“Thirty-Four Years of Biology Education at CWRU: A Personal Journey”

Dr. Richard F. Drushel
Instructor and Executive Officer
Department of Biology
Case Western Reserve University

18 November 2014
Seminar Outline

• Career and Personal Overview
• Transformational Experiences
• Classroom Style and Features
• LEGO Robotics Laboratories
• Summary
Take-Home Messages for Effective Teaching (and Advising)

- Transparency
- Ownership
- Craft
- Alignment
- Consistency
- Fairness
- Sandboxes
- Feedback
- Flexibility
- Trust
- Availability
Who is Rich Drushel?
Education and Career

• 1980–1984: biology/premed; 2 semesters and 2 summers of research (Arnold Caplan lab); BIO-BA (Honors in Biology) and CHE-MIN
• 1984–1986: CWRU School of Medicine (withdrew at end of 2nd year)
• 1986–1987: Lab Technician I (Caplan lab)
• 1987–1993: BIO-PHD student (Caplan lab)
• 1993–2004: Research Assistant, Research Associate, Senior Research Associate (Hillel Chiel lab)
• 1996–2004: Adjunct Instructor
• 2004–2006: Full-Time Lecturer
• 2007–date: Instructor and Executive Officer
Courses Taught and Co-Taught

• **BIOL 119** (Concepts for a Molecular View of Biology I) — 1996-1997, 2008-2012 (7x)
• **BIOL 121** (Concepts for a Molecular View of Biology II) — 1997-1998, 2008-2011 (6x)
• **BIOL/EECS 375/475** (Autonomous Robotics, “LEGO Lab”) — 1995-2004 (co-taught 19x, alternating with Dr. Randy Beer and Dr. Hillel Chiel)
• **BIOL 223** (Vertebrate Biology, “Vert Lab”) — 2005-2015 (solo 6x, co-taught 4x with Dr. Ron Oldfield)
• **BIOL 346** (Human Anatomy) — 2004-2006, 2012-2014 (6x)
• **CEG 499** (WWW Autonomous Robotics) — 2005, 2006, 2008 — remote co-instructor with Dr. John Gallagher, Wright State University
Student Organization Involvement

• Faculty Advisor, Beta Nu Chapter, Theta Chi Fraternity (1998-date)
• Regional Counselor, Theta Chi Fraternity (2004-2012) — at Youngstown State, Kent State, University of Akron, and CWRU
• Faculty Advisor, CWRU Film Society (2002-date)
• Alpha Phi Omega “Ugly Professor” charity contest — 1997-2010 (11x, won 7x on behalf of the Cleveland Food Bank)
Teaching and Advising Awards and Nominations

• J. Bruce Jackson, M.D., Award for Excellence in Undergraduate Mentoring — nominee 2005
• Student Leadership Award, Outstanding Faculty Advisor for a Student Organization — winner 2002 (ΘX), 2005 (ΘX, Film Society); nominee 2007 (ΘX)
• IFC-Panhel Award for Outstanding Faculty Member — winner 2005
• Robert Niebaum Award for Outstanding Chapter Advisor — winner 2013 (ΘX)
• USG Undergraduate Teaching Excellence Award — nominee 2005
Who is Rich Drushel REALLY?
RFD Speed Dating 1

transparent

do it yourself

cement

lumper

stability

old

craft

repair/reuse

versus

guarded

delegate

abstract

splitter

change

new

art

discard/replace
RFD Speed Dating 2

lawful good   chaotic evil
Morlock       Eloi
Hufflepuff    Slytherin
Kirk          Picard
Mary Ann      Ginger
DC comics      Marvel comics
Wile E. Coyote  Roadrunner
Han shot Greedo first  midichlorians
RFD Speed Dating 3

big band swing

MAD Magazine

Rockwell

Poe

plaintext

Century Schoolbook

BASIC, assembler

“Bob”

versus

bebop

The Simpsons

Rothko

Joyce

<HTML>

Times New Roman

Java, Python

FSM
Transformational Experiences

• Your past shapes your present, and both shape your future.
• Serendipity is a force of nature, but you can recognize its power only in retrospect.
Some Transformational Experiences

• a ream of white Xerox paper given to me by my kindergarten teacher on the last day of school
  → fine art, cartooning, animation, medical illustration

• family crises (poverty, hunger, death, divorce)
  → advising empathy for students in distress

• not becoming a physician → accepting that different is not necessarily bad, it’s just different

• the Fall 2003 UCITE Learning Fellows Program
  → affirmed that I was already a good teacher, but showed me things to try which might make me better
My Transformational Teachers

• had good mastery of the material, and could do all the work which they were asking me to do
• made connections to other subjects
• gave elegant, thoughtful exams which they wrote themselves
• had open labs with the freedom to work unsupervised, to try new things, and even to fail
• made me work hard, but also inspired me to work hard
• never pushed me so hard that I broke
• trusted me first, instead of doubting me
A Transformational Tale of Trust

BIOL 210 (Cell Biology)
Fall 1981
Dr. Christopher Town
Exam #1
On my honor as a gentleman and a scholar this was done without outside aid (books, notes, etc.)

Richard E. Draude
2:45 PM
5 October 1981
Classroom Style and Features
Copious Documentation

Concepts Toward a Molecular View of Biology, Part I
BIOL 119

Spring 2011

Instructor: Dr. Richard F. Drushel
Clapp 402
(216) 368-4804
rfd@cwru.edu

Office Hours: by appointment (calendar sign-up outside my office)

SI Leader: Tessa Polakowski
tmp26@cwru.edu
session dates/times to be announced

Class Meetings: Mondays and Wednesdays, 12:30–1:45 PM, Rockefeller 301

Class E-Mail Lists: through Blackboard, http://blackboard.cwru.edu/

Please check E-mail at least daily; I will use it to communicate news and course changes, as well as to answer student questions.


Optional Text: The Physician’s Desk Reference (PDR), any edition not more than 5 years old. They are available in the Reference Section of the Health Sciences Library. New editions appear yearly; you might want to consider buying one now for use during your next 4 years in nursing school.

