

HOW TO EFFECTIVELY TEACH
A FLIPPED RADIOGRAPHY COURSE

A rectangular box containing a handwritten signature in cursive script that reads "Patricia Burnley".

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HOW TO EFFECTIVELY TEACH
A FLIPPED RADIOGRAPHY COURSE

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Abstract

HOW TO EFFECTIVELY TEACH A FLIPPED RADIOGRAPHY COURSE

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An interactive classroom environment has been shown to improve the atmosphere and learning experience for students. This educational project looks at the positive effects and possible hurdles of integrating the flipped classroom concept in the Imaging Equipment Course in the Radiography program at Madison College. The flipped classroom concept is defined, best practices have been outlined, and overview of past flipped classroom outcomes have been provided. Pre-made and authentic videos will be integrated into the course construction of the flipped classroom. Additional resources that will be utilized in the course construction were acquired through attendance in “Preparing to Teach a Flipped Class”. Research shows the flipped classroom concept to be an effective teaching method with positive reactions from both students and instructors.

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Chapter One: Introduction

The Madison College Radiography program offers a three credit Imaging Equipment Operation course which adheres to state wide curriculum. Based on student feedback, the concepts required for the course are difficult to comprehend and more hands-on activities would make the information easier to understand. In order to improve understanding of material and the transfer of learning, a more interactive classroom approach will be taken. This will be accomplished through instructional design of the flipped classroom. The flipped classroom is an “inverted approach in which the students’ homework is to view a recording of the lecture, and class time is used for active problem-solving activities with instructor guidance” (DeMaio and Oakes, 2014, p. 340). The new homework will include Power Points with audio, videos from a variety of sources, and review of the concepts in the required textbook and online sources. This is different from the traditional classroom in which students listen to the lectures in the classroom and complete the practice assignments at home. The attention is directed toward the learner and away from the instructor (Bergmann & Sams, 2012).

Jonathan Bergmann and Aaron Sams are two high school teachers credited with developing the flipped classroom framework. The flipped classroom idea came to be in 2007 when they started to record lectures for students who were unable to attend class. With immediate positive feedback from both students and parents, the flipped classroom was born (Bergmann & Sams, 2012). The flipped classroom framework has continued to grow and be molded to fit the specific needs of different topics and instructors.

Many tools have been developed for use in the flipped classroom, Bergmann and Sams (2014) refer to the tools as “learning objects.” Learning objects include not only videos but also

books, periodicals and online periodicals. For uniformity throughout this project, all instructional tools will be referred to as learning objects.

This educational project on the flipped classroom is meant to develop a more engaging classroom environment for the students. The flipped classroom activities will inspire discussion, collaboration, critical thinking, inquiry, and problem solving. The classroom will become more of a creative space and increase the interactive time students have with the instructor (Valenza, 2012). The flipped classroom framework grants instructors the opportunity to personalize the education each student receives so it fits their individual needs (Bergmann & Sams, 2012). With further development, an instructor can implement a flipped mastery class in which students progress through the content at their own pace (Bergmann & Sams, 2012). This advanced concept is beyond the scope of this project.

The flipped classroom is a concept that can be adjusted to fit the needs of each classroom but should always contain the four pillars of flipped learning (Hamdan, McKnight, McKnight, & Arfstrom, 2013). The four pillars are:

- flipped learning requires flexible environments
- flipped learning requires a shift in learning culture
- flipped learning requires intentional content
- flipped learning requires professional educators

Purpose of the Study

A review of literature of the flipped classroom as it relates to the Imaging Equipment Operation course in the Radiography program at Madison College was conducted for this project. Review of the best practices of teaching a flipped classroom, the process used to flip a classroom, attitudes toward the flipped classroom, and available learning resources that will be

used in the flipped classroom were reviewed. The project provides a flipped lesson plan and syllabus as it applies to this course.

Significance of the Study

The study of the flipped classroom is important to the practice of the learner-centered approach and flexible learning environment (Hamden, et al., 2013). This work will impact the use of interactive classrooms and should be of importance to others seeking information related to best practices. This educational project will be of significant value to instructors who are required to follow the Radiography curriculum for Imaging Equipment Operation.

Statement of the Problem

How can a flipped classroom increase student preparation and understanding of course content? How will reviewing learning objects at home and completing homework during the class period improve the effectiveness of the radiography course?

Definition of Terms

Flipped classroom: “Inverted approach in which the students’ homework is to view a recording of the lecture, and class time is used for active problem-solving activities with instructor guidance” (DeMaio & Oakes, 2014, p. 340).

Traditional classroom: “Instructors begin by lecturing about a topic that requires students to solve problems. Then, after providing an example, the instructor assigns additional problems for students to solve at home” (DeMaio & Oakes, 2014, p. 340).

Best practices: “Techniques or methodologies which are recognized as producing the best performance” (Institute of Educational Sciences, 2008)

Delimitations of Research

The literature was collected over a 75 days period from several search engines through EBSCOHOST at the Karmann Library on the University of Wisconsin Platteville campus. Other resources were found through GoogleScholar and professional journals received from being a member in the American Society of Radiologic Technologist professional organization. The key terms used were “flipped classroom”, “teaching a flipped classroom”, and “best practices flipped classroom”.

