

GENERAL CHEMISTRY B

Instructor: Willetta Greene Johnson, Ph. D.

Contact: Office: St. Joseph Seminary, Room 121 773-508-3537

wgreene@luc.edu

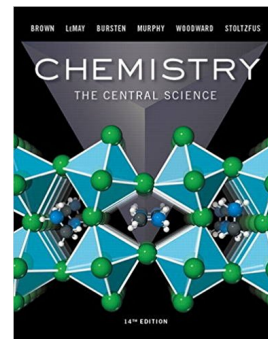
Who am I: A chemical physicist (Stanford University/ University of Chicago) interested in surface optico-physical interactions and mildly interested in (1) thermodynamics (2) unstable systems; (3) producer, composer, orchestrator, pianist, arranger and conductor. In Spring 2019, a work of mine was performed by the Cincinnati Symphony. It was originally commissioned by the Chicago Sinfonietta and I also guest conducted in that concert. One of my songs was doubly tracked on a Grammy award winning CD in 2004. Since then, it has been covered by seven other groups.

Office Hours: Wednesday 10:30 A – 11:45 A note: FH-129
and by appointment.

1. **Prerequisites:** CHEM 101 and 111, or 105 and completion of Math 118 or higher with a grade of C- or better. **Co-requisite:** 112.

2. **Required Text:**

- **Chemistry, the Central Science.** 14th ed. Theodore L. Brown, *et. al.* Boston: Pearson Prentice Hall: 2011 ISBN: 978-0134414232. (*Mastering Chemistry* is NOT required).
- **Chemistry 102 Course Packet**, authored by the instructor. This lecture packet is available online at www.universityreaders.com. The course packet will be mailed to you within a few days of ordering, and you'll have immediate online access to 30% once order is completed.



Meetings: Lectures are scheduled MWF in FH-133 at 9:20 A–10:10 A. You must also be registered in discussion sections 007-009.

Discussions: meet on Thursdays according to the following schedule:

| Section | Instructor | Location | Time |
|---------|--------------------|----------|----------------------|
| 007 | Dr. Greene Johnson | FH- 007 | F: 11:30 A – 12:20 P |
| 008 | Dr. Greene Johnson | FH- 007 | F: 12:35 P – 1:25 P |
| 009 | Dr. Greene Johnson | FH- 007 | F: 1:40 P – 2:30 P |



Due to the large number of students / sections that are matriculated through this course yearly, there can be absolutely no alteration of this schedule.

Course Description: A study of chemical principles and generalizations with emphasis on the development of a scientific attitude and an understanding of the fundamental concepts of chemistry.

Calculators: A scientific calculator is sufficient. Calculators cannot be shared while exams are in progress and their cases/covers must be removed. Be familiar with your calculator and the status of its batteries. The student is responsible for having a working calculator in lecture and on an exam day.

Cell Phone¹ Policy: It is forbidden to video/audio record lecture (except Loyola University staff). Stills of the board may be taken after class. ***During exams, cell phone, wireless devices, and unauthorized materials are strictly forbidden; subject to device confiscation and dismissal from exam.***

SAKAI Connection: The syllabus, homework assignments for the semester, discussions, and discussion answers will be posted at the following website: www.luc.edu, look under LINKS, click on **Sakai**). Students possessing a Loyola email address should be able to access this site.

¹ All technology, smart phone, tablets, laptops, surface pros, ... **Violations will be treated as instances of academic dishonesty** (see page 5)

Additional Information: For your convenience, test taking tips are listed on page 7 of this syllabus, as well as a protocol on page 12 regarding soliciting a recommendation from me, should you desire one and qualify (see protocol)..