Required Items: battery-powered, pocket scientific-type calculator, capable of logarithms, exponentiation, and display in scientific (exponential) notation, such as the Texas Instruments TI-30 family. Note: you cannot use a cell phone, PDA, or other multi-function electronic device capable of storing “cheat” notes in text or image format as a calculator during exams.

Syllabus
BIOL 119 Spring 2011
revised 7 January 2011

Readings are from Denniston et al. (2011), 7th edition.

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
<th>Topic</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/10 (Mon.)</td>
<td>1</td>
<td>Introduction and course policies</td>
<td>Course Description and Syllabus</td>
</tr>
<tr>
<td>1/12 (Wed.)</td>
<td>2</td>
<td>Chemical methods and measurements 1</td>
<td>Chapter 1</td>
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<tr>
<td>1/17 (Mon.)</td>
<td>3</td>
<td>Chemical methods and measurements 2</td>
<td>Chapter 1</td>
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<tr>
<td>1/19 (Wed.)</td>
<td>4</td>
<td>Atomic structure and the periodic table 1</td>
<td>Chapter 2</td>
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<td>1/24 (Mon.)</td>
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<td>Atomic structure and the periodic table 2</td>
<td>Chapter 3</td>
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<td>1/26 (Wed.)</td>
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<td>Ionic and covalent compounds 1</td>
<td>Chapter 3</td>
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<td>2/02 (Wed.)</td>
<td>7</td>
<td>Ionic and covalent compounds 2</td>
<td>Chapter 4</td>
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<td>2/07 (Mon.)</td>
<td>8</td>
<td>Ionic and covalent compounds 3</td>
<td>Chapter 4</td>
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<td>2/09 (Wed.)</td>
<td>9</td>
<td>Chemical equations and computations 1</td>
<td>Chapter 4</td>
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<td>2/10 (Thur.)</td>
<td>10</td>
<td>Chemical equations and computations 2</td>
<td>Chapter 4</td>
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<tr>
<td>2/14 (Mon.)</td>
<td>11</td>
<td>Gases, liquids, and solids 1</td>
<td>Chapter 5</td>
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<tr>
<td>2/16 (Wed.)</td>
<td>12</td>
<td>Gases, liquids, and solids 2</td>
<td>Chapter 5</td>
</tr>
<tr>
<td>2/21 (Mon.)</td>
<td>13</td>
<td>Exam #1 (take-home) handed out at the end of class</td>
<td>Lectures 1–7</td>
</tr>
<tr>
<td>2/23 (Wed.)</td>
<td>14</td>
<td>Exam #1 (take-home) due in Biology Department Office (DeGrace 203) by 5:00 PM</td>
<td>Lectures 1–7</td>
</tr>
<tr>
<td>3/02 (Wed.)</td>
<td>15</td>
<td>Solutions 1</td>
<td>Chapter 6</td>
</tr>
<tr>
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<td>16</td>
<td>Solutions 2</td>
<td>Chapter 6</td>
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<td>3/02 (Wed.)</td>
<td>17</td>
<td>Energy, reaction rates, and equilibrium 1</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>3/02 (Wed.)</td>
<td>18</td>
<td>Energy, reaction rates, and equilibrium 2</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>3/02 (Wed.)</td>
<td>19</td>
<td>Acids, bases, oxidation, and reduction 1</td>
<td>Chapter 8</td>
</tr>
<tr>
<td>3/02 (Wed.)</td>
<td>20</td>
<td>EXAM #2 (closed book/note)</td>
<td>Lectures 8–13</td>
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</tbody>
</table>

12:30–1:45 PM
Rockefeller 301
Detailed Grading Policies

Coursework and Grading Policy.

There are 4 written examinations and a cumulative Review Test; see the Syllabus for specific dates, times, and locations. There are no graded homeworks or quizzes, but practice problems will be suggested for every chapter of the text, and answer keys made available.

Exams are worth 100 points each, plus a 4-point bonus question. The Review Test is worth 25 points, plus a 4-point bonus question. Thus, there are 445 points maximum to be earned during the semester (but 425 used for computing grade percentages). Guaranteed minimum letter-grade cutoffs are:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>85%</td>
<td>361</td>
</tr>
<tr>
<td>B</td>
<td>75%</td>
<td>319</td>
</tr>
<tr>
<td>C</td>
<td>65%</td>
<td>276</td>
</tr>
<tr>
<td>D</td>
<td>55%</td>
<td>234</td>
</tr>
<tr>
<td>F</td>
<td>below 55%</td>
<td>below 234</td>
</tr>
</tbody>
</table>

These may go lower at my discretion in borderline cases, but they will never go higher. If the whole class gets 85%, the whole class gets As. Grades will not be curved to a normal or any other distribution. However, in the interest of fairness, if a given exam is a disaster for the whole class, I reserve the right to “fix” those grades so as not to wreck everyone’s overall course grade.

Nonetheless, in the absence of whole-class extenuating circumstances, students who earn poor grades will receive poor grades. Dr. Drushel is not afraid to assign Cs, Ds, or Fs. Your GPA, graduation requirements, professional school admissions requirements, etc., are your own responsibility.

Except for the 4-point bonus question that accompanies each exam and the Review Test, there is no extra credit. You are not in high school anymore.
Interpretation of Grades

What Dr. Drushel’s Grades Mean.

Some students can advance very far in high school (and even in college) by just memorizing and regurgitating large masses of data in exams. Unfortunately for those students, in my lecture classes, the strategy of rote memorization/regurgitation will fail. Here is what my grades mean in terms of actual student performance.