Method of Approach

The method of approach for this educational project is to take a traditional classroom model and modify a majority of the content into a flipped classroom model. The approach of this educational project not only includes the review of literature as it relates to the flipped classroom but also insights gained through the “Preparing to Teach a Flipped Class” course completed by the author through the Center of Excellence in Teaching and Learning (CETL) at Madison College. A list of best practices as it relates to online material was obtained through the course “Instructional Design for E-Learning” completed through University of Wisconsin – Stout. Course outcomes comparison assessment (COCA) will be used when developing formative and summative assessments that link to each course competency (Angelo & Cross, 1993) (see Appendix C). The Imaging Equipment Operation flipped classroom will be set up in Blackboard through Madison College but will also utilize other outside sources.

Chapter Two: Review of Literature

The course outcome summary for the Imaging Equipment Operation course was developed in September of 2003 by the Radiography Statewide Curriculum Alignment Team, facilitated by Leah Osborn. The curriculum was revised in June of 2010 by Terri Johnson of Worldwide Instructional Design System (WIDS). Within the Technical College System, WIDS is the method of choice for creating curriculum which outlines tasks used to accomplish desired educational results (World Wide Instructional Design System, 2014). Following the WIDS guidelines, the three parts that make up a curriculum are learning outcomes, performance standards, and learning objectives.

The course description as outlined in the course outcome summary is: “Introduces radiography students to the principles and application of x-ray technology. Students analyze how x-rays are produced and determine the corrective actions necessary for common equipment malfunctions.” (Johnson, 2010) (see Appendix A). The ten competencies in the Imaging Equipment Operation course are as follows:

- Analyze the purpose and function of automatic exposure control (AEC)
- Summarize the purpose and function of x-ray circuitry
- Summarize the purpose and function of traditional analog radiographic equipment
- Analyze the purpose and function of diagnostic x-ray tubes
- Identify the components of image intensification fluoroscopy
- Interpret the electromagnetic spectrum
- Analyze the relationship of wavelength, frequency, and energy of an x-ray photon
- Outline the conditions necessary to produce x-ray

- Compare the production of Bremsstrahlung and characteristic x-ray production
- Interpret the x-ray emission spectrum diagram

Best Practices of the Flipped Classroom

The flipped classroom as defined by the Bishop & Verleger (2013) consists of interactive group learning activities inside the classroom and outside activities of computer-based individual instruction. There are several advantages of the flipped classroom but also some challenges that have to be addressed. The learning opportunities offered in a flipped classroom can be achieved through varied forms of instruction and learning tools. The learning objects can be provided in written material, videos, and audio. This variety will help students who prefer one learning style over another. The videos also offer the students the ability to access the online material whenever it is convenient, to pause and if need be, rewind the videos to hear the information again. This allows the student to take notes and comprehend the material before moving onto the next point. This may make a more comfortable and less stressful learning environment for the student, who may feel rushed taking notes in a traditional classroom. Technology is not meant to replace the instructor but to enhance the classroom learning. Roehl, Reddy, and Shannon (2013), discuss the importance of involving technology and active learning into the classroom. The Millennials, individuals born between 1982 and 2002, are a generation who are more particular on how course information is disseminated. Millennials are less tolerant of the instructor led lecture format that occurs in the traditional classroom.

With the online pre-class lectures or videos laying the groundwork for the understanding of the concepts, class time can be spent practicing and mastering the concepts. The interactive classroom helps the students delve deeper into the concepts instead of only regurgitating the information for test purposes. Instead of an instructor completing the traditional in-class lectures,

this time can be used for student-to-student interaction and student-to-instructor interactions.

This time allows the students to get answers in real-time from the instructor and for the instructor to see what areas may need further clarification or practice. The instructor will be able to address questions and work with students who may be in need of immediate assistance. Peer collaboration and hands-on learning, which are the foundations of the flipped classroom, help with this transfer of learning. Table 1 compares how class time is spent in a traditional versus flipped classroom (Bergmann & Sams, 2012, p.15).

Table 1

Traditional Classroom versus Flipped Classroom

Traditional Classroom		Flipped Classroom	
<u>Activity</u>	<u>Time</u>	<u>Activity</u>	<u>Time</u>
Warm-up activity	5 min.	Warm-up activity	5 min.
Go over previous night's homework	20 min.	Q&A time on video	10 min.
Lecture new content	30-45 min.	Guided and independent practice and/or lab activity	75 min.
Guided and independent practice and/or lab activity	20-35 min.		

In order for the transfer of learning to be successful, the in-class activities assigned by the instructor must be relevant and correlate with the out-of-class activities. The out-of-class activities are on the lower end of Bloom's Taxonomy, such as knowledge and comprehension (Garver & Roberts, 2013). Knowledge and comprehension correlate with remembering and understanding on the new version of Bloom's Taxonomy. The in-class activities can be used as

formative assessment to assess student understanding and to integrate the activities with the material learned outside of class. A higher order of thinking for the students will be required when combining the out-of-class and in-class activities. This higher order of thinking will utilize the top three tiers of Bloom's Taxonomy which are analyzing, evaluating, and creating (Roehl et al. 2013). By utilizing these top three tiers, the transfer of learning process will become more efficient and increase student retention of the material.

When designing the course and learning activities, another reference point that can be utilized is Fink's Taxonomy of significant learning. Fink's Taxonomy addresses new kinds of learning and builds on Bloom's Taxonomy. The taxonomy developed by Fink is more integrative than Bloom's hierarchal model. The six parts of Fink's taxonomy include: foundational knowledge, application, integration, human dimension, caring, and learning how to learn. When all six parts are addressed throughout a course, there should be a significant increase in learning (Fink, 2007).