Objective of this course in grander detail:

By the conclusion of this course, the student should experience the following outcomes:

1. Understand the fundamental principles of physical chemistry
2. Acquire a knowledge base of basic terminology and classifications
3. Apply concepts creatively as well as solve multi-tiered problems
4. Know how to rank, estimate, analyze and critically evaluate a range of models
5. Gain a broader understanding of the role of chemistry in human endeavor
6. Appreciate the collaborative and global effort of the scientific enterprise


Specifically the engaged student should improve in her or his ability to

- **Comprehend the following concepts:**
 - Kinetics, reaction rate, Arrhenius equation, reaction mechanism, rate limiting step
 - Dynamic equilibrium and Equilibrium constants
 - Titrations, Buffers, pH, Lewis and Arrhenius A/B models, Solubility product
 - Complex ions and octahedral Crystal Field theory
 - Electrochemical cells (batteries, fuel cells, transduction, respiration)
 - Spontaneity vs. nonspontaneity, entropy, cyclic processes, and free energy
 - Introduction to nuclear chemistry
- **Identify reagents and general chemical processes:**
 - Identify acids, bases, acidic and basic salts, buffers, solubility rules (Chemistry101)
 - write appropriate net ionic prototypical rxns in aqueous solution
 - be able to closely estimate and accurately calculate pH
 - equilibrium constant K and how it predicts spontaneity status of a reaction
 - complex ion, Lewis bases, geometry of “simpler” complex ions and compounds.
- **Assess outcome feasibility:** estimate energy and entropy of chemical processes
- **Work and exchange ideas with others:** cordially solve weekly group problems
- **Appreciate the impact of chemistry:** realize better how chemistry impacts life processes, technology, local, and global issues.
- **Contribute constructively:** as a science-literate, ethically responsible citizen and voter.

Later this semester, you will receive an emailed invitation to assess me via the **SmartEvals**. This survey provides a thorough diagnostic of how effectively students think the instructor realized the objectives boxed above, as well as the value of the course and other contextual experiences. This survey will be emailed to you from the Office of Institutional Effectiveness and will be available for approximately a one-week window only.

As student raters, please be aware that the results of your ratings for this class will be included as part of the information used to make decisions about promotion/tenure/salary increases for this instructor. Fairness to both the individual and the institution require *accurate and honest* answers.

Chemistry 102 Schedule of Topics

| Date | Day | Topic | Chapter | Pages (approx) |
|---|------|---|------------------------|---|
| 1/13 JAN | M | Liquids & Interm. Forces | 11 & 12 | 444-466, 472-500 |
| 1/15 | W | Kinetics & Chemical Rate | 14 | 574-582 |
| 1/17 | F | Integrated Rate Law; <i>Example:</i> Radioactive Decay | 14 21 | 582-590, 591-600, 913-916 (rev. 902-905) |
| 1/22-1/24 | W-F | Arrhenius Eq'n; k vs. T Rxn mechanisms; | 14 | 601-606 607-615 |
| 1/27- 1/29 | M, W | Rate limiting step | 14 | 615-622 |
| 1/31 | F | Gas phase Equil'm | 15 | 628-637 |
| 2/3 FEB | M | Const. K; Equil. Table | 15 | 632-644; 644-650 |
| 2/5 | W | van't Hoff equation | 15 | 648-656 |
| 2/7 | F | Le Chateliér's Principle | 16 | 657-660 |
| 2/10 | M | Acid/base categories SA,... | 16 | 670-679, 684-687 |
| 2/12 | W | REV 11,14-16 (~ 25 min) | | OPTIONAL |
| 2/14  | F | Exam 1: Ch.11, 14-16 | IN CLASS | SKIP Every 3 rd row! |
| 2/17 | M | Dissoc'n K_a, K_b ; Eq. Table | 16 | 664-676; 678-680 |
| 2/19 | W | A/B Salts, Binary acids | 16 | 694-699, (702-704) |
| 2/21 | F | WA, WB strength K_a & K_b | 16 | 681-695 |
| 2/24 | M | Buffers | 17 | 724-729 |
| 2/26 | W | Titration SA/SB; SA/WB; SB/WA | 17 | 730-739 |
| 2/28 | F | K_{sp} and ppt equil'm Common Ion Effect | 17 | 740-743 744-746 |
| 3/2-7 MAR | M-Sa | SPRING BREAK | sPrInG BrEaK | Spr. Break Worksheet |
| 3/9 | M | Complex Ions (Lewis Acid/Base) | 23 17 | 1002-1006 756-758 |
| 3/11 | W | Ligands, Nomenclature | 23 | 1007-1016 |
| 3/13  | F | Review: 16, 17, 23 ~25 min | | Optional no handout |
| 3/16 | M | EXAM 2: Ch.16, 17, 23 | IN CLASS | SKIP Every 3 rd row! |
| 3/18 | W | Crystal Field Theory | 23 | 1020-1026, 1030-3 |
| 3/20 | F | Spont. And Temp. Statistical origin (physics) | 19 | 812-818 821-828 (opt) |
| 3/23 | M | Entropy, standard, 2 nd Law | 19 | 818-821, 828-831 |
| MAR. 23 (5 PM) LAST DAY TO WITHDRAW WITH A GRADE OF W | | | | |