A  can memorize basic facts
    can recognize them and apply them in novel situations, most of the time

B  can memorize basic facts
    can recognize them and apply them in novel situations, some of the time
    other times, cannot recognize the information unless it is given exactly as it was presented in lecture or in the textbook

C  can memorize basic facts
    usually cannot recognize information in a form other than how it was presented in lecture or in the textbook
    cannot apply knowledge to novel situations
    knowledge is very “brittle”

D  has trouble memorizing basic facts
    knowledge is “brittle” as in C students

F  cannot memorize basic facts, OR
    overwhelmed by catastrophic external circumstances (illness, emergency, family death, relationship breakup)
## Rubric Matrix Grading 1

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Undated Pages</strong></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Format</strong></td>
<td>Notebook is all in pencil; no ink used for regular entries or drawings. Writing is printed, not cursive. Clear and legible, no smearry pencil. Sharp pencil used throughout. No loose sheets. Notebook is well-organized with clear page layout. Every page is clearly dated. The work done for each lab is easy to find. All drawings are clearly labelled. Good English grammar and correct spelling of anatomical terms. It is clear that the student has looked at all the material himself and made a good effort to record his own observations.</td>
<td>Notebook has a few regular entries in ink, or a few regular entries in cursive writing. Handwriting is readable but could be improved. Need to sharpen your pencil more often, things are smudgy. Some loose sheets. Drawings are too small and/or under-labelled, though most of the desired content is present. Poor page layout. Hard to find dates on pages. Each lab’s work is not kept together, but is scattered haphazardly. Frequent misspellings of common anatomical terms. Some grammar and word choice errors (“it’s” as a possessive). Can be improved by being more meticulous.</td>
<td>Written with ink, dull pencils, crayons, or water-based markers that got wet and bled. Illegible or indecipherable handwriting. No especial care seemingly taken to keep fluids and slime off the pages. Many loose pages (or no 3-ring binder, just a stack of sheets, maybe with a clip or too-small paper clip or inadequate stapling at the upper left-hand corner). Drawings are poor due to inadequate detail (not because they are not professional medical illustrations). Many unlabelled or incorrectly-labelled figures. Full of typos and systematic misspellings. Very bad English grammar and usage. May also include drawings or text that has clearly been clearly copied from a book rather than from the actual material in the laboratory. Grade-school quality. Unacceptable and unprofessional at the college level.</td>
<td></td>
</tr>
</tbody>
</table>
### Rubric Matrix Grading 2

#### Class Participation

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group Dynamics</strong></td>
<td>All members work productively together. Cordial resolution of any differences. All opinions are respected.</td>
<td>Group is productive, but one member is somewhat less effective (or perhaps less respected) than the others. Can be improved with instructor intervention/counselling, since oftentimes it's subtle and unintentional.</td>
<td>Group is still productive, but there is noticeable internal friction. Some backbiting, rude comments. Instructor intervention is usually not successful, except to reduce the more overt displays of discontent.</td>
<td>Group has significantly reduced productivity compared to their potential. Frequent bickering and disrespect. Members undo each others' work at extra sessions, when the originators aren't around. Often occurs if a co-worker relationship breaks up during the semester.</td>
<td>Dysfunctional, pathological group. Open hostilities, ganging up, shunning, &quot;recorder&quot; who just take notes, people who stare off into space, read E-mail, or work on other coursework. No tangible progress. Extremely rare. Has occurred only 3 to 5 times over the entire history of the course.</td>
</tr>
<tr>
<td><strong>Personal Contribution (peer assessment)</strong></td>
<td>Equally conversant with both hardware and software, even if specializing in one or the other. Readily communicates knowledge to the rest of the group. Can accept ideas from others, as well as constructive criticism.</td>
<td>Knows both hardware and software, but less able to share specialized knowledge. Still open to input from others, and not too critical of failures.</td>
<td>Knows a specialty adequately, but has little concern about what others are doing. Begins to blame others for failures. Mantras: &quot;Hey, I'm just the mechanical guy&quot; or &quot;Hey, I'm just the code monkey.&quot;</td>
<td>Supposedly has specialized or accepted responsibility for a given task, but actually is clueless about how to do the job—and won't give it up to someone else who can do it! Knows nothing about what others are doing. Mismatch between perceived and actual abilities.</td>
<td>Is just &quot;there&quot; occupying space-time and consuming oxygen. Might be writing very diligently in his design notebook, perhaps even making an excellent one, but is not helping the others in any tangible way. A tragic waste.</td>
</tr>
</tbody>
</table>

**BIOL/EECS 375/475 (Autonomous Robotics), Fall 2004**
Extra Documentation as Needed

Rich’s Review of High School Mathematics
for Biology 119 and 121


The following is a brief review of mathematical concepts and skills with which you are expected to be proficient for Biology 119 and 121. It is intended to be representative, but not exhaustive. You should have had this material in high school algebra, trigonometry, and calculus. In principle, you had to know it well enough to get past the math portion of the SAT or ACT, in order to get admitted to CWRU in the first place. This material will not be covered in class. In addition, it is assumed that you can quickly and accurately perform grade-school arithmetic (addition, subtraction, multiplication, division, fractions, and decimals), both with and without a calculator. If you have any difficulty with this material, please see Dr. Drushel immediately.

Nomenclature.

Addition: addend + addend = sum.

Subtraction: minuend − subtrahend = difference.

Multiplication: factor × factor = product.

Division: dividend ÷ divisor = quotient.

Fractions: numerator ÷ denominator.

Reciprocal of a number: 1 . Very large numbers have very small reciprocals; and very small numbers have very large reciprocals. At the limits, the reciprocal of infinity is zero, and the reciprocal of zero is infinity. (Technically, reciprocals of these limits are “undefined”, but practically it’s helpful to think of them as given here.)

Scientific (exponential) notation: mantissa × 10<sup>exponent</sup>, with 1 ≤ mantissa < 10.

Biology 119/121
Calculator Self-Test

Verify that you can get the following correct answers using your own calculator. If you have difficulty, please bring your calculator (and user manual, if it’s a complicated type) to Dr. Drushel, and together we’ll figure out how to use it. You must be proficient with your calculator in order to do well in Biology 119 and 121!

Answers are rounded off; no significant figures are observed.