The end result of a flipped classroom is that the instructor is able to spend more time actually teaching and facilitating, instead of only lecturing (Fulton, 2012). The concept of the flipped classroom sounds easy enough to do but it does come with challenges. Since the structure of the flipped classroom varies from that of the traditional classroom, the change is not only different for the students but also for the instructor. The instructor has to be willing to give up control of an organized classroom, be flexible, and adjust quickly depending on the needs of the students. From an outside perspective, the classroom may look chaotic and unorganized. This chaos is what makes a successful flipped classroom.

The instructor also has to understand the time commitment of flipping a classroom. The time commitment begins by making the students understand the importance of completing the

pre-class activities and coming to class prepared. Appendix D provides a lesson plan that outlines the pre-class and in-class activities. This does raise the question of what an instructor should do if a student does not come to class prepared. Herried and Schiller (2013) polled STEM case teachers who were at the time teaching a flipped classroom,. The STEM case teachers provided some insight into making sure students come to class prepared. The teachers suggested giving a short quiz online or in the classroom. Another possibility was having activities where the answers can be found in the videos or readings that were required to be completed before attending class. Ash (2012), offered another suggestion, one that pioneers of the flipped classroom, Bergmann and Sams required of their students. The first part of the assignment was for students to bring in their notes they took on the outside of class learning objects. In addition, students were required to bring in one thoughtful question about the material to share with the class.

Another issue that has to be addressed for both the instructor and students is technology. An instructor may want to make their own videos but find that lack of knowledge or limited resources may be a stumbling point. An instructor may also not have sufficient time to learn new technological skills required to make the videos. The videos and resources used do not have to all be made by the instructor, but there is a time commitment to find pre-made reliable videos or resources.

Because coming to class prepared is the basis of the flipped classroom, student knowledge of technology and access to the information is instrumental. The instructor cannot assume that all students are technologically savvy and have immediate access to the internet. Additional time may have to be allowed in the beginning of the class to teach the technology to

the students. If a student does not have internet access, the instructor may end up providing the information on a DVD or jump drive.

All of the instructional material should be ADA compliant with the American with Disabilities Act (ADA), Section 508 Amendment to the Rehabilitation Act of 1973 (Enfield, 2013). The online videos should also provide captions or transcripts. All learning objects should have a printable version accessible to the students.

Professor Attitude Toward the Flipped Classroom

The Flipped Learning Network conducted a survey of 453 educators and found that 67% reported improved test scores in the flipped classroom setting (LaFee, 2013). Within that same survey, 88% of the educators said their own job satisfaction increased, 80% felt student attitude improved, and 99% said they will do the flipped classroom again (Valenza, 2012).

Even though the flipped classroom has shown positive outcomes, there are some things to keep in mind when first flipping a classroom. The author consulted two Madison College instructors, who have experience with the flipped classroom, for recommendations. One instructor recommends starting out slowly and selecting a unit or two that students are having difficulty with. It is not necessary to flip the entire semester right away as more flipped units can be added at a later date (N. Woodward, personal communication, July 27, 2014). The other instructor recommends that when making video, the novice should not expect perfection. Instruction in the traditional classroom is not perfect and students prefer to see the instructor as a human instead of a robot (T. Rettler-Pagel, personal communication, July 27, 2014).

Learner Attitude Toward the Flipped Classroom

A study completed in 2012 at the Australian National University (Butt, 2014) showed an improvement in student attitudes from the beginning to the end of the semester in a flipped

course. At the start of the semester, only 50% of the students anticipated that the proposed flipped classroom would be beneficial. By the end of the semester, the percentage of students who found the flipped classroom to be beneficial to their learning increased to 75% (Butt, 2014). These results are similar to the results found by Schullery, Reck, and Schullery (2011). Student responses from open-ended survey questions included comments such as, “I like that its [sic] more independent and the teacher doesn’t lecture the whole time,” and “The class makes it so each student is involved and requires everyone to be prepared.” The interactive and hands-on activities were preferred by the students.

Regarding the videos viewed by students, shorter videos were preferred over longer videos (Bishop & Verleger, 2013) and students were also more receptive when the videos were recorded by the instructors. Each video should be only approximately 3-5 minutes long. The maximum length of any one video should be approximately 10 minutes. Having short videos, each focused on a different concept, allows students the opportunity to easily review only selected videos.

The Flipped Learning and Democratic Education survey which was conducted at Columbia University in 2012 by Tom Driscoll (Hamdan et al., 2013), showed positive results. The survey consisted of 203 students from the United States. Close to 80% of the students felt there were more positive interactions with teachers and other students while in the flipped classroom and viewed learning as a more active process than in a traditional classroom.

Outcomes of Flipped Classroom

Currently there is a limited amount of research that has been completed on the effects that the flipped classroom has on learning. Even Bergmann himself, the coauthor of *Flip Your Classroom*, states there is a lack of hard proof but is optimistic that research will continue to

support the personal experiences in the flipped classroom (LaFee, 2013). Of the research that has been done, there is a positive correlation between the flipped classroom and increased summative assessment scores when compared to a traditional classroom. In one study completed at the Arizona State University by Amresh, Carberry, and Femiani (2013), the flipped model course produced higher average scores than the traditional classroom. The pre-term, midterm, and final scores of the flipped classroom were greater than the traditional classroom with the post-midterm scores being only .8 below the traditional classroom.

