MUSCLE
- D. TENON'S CAPSULE
- E. DURAL SHEATH OF OPTIC NERVE
- F. SUSPENSORY LIGAMENT OF LOCKWOOD
- G. CHECK LIGAMENT
- H. PALPEBRAL LIGAMENT
- I. LACRIMAL SAC
- J. HORNER'S MUSCLE

Orbital Septum Location

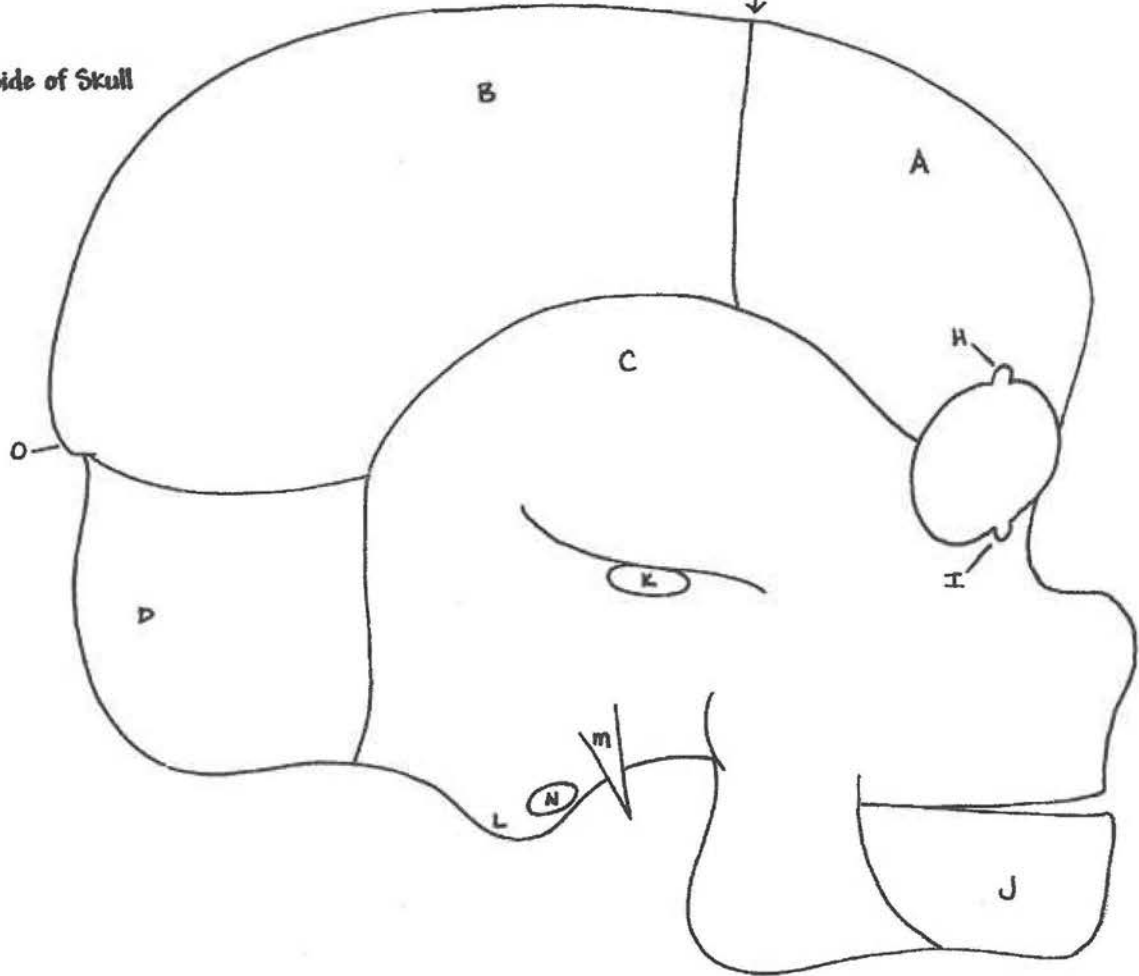
Transverse Section of Globe and Connective Tissues