1. \( \frac{(4.3 \times 62.7) + 92.1}{16 - 2.91} = 27.6325 \)

2. \( \log_{10}(0.325) = -0.4881 \)

3. \( \text{anti log} \left( \frac{77}{14.92} \right) = 144,829.79 \)

4. \( \sin(135^\circ) = 0.6947 \)

5. \( \frac{(11 + 14.3)(2 - 15.91)}{4.5 \times 10^3} = -7.8205 \times 10^{-2} \) or \(-0.078205 \)

6. \( \log_{10}(6.02 \times 10^{23}) = -2.378 \times 10^4 \) or \(-23.78 \)

7. \( \log_{10}(9.3 - 8.01) \sqrt[3]{2} = 32.0080 \)

8. \( \arctan \left( \frac{3.6}{7.3} \right) = 30^\circ \)

9. \( \arctan \left( \frac{1}{\sqrt{2}} \right) = 45^\circ \)

10. \( (7.62 \times 10^{-1}) - (3.33 \times 10^{-9}) = 7.287 \times 10^{-1} \)
Textbook for CEG 499
LABORATORY MANUAL

BIOLOGY 346
HUMAN ANATOMY

FALL 2014

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Dr. Richard F. Drushel
Department of Biology
Case Western Reserve University
Cleveland, Ohio

BIOL 346 Fall 2014

Lab #3

Anconeus

O: posterior surface of the lateral epicondyle of the humerus
I: lateral aspect of olecranon extending to the lateral part of ulnar body
A: (1) extends the forearm at the elbow
(2) supports the elbow when in full extension
N: radial nerve, C7, C8
B: middle collateral artery from the profunda brachii artery

Vasculature

Deep brachial artery (profunda brachii)
distal part is visible posteriorly; proximal origin is from the brachial artery, best seen anteriorly

Nerves

Radial nerve
lies in the radial groove of the humerus, near the deep brachial artery
innervates triceps brachii and anconeus (the extensors of the forearm at the elbow)

Posterior antebrachial cutaneous nerve
branch of the radial nerve

Ulnar nerve
runs posterior to the medial epicondyle of the humerus
liable to injury since it is very superficial here; the “funny bone” sensation if bumped

Posterior Forearm

General

As in dissecting the posterior arm, the circumferential skin incisions made for dissection of the anterior surface (at elbow and wrist) are extended posteriorly until the skin can be completely detached. Superficial veins must be removed in order to expose deeper structures.

The extensor tendons are held down posteriorly by a dense band of connective tissue, the extensor retinaculum, which runs transversely and circumferentially around the proximal bones of the wrist. (This is a continuation of the flexor retinaculum on the anterior surface, see Lab #2.) The extensor retinaculum must be cut to fully expose the path of the extensor tendons into the hand.
Ordinary Lectures are taught from the Chalkboard

no PowerPoint
no MediaVision
LIVER (hepatic, hepatocyte)

Functions:
1) Metabolic regulation
   - Hepatocytes
   - Detoxification
   - Glycogen storage
   - Conversion of amino acids into urea

2) Excretory functions
   - Formation of bile salts
   - Storage and excretion of bile

3) Synthetic functions
   - Protein synthesis
   - Formation of vitamin A and B12
   - Conversion of cholesterol into bile acids

Regulation:
- Hormonal control
  - Glucagon, insulin, epinephrine
- Unossified bone metabolism
- Uptake of amino acids
- Uptake of fatty acids
HISTOLOGY

Central Vein

Fig. 25.20 (687)

Portal Triad

Hexagonal Lobule

Made of individual Hepatocytes
GALL BLADDER

- Fundus
- Hepatic duct
- Common
- Body
- Neck
- Cystic duct
GALL BLADDER

- Fundus
- Hepatic duct
- Common hepatic duct
- Porta
- Body
HEPATO-PANCREATIC AMPULLA (of VATER) with Sphincter (of ODDI)

CBD

(MAJOR) PANCREATIC DUCT

precipitation of bile salts

GALL STONES (CHOLELITHIASIS)

bile stone

HISTOLOGY

PORTAL TRAIT

Fig. 25.20 (687)

HEPATIC HEART
Use technology where appropriate.
Lab #11: Back; Posterior Hip, Thigh, Leg, and Foot; Knee Joint

Biol 346 Fall 2014

12 November 2014 9:10
Plan of Dissection
Piriformis, Quadratus Femoris, and the Sciatic Nerve
Celiac Trunk
Types of Assessment

- Homework (BIOL 119/121)
  numeric problems, chemical reactions, case studies
- Exams (BIOL 119/121, BIOL 346/340)
  objective, numeric problems, short answers, case studies
- Lab Practicals (BIOL 223, BIOL 346)
- Lab Notebooks (LEGO 375/475, BIOL 223)
- Project Reports (BIOL 223, LEGO 475)
- Other (BIOL 223, LEGO 375/475)
(11) According to the Brønsted-Lowry definition, an acid is 

- a substance with a low pH — not relevant for B-L definition
- produces hydroxide ions in solution — NO
- an H donor
- an H acceptor — no, this is B-L base

(12) Barium hydroxide can neutralize how many equivalents of acid?

- S
- T — barium hydroxide is an acid itself
- O
- N
- P

(13) The conjugate base of HSO₄⁻ is

- C hydrogen sulfate
- D dihydrogen sulfate
- E sulfate
- F sulfate

(14) The conjugate acid of H₂O is

- M H₂O⁻
- N H₂O
- O H⁺
- P OH⁻

(15) In an aqueous solution containing equal molar amounts of a weak acid and its conjugate base, which of the following statements is false?

- Q the solution acts as a buffer — true
- R the product of the hydronium and hydroxide ion concentrations is 1.00 x 10⁻¹² — true
- S the pH will not change appreciably if moderate amounts of acid or base are added — true
- T all of the weak acid will exist in its ionized form — false

(16) Someone who is vomiting profusely — nausea losing H⁺ — alkalosis

- I may show a slowed respiratory rate in an attempt to offset alkalosis by reducing the loss of metabolic CO₂ — YES
- J will have reduced delivery of oxygen to peripheral tissues because the vomiting-induced pH change shifts the oxygen saturation curve of hemoglobin to the right — YES
- K both I and J
- L neither I nor J

---

(5 points) A 5.00 mg dose of ¹³¹I (t₁/₂ = 8.1 days) is administered (as intravenous aqueous potassium iodide) to a patient suffering from hyperthyroidism. Assuming no other route of elimination from the body, how much ¹³¹I would be left in the patient after 125 days? Show all work. Don’t forget the units!

\[ m_f = m_i \times 2^{-n} \text{ where } n = \text{# of half-lives} \]

\[ n = \frac{125 \text{ days}}{8.1 \text{ days}} = 15.5 \approx 16 \text{ half-lives} \]

\[ m_f = (3.00 \text{ mg})(2^{-16}) = \frac{3.00}{65536} \approx 0.000046 \text{ mg} \]

(2 points) Why would a hyperthyroid patient be given ¹³¹I? Explain briefly.