Another study completed by Papadopoulus and Roman in 2010 showed that students progressed through material faster and the topics were understood in greater depth in a flipped classroom (as cited in Hamdan et al., 2013). Posttest scores in the flipped classroom were also higher with 31.2% of correct answers versus 24.1% of correct answers in the traditional classroom.

Online Resources for Flipped Classroom

The instructor has the option to make original videos or utilize resources that are already available on the Internet. There are a variety of screencasting tools available online which are either free or can be purchased for a small fee. An instructor should check with their organization as some video software may be available for academic use. Some of the most common screencasting tools are Jing, Snag-it, Camtasia, Screenr, Screencast-O-matic, and YouTube (T. Rettler-Pagel, personal communication, March 14, 2014). Making videos can be as simple as using lecture boards or poster boards, along with some type of video recording device such as a video recorder or Ipad. If there is no access to the screencasting tools due to cost or technological limitations, an instructor can add audio to Power Points. There are a few websites that offer free pre-made videos for instructor use. These websites include the Khan Academy which was

founded in 2006 by Salman Kahn (Bishop & Verleger, 2013), YouTube videos, YouTubeEDU, TedEd and Ted Talks. There are also a multitude of Ipad applications and additional technologies, such as Livescribe and Wacom Bamboo, which are available to assist with the online component of the flipped classroom. Other options of slide narrations include SlideRocket EDU, MyBrainshark, Present.me, Movenote, and Powtoon (Valenza, 2012).

For the implementation of the flipped classroom concept into the Imaging Equipment Operation course, a variety of “learning objects” will be integrated into the class. Along with the traditional textbook and e-book, there will also be additional online component, the *Mosby’s Radiography Online (MRO)* which will be an essential part to the flipped classroom. The *MRO* (Johnston & Fauber, 2012a) consists of simulations, narrated animations, interactive activities, and quizzes. The modules within the *MRO* correlate with the competencies outlined in the Imaging Equipment Operation course outcome summary (see Appendix A). For this flipped classroom project, the instructor will utilize Screencast-O-matic, Power Points with audio, YouTube, *MRO*, and Films on Demand. Short video clips provided by the American Society of Radiologic Technologists (ASRT) will also be utilized during this course. If questions arise regarding technology or the flipped classroom in general, the instructor will consult the faculty and staff at CETL. As the Imaging Equipment Operation flipped classroom progresses through the years, additional online resources will be integrated into the syllabus.

Madison College Resources for Flipped Classroom

Madison College has an entire department, the Center for Excellence in Teaching and Learning (CETL), which is dedicated to the betterment of instructors at the college. The CETL office offers instructor support through consultation with experienced faculty and staff, faculty development seminars, and a multitude of resources available for use (Madison College CETL,

n.d.). Within CETL, there is a specific room that an instructor can use to produce videos. In the room, there is a computer and a tripod that can hold a video recording device. One of the walls in the room has a green backdrop which the instructor stands in front of when recording the video. After the instructor is finished recording the video in front of the green backdrop, video editing software can be used to add in a variety of backgrounds to the video.

Through the Madison College library, pre-made videos called Films on Demand are available for instructor and student use. These short video clips will be integrated into the at-home activities the student will view for the flipped classroom.

Summary

In summary, this flipped classroom project will be implemented in Fall semester 2014 and will be administered through the Blackboard platform. The instructor will utilize Screencast-O-matic, Power Points with audio, YouTube, *MRO*, and Films on Demand for the video and audio tools. Videos provided by the ASRT will also be used. If any questions regarding technical issues or ideas to use in the flipped classroom arise, CETL's faculty and staff will be consulted. The flipped classroom concept is outlined in the course syllabus (see Appendix B) and will be explained in detail on the first day of class. A graphic syllabus will also be provided depicting the flipped classroom concept and course competencies. When explaining the flipped classroom to the students, the instructor will be enthusiastic and clear about what is expected of the students along with the role of the instructor.

The COCA (see Appendix C) will be completed for all of the course competencies. There will be both formative and summative assessments aligned with each competency. The COCA will be referenced when developing weekly lesson plans (see Appendix D). The COCA will also be assessed and modifications made as needed throughout the course of the semester

Chapter Three: Conclusions and Recommendations

Research has shown that watching videos and listening to online lectures before attending class has encouraged learners to become more engaged and has increased both formative and summative assessment scores. A large part of the flipped classroom success is making sure the students complete the pre-class activities and come to class prepared. This can be a challenging point when first integrating the flipped classroom as students may be resistant to the change. Assigning students to view lectures at home and complete activities in the classroom will increase both student-to-student and student-to-teacher interactions. The interactive in-class activities will allow the instructor to see areas of difficulty and immediately assist the students. Heightened access to the instructor will increase the effectiveness of transfer of learning, resulting in a better understanding of the radiography imaging equipment and its operation.

Based on these conclusions, when planning and implementing the flipped classroom into the Imaging Equipment operation course, a few key points will be followed. Spencer, Wolf, and Sams (2014) recommend thinking about the flipped classroom process with the desired end result in mind. Quality learning objects should be created and collected throughout the entire flipped classroom process. The learning objects from outside the classroom have to correlate with the classroom activities. It is important for the instructor to keep in mind that it is necessary at times to step aside and take an actively passive approach in the classroom. This passive approach will allow the students to be actively engaged in the learning process.