Superior View of Skull

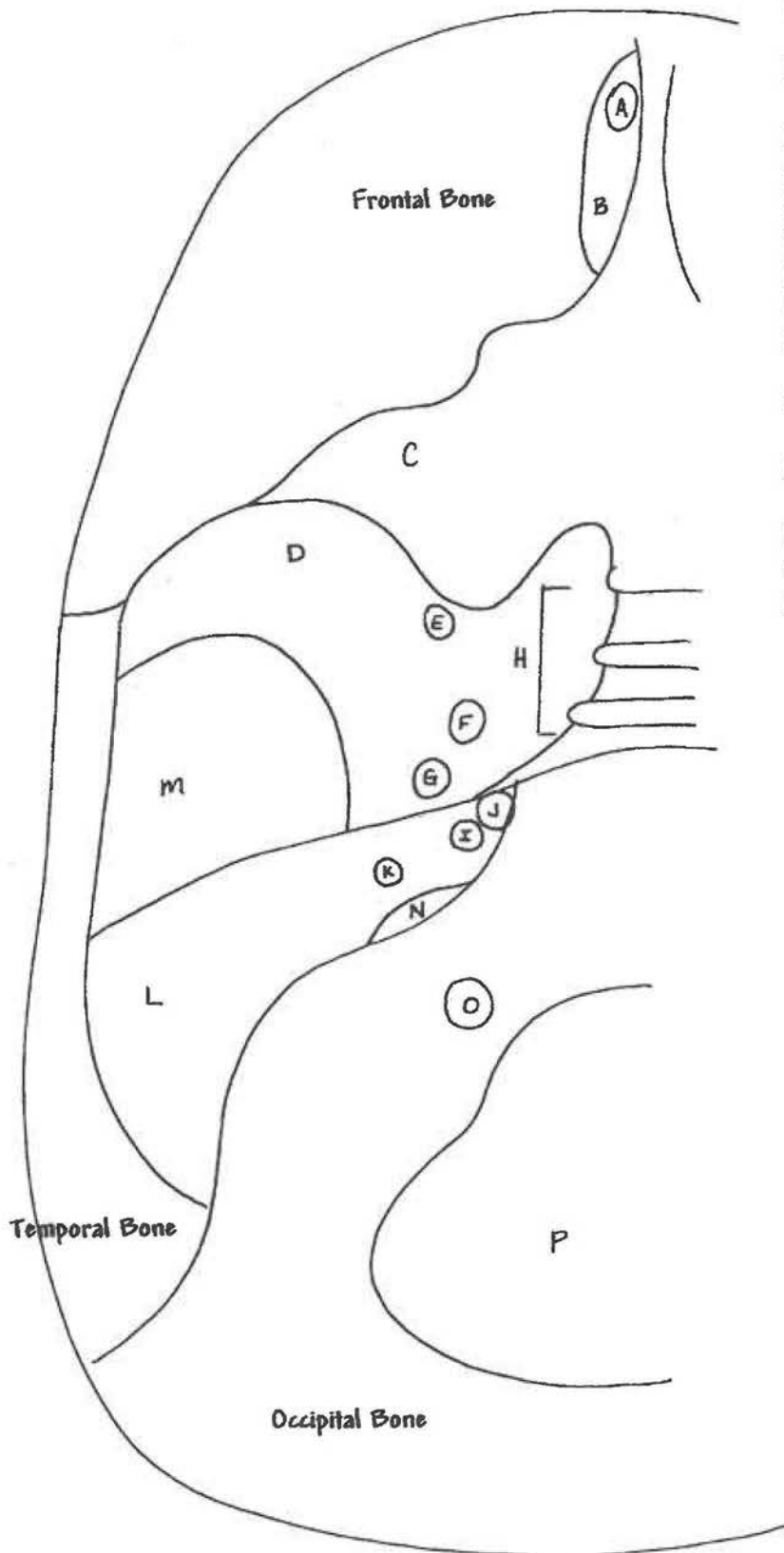


Right Side of Skull

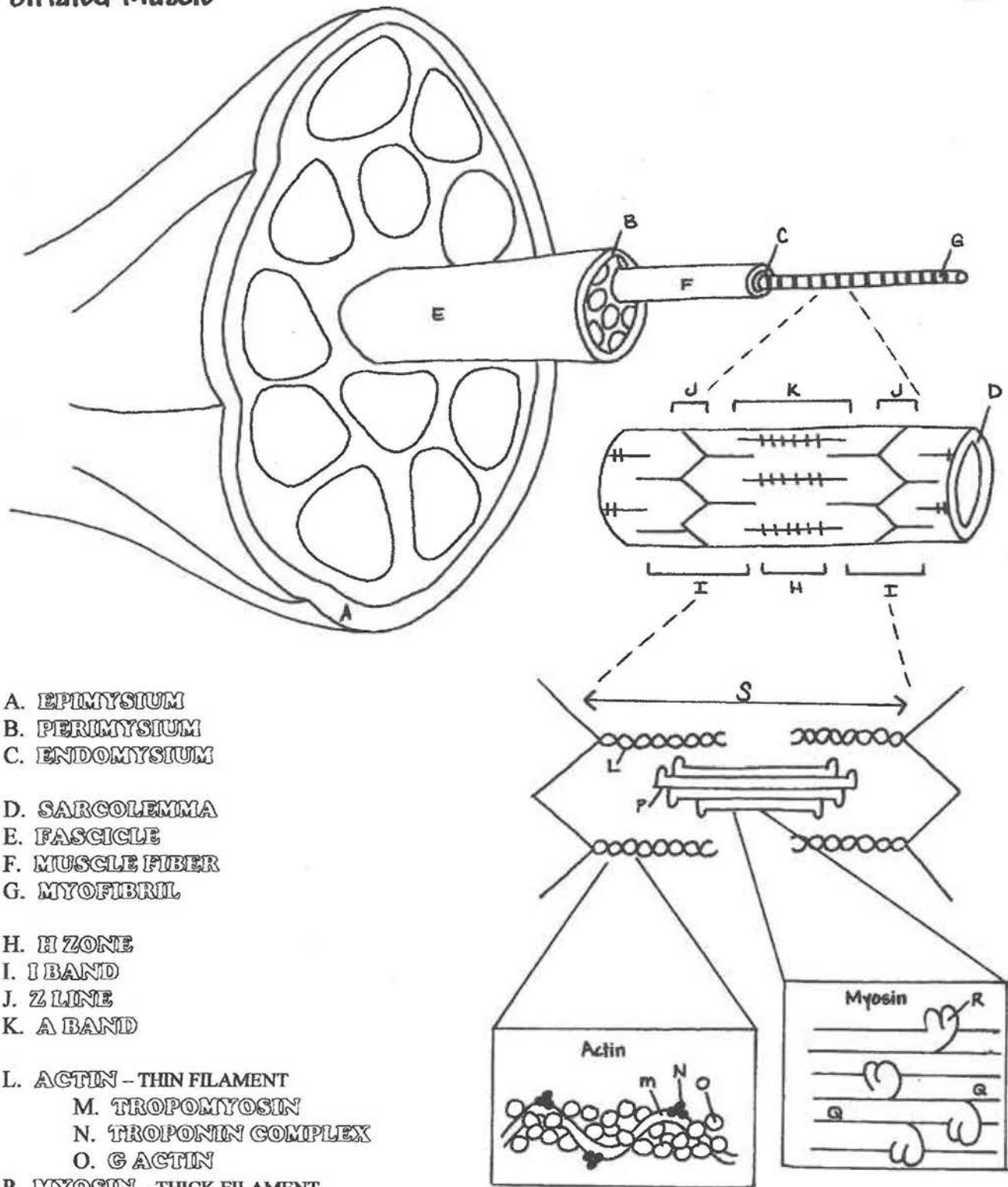


- A. FRONTAL BONE
- B. PARIETAL BONE
- C. TEMPORAL BONE
- D. OCCIPITAL BONE
- E. CORONAL SUTURE
- F. SAGITTAL SUTURE
- G. LAMBDOID SUTURE

- H. SUPRAORBITAL NOTCH
- I. INFRAORBITAL NOTCH
- J. MANDIBLE BONE
- K. EXTERNAL ACOUSTIC FOREMAN
- L. MASTOID PROCESS
- M. STYLOID PROCESS
- N. STYLOMASTOID FORAMEN
- O. EXTERNAL OCCIPITAL
PROTUBERANCE OR INION



- A. OLFACTORY FOREMAN
- B. CRIBIFORM PLATE OF ETHMOID BONE
- C. LESSER WING OF THE SPHENOID
- D. GREATER WING OF THE SPHENOID
- E. FOREMAN ROTUNDUM
- F. FOREMAN OVALE
- G. FOREMAN SPINOSUM
- H. SELLA TURCICA
- I. CAROTID CANAL
- J. FOREMAN LAGERUM
- K. INTERNAL ACOUSTIC FOREMAN
- L. PETROUS PORTION OF THE TEMPORAL BONE
- M. SQUAMOUS PORTION OF THE TEMPORAL BONE
- N. JUGULAR FOREMAN
- O. HYPOGLOSSAL CANAL
- P. FOREMAN MAGNUM

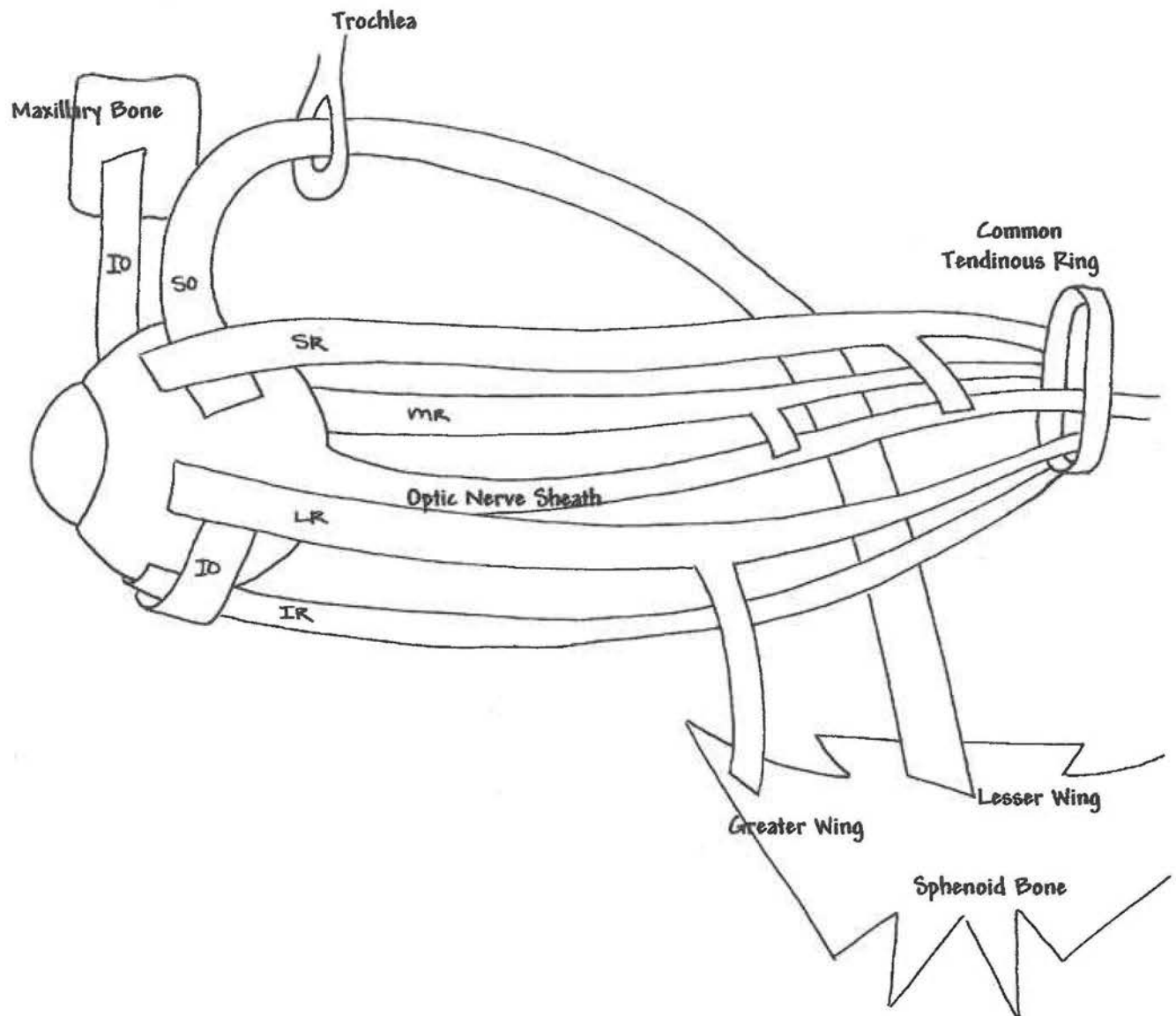


- A. EPIMYSIUM
- B. PERIMYSIUM
- C. ENDOMYSIUM

- D. SARCOLEMMMA
- E. FASCICLE
- F. MUSCLE FIBER
- G. MYOFIBRIL

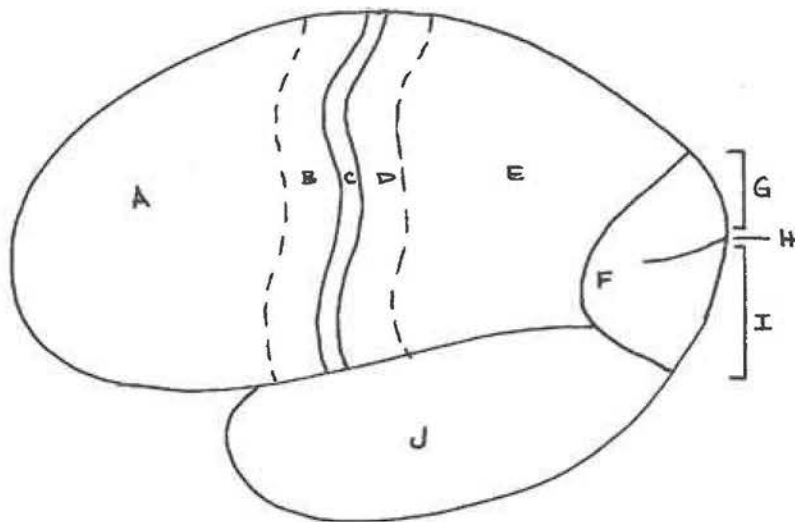
- H. H ZONE
- I. I BAND
- J. Z LINE
- K. A BAND