Hyperthyroidism is too much thyroid activity. ¹³¹I homos preferentially to the thyroid gland (I⁻ is part of thyroxin, the thyroid hormone). The radiation is concentrated in the thyroid gland killing it, so all thyroid hormone secretion stops. Normal amounts of thyroid hormone are given orally to restore function. The short half-life of ¹³¹I decreases the whole-body radiation risk — only 3% is left after 40 days.

(2 points) Complete the following nuclear equation:

\[ p + n \rightarrow \text{Be} + \text{neutron} \rightarrow \begin{array}{c} 7 \text{Li} + \text{proton} \end{array} \]

AlternateGEL ™ (Liquid High-Potency Aluminum Hydroxide Antacid)
The following is taken from an actual autopsy report. Read it carefully and answer the questions about it. Don’t be distracted by extraneous details. Focus on the GI system and vasculature. Don’t panic!

Autopsy Number: ME3-356
Name: OSVALDO, Lee Harvey
Age: 24 Race: White Sex: Male
Autopsy date: 11-26-63, 2-45 P.M.

EXTERNAL EXAMINATION:
External examination reveals a 5 foot, 9 inch white male, the estimated weight is 150 pounds.

ENTRANCE WOUND
23 inches from the top of the head and 3 3/4 inches to the left of the midline anteriorly and 10 3/4 inches to the left of the midline posteriorly, over the lower aspect of the left chest there is an entrance-type (gunshot) wound which measures 1/4 x 5/16 inch in diameter. This is surrounded by a contusion ring, the bullet diameters of the contusion ring are 3/8 of an inch.

EXIT WOUND
23 inches from the top of the head and 9 3/4 inches to the right of the midline anteriorly and 8 1/4 inches to the right of the midline of the back there is a vertical 2 x 1 inch [gaping] wound. Posterior to this by 1/2 inch there is a 3/4 x 3/8 inch irregular contused area.

SEROUS CAVITIES: Examination of the serous cavities is made. In the left pleural space [there is] approximately 1 3/4 cc of blood. [cc = cubic centimeter = ml.] In the right pleural space there is in excess of 600 cc of blood. In the peritoneal cavity there is in excess of 1000 cc of blood with clot formation. In addition, there is massive retroperitoneal hemorrhage. The omentum adjacent to the transverse colon and sigmoid is hemorrhagic and irregularly torn.

ENTRANCE WOUND
THE COURSE OF THE WOUND IS FOLLOWED. It is found to notch the undersurface of the seventh rib at the costochondral junction, this is surrounded by hemorrhage. In its course it notches the diaphragmatic attachment in this region, however, the left lung is not penetrated. The course is found to go from left to right and forward. In its course it is found to strike the anterior edge of the spleen and there is a cruciate [cross-shaped] laceration of the spleen measuring approximately 1.5 x 2 cm. The muscle is found to penetrate the stomach along the greater curvature of the body of the stomach, the penetration measuring 9 mm. It exits from the stomach along the posterior wall, lesser curvature, 2 cm distal to the cardiosophageal junction. The penetration measures 8 mm. It pursues a course backwards to the right slightly caudad to the colic axis and there is extensive hemorrhage in this area. The anterior and right anterior-lateral aspects of the aspect is torn with the superior mesenteric artery being severed. The right renal artery shows destruction and hemorrhage along the cephalad portion. The right renal vein is torn and the tear involves the inferior vena cava, the dorsal surface. It courses through the upper pole of the right kidney along the anterior surface causing a jagged and irregular laceration covering a distance of 5 x 2 cm, with penetration into the calyces. It becomes perforated in the hepaticorenal pouch and there is a jagged and irregular laceration of the liver covering a distance of 9.5 x 2 x 2 cm. From the liver it penetrates the diaphragm posteriorly on the right side. It then passes adjacent to the lung in the pleural space and the right lung is not penetrated. The eleventh rib to the right of the midline is irregularly fractured and an exit type of wound in this region and in the soft tissue along the posterior axillary line right side there is an indented wound and fragmentation of the rib.

LIVER: The liver weighs 1260 gm. The penetration of the liver has previously been described.

(4 points) On the left skeletal diagram, mark the location of the entrance wound. On the right skeletal diagram, mark the location of the exit wound. Be specific, using the information provided in the autopsy report (including measurements). Clearly label each wound. Label the anatomical landmarks that were mentioned to specify the location of each wound.

Accurate are dimensions difficult to show on flat drawings of curved skeletal surfaces. Moreover, the ribs in the posterior view are sagging inferiorly somewhat. The actual named anatomical landmarks are easy to find, however.

(8 points) On the following digestive system diagram, mark the locations of the entrance and exit wounds to the stomach, using the information provided in the autopsy report (including measurements). Clearly label each wound. Label the four anatomical surface features of the stomach that were mentioned in the autopsy report.

EXIT WOUND
somewhere near here, on posterior surface

(1) CARDIO-
ESOPHAGEAL
JUNCTION

(2) LESSER
CURVATURE

2 cm
about 5 cm

LIVER
somewhere near here, on anterior surface
BIOL 223 Spring 2014 Lab Practical #2
STATION 2.