When designing and implementing the flipped the classroom, basic guidelines and possible hurdles will be taken into consideration. A variety of learning objects and more hands-on activities will be integrated into the Imaging Equipment Operation course. The flipped

classroom will push the students to a higher order of thinking which is an integral part of the learning process and also increase the understanding of difficult concepts.

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APPENDIX A

Appendix A

Imaging Equipment Operation - Course Outcome Summary

Course Information

Organization	WTCS - Wisconsin Technical College System
Developers	Radiography Statewide Curriculum Alignment Team Facilitated by WIDS – L. Osborn
Development Date	9/1/2003
Revised By	Terri Johnson, WIDS
Revised Date	6/29/2010
Course Number	10-526-194
Instructional Area	Health Services
Total Credits	3

Description

Introduces radiography students to the principles and application of x-ray technology. Students analyze how x-rays are produced and determine the corrective actions necessary for common equipment malfunctions.

Prerequisites

Prerequisite: Admission to the Radiography program

Exit Learning Outcomes

Program Outcomes

- A. Carryout the production and evaluation of radiographic images
- B. Apply computer skills in the radiographic clinical setting

External Standards

- H.I. X-ray Circuit
- H.II. Radiographic Equipment
- H.III. Diagnostic X-Ray Tubes
- H.IV. Image Intensified Fluoroscopy
- H.V. Linear Tomography
- M.I. Structure of the Atom
- M.II. Nature of Radiation
- M.III. X-Ray Production
- M.IV. Interaction of Photons with Matter

Competencies

1. Analyze the purpose and function of automatic exposure control (AEC)

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

Apply computer skills in the radiographic clinical setting

You will demonstrate your competence:

1.a. in an oral, written, or graphic analysis

Your performance will be successful when:

1.a. analysis describes the functions of the AEC

1.b. analysis relates the uses of AEC for radiation protection, image quality, positioning, beam restriction, and other aspects of radiography

1.c. analysis describes the location and function of AEC components

1.d. analysis explains the set-up procedures for AEC

1.e. analysis details the radiographer's responsibilities when using AEC to ensure patient safety and image quality

1.f. analysis describes the potential benefits of using AEC

1.g. analysis describes common malfunctions and their corrective measures

2. Summarize the purpose and function of x-ray circuitry

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

2.a. in an oral, written, or graphic summary

Your performance will be successful when:

2.a. summary describes the function of x-ray circuitry

2.b. summary identifies the key features and components of x-ray circuitry

2.c. summary specifies the relationship between circuitry components

2.d. summary relates the function of components to producing x-rays

2.e. summary specifies appropriate safety procedures

2.f. summary describes common malfunctions and their corrective measures

3. Summarize the purpose and function of traditional analog radiographic equipment

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

3.a. in an oral, written, or graphic summary

Your performance will be successful when:

3.a. summary describes the key features and functions of analog radiographic equipment

- 3.b. summary compares different types of radiographic equipment
- 3.c. summary describes the purpose and application of analog radiographic equipment
- 3.d. analysis specifies appropriate safety procedures
- 3.e. analysis includes a description of the components of diagnostic x-ray tubes
- 3.f. analysis describes common malfunctions and their corrective measures

4. Analyze the purpose and function of diagnostic x-ray tubes

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

- 4.a. in an oral, written, or graphic analysis

Your performance will be successful when:

- 4.a. analysis clarifies the purpose and function of diagnostic x-ray tubes
- 4.b. analysis identifies the safety hazards posed by diagnostic x-ray tubes
- 4.c. analysis specifies appropriate safety procedures
- 4.d. analysis includes a description of the components of diagnostic x-ray tubes
- 4.e. analysis describes common malfunctions and their corrective measures

5. Identify the components of image intensification fluoroscopy

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

- 5.a. in an oral, written, or graphic analysis

Your performance will be successful when:

- 5.a. analysis summarizes the process of image intensified fluoroscopy
- 5.b. analysis clarifies the purpose and function of image intensified fluoroscopy
- 5.c. analysis compares the purpose and function of the components of image intensified fluoroscopy
- 5.d. analysis specifies appropriate safety procedures
- 5.e. analysis describes common malfunctions and their corrective measures
- 5.f. analysis describes the components of digital fluoroscopy
- 5.g. analysis compares digital and analog fluoroscopy

6. Interpret the electromagnetic spectrum

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

- 6.a. in an oral, written, or graphic interpretation

Your performance will be successful when:

- 6.a. interpretation describes the electromagnetic spectrum
- 6.b. interpretation explains how the electromagnetic spectrum applies to radiography

6.c. interpretation predicts how aspects of the electromagnetic spectrum impact radiographic images

7. Analyze the relationship of wavelength, frequency, and energy of an x-ray photon

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

7.a. in an oral, written, or graphic analysis

Your performance will be successful when:

7.a. analysis describes the important features or attributes of wavelength

7.b. analysis compares the similarities and differences of wavelength, frequency, and energy of an x-ray photon

7.c. analysis explains the impact of wavelength, frequency, and energy of an x-ray photon on a finished radiograph

7.d. analysis includes the wave-particle duality of x-rays

8. Outline the conditions necessary to produce x-radiation

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

8.a. in an oral, written, or graphic response

Your performance will be successful when:

8.a. you depict all of the items in the process of producing x-rays

8.b. you show the relationship of one step to another in the production of x-rays