| Date | Day | Topic | Chapter | Pages |
|------------------|-------------|---|--|---|
| 3/25 | W | Coupled Reactions | 19 | 842-844 |
| 3/27 | F | Gibb's Energy and Temp Gibbs Energy and K Hess's Law for ΔG , ΔS | 19 | 831-838 838-841 |
| 3/30 | M | Electrochemistry Redox Voltaic Cell $E^{\circ} = E_{\text{ox}}^{\circ} + E_{\text{red}}^{\circ}$ | 20 | 856-865 858-868 |
| 4/1 APRIL | W | E_{red}° , E_{ox}° , Spontaneity | 20 | 868-874 |
| 4/3 | F | Work and ΔG | 20 | 876-879 |
| 4/6 | M | Graphical Technique | 20 | In class only |
| 4/8 | W | Nernst Equation E° and Equil'm const. | 20 | 880-886 886-892 |
| 4/9-4/13 | Th-M | EASTER BREAK   |  | Enjoy Safely! |
| 4/15 | W | REVIEW 19-20 (25 min) | | Optional may not be a handout |
| 4/17 | F | Exam 3: Ch. 19-20 | IN CLASS | Seating: SKIP Every 3rd row |
| 4/20 | M | Electrolysis/applications | 20 | 893-896 |
| 4/22 | W | Solutions; Solubility Units | 13 | 524-540 |
| 4/24 | F | Colligative Properties | 13 | 541-558 |
| 4/29 | W | REVIEW FOR FINAL EXAM | | FH-133 details TBA Aim: 10:15-11:15 |
| 5/2 MAY | SAT | FINAL EXAM: Ch. 11 - 12, 14 - 17, 23, 19 - 20, (13) | 1:00 P - 3:00 P | (FH133 probably) |

Representative Problems, End of Chapter Problems & Discussions:

Students who are making good progress should be able to solve, independently, most or all of the end-of-chapter problems in the text, listed below as assigned problems, particularly before taking exams. The solution manual is on reserve in Cudahy Library. A comprehensive review containing additional problems will be posted approximately one week before midterm exams; these also serve for final exam.

Discussions (10% of grade) should be attended. Assigned worksheet problems will be solved by groups of 3-4 students within the 50-minute discussion. Students must stay the entire period (unless otherwise instructed) and work on the problem(s) to earn up to 10% of grade. Solutions will be posted on SAKAI and graded discussions will be returned by the following discussion, or during the same week if an exam occurs in that week. The student is strongly encouraged to attempt all suggested problems (text-book and discussion) and contribute significantly to the group discussion activity. **The extent of group participation will be noted** and mentioned in any recommendation letters.

Assigned Exercises:

| chapter | page | Problems (*means more involved;** means unassigned reading may be required) |
|-------------------|-------|--|
| 11 | 464 | 1, 2, 6, 7, 9, 15,17,19, 21, 23, 37, 39, 41, 47, 52, 54, 57, 61, 64, 85: <i>Clausius Clapeyron Eq'n</i> and 2 data points to find ΔH_{vap} . |
| 12 | 514 | 11-13,15, 17, 32, 47 (look online), (guess: 4, 6, 7), |
| 14 | 610: | 3, 5, 7, 9, 12, 14, 19, 21 a - c, 23, 25 (sim. to 23), 27, 29, 33, 35, 37, 39, 41, 43, 46, 50 a-b (glucose is $\text{C}_6\text{H}_{12}\text{O}_6$) 57, 61, 63*, 67, 68, 73, 75, 91, 95, 99,105, *117. |
| 21, only kinetics | 938: | 35 – 39a, *41, **43; radioactivity (radionuclide decay) is a 1^{st} order kinetic process $1 \text{ Becquerel (Bq)} = \text{s}^{-1}$. $1 \text{ gray (Gy)} = 1 \text{ J per kg of tissue}$. $1 \text{ rad} = 10^{-2} \text{ J/kg of tissue}$ |
| 15 | 656: | 3, 5, 7, 9, 13, 15, 17, 23, 25, 26, 27, 28, 33a, 35, 37 ($K_p = K_c$ why??), 39, 41, 45 find $[\text{Cl}_2]$, next $PV = nRT$, 49, 51, 53, 55, 57, Le Chateliér: 61, 63, 65, 68, *74a,c, 79, 81. I don't overly emphasize K_c vs K_p but for practice, do #24, use formula 15.15 on page 631 |
| 16 | 709: | 1, 4, 5, 10, 15, 19, 21, 23, 25, 27, 29, 33, 37, 43, 45, 47, 53, 55, 57, 61, 65a-b, 69, 71, 73, 77, 79, 81, 83, 84, 85, 93, 109, 115, 118*; 95**, 99** **compares various A/B models % ionization $= x/x_0 \cdot 100\%$; $x_0 = \text{starting concentration, unit usually M}$ |
| 17 | 766: | 1, 5, 6, 17 (% ionization $\leftrightarrow [\text{H}^+]$),19, 21, 23, 27, 29, 33, 35, 37, 41, 43, 47,10, 53, 55, 57, 61, 69, 73, 83, 12**, 67 a-b note: K_{sp}, and K_f needed in Prob. 67 concurrently. |
| 19 | 839: | 3, 4, 6, 9ab, 11, 13, 15, 21, 25, 35, 37, 41, 45, 47, 49, 53, 59, 61, 63, 65, 69, 73ab; 79, 83 (K_a), 85, 88, 103, 96*: for each species, 1^{st} find ΔG^\ominus (appendix), 2^{nd} : then use $\Delta G = \Delta G^\ominus + RT\ln Q$; note: $\Delta G^\ominus = -RT\ln K_p$. 75*, 92*, 106** |
| 20 | 891: | 4, 6, 7, 12, 13,15,17 part ii; 19, [23, 25 review balance redox] 29a-e, 31, 37, 39, 43, 53, 55, 57, 59, 61a, 63ab, 65, 67, 76ab, 84b, 88, 99, 102; 106* (organic-y) |
| 21 | 936: | 1, 5, 9, 11, 13,17, 21, 29, 35, 37, 47, 49, 55, 61 extra: 72, 74; 31**, 51*, 63*, 80* |
| 23 | 1023: | 15, 16, 23, 25, 27, 33-35, 37, 41, 43, 47, 55, 57, 59, 61, 63; extra nerdy: 73, 74, 78 |
| 13 | 559: | 1, 3, 7, 11, 15, 17a, 22, 25, 27, 32, 37-39, 41, 43, 47, 57, 61, 67, 75, 77, 78 |

Grading Scheme:

There are two grading schemes, and whichever one yields the higher grade will be employed after the final has been taken:

If all midterms went fairly well: 20% midterm, 10% discussion, 30% final

If one midterm not so good: 20% the other two, 10% discussion, 50% final

Grading Scale:

| | | | | | |
|---------------------|--------------|-------------|--------------|--------------|----------------|
| Grade Scale: | A | ≥ 91 | A- | 88-90 | |
| B+ | 85-87 | B | 81-84 | B- | 78-80 |
| C+ | 75-77 | C | 71-74 | C- | 67-70 |
| D+ | 64-66 | D | 61-63 | F | < 60 |

Examinations

Three hour exams and the final exam will be given on **February 14**, **March 16**, **April 17**, and **May 2**, respectively, also noted in the schedule. 90% of your course grade will be determined from these as explained further below. The other 10% will be determined from your discussion grades. The exams are cumulative, *i. e.*, may include material that has been queried on previous exams. The final exam is comprehensive and cumulative.