- L. ACTIN - THIN FILAMENT
 - M. TROPOMYOSIN
 - N. TROPONIN COMPLEX
 - O. G ACTIN
- P. MYOSIN - THICK FILAMENT
 - Q. MYOSIN TAIL
 - R. MYOSIN HEAD
- S. SARCOMERE



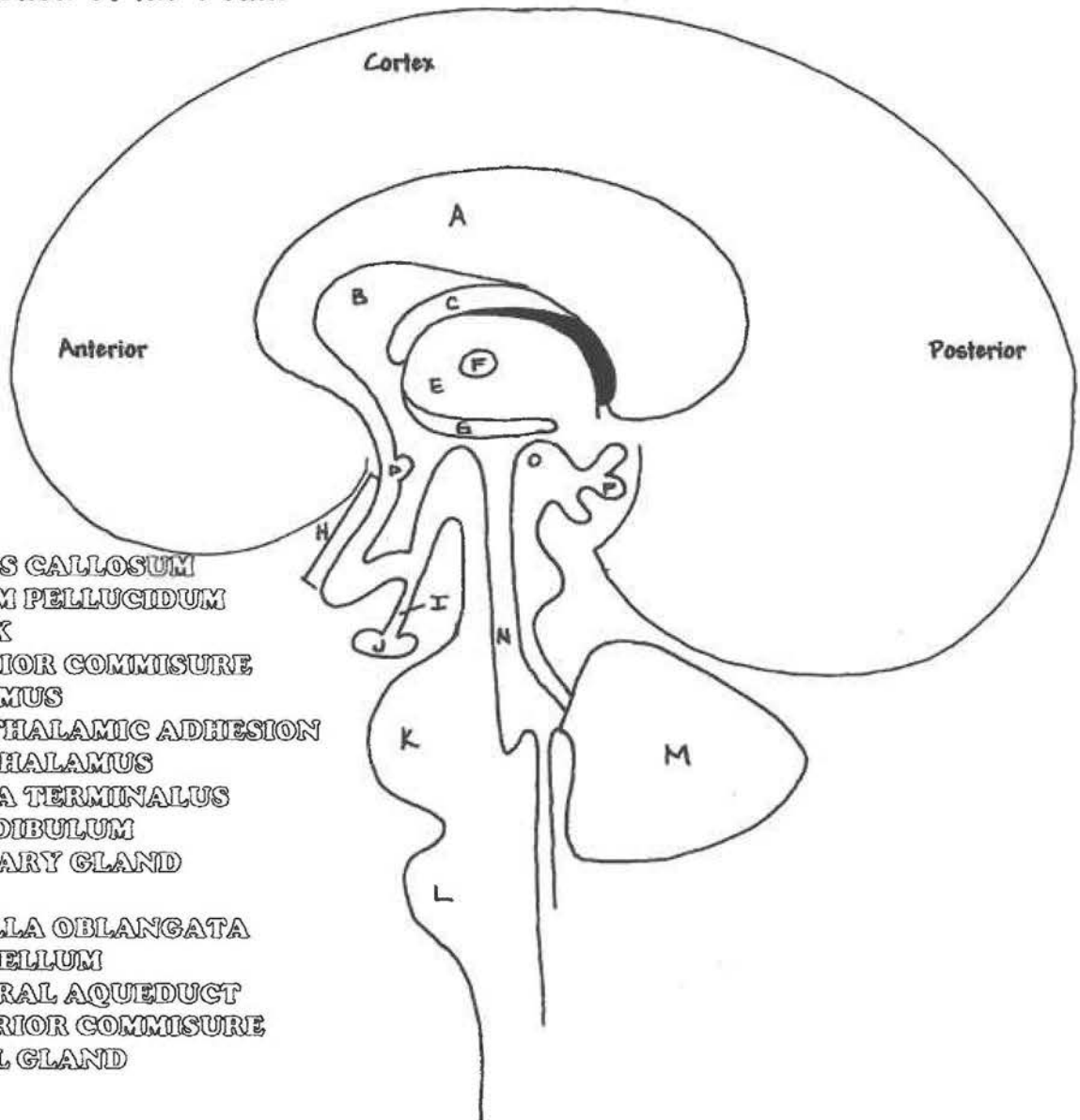
SO SUPERIOR OBLIQUE MUSCLE
IO INFERIOR OBLIQUE MUSCLE

SR SUPERIOR RECTUS MUSCLE
MR MEDIAL RECTUS MUSCLE
LR LATERAL RECTUS MUSCLE
IR INFERIOR RECTUS MUSCLE



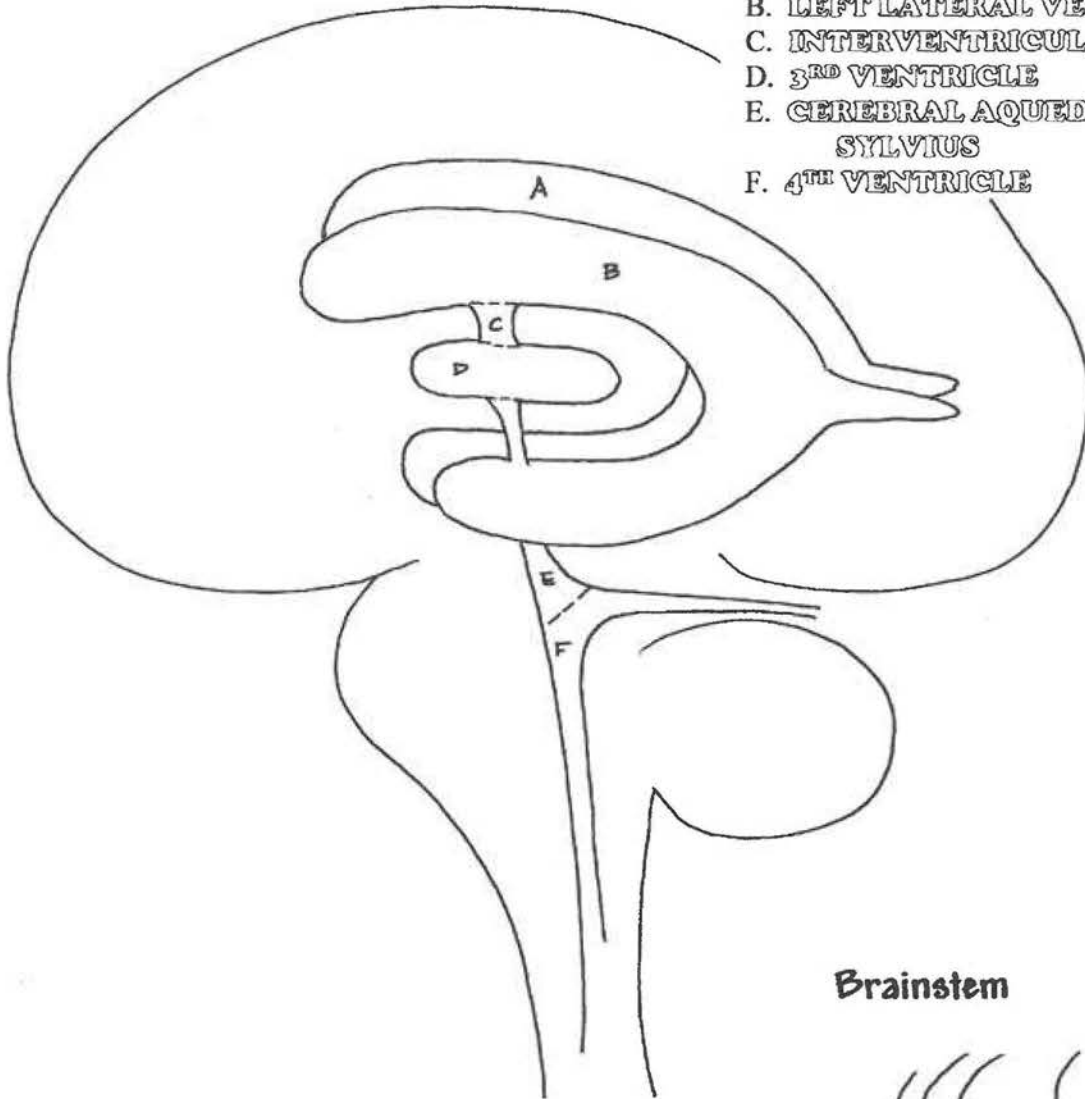
- A. FRONTAL LOBE
- B. MOTOR CORTEX OF FRONTAL LOBE
- C. CENTRAL SULCUS
- D. SENSORY CORTEX OF PARIETAL LOBE
- E. PARIETAL LOBE
- F. OCCIPITAL LOBE
- G. CUNEOUS GYRUS
- H. CALCARINE FISSURE
- I. LINGUAL GYRUS
- J. TEMPORAL LOBE