8.c. you show a clear understanding of how x-rays are produced

8.d. you describe how electrons are accelerated and decelerated

8.e. you detail the criteria necessary to create x-rays

9. Compare the production of bremsstrahlung and characteristic x-ray production

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

9.a. in an oral, written, or graphic comparison

Your performance will be successful when:

9.a. comparison explains Bremsstrahlung x-ray production

9.b. comparison explains characteristic x-ray production

9.c. comparison describes how target materials effect the quality of each x-ray produced

10. Interpret the x-ray emission spectrum diagram

Linked Program Outcomes

Carryout the production and evaluation of radiographic images

You will demonstrate your competence:

10.a. by interpreting a diagram

Your performance will be successful when:

10.a. interpretation includes the x-ray emission spectrum

10.b. interpretation includes an appropriate level of detail

10.c. interpretation includes a features and factors that impact the size and shape of the graph

10.d. interpretation includes the parts of the x-ray emission spectrum

APPENDIX B

Imaging Equipment Operation Syllabus – Fall 2014



MADISON
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Instructor Information

Instructor: Darcy Willis
Office: Health Education Building – Room 212
Telephone: (office) 608-258-2363
(cell) 608-235-8657
Email: DRWillis@madisoncollege.edu

Office Hours: Thursday 9:00 am – 12:00 pm
Others times available by appointment only

Course Information

Class #: 10-526-194

Dates: 9/2/14 – 12/23/14

Course Description: Introduces radiography students to the principles and application of x-ray technology. Students analyze how x-rays are produced and determine the corrective actions necessary to common equipment malfunctions.

Credits: 3 - Approximately 6 hours of study time per week should be allotted for this course.

Course Format: Face to Face (Flipped classroom – see explanation below)

Class Schedule: Tuesday 9:00 am – 12:00 pm

Location: Health Education Building – Truax, Room #170B

Pre-requisites: All first & second semester classes and 10-526-193

Corequisites: 10-526-195, 10-526-196, and 10-526-199

Textbook: Johnston, J. N. & Fauber, T. L. *Essentials of Radiographic Physics and Imaging (1st Edition)*

Carlton, R. R. & Adler, A. M. *Principles of Radiographic Imaging (5th Edition)*

Online Course: Johnston, J. N. & Fauber, T. L. *Mosby's Radiography Online (MRO): Physics and Imaging for Essentials of Radiographic Physics and Imaging (1st Edition)*

Supplies: Access to computer and internet, folder or binder

Course Competencies:

- Analyze the purpose and function of automatic exposure control (AEC)
- Summarize the purpose and function of x-ray circuitry
- Summarize the purpose and function of traditional analog radiographic equipment
- Analyze the purpose and function of diagnostic x-ray tubes

- Identify the components of image intensification fluoroscopy
- Interpret the electromagnetic spectrum
- Analyze the relationship of wavelength, frequency, and energy of an x-ray photon
- Outline the conditions necessary to produce radiation
- Compare the production of bremsstrahlung and characteristic x-ray production
- Interpret the x-ray emission spectrum diagram

Program Outcomes

Carryout the production and evaluation of radiographic images.

Adhere to quality management processes in radiography

Apply computer skills in the radiographic clinical setting.

External Standards

- X-ray circuit
- Radiographic equipment
- Diagnostic x-ray tubes
- Image intensified fluoroscopy
- Linear tomography
- Structure of the atom
- Nature of radiation
- X-ray production
- Interaction of photons with matter

Core Abilities

Madison College Core Abilities are eight key life and success skills that contribute to the development of students as life-long learners on the job, at home, and in the community. The Core Abilities are skills and abilities taught and assessed in classes, labs, and field experiences at Madison College. For more information on Core Abilities, please visit

<http://madisoncollege.edu/core-abilities>. This class addresses the following core abilities:

Communication
 Critical thinking
 Science and Technology
 Ethics
 Mathematics

Responsibilities and Policies

Student Responsibilities: Students are expected to be familiar with Madison College policies and procedures. Many of the important policies and procedures are on the Madison College website, located at <http://madisoncollege.edu/student-rights-responsibilities>

Academic Integrity is an expectation in all Madison College classes. Plagiarism, cheating and collusion are prohibited at Madison College. Plagiarism is defined as passing of another person's work as your own. Students who fail to observe these standards

are subject to disciplinary action. Madison College has a strong policy on Academic Misconduct which is published on the Madison College website. Please refer to this page on the Madison College Website to review all Academic Integrity and Misconduct policies located at <http://madisoncollege.edu/academic-integrity>

Withdrawal Policy: If a situation arises that prevents the successful completion of this course, please note that it is each student's responsibility to formally withdraw from this course.

Attendance: Attendance is expected and will be considered in the final grade (tardiness and leaving class will also be considered in the final grade). Your grade will be dropped by one grade increment if more than 25% of class time is missed. Class attendance is the responsibility of the student. Students will not receive credit for attending class.

Class participation: Constructive class participation is highly encouraged. Working with classmates on group projects will be required.

Submitting Work: **ONLINE SUBMISSIONS-** All work must be submitted as directed in Microsoft Word format, either as a .doc or .rtf file. Please name your file in the following way, with your last name and assignment name. For example, Smith.onlineassignment.
IN CLASS SUBMISSIONS – All assignments (worksheets, papers, etc) have to be your name at the top of the first page, stapled, and if handwritten, legible.