A. Completely identify the connective tissue structure marked A.

B. Identify the structure marked B. (multiple pins)
Station 24.

A Identify the specific part of the brain marked A.
medulla oblongata

B Identify the specific region of the brain marked B. (yellow)
posterior lobe of cerebellum
Assignment #4
February 8, 2000

* Began writing code to detect Headbot. First algorithm, working well, will switch by rotating Headbot 360° taking values from both sensors at every 90°. Incremental. We have an error of 3 degrees = 5°. As Headbot does its rotation, it will remember in which direction the minimum sensor reading took place.

```
For S1, see Design-2.c
```

* Inserted a snippet of code to output data from both sensors to serial port.

```
Data output: [S1, S2]
```

* The lowest sensor minimum, this is to say the best minimum for A and B, were at 15° and 12° respectively, which was confirmed by observation. For this trial, the robot was closer to base A.

* A better algorithm could possibly detect all 4 minimums, or even only 1. Repeated, the sensor was dysfunctional, not any of the two, thus detected the incorrect direction.

---

(a) Build a design of some kind in front of robot? It could be behind the egg displacement. Each wall was done. Some designs were used. A blue dispenser and 2 track plates to create a budget that will send the robot to the egg. Egg moves about 15° from about 25° away from the left or the right. It will push the egg inside and a little back towards the right next to it. The bump pushes the egg over the lip and the way to the back of the nest. Also, build a prototype frame for the robot with a motor driving a middle separated wheels. Finally, build a box for the nest director (the second group 3's design for a sensor box) and hemispheres with a program that outputs values to the led. Each input, distance and numbers for the sensors values at those lengths from the nest light sensors, and Nudge 1C included. We also tried heater design by using the same type of sensor, which halved the current derived track may have too much friction and may be too wide, but it was designed to keep the robot track low to the ground and under the robot's light. This would keep the robot from not having the wall to see the nest, as happened on the last one, be wider, but is harder to turn.
Journal Entry 2

Behavior 1 - LESSON 5

6/2/07 -
I decided to start with a simple philosophy towards this problem with two states:
1. If there are lights in front, then balance between the right and left
2. If there is no light in front then stop, your

I then realised that if I only balanced between the left and right then I risked heading straight for a light and running into it. I tried it just trying to balance the right three with the left three and it ran right smack into the light pole.

I changed my strategy. I now had three states:
1. If there are lights in front, balance between the right and left
2. If you’re close enough to use distance sensors on the front 4 sensors, ignore the lights, and balance using this
3. If there are no lights in front and you see some in back, then stop

I was really surprised, but this worked near perfect the first time I ran it!!!
With a little tweaking it worked on both behavior 1 and behavior 2! This worked because going towards the average light took me near the center, and then if I avoided the pole, I ended up going straight through!

6/3/07 - 6/4/07 LESSON 6
At first I started out using a program which was very similar to the program which goes and finds balls on the other end and brings them back. This didn’t work out though because that program was made more to follow the wall and then find balls along the wall. Unfortunately, I needed something which would eventually wander everywhere in the room. I started out with the following model:

1. Go straight
2. If you see something go into lock on mode
3. Get close and then put down the gripper
4. If there is something in the gripper close,
5. If not then simply turn around and go back to state 1.

The basic idea worked but some issues needed to be cleared up, for instance the robot needed to stop when it finally got a ball, and I also improved how the robot sensed if the found object is a ball or a wall so it didn’t put down the arm if there obviously was not a ball.

Once I finished, this program found the ball in most all cases
I write all my own exams and lab practicals, different every year.

_no publishers’ test banks_

I do assign homework problems from the textbook (BIOL 119/121)
Review Materials

• Detailed review materials, including topics and a blank copy of the previous year’s exam for practice, and a worked answer key, are made available 1 week before every exam or lab practical.

• I hold a 2-hour review session before every exam or lab practical. This is separate from any reviews that may be held by SIs or TAs (if available).
Extra Credit and Penalties

• All exams and lab practicals have a 4-point Bonus Question.

• Spelling, grammar, math computation, and significant figures errors are penalized at $-\frac{1}{2}$ point per instance.

• Instructor spelling, grammar, and other typographical errors, if detected before the end of the exam period, give every student in the class +1 point per instance.

• The Bonus Question and instructor-error bounties are the only extra credit available.
Grading

• I grade at least 50% of all students’ work, though usually I have graded 100%.

• Detailed answer keys with rubrics for partial credit are given to a grader.

• I validate the answer keys by grading some of my half first, before giving the key to a grader.

• Sometimes students think of novel, valid answers, which deserve credit.

• Answer keys are made public so students can check their work and double-check the grading.

• Written feedback is given on all coursework.
It is important to provide opportunities to practice new skills in a supportive environment, so that students can get acclimated, get feedback from the instructor, and learn from failures, before it is too late.

Give students a “sandbox” to play in for awhile.
The first lecture exam is an overnight take-home, open-book, open-note, but group work is expressly prohibited.

- allows students to get accustomed to the exam format, which may be new or unfamiliar
- provides experience for the remaining exams, which will be time-limited, closed-book, closed-note
- the mean should be 95%+ (an A in the bank)
- anyone <90%ish is identified for intervention
Spot-Check Day for Lab Notebooks

• The first 2 weeks of the course are “free” — they will not be counted towards the final grade.
• In preparation for Spot-Check Day, every student will self-grade his/her notebook according to the specified criteria.
• On Spot-Check Day, the instructor will briefly examine every student’s lab notebook in a 1-on-1 meeting, and assign an informational grade.
• Any deficiencies or discrepancies between the student’s grade and the instructor’s grade can be discussed.
• Good students can be reassured that they are doing well. Poor students can be given feedback on how to improve.
• Only work done after the Spot-Check meeting is counted towards the final grade.
Take-Home Messages for Effective Teaching (and Advising)

- Transparency
- Ownership
- Craft
- Alignment
- Consistency
  - Availability
- Fairness
- Sandboxes
- Feedback
- Flexibility
- Trust
Traits of Effective Teaching/Advising 1

• Transparency — all the expectations, rules, and procedures are clearly documented

• Ownership — you have “effective command”; the students are getting you, not the book, SI, or TA.