Cross Section of the Brain



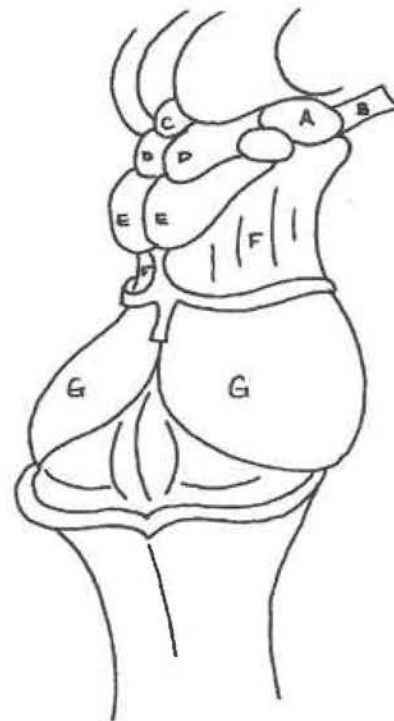
- A. CORPUS CALLOSUM
- B. SEPTUM PELLUCIDUM
- C. FORNIX
- D. ANTERIOR COMMISSURE
- E. THALAMUS
- F. INTERTHALAMIC ADHESION
- G. HYPOTHALAMUS
- H. LAMINA TERMINALIS
- I. INFUNDIBULUM
- J. PITUITARY GLAND
- K. PONS
- L. MEDULLA OBLONGATA
- M. CEREBELLUM
- N. CEREBRAL AQUEDUCT
- O. POSTERIOR COMMISSURE
- P. PINEAL GLAND

- A. RIGHT LATERAL VENTRICLE
- B. LEFT LATERAL VENTRICLE
- C. INTERVENTRICULAR FOREMAN
- D. 3RD VENTRICLE
- E. CEREBRAL AQUEDUCT OF SYLVIVS
- F. 4TH VENTRICLE

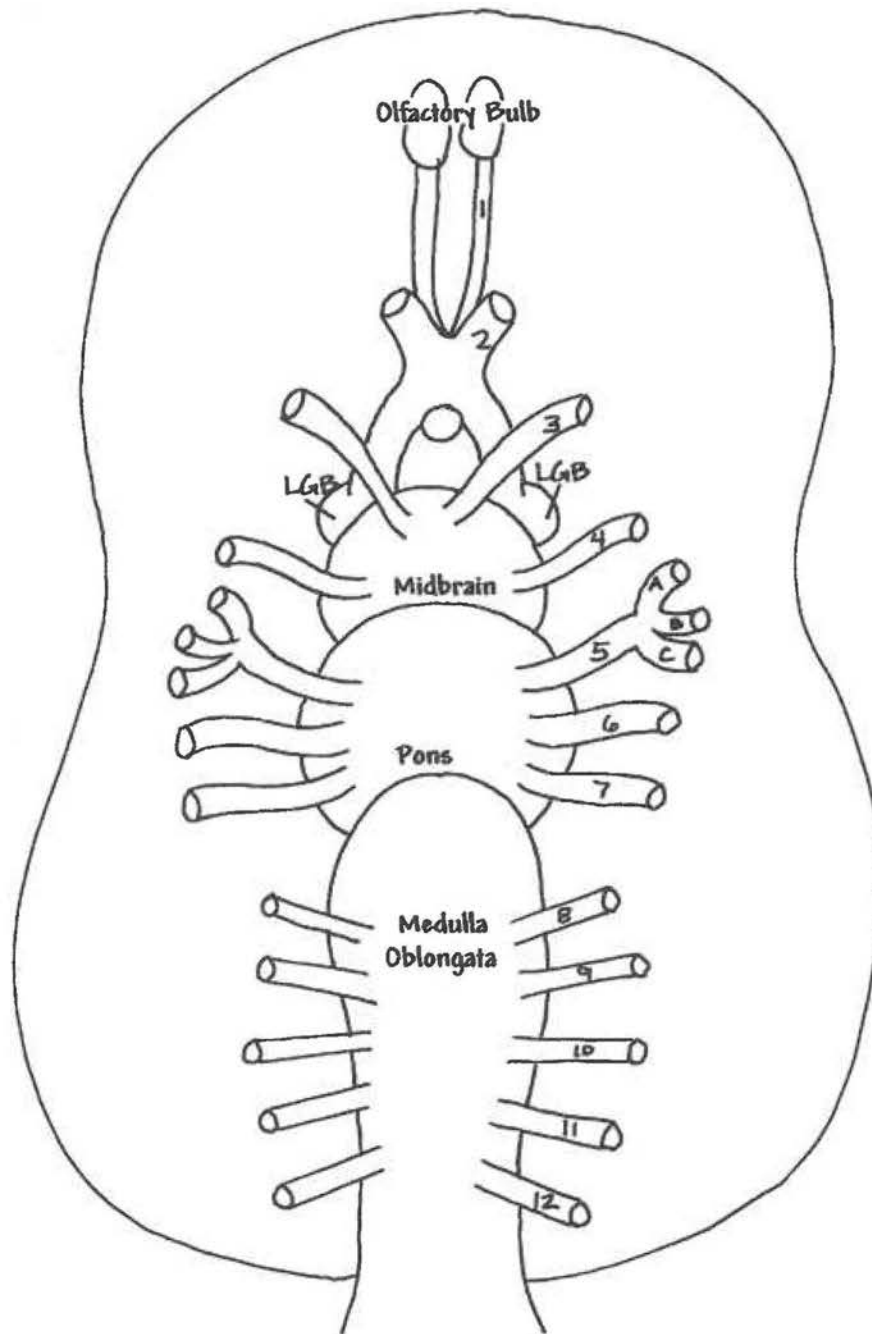


Brainstem

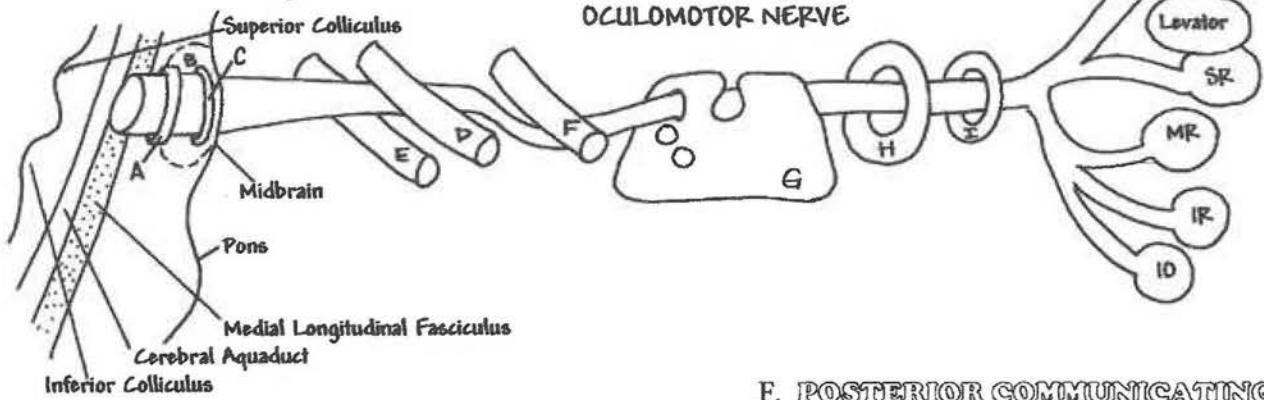
- A. LATERAL GENICULATE BODY
- B. OPTIC TRACT
- C. PINEAL GLAND
- CORPORA QUADRIGEMINI:
 - D. SUPERIOR COLLICULI
 - E. INFERIOR COLLICULI
- F. CEREBRAL PEDUNCLE
- G. PONS