Student Email: Madison College offers a student e-mail account for all students. You are responsible for monitoring your student e-mail account. Student e-mail can be accessed at: <http://madisoncollege.edu/email>

Use of Electronic Devices: Please refrain from cellphone use (making and receiving phone calls or texting) during class. Cellphones should either be turned off or silenced and put away during class. Cellphones may be used during designated breaks or during emergency situations.

Ipads may be used during class for classroom work only.

Other Policies: Please be respectful and refrain from any unnecessary "side talking" during class. "Side talking" is disruptive to learning for yourself and your classmates.

Technical Assistance: Student Computer Help Desk is located in the Truax Campus Library Room 230. Student lab assistants are available in person, and by phone, (608) 243-4444; toll-free at (866) 277-4445; by email at <http://madisoncollege.edu/student-helpdesk> to provide computer support to fellow students. These services are available Monday - Thursday: 7:30 a.m. - 9:00 p.m., Friday: 7:30 a.m. - 4:30 p.m., and Saturday: 9:00 a.m. - 1:00 p.m. In addition, students can call an after-hours help desk until 10pm most days, by calling (608) 246-6666.

Disability Act Statement: Madison College complies with all provisions of the Americans with Disabilities Act and makes reasonable accommodations upon request. Please contact Disability Resources Services at 246-6716 (Students who are deaf via Relay 711), room 159 at Truax or email drs@madisoncollege.edu

If you have an **accommodation card** from their office indicating that you have a disability which requires academic accommodations, please present it to me so we can discuss the accommodations that you might need in this class. It is best to request these

accommodations at the beginning if not before class so there is ample time to make the accommodations.

I will maintain the confidentiality of the information you share with me.

Class Cancellation: Besides local radio stations and the Madison College website, students can call the hotline to inquire about weather related school closings. (608) 246-6606.

If class is cancelled, I will notify you via your Madison College email account.

Learner Responsibilities: As a student in this class, I expect you to:

take responsibility for your own learning.

be prepared for class and be an enthusiastic participant during class

treat others with tolerance and respect

act responsibly and reliably in group work

set high standards for your work

The student must be aware that learning is an active process. The teacher's responsibility is to clarify, guide and direct activities that assist the student in meeting course objectives. The student is responsible to prepare and participate in lecture/discussions and group activities. The student must be able to accept responsibility for learning specific objectives within a defined period of time.

Instructor Responsibilities: As your instructor, I commit to communicating openly and frequently with you about this class. I will maintain a professional, safe learning environment adhering to the policies of the college. You can expect a reply to communication, be it via e-mail, through online discussions, voicemail or in person, within 24-48 business hours.

Blackboard: A Blackboard course site has been created for this class. You can access this course by logging in to the following page:
<http://blackboard.madisoncollege.edu/>

Blackboard Student Support information: <http://madisoncollege.edu/blackboard-help> . Consult your instructor for support with Blackboard problems.

Computer difficulties are not a long-term excuse for non-participation. If you experience problems with your computer, call the computer help desk at (608) 243-4444 or toll-free at (866) 277-4445. They can talk you through fixing many, many problems.

Blackboard Outages: Madison College does its best to keep our Blackboard classroom up and running. However, despite our best efforts, our virtual classroom may go down unexpectedly. If you cannot access our classroom, here is what you should do:

Phone the student help desk: (608) 243-4444; toll-free at (866) 277-4445. They can often resolve your problem over the phone.

Other Resources

Peer to Peer Tutoring Services at Madison College:

<http://madisoncollege.edu/tutoring>

Counseling Services at Madison College: 608-246-6076,

<http://madisoncollege.edu/counseling>

Career Resources at Madison College: (608) 246-640,

<http://madisoncollege.edu/sdc>

Student Writing Center Assistance: (608)243-4289,

<http://madisoncollege.edu/plus/writing-center>

Library Resources: Films on Demand

Syllabus Changes: As your instructor, I retain the right to make changes based on the timeline of the class, feedback from learners and/or logistical issues and will inform you as soon as a change is made.

Grading Policy

- Exams and assignment due dates will be announced a reasonable amount ahead of time.
- Any missed graded quizzes, exams, or assignments must be made up within one week (by the beginning of the next class period).

If the assignment is a week late, 10% of the total points will be deducted from the grade. If the exam or assignment is not made up within two weeks of the due date, the grade will result in a zero.

Example: Assignment due date 8/11

Assignment made up before class on 8/18 – 10% of total points will be deducted

Assignment made up before class on 8/25 – 20% of the total points will be deducted

Assignment made up after 8/25 – grade will be zero

- Only one test or quiz make-up is allowed over the semester.
- Arrangements for make-up work or for missed class periods are the sole responsibility of the student. Make-up work will not be allowed during class time or clinical time.
- Grades will be posted on Blackboard. It is the responsibility of the student to check their posted grades frequently, and to request help if wanted. Please notify the instructor about any errors in posted grades within two (2) weeks of the posted date, to correct the grade.
- The final grade will consist of the point total of all graded quizzes, exams, and assignments. The point total will be converted to a percentage and will correlate to the grade scale provided below.
- Occasionally extra credit will be offered. Extra credit will be offered at the discretion of the instructor and will be offered to the entire class. There will be no individual extra credit options.