• Craft — you take teaching seriously, and do a good job

• Alignment — what you assess is what you teach, and vice versa
Traits of Effective Teaching/Advising 2

• Consistency — everyone with the same situation is treated in the same way

• Fairness — the game is not rigged; students can succeed; you have provided a workable path for those who follow your directions

• Sandboxes — students have a chance to try out new things without penalties for failure

• Feedback — you tell students what they are doing right as well as what they are doing wrong
Traits of Effective Teaching/Advising 3

• **Trust** — you believe students first, rather than doubt them, and you are honest with students, so that they can believe you

• **Flexibility** — you’re able to deal with the unforseen, in ways that don’t break your course policies or set bad precedents

• **Availability** — you provide guidance and support, and respond when asked
History of LEGO 375 1

- Created in Spring 1995 by Randy Beer and Hillel Chiel, with grants from the Howard Hughes Medical Institute (HHMI)
- Inspired by Fred Martin’s 6.270 robotics course at MIT (1992–date)
- Low-floor, no-ceiling course that teaches programming, mechanical design, and debugging, with a fun real-world robot contest at the end
Dr. Randy Beer (1997)
History of LEGO 375 2

- Taught by Beer/Chiel/Drushel for 20 semesters (Spring 1995–Fall 2005)
- Hugely popular (542 students lifetime, 22 ΘΧs, 13 Filmies, 5 married couples), with waiting lists 1+ semesters in advance
- Arguably one of the best courses ever at CWRU
- Case Alumni Association sponsored LEGO Lab alumni reunion events at Homecoming 2012 and 2013
LEGO Lab Reunion, Homecoming 2012

photo by Gabe Schaffer
(Spring 1996)
Significant Alumni

• Paul Buchheit (Spring 1996) — Google employee #23, author of Gmail; “Don’t be evil” was coined in the class in response to excessive competitiveness

• Andy Rollins (Fall 1996) — Associate Professor, BME

• Mike Reed (Fall 1998) — asked RFD to become Faculty Advisor for Theta Chi

• Ian Charnas (Spring 2000) — Manager of think[box]

• Dave Kwartowitz (Fall 2002) — asked RFD to become Faculty Advisor for the CWRU Film Society

• Chris Fietkiewicz (Fall 2003) — Assistant Professor, EECS
LEGO 375 Course Design 1

• Target: science/engineering undergrads, but really anyone can take the course, just be willing to try new things

• Object: learn to build and program a robot with a rich sensory and motor repertoire to perform complex tasks autonomously — no remote control

• Assumes no programming skills

• Students work in groups and teams
LEGO 375 Course Design 2

• First half of semester: structured exercises in programming, mechanical design with LEGO, sensors, motors, and sensory integration. Students work in groups of 3.

• Second half of semester: 2 groups of 3 students design and build a pair of robots to compete in a public Egg Hunt competition.

• http://drushel.cwru.edu/375/ for links to archival course materials, photos, videos, and publications
LEGO 375 Course Design 3

• Grading: 70% design notebook (handwritten or electronic format), 30% participation
• 0% for robot performance unless students are just not doing the work (pathological)
• Freedom to experiment and fail, limited only by the materials
LEGO 375 Course Materials

- Box of 2000+ LEGO pieces (beams, plates, gears, axles, connectors)
- MIT 6.270 microcontroller board (68HC11 CPU, 32K RAM), programmed in Interactive C (interpreter with CLI)
- Many sensors, motors, lamps, IR LEDs
- Desktop computer (MacOS 9.x) for code development
- Lots of extra lab time as arranged with course alumni
MIT 6.270 Board

- **CHOOSE button**
- **ESCAPE button**
- **servo motor port (±s)**
- **LCD contrast adjustment knob**
- **serial cable jack**
- **motor ports 0–3 (bidirectional)**
- **6 volt motor battery jack (center -)**
- **AA logic battery jack (- +)**
- **ON/OFF switch**
- **RESET button**
- **“frob knob” variable resistor**
- **digital sensor ports 0–7**
- **LED output ports 0–1 (+ -)**
- **motor ports 4–5 (unidirectional)**
- **DIP switches 0–3**
- **analog sensor ports 12–27**

LCD display:

```
Interactive C
U 2.81 9/28/93
```
Robot Kit (Spring 1998)
/*
 * turn_right(speed, time)
 * turns the robot to the right by driving the left motors forward and the right motors backward
 * speed should be 0-100
 * time is in seconds
 * ***** NOTE  ***** magic time=0 means turn of photophobia_daemon()
 * motors are plugged in so that, to go forward, all motors are +speed
 */

void turn_right(int speed, float time)
{
  if (time==0.0)
    MY_STATUS=PHOTOPHOBIA_STATE; /* light avoid turn */
  else
    MY_STATUS=R_STATE; /* standard right turn */
  motor(LF_MOTOR, speed);
  motor(RF_MOTOR, speed);
  motor(LR_MOTOR, speed);
  motor(RR_MOTOR, speed);
  sleep(time); /* wait for timeout */
}

/***********************************************************************
 * avoid_daemon()
 * obstacle avoidance using bumper inputs
 * spawned in main
 * can be killed and restarted by photophobia_daemon()
 */

void avoid_daemon()
{
  while(1)
  {
    forward(MAX_SPEED, 1.);
    if (LF_STATUS==1)
      {
        backward(MAX_SPEED, 2.);
        turn_right(MAX_SPEED, 2.);
      }
    else
      {
        if (RF_STATUS==1)
          {
            backward(MAX_SPEED, 2.);
            turn_left(MAX_SPEED, 2.);
          }
        else
          {
            /* do nothing! */
          }
      }
  }
}
Egg Hunt Rules

• Arena contains 40 shiny, pastel-colored eggs (+1 point) and 10 flat-black eggs (–4 points), so net score = zero
• Object: have the higher score in your nest (sum of all egg values) at the end of a 10-minute round
• Basic strategy: robots collect eggs, sort by color, deliver to appropriate nest (pastel to yours, ignore black or take them to your opponent’s)
• Variations: Independent vs. cooperative; offensive vs. defensive; single-egg vs. multi-egg collection; direct vs. remote delivery
• No touching of robots — complete autonomy
• Modified double-elimination tournament
Egg Hunt Arena

Nest A
horizontally polarized light beacon

Nest B
vertically polarized light beacon

Beacon-to-beacon = 23.3 feet
Max arena width = 11.5 feet
All walls are 1 foot high.
Arena walls are flat black.
Nest walls and floor are flat white.
I was at the Spring 1999

"LEGO™ my™ Egg-o™!"