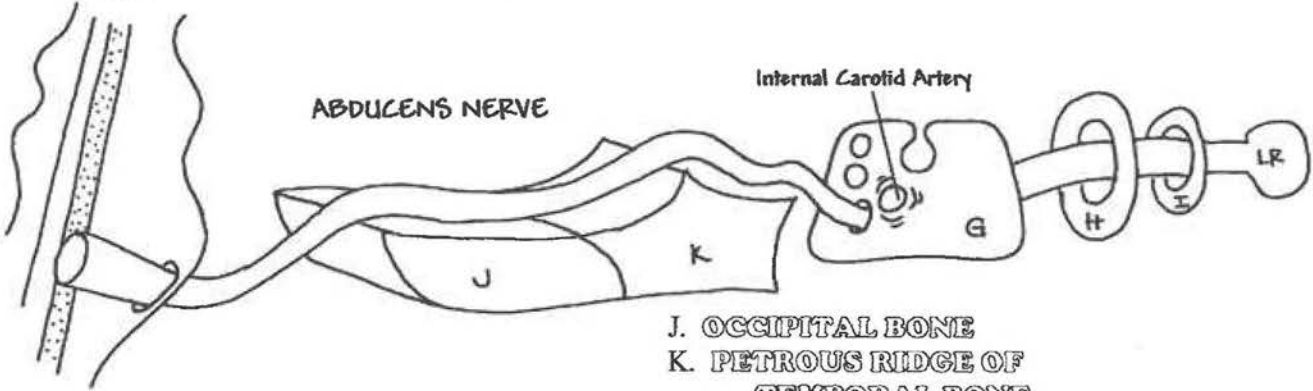
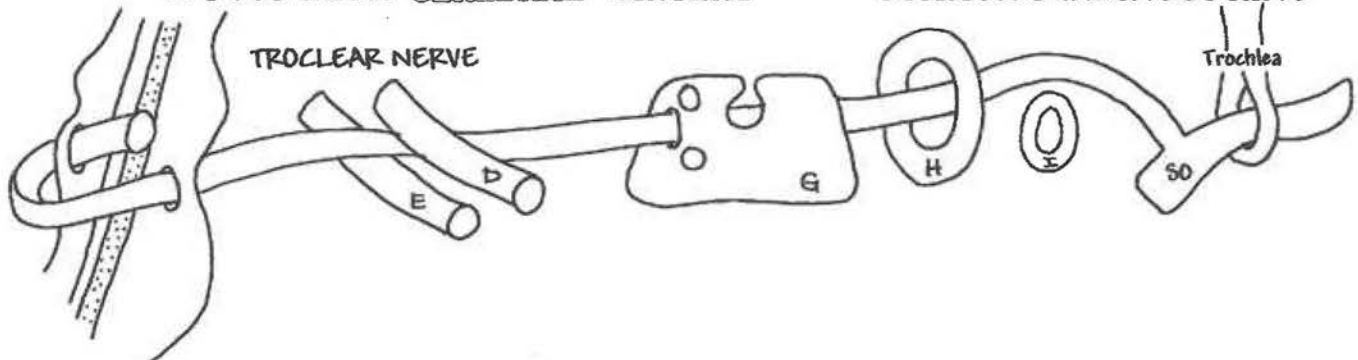
- | | | | |
|---|---------------------|----|----------------------------------------|
| 1 | OLFACTORY NERVE | 8 | VESTIBULOCOCHLEAR
or ACOUSTIC NERVE |
| 2 | OPTIC NERVE | 9 | GLOSSOPHARYNGEAL NERVE |
| 3 | OCULOMOTOR NERVE | 10 | VAGUS NERVE |
| 4 | TROCHLEAR NERVE | 11 | ACCESSORY NERVE |
| 5 | TRIGEMINAL NERVE | 12 | HYPOGLOSSAL NERVE |
| | A OPHTHALMIC BRANCH | | |
| | B MAXILLARY BRANCH | | |
| | C MANDIBULAR BRANCH | | |
| 6 | ABDUCENS NERVE | | |
| 7 | FACIAL NERVE | | |



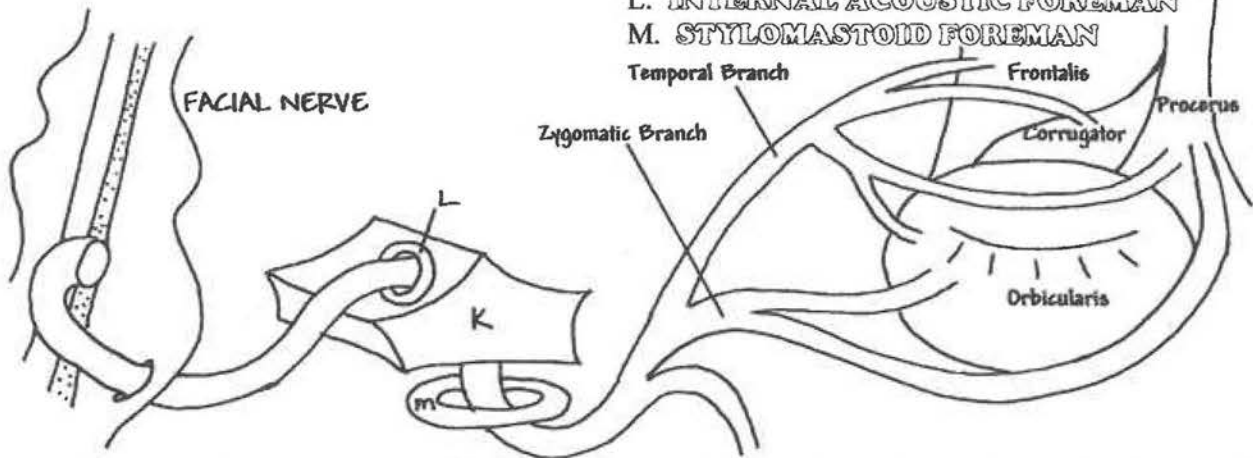
Nerve Pathways



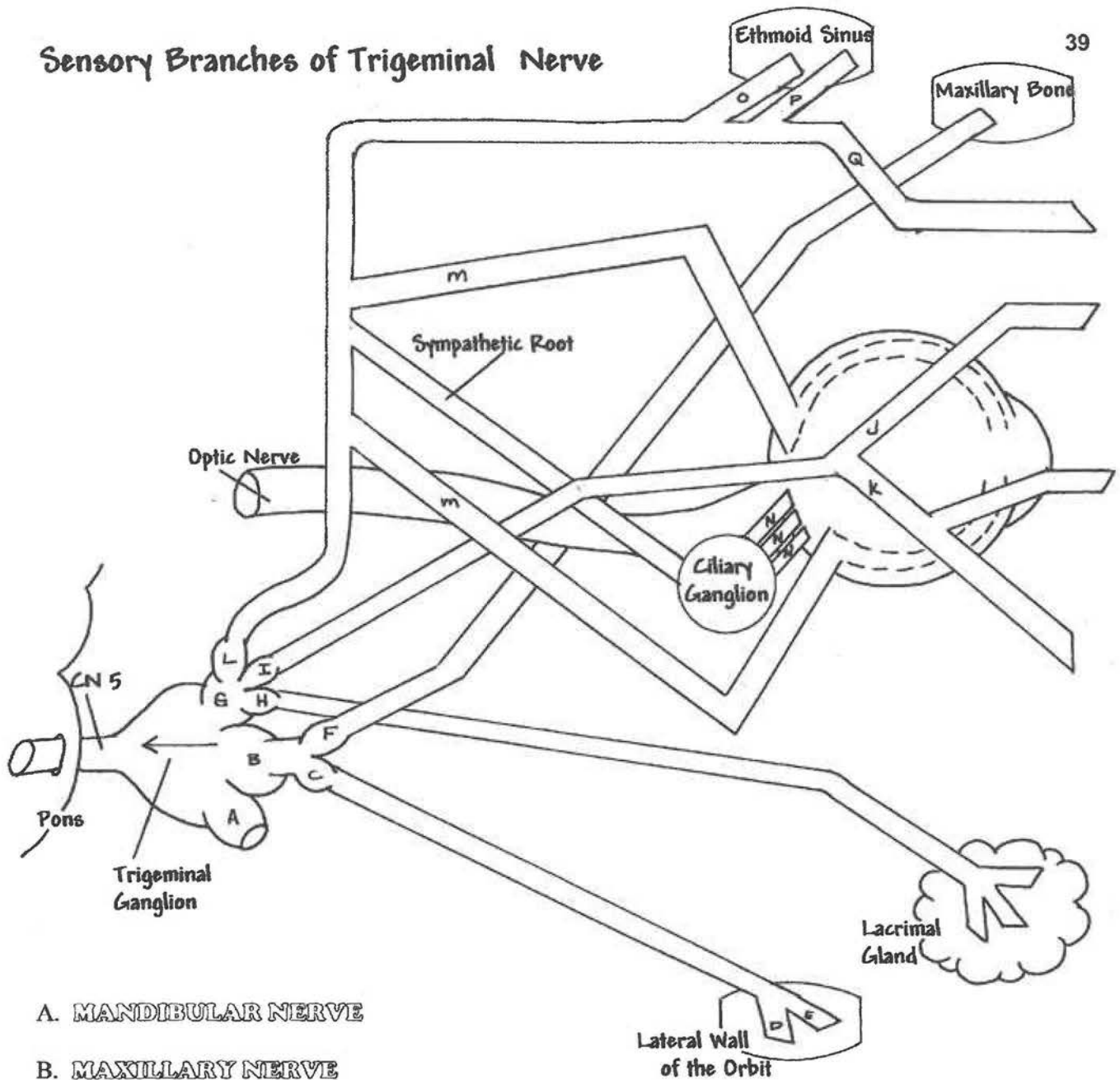
- A. RED NUCLEUS
- B. CEREBRAL PEDUNCLE
- C. INTERPEDUNCULAR FOSSA
- D. SUPERIOR CEREBELLAR ARTERY
- E. POSTERIOR CEREBRAL ARTERY
- F. POSTERIOR COMMUNICATING ARTERY
- G. CAVERNOUS SINUS
- H. SUPERIOR ORBITAL FISSURE
- I. OCULOMOTOR FOREMAN or COMMON TENDINOUS RING