Final Exam:

The University sets the schedule for all final exams. The final will be held on:

MAY 2, 2020 1:00 P-3:00 P

You will have exactly 2 hours to complete the exam. Additional time will not be granted, even if you arrive late. There will be no make-up final exams given under any circumstance, and the exam will not be given early either. Instructors may not reschedule final exams for a class for another day and/or time during the final exam period. There can be no divergence from the posted schedule of dates for final exams. Individual students who have four (4) final examinations scheduled for the same date may request to have one of those exams rescheduled. If a student reports having four final examinations scheduled for the same date, students should be directed to e-mail a petition to Lester Manzano, Assistant Dean for Student Academic Affairs, CAS Dean's Office (lmanzan@luc.edu)

Please note that **the final examination must be taken**. Failure to take the final exam will result in the grade "F".

Academic Honesty:

All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, which can be viewed at: <http://www.luc.edu/cas/advising/academicintegritystatement/>

A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty.

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents.

Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) will be reported to The Chair of The Department of Chemistry & Biochemistry who will decide what the next steps may be. As in the past, cheating will be SEVERELY dealt with—

- *minimally* costing the offender a grade of “zero” for the item that was submitted; this grade *cannot* be dropped. Additionally,
- incident is reported to both the Chemistry Department Chair and the Office of the CAS Dean.
- incident will be noted on one's transcript.
- depending upon the seriousness of incident, additional sanctions may be imposed.

Loyola University Absence Policy for Students in Co-Curricular Activities (including ROTC):

Students missing classes while representing Loyola University Chicago in an official capacity (e.g. intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes.

Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation (develop standard form on web) describing the reason for and date of the absence.

This documentation must be signed by an appropriate faculty or staff member, and it must be provided as far in advance of the absence as possible. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to give the student the opportunity to take the examination at another time. (<https://www.luc.edu/athletheadvising/attendance.shtml>)

Accommodations for Religious Reasons

If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor ***within 10 calendar days of the first class meeting of the semester*** to request special accommodations, which will be handled on a case by case basis.

Course Repeat Rule:

Effective Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department: <http://www.luc.edu/chemistry/forms/> and obtain a signature from the Undergraduate Program Director, Asst. Chairperson, or Chairperson in Chemistry and Biochemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

Laboratory:

Chemistry 112, the general chemistry laboratory course, should be taken concurrently with the lecture course in general chemistry. The lecture and the laboratory courses are graded independently. Students should first consult the Chemistry Department Bulletin opposite the wall facing the chemistry office for information. Then, if they still have unresolved issues, they should contact **Dr. Katrina Banaku**, the administrator of the laboratories.

Statement of Intent: By remaining in this course, students are agreeing to accept this syllabus and to abide by the guidelines outlined in the document. Students will be informed should there be a necessary change to the syllabus.

Intellectual Property: All lectures, notes, Power Points and other instructional materials in this course are the intellectual property of the professor. As result, they may not be distributed or shared in any manner, either on paper or virtually without my written permission.

Lectures may not be recorded without my written consent; when consent is given, those recordings may be used for review only and may not be distributed. Also recognizing that your work is your intellectual property, I will not share or distribute your work in any form without your written permission.

Class Conduct: One important aspect of a Jesuit education is learning to respect the rights and opinions of others. Please respect others by

- (1) allowing all classmates the right to voice their opinions without fear of ridicule
- (2) not using profanity or making objectionable (gendered, racial or ethnic) comments, especially comments directed at a classmate.

Special Circumstances—Receiving Assistance: Students are urged to contact me should they have questions concerning course materials and procedures. If you have any special circumstance that may have some impact on your course work, please let me know so we can establish a plan for assignment completion. If you require assignment accommodations, please contact me early in the semester so that arrangements can be made with Services for Students with Disabilities (SSWD) (<http://www.luc.edu/sswd/>).

