Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Clinical Neuroanatomy for Undergraduates
The course provides an overview of the structure of the central nervous system

- Topographical anatomy of the brain and spinal cord
- The organization of the major neural systems underlying sensory, motor and cognitive function.
Clinical Neuroanatomy
for undergraduates

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Keys to the (active) learning process

• **Hands-on** examination of human brain specimens
• **Interactive** brain atlas and glossary exercises
• **Solving** anatomical puzzles (clinical cases)

CLINICAL NEUROANATOMY *method* of studying lesions of the human nervous system as a tool to reinforce and amplify learning of the structure and organization of the CNS.

not training neurologists ...
Clinical Neuroanatomy for undergraduates

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Neuroanatomical training is fundamental .... but why teach *clinical* neuroanatomy to undergraduates?

• As part of pre-medical training

* It’s an effective method for providing the necessary anatomical foundation for further study in the neurosciences

• motivational

• instructional
Clinical Neuroanatomy
for undergraduates

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

“Non-clinical” Neuroanatomy
Learning objective: Understand the organization of the partial crossing of fibers in the optic chiasm.

The nasal (medial) retinal fibers for each eye, which are responsible for information in the temporal (lateral) hemifields, cross the midline at the optic chiasm. Lesions of the middle portion of the optic chiasm therefore produce bitemporal visual field defects (bitemporal hemianopia).
PATIENT PRESENTATION

A 50-year-old woman went to an ophthalmologist because of several months of worsening vision that had begun to interfere with her driving. Past history is notable for long-standing menstrual irregularity and infertility.
PATIENT PRESENTATION

A 50-year-old woman went to an ophthalmologist because of several months of worsening vision that had begun to interfere with her driving. Past history is notable for long-standing menstrual irregularity and infertility.

MENSTRUAL IRREGULARITY AND BITEMPORAL HEMIANOPIA
Introduction
- Overview
- Rationale

Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

Resources:
- Textbooks
- Lab manual
- Course website
- Sylvius
- Integration

---

**the cases:**

richly illustrate our learning objectives (e.g. organization of the partial crossing of fibers in the optic chiasm)

significantly expands the discussion (e.g. spatial relationship of pituitary and chiasm, asymmetry of visual field cut)

interesting and motivating for students
Clinical Neuroanatomy for undergraduates

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration
Clinical Neuroanatomy for undergraduates

Introduction
- Overview
- Rationale

Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

Resources:
- Textbooks
- Lab manual
- Course website
- Sylvius
- Integration

examination vs dissection
**Clinical Neuroanatomy for undergraduates**

**Introduction**
- Overview
- Rationale

**Course format:**
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

**Resources:**
- Textbooks
- Lab manual
- Course website
- *Sylvius*
- Integration

---

**CASE 7.5**

**SENSORY LOSS OVER BOTH SHOULDERS**

**PATIENT PRESENTATION**
A 46-year-old man who had been in an accident at age 18 has had increasing difficulty walking. He has also developed pain and numbness in the shoulders and arms, more severe on the left side.

**KEY SYMPTOMS AND SIGNS**
- Decreased pinprick sensation and painful numb paresthesias in bilateral shoulders and in the left arm
- Weakness, increased tone, and hyperreflexia in all extremities
- Slow, shuffling gait

**FINAL DIAGNOSIS**
C3-C4 syringomyelia causing central cord syndrome

**OUTCOME**
Underwent decompressive surgery and did well immediately post-operatively. Subsequently lost to follow-up.

---

40 cases presented by students
Clinical Neuroanatomy for undergraduates

Introduction
- Overview
- Rationale

Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

Resources:
- Textbooks
- Lab manual
- Course website
- Sylvius
- Integration

9: lesion produces ______?
Clinical Neuroanatomy
for undergraduates

Introduction
- Overview
- Rationale

Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

Resources:
- Textbook
- Lab manual
- Course website
- Sylvius
- Integration

Challenge:
- clinical orientation of material for non-medical students

Neuroanatomy Through Clinical Cases
Hal Blumenfeld, M.D., Ph.D., Yale University School of Medicine

The NeuroExam Video
neuroexam.com

Recommended text
Neuroscience 3rd edition
Purves, Augustine, Fitzpatrick, Hall, LaMantia, McNamara & Williams
Clinical Neuroanatomy
for undergraduates

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Challenge:
• directing and focus brain specimen examination

Figure 6B. The lateral surface of the human brain. Drawing of a partially dissected brain. Portions of parietal and temporal lobes have been removed, exposing the underlying brain. Where the hemisphere cut, the 2 mm thick central cortex can be seen. Beneath it is the white matter of the hemispheres.

Medial aspect of the brain.