- J. OCCIPITAL BONE
- K. PETROUS RIDGE OF TEMPORAL BONE
- L. INTERNAL ACOUSTIC FOREMAN
- M. STYLOMASTOID FOREMAN



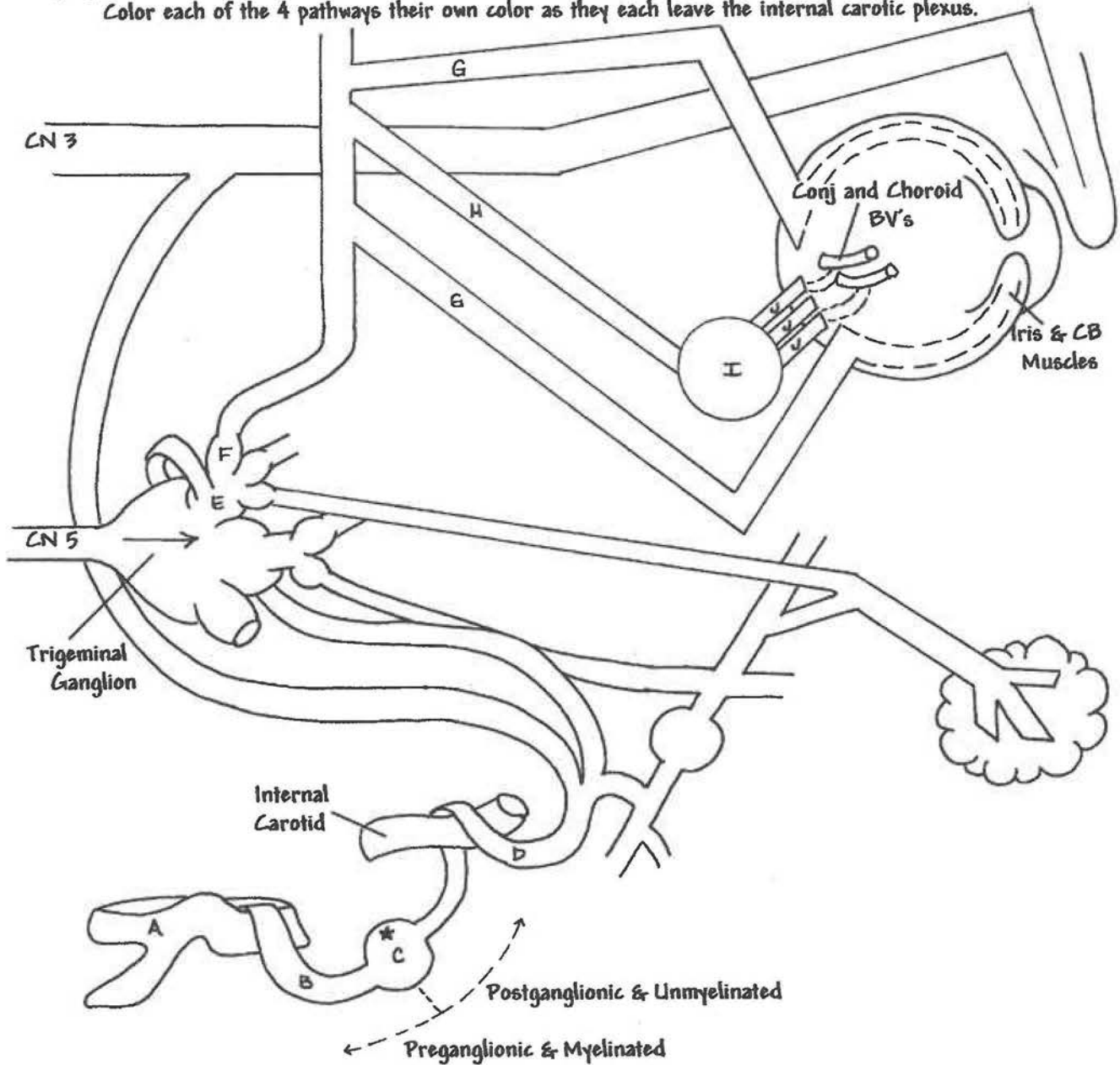
Sensory Branches of Trigeminal Nerve



- A. MANDIBULAR NERVE
- B. MAXILLARY NERVE
 - C. ZYGOMATIC NERVE
 - D. ZYGOMATICOTEMPORAL NERVE
 - E. ZYGOMATICOFACIAL NERVE
 - F. INFRAORBITAL NERVE
- G. OPHTHALMIC NERVE
 - H. LACRIMAL NERVE
 - I. FRONTAL NERVE
 - J. SUPRATROCHLEAR NERVE
 - K. SUPRAORBITAL NERVE
 - L. NASOCILIARY NERVE
 - M. LONG CILIARY NERVES
 - N. SHORT CILIARY NERVES
 - O. POSTERIOR ETHMOID NERVE
 - P. ANTERIOR ETHMOID NERVE
 - Q. INFRATROCHLEAR NERVE

Sympathetic Innervation

Color each of the 4 pathways their own color as they each leave the internal carotid plexus.