ROBOT EGG HUNT

BIOL / ECES 375 / 475
AUTONOMOUS ROBOTICS
CASE WESTERN RESERVE UNIVERSITY

CWRU

Wednesday
28 April 1999
12:00 - 2:30 PM
Crawford 14

LEGO™ is a trademark of LEGO Industries.
Egg-o™ is a trademark of W.K. Kellogg Co.
my™ isn’t a trademark, but we thought it was cute.

SPONSORED BY GRANTS FROM
THE CASE ALUMNI ASSOCIATION
AND GENERAL MOTORS
LEGO 375 Egg Hunt Contest
(Spring 2004, Great Lakes Science Center, Cleveland, Ohio)

video clip (4:59, 640 x 480, 63.6 MB) currently available at
http://rinette.cwru.edu/~drushel/LEG0375_s2004_r6a.mov
Spinoffs
BIOL 803 (Inquiry-Based Approaches to Autonomous Robotics)

- Originally just a 2-week distillation of LEGO 375 for 5 pairs of teachers, restricted to high-school science teachers (1998–2000)
- Any teacher K–12 eligible (2001)
- Teacher-student pairs eligible (2003)
- Prototype 2-day distance learning robotics module (2004)
- Almost all distance learning curriculum; only 2 days of physical LEGO robots (2005)
- Final no-LEGO curriculum (2006)
Rhonda Kates and Elanor Drushel
16 June 2005
in the old Olin 803 lab
(now repurposed for ENGR 131)
CEG 499
WWW Autonomous Robotics

Wright State University

Dr. John C. Gallagher (WSU)
Dr. Richard F. Drushel (CWRU)
Dr. John Gallagher (WSU)
CEG 499 Course Design

- Target: engineering undergraduates
- Object: learn to program a robot with fixed sensory and motor repertoire to perform complex tasks autonomously
- Assumes some programming skills (in any language, but Java or C/C++ preferred)
- Students are ultimately responsible for their own work, but public virtual environments are available for student interaction and full-class discussion with instructors
- Grade is 60% written journal (PDF), 40% discussion participation (logged chats)
The Khepera Robot

- Wheeled base
- Gripper arm (open/close, up/down)
- Distance sensors (reflectance: IR emitter/detector)
- Light sensors
- RS-232 serial port
- Expansion modules available
Khepera Remote Control Console Simulator
by Duane Bolick, Wright State University

Type <help> for a list of commands.

KHEPERA> help

The following commands are supported:

--- System Commands ---
help  brings up this menu
quit  exits the program
ver   displays the controller version
sim   selects SIMULATOR mode
remote selects REMOTE mode

--- Robot Movement Commands ---
f     moves FORWARD
b     moves BACKWARD
l     turns LEFT (counterclockwise)
r     turns RIGHT (clockwise)

c     SHORT (100 ms)
m     MEDIUM (500 ms)
l     LONG (2000 ms)

Default duration is MEDIUM if no option is specified. Thus, <f> is the same as <fm>, etc.

--- Gripper Arm Command ---
   a     causes the ARM to move up
   d     causes the ARM to move down
   g     causes the GRIPPER to open
   c     causes the GRIPPER to close

--- Sensor Status Queries ---
   sd    returns current average distance
   sl    returns current average light intensity

KHEPERA>

--- Type commands below: ---
Distance Learning BIOL 803
Course Design (2005)

• Introduction to teleoperated robotics (2 days)
• LEGO robotics (MIT Handy Board) 375 (2 days)
• Java programming tutorial (1–2 days)
• Sensory integration (Khepera) (1–2 days)
• Robot contest (3–4 days)
• Exit interviews/debriefing/party : -)
• Grade is based upon electronic design journal
The Virtual Classroom Environment of a WWW-Based Autonomous Robotics Laboratory: Factors Affecting Student Participation, Communication, and Performance

Dr. Richard F. Drushel
Department of Biology
Case Western Reserve University

Dr. John C. Gallagher
Department of Computer Science and Engineering
Wright State University

ASEE Annual Conference, Pittsburgh
Monday, 23 June 2008
Division of Experimentation and Laboratory Oriented Studies (DELOS) of the American Society for Engineering Education (ASEE)

2008 Best Paper Award

Is Presented to

Richard Drushel

In Recognition of an Outstanding Contribution Entitled:

"THE VIRTUAL CLASSROOM ENVIRONMENT OF A WWW-BASED AUTONOMOUS ROBOTICS LABORATORY: FACTORS AFFECTING STUDENT PARTICIPATION, COMMUNICATION, AND PERFORMANCE"

Presented at ASEE Annual Conference and Exposition,

June 22-25, 2008, Pittsburgh, PA
Summary

• I’ve taught many different kinds of classes.
• I’ve taught many different kinds of students.
• I’ve advised many different kinds of students.
• Various transformational experiences during my lifetime have significantly affected my teaching and advising.
• I’ve been successful at teaching and advising by many different measures, but I can always try to improve.
• Multi-disciplinary courses are hard, but I believe that they are the most worthwhile kind.
Take-Home Messages for Effective Teaching (and Advising)

- Transparency
- Ownership
- Craft
- Alignment
- Consistency
- Fairness
- Sandboxes
- Feedback
- Flexibility
- Trust
- Availability
Acknowledgements

- all my students, advisees, ΘXs, and Filmies
- all my teachers in Biology and elsewhere at CWRU
- all my LEGO robotics colleagues
- my family, for all the hours they missed me, but also for all the hours they helped me
- everyone who ever gave me a chance, or a second chance
- Mrs. Judy Gardner, E.J. Blott Elementary School, Liberty Township, Ohio, who gave me a ream of white Xerox paper at the end of kindergarten in 1968, because she saw that I liked to draw
VOTE DRUSHEL FOR SENIOR INSTRUCTOR