When the brain is cut in the parasagittal plane, all of its subdivisions are visible on the cut surface (Figure 6A). The subdivisions are arranged as though they were stacked on top of one another, the hemisphere bulging out tangentially at the top and the corona radiata bulging out directly above half way up. The central hemisphere, because of its great size, is still the most prominent part of the brain in this section. From the frontal lobe extends from the central sulcus toward. (Figure 5 tells you how to identify the location of the sulcus, which is just barely visible on this view.) At the junction of the frontal and parietal lobes on the surface of the hemispheres, the paracentral lobule looks like a continuation of both the pre- and postcentral. It contains the representation of the leg area in both sensory and motor cortex.

The parieto-occipital sulcus, a prominent sulcus extending from the superior to the inferior aspect of the hemisphere, separates the parietal and occipital lobes. The calcarine sulcus extends into the occipital lobe at right angles from the parieto-occipital sulcus. It marks the location of the visual cortex which occupies the adjacent to it. (The temporal lobe was partially dissected off of this view shown in Figure 7 before it was graphed.) A portion of the medial surface of the temporal lobe would normally be visible on this view. A less common view of the temporal lobe is shown in Figure 7.
Challenge:
- organizing and distributing course resources
Clinical Neuroanatomy for undergraduates

Introduction
- Overview
- Rationale

Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

Resources:
- Textbooks
- Lab manual
- Course website
- Sylvius
- Integration

Challenge:
- organizing and distributing course resources
Clinical Neuroanatomy
for undergraduates

Introduction
• Overview
• Rationale

Challenge:
• organizing and distributing course resources

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

S. Mark Williams, Ph.D.
Department of Neurobiology
Duke University Medical Center
markw@neuro.duke.edu
Challenge:
- organizing and distributing course resources

Introduction
- Overview
- Rationale

Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

Resources:
- Textbooks
- Lab manual
- Course website
- Sylvius
- Integration
Clinical Neuroanatomy for undergraduates

Challenge:
- organizing and distributing course resources

Introduction
- Overview
- Rationale

Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

Resources:
- Textbooks
- Lab manual
- Course website
- Sylvius
- Integration
Challenge:
• organizing and distributing course resources
Clinical Neuroanatomy
for undergraduates

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Challenge:
• content management !

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Challenge:
• content management !

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Challenge:
• content management !

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Challenge:
• content management !

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Challenge:
• content management !
Clinical Neuroanatomy for undergraduates

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• *Sylvius*
• Integration

Challenge:
• 1985, technological limitations; 2005, pedagogical value

---

**Announcing a comprehensive set of teaching programs entitled The Senses**

---

*BIOPSYCH Educational Tools, Inc.*

---

Notice how the alternating compression and rarefaction of air molecules (as represented by a sine wave) is translated into the “back and forth” piston action of the stapes on the cochlea.

{Click mouse to stop animation.}
Challenge:
• 100s of new, unintuitive terms
CNS quick reference tool
CNS quick reference tool
Challenge:
• 100s of new, unintuitive terms
... students are mobile

“...after class, we go to breakfast and quiz each other on brain structures using the iPod.”

SylviusVG: Visual Glossary of Human Neuroanatomy, iPod edition
S. Mark Williams, Ph.D., Leonard E. White, Ph.D., and Andrew C. Mace
Challenge:
• 3D organization of brain is complex
3D Dissector and Atlas
Clinical Neuroanatomy
for undergraduates

Introduction
• Overview
• Rationale

Course format:
• Lectures
• Labs
• Clinical cases
• Review sessions
• Content

Resources:
• Textbooks
• Lab manual
• Course website
• Sylvius
• Integration

Challenge:
• integrating the resources to effectively meet learning objectives
Problem: Increasing need for neuroanatomical expertise

Part of the solution? Teach fundamental neuroanatomy to undergraduates (and graduate students) using clinical cases

Benefits:

• Increase learning efficacy and retention (supposition)
• Offers numerous active learning opportunities
• Wealth of resources, leverage medical school teaching resources

Challenges:

• Orientation complexity of clinical material for non-medical students
• New terminology, spatial relationships of brain structures
<table>
<thead>
<tr>
<th>No</th>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Wed, August 31</td>
<td>Introduction to the Course</td>
</tr>
<tr>
<td>02</td>
<td>Fri, September 02</td>
<td>Lecture: Organization of the Nervous System I</td>
</tr>
<tr>
<td>03</td>
<td>Wed, September 07</td>
<td>Lecture: Organization of the Nervous System II</td>
</tr>
<tr>
<td>04</td>
<td>Fri, September 09</td>
<td>Lecture: Gross anatomy of the Brainstem and Thalamus</td>
</tr>
<tr>
<td>05</td>
<td>Wed, September 14</td>
<td>Lab Demo: Gross Anatomy of the Brain and Spinal Cord I</td>
</tr>
<tr>
<td>06</td>
<td>Fri, September 16</td>
<td>Lab Demo: Gross Anatomy of the Brain and Spinal Cord II</td>
</tr>
<tr>
<td>07</td>
<td>Wed, September 21</td>
<td>Review: Gross Anatomy of the CNS</td>
</tr>
<tr>
<td>08</td>
<td>Fri, September 23</td>
<td>Exam No.1</td>
</tr>
</tbody>
</table>