Pathway #1

- A. THORACIC VERTEBRAE 1-3
- B. VENTRAL ROOT
- C. SUPERIOR CERVICAL GANGLION
- D. INTERNAL CAROTID PLEXUS

- E. OPHTHALMIC DIVISION
- F. NASOCILIARY NERVE
- G. LONG CILIARY NERVE

iris dilator causing mydriasis & decrease in ciliary body muscle tone

Pathway #2

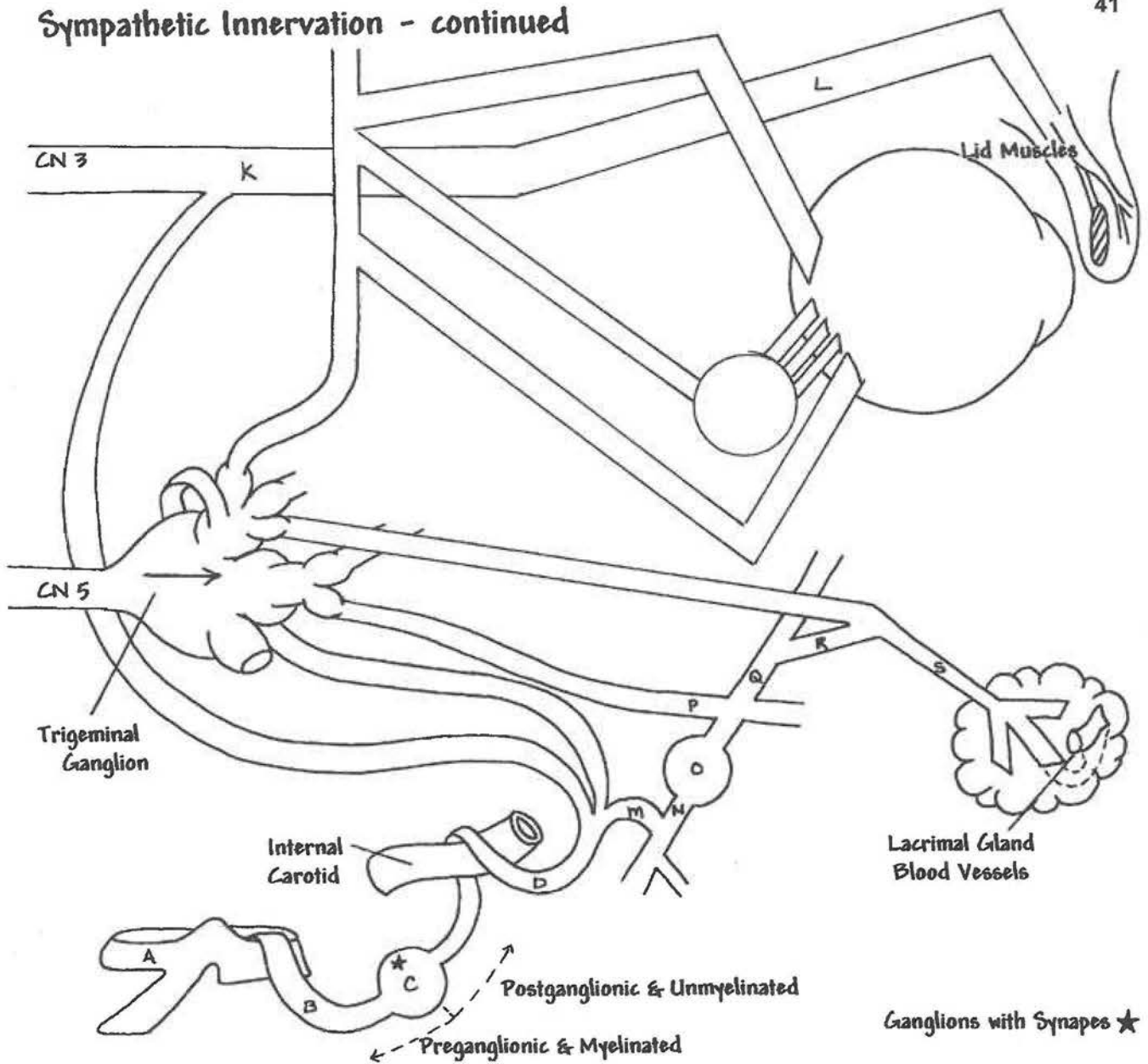
Ganglions with Synapses ★

- A. THORACIC VERTEBRAE 1-3
- B. VENTRAL ROOT
- C. SUPERIOR CERVICAL GANGLION
- D. INTERNAL CAROTID PLEXUS

- E. OPHTHALMIC DIVISION
- F. NASOCILIARY NERVE
- H. SYMPATHETIC ROOT
- I. CILIARY GANGLION
- J. SHORT CILIARY NERVES

vasoconstriction by choroidal & conjunctival blood vessels

Sympathetic Innervation - continued



Pathway #3

- A. THORACIC VERTEBRAE 1-3
- B. VENTRAL ROOT
- C. SUPERIOR CERVICAL GANGLION
- D. INTERNAL CAROTID PLEXUS

- K. OCULOMOTOR NERVE
- L. SUPERIOR DIVISION OF OCULOMOTOR NERVE

palpebral fissure increase by superior tarsal muscle

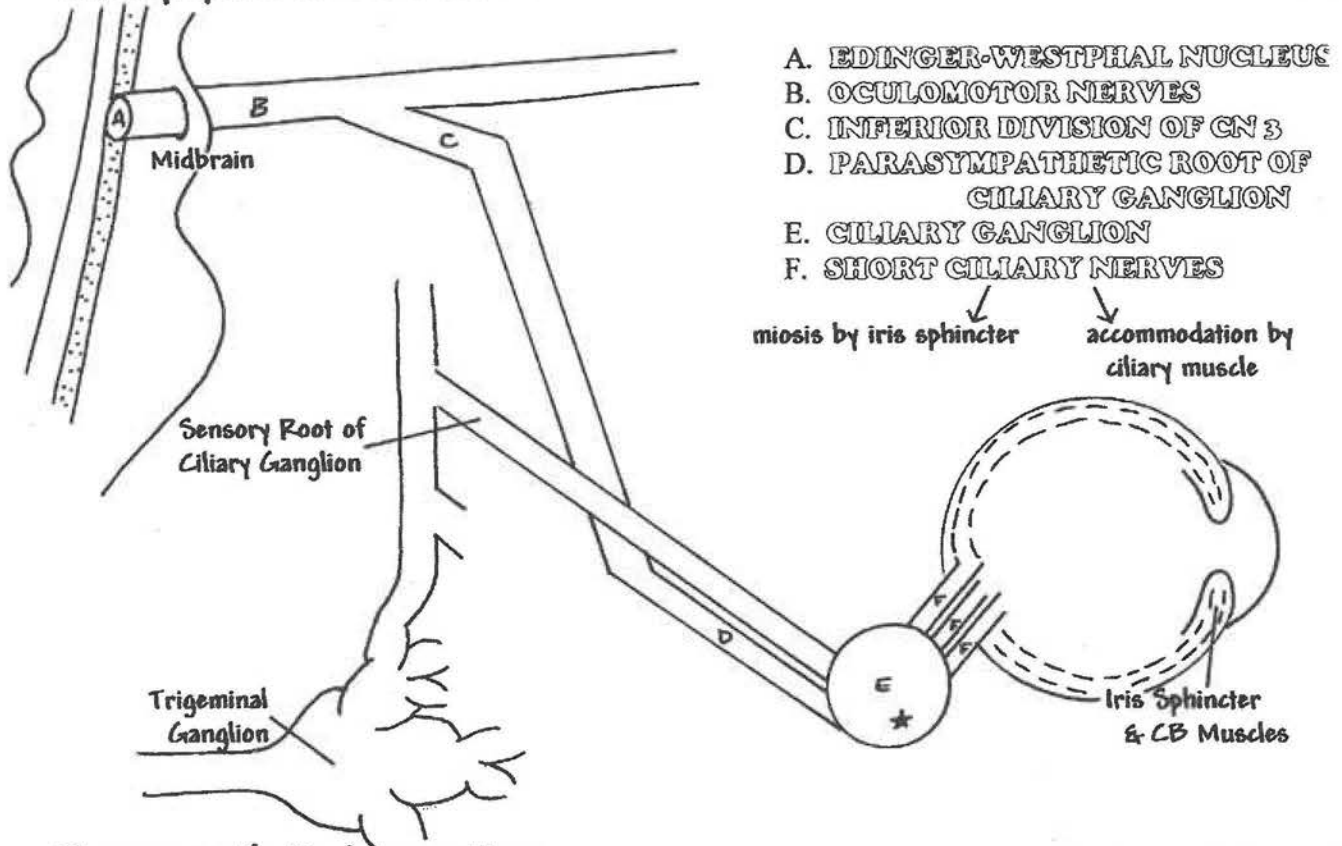
Pathway #4

- A. THORACIC VERTEBRAE 1-3
- B. VENTRAL ROOT
- C. SUPERIOR CERVICAL GANGLION
- D. INTERNAL CAROTID PLEXUS

- M. DEEP PETROSAL NERVE
- N. VIDIAN NERVE
- O. PTERYGOPALATINE GANGLION
- P. MAXILLARY NERVE
- Q. ZYGOMATIC NERVE
- R. COMMUNICATING BRANCH
- S. LACRIMAL NERVE

decrease secretions by vasoconstriction of the lacrimal gland blood vessels

Parasympathetic Innervation

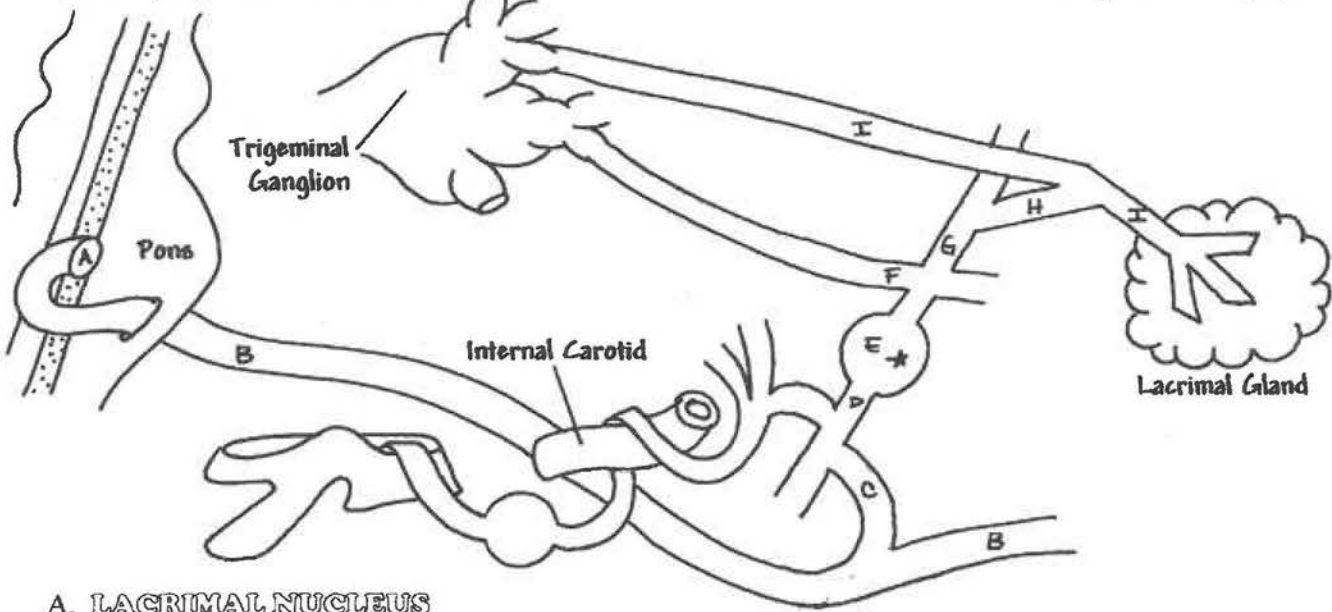


- A. EDINGER-WESTPHAL NUCLEUS
- B. OCULOMOTOR NERVES
- C. INFERIOR DIVISION OF CN 3
- D. PARASYMPATHETIC ROOT OF CILIARY GANGLION
- E. CILIARY GANGLION
- F. SHORT CILIARY NERVES

miosis by iris sphincter accommodation by ciliary muscle

Ganglions with Synapses ★

Parasympathetic Innervation



- A. LACRIMAL NUCLEUS
- B. FACIAL NERVE
- C. GREATER PETROSAL NERVE
- D. VIDIAN NERVE
- E. PTERYGOPALATINE GANGLION
- F. MAXILLARY NERVE
- G. ZYGOMATIC NERVE
- H. COMMUNICATING BRANCH
- I. LACRIMAL NERVE OF CN 5'S OPHTHALMIC BRANCH