Student Support Resources:

- ITS HelpDesk 773-508-4487
 - helpdesk@luc.edu
- Library
 - Subject Specialists:
<http://libraries.luc.edu/specialists>
- Services for Students with Disabilities
 - <http://www.luc.edu/sswd/>
- Writing Center
 - <http://www.luc.edu/writing/>
- Ethics Hotline- 855.603.6988
 - <http://luc.edu/sglc/aboutus/>

Room Instructions on Exam Days

- 1) When you enter the auditorium, **go to the front** and **place your book bag there**. **Remove your calculator slipcover** and placed it in book bag.
- 2) Starting from the first row nearest the lectern, **sit quickly** in every other seat and **skip every third row**. This vacant third row provides an aisle for the proctor to walk through and address any appropriate questions that student may have during exam. Do not try to sit with friends or near one's usual area. The exam is only **50 minutes**, so excessive delays will cut into exam-taking times.
- 3) **Place your student ID conspicuously** on your desk so that attendance may be noted (during exam).
- 4) Have **several pencils/pens, eraser**, etc. and a **calculator** in good **working** order.
- 5) Proctors have been instructed to **confiscate the exams of any student** using a calculator with its slipcover in place or **whose actions are suspect**.
- 6) **Read over the entire exam**. You may find a problem in the middle, or at the end, that suits you better to start. The three or so minutes spent glancing over the entire exam will be more than compensated for by the strategy and priorities that you formulate. The recommended **order to do problems** is:
 - (1) what you **know well FIRST**
 - (2) what you're sure you **can at least start NEXT**
 - (3) what you **haven't have a clue LAST**

I have tried to arrange problems in a reasonable order, but my perception and the student's will certainly differ in some aspects. So, take a few minutes to read over the exam and **devise your own strategy**.
- 7) When you have **concluded, turn in your exam** to a proctor. Then **leave as quietly** and as expeditiously as possible as to not disturb other exam takers.
- 8) Normally exams will be returned within two class-meets (with exception of the final exam which usually involves much more calculation).

Advanced Studies Recommendation Protocol

Later on, you may require a letter of recommendation (LOR) for graduate school, medical school, or the like. If I am chosen among your recommenders, the following policy ensues:

1. **Deadline for LOR (letter of recommendation) requests: Feb 1st of the application year.**
2. Student must generally possess GPA of 3.5 or above. However, a student might be considered if she or he presents a **written explanation** that reveals an exceptional circumstance accounting for a lower grade point average.
3. Student must provide attached in one email, a document listing his/her correct GPA, contact information, deadline(s), and also all chemistry, biology and physics courses and labs that the student has taken—in the following format (or Committee format, if you are applying through committee):
 - a. **GPA**
 - b. reliable, current email and telephone # that student checks *regularly*
 - c. **DEADLINE**
 - d. Table with header: course taken, instructor, grade

Example:

| Course | Semester/year | Instructor | Grade |
|---------------|---------------|------------------|-------|
| Chemistry 101 | Fall /2020 | Dr. WGJ | A |
| Biology 210 | Spring / 2019 | Dr. Barbara Haas | A- |

- e. If applying through Committee, *student initiates* process that culminates in a link being sent to me with which to submit LOR.
 - f. If applying “outside the Committee”—see items 5, 6 below, a list of all schools of the applicant and **ALL of their DEADLINES**.
 - g. Regarding part f: all cover forms, application packages, envelopes in one binder, folder, or otherwise secure containment, with like items paper-clipped together.
4. I'd love to read your personal statements, even in rough draft form. It tells me something about you and helps me to shape a recommendation. This article is not required, but I recommend it.
 5. **It is STRONGLY recommended that the student apply through the Loyola Pre-Health Advisory Committee.** Well-regarded by the medical /dental/ pharmaceutical community, the Committee's voice of endorsement will increase the merit of the student's application. Their method also assures that the student's personal statement is strong and well written. If the student applies via Committee, I will be contacted.
 6. **APPLICATIONS OUTSIDE COMMITTEE:** If a student who I can recommend elects to apply apart from the Pre-Health Advisory committee, she/he must perform steps 2-4 and email me at wgreene@luc.edu. Online LOR uploading protocols (AMCAS, PTCAS, Interfolio, etc.) are **STRONGLY** preferred.

Because of the number of requests, your LOR won't be started until all items in 3 are fulfilled