**Introduction**

- Overview
- Course goals
- Rationale

**Course format:**

- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

**Resources:**

- Textbooks
- Lab manual
- Course website
- *Sylvius*
- Integration

**Block 1**

- Background
- Surface features and internal anatomy of brain and spinal cord
## Clinical Neuroanatomy for undergraduates

### Introduction
- Overview
- Course goals
- Rationale

### Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

### Resources:
- Textbooks
- Lab manual
- Course website
- *Sylvius*
- Integration

<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Wed, August 31</td>
<td>Introduction to the Course</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>Fri, September 02</td>
<td>Lecture: Organization of the Nervous System I</td>
<td>Blum 2 (pp.122-135)</td>
</tr>
<tr>
<td>03</td>
<td>Wed, September 07</td>
<td>Lecture: Organization of the Nervous System II</td>
<td>Blum 12 (pp.461-469); 7 (pp.271-276)</td>
</tr>
<tr>
<td>04</td>
<td>Fri, September 09</td>
<td>Lecture: Gross anatomy of the Brainstem and Thalamus</td>
<td>Blum 12 (pp.461-469); 7 (pp.271-276)</td>
</tr>
<tr>
<td>05</td>
<td>Wed, September 14</td>
<td>Lab Demo: Gross Anatomy of the Brain and Spinal Cord I</td>
<td>LM 1</td>
</tr>
<tr>
<td>06</td>
<td>Fri, September 16</td>
<td>Lab Demo: Gross Anatomy of the Brain and Spinal Cord II</td>
<td>LM 1</td>
</tr>
<tr>
<td>07</td>
<td>Wed, September 21</td>
<td>Review: Gross Anatomy of the CNS</td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>Fri, September 23</td>
<td>Exam No.1</td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>Wed, September 28</td>
<td>Lecture: Introduction to Clinical Cases</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Fri, September 30</td>
<td>Lecture: Corticospinal Tract and Other Motor Pathways</td>
<td>Blum Chps. 1, 3, 4 (selected)</td>
</tr>
<tr>
<td>11</td>
<td>Wed, October 05</td>
<td>Cases: Corticospinal Tract and Other Motor Pathways</td>
<td>Blum Chp. 6</td>
</tr>
<tr>
<td>12</td>
<td>Fri, October 07</td>
<td>Lecture: Somatosensory pathways</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Wed, October 12</td>
<td>Cases: Somatosensory pathways</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Fri, October 14</td>
<td>Lecture: Visual System</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Wed, October 19</td>
<td>Cases: Visual System</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Fri, October 21</td>
<td>Lecture: Brainstem I (Cranial Nerves)</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Wed, October 26</td>
<td>Lecture: Brainstem II (Cranial Nerve Nuclei)</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Fri, October 28</td>
<td>Cases: Brainstem/Cranial Nerves</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Wed, November 02</td>
<td>Review: Long Tract Pathways and Brainstem</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Fri, November 04</td>
<td>Exam No.2</td>
<td></td>
</tr>
</tbody>
</table>

### Block 2
- Introduction to clinical cases
- Long tracts, visual pathways, cranial nerves, cranial nerve nuclei
### Clinical Neuroanatomy for undergraduates

#### Introduction
- Overview
- Course goals
- Rationale

#### Course format:
- Lectures
- Labs
- Clinical cases
- Review sessions
- Content

#### Resources:
- Textbooks
- Lab manual
- Course website
- Sylvius
- Integration

#### Block 3
- Motor modulation (cerebellum and basal ganglia)
- Limbic system and cerebral cortex

<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Wed, November 09</td>
<td>Lecture: Motor modulation I (Cerebellum)</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Fri, November 11</td>
<td>Lecture: Motor modulation II (Basal Ganglia)</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Wed, November 16</td>
<td>Cases: Basal Ganglia and Cerebellum</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Fri, November 18</td>
<td>Lecture: Limbic System and Cerebral Cortex I</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Wed, November 23</td>
<td>THANKSGIVING BREAK</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Fri, November 25</td>
<td>THANKSGIVING BREAK</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Wed, November 30</td>
<td>Lecture: Cerebral Cortex II</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Fri, December 02</td>
<td>Cases: Limbic System and Cerebral Cortex II</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Wed, December 07</td>
<td>Cases: Cerebral Cortex II and Review</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Fri, December 09</td>
<td>Exam Review and Final Discussion</td>
<td></td>
</tr>
</tbody>
</table>