lacrimation by lacrimal gland

Pupillary Light Response

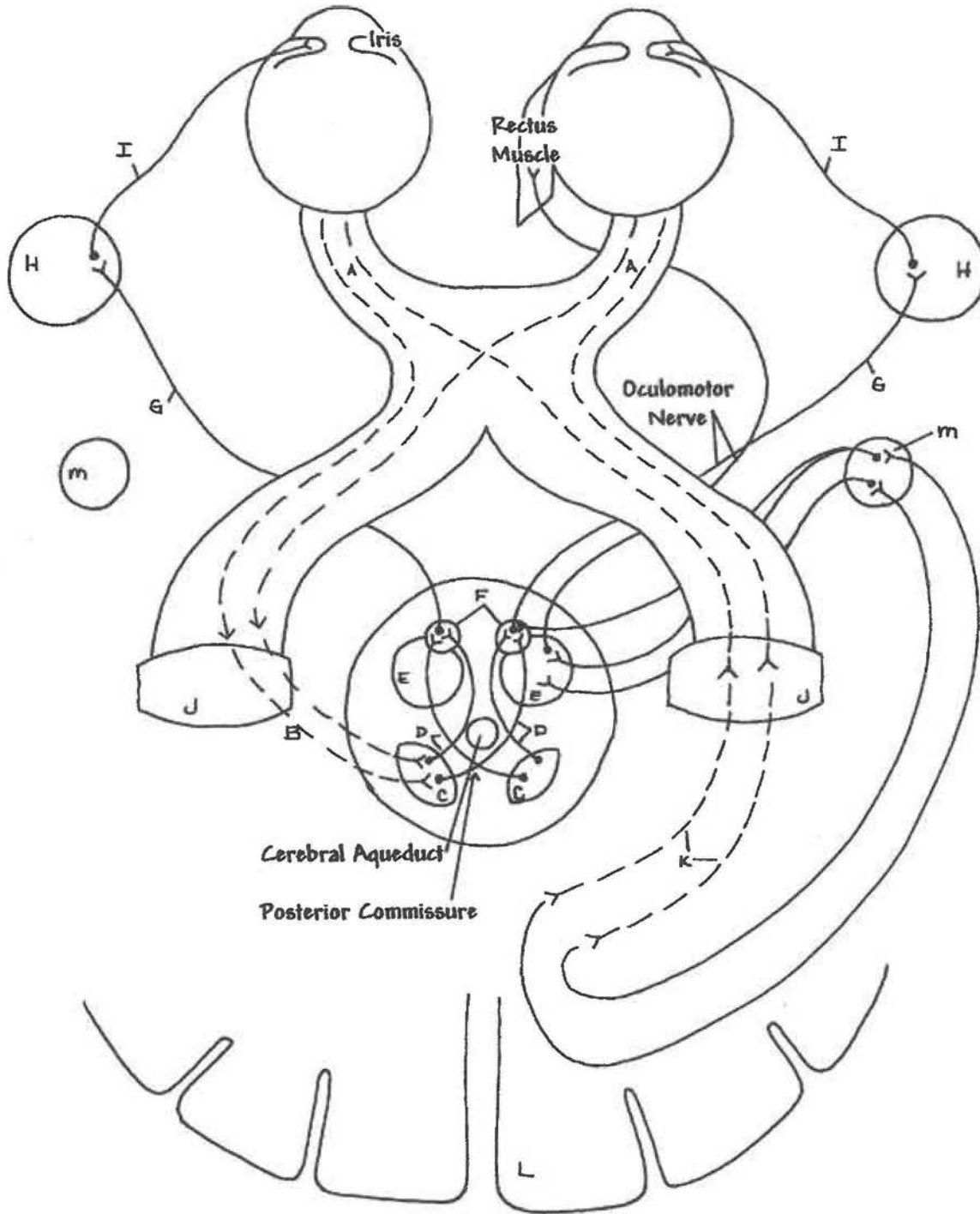
Structures in Order

- A. OPTIC NERVE
- B. SUPERIOR BRACHIUM
- C. PRETECTAL NUCLEUS
- D. TECTOTEGMENTAL TRACTS
- E. OCULOMOTOR NUCLEUS
- F. EDINGER-WESTPHAL NUCLEUS
- G. PARASYMPATHETIC DIVISION OF THE OCULOMOTOR NERVE
- H. CILIARY GANGLION
- I. SHORT CILIARY NERVE

Near Response

Structures in Order

- A. OPTIC NERVE
- J. LATERAL GENICULATE BODY
- K. OPTIC RADIATIONS
- L. STRIATE CORTEX
- M. FRONTAL EYE FIELDS
- E. OCULOMOTOR NUCLEUS & F. EDINGER-WESTPHAL NUCLEUS
- G. PARASYMPATHETIC DIVISION OF THE OCULOMOTOR NERVE
- H. CILIARY GANGLION
- I. SHORT CILIARY NERVE

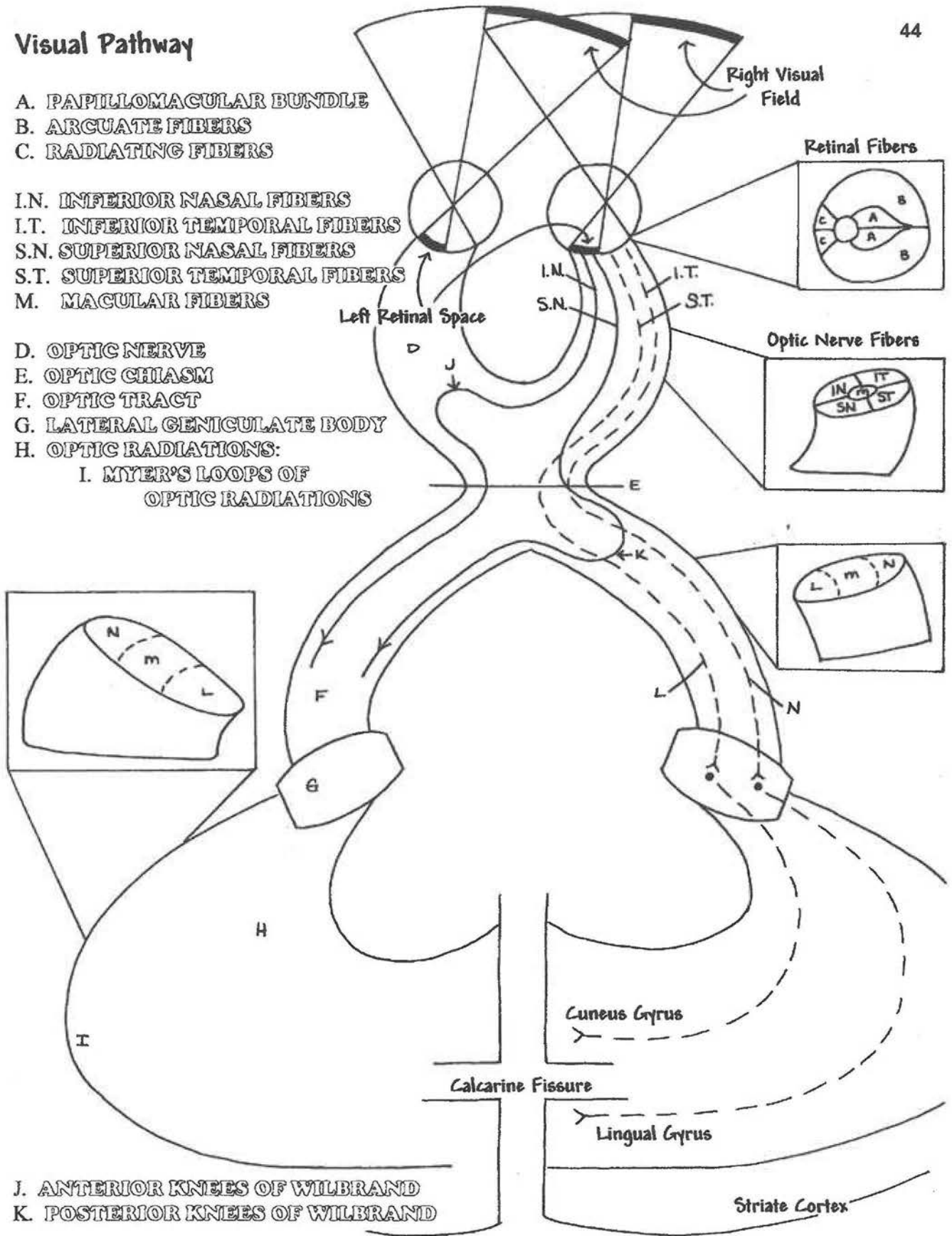


Visual Pathway

- A. PAPILLOMACULAR BUNDLE
- B. ARCUATE FIBERS
- C. RADIATING FIBERS

- I.N. INFERIOR NASAL FIBERS
- I.T. INFERIOR TEMPORAL FIBERS
- S.N. SUPERIOR NASAL FIBERS
- S.T. SUPERIOR TEMPORAL FIBERS
- M. MACULAR FIBERS

- D. OPTIC NERVE
- E. OPTIC CHIASM
- F. OPTIC TRACT
- G. LATERAL GENICULATE BODY
- H. OPTIC RADIATIONS:
 - I. MYER'S LOOPS OF OPTIC RADIATIONS



- J. ANTERIOR KNEES OF WILBRAND
- K. POSTERIOR KNEES OF WILBRAND

- L. S.T. FIBERS FROM RIGHT EYE WITH S.N. FIBERS FROM LEFT EYE
- N. I.T. FIBERS FROM RIGHT EYE WITH I.N. FIBERS FROM LEFT EYE

Optic Nerve Dimensions

Total Length = 4.7-5.7 cm

- A. INTRAOCULAR .7-1mm
- B. INTRAORBITAL 30mm
- C. INTRACANAL 6-10mm
- D. INTRACRANIAL 10-16mm