Grading Scale

Grade	% Attained
A	94-100
AB	89-93
B	85-88
BC	81-84
C	76-80 (required for program continuation)
D	70-75
F	69-below

Flipped Classroom

What is a flipped classroom? Traditionally when you go to class, your teacher lectures, you take notes, and maybe do some work to reinforce what you learned. Then you are given homework where you do more work that reinforces the material. A flipped classroom is a class where you as the student will review the lecture material at home and spend class time reinforcing and learning the information.

Why flip a classroom? Learning from a lecture is not only boring but generally ineffective. As a student you remember very little from lecture, despite spending a lot of class time taking notes. And to top it off, what you don't understand in class, you have to try to learn at home by doing homework on your own, often with no help. Instead let's spend time at home introducing the information, and then class time really understanding it.

What will you do at home? You will watch videos, read and listen to Power point presentations, and view animations and/or videos provided in MRO. While you watch, you will take notes just like you would normally. While viewing, you will be completing Power point packets and/or taking notes on the content.

What will we do in class? When you come to class, your Power Point will be checked for completion. Each class we'll warm up with a quick quiz (graded or ungraded) to check for understanding of the material from the lecture notes. Then we'll dive into worksheets and activities. Mini lectures will be done with a group of students or the whole class if extra explanation is needed.

What if you do not come to class prepared? If you have not watched the assigned videos and Power Point presentations, or completed the handouts, you may be assigned a computer to view the material before returning to the in-class activities.

The flipped classroom IS NOT:

- a synonym for online videos
- about replacing teachers with videos
- an online course
- students working without structure
- students spending the entire class staring at a computer screen
- students working in isolation

The flipped classroom IS:

- a way to increase contact time between students and teachers
- an environment where students take responsibility for their own learning
- a classroom where the teacher is not the "sage on the stage", but the "guide on the side"
- a blending of direct instruction with constructivist learning
- a classroom where students who are absent from class, don't get left behind
- a class where content is permanently archived for review or remediation
- a class where all students are engaged in their learning
- a place where all students can get a personalized education

Course Calendar

Date of class	Topic	Pre-class activities	Assigned activities (Due before class unless otherwise indicated)
9/2/14	Explanation of class structure, books, and computer resources	Bring required books and MRO to class <ul style="list-style-type: none"> ▶ have book and MRO purchased before class ▶ Do not log into MRO before class! 	9:00 am – meet in room 170 10:00 am – meet in room 235 (computer lab)
9/9/14	Introduction to Imaging Sciences Structure of the Atom	Johnson & Fauber <ul style="list-style-type: none"> - Ch.1 Intro - Ch.15 pg.196-200 - Ch.2 Structure of the atom MRO <ul style="list-style-type: none"> - Module 1 : Sections 2, 3 & 5 - Module 2 : Sections 2 & 3 Carlton & Adler (optional) <ul style="list-style-type: none"> - Ch.1 pg.17-18 (Tbl. 1-2,1-3,1-4) - Ch. 5 pg. 91-94 	Handouts completed that coordinate with pre-class activities MRO Module 2 quiz (repeatable & graded)
9/16/14	Electromagnetic Radiation	Johnson & Fauber <ul style="list-style-type: none"> - Ch. 3 Electromagnetic Radiation MRO <ul style="list-style-type: none"> - Module 3: Sections 2, 3 & 4 Carlton & Adler (optional) <ul style="list-style-type: none"> - Ch. 2 Radiation Concepts 	Handouts completed that coordinate with pre-class activities MRO Module 3 quiz (repeatable & graded) Test at end of class- Ch. 1, Ch. 2, Ch. 3, Ch. 15 (pg. 196-200)

9/23/14	X-ray Circuit	<p>Johnson & Fauber - Ch. 4 X-ray Circuit (pg. 27-31)</p> <p>MRO - Module 4: Sections 2, 3 & 4</p> <p>Carlton & Adler (optional) - Ch. 3 Electricity</p>	<p>Handouts completed that coordinate with pre-class activities</p> <p>MRO Module 4 quiz (repeatable & graded)</p>
9/30/14	X-ray Circuit cont.	<p>Johnson & Fauber - Ch. 4 X-ray Circuit (pg. 31-34)</p> <p>MRO - Module 4: Sections 5, 6 & 7</p> <p>Carlton & Adler (optional) - Ch. 4 Electromagnetism</p>	<p>Quiz on 9/23 content</p> <p>Handouts completed that coordinate with pre-class activities</p> <p>MRO Module 4 quiz (repeatable & graded)</p>
10/7/14	X-ray Circuit cont.	<p>Johnson & Fauber - Ch. 4 X-ray Circuit (pg. 34-42)</p> <p>MRO - Module 4: Sections 8 & 9</p> <p>Carlton & Adler (optional) - Ch. 5 X-ray Equip.(pg.94-104)</p>	<p>Handouts completed that coordinate with pre-class activities</p> <p>MRO Module 4 quiz (repeatable & graded)</p> <p>X-ray Circuit & X-ray tube project due 11/4</p> <p>Test near end of class – Ch. 4 X-ray Circuit</p>

10/14/14	AEC & QC	<p>Johnson & Fauber</p> <ul style="list-style-type: none"> - Ch. 13 Automatic Exposure - Ch. 12 screen maintenance (pg. 150-151) - Ch. 12 quality control (pg. 154-155) & additional handout <p>MRO</p> <ul style="list-style-type: none"> - Module 13: Sections 2, 3.10, 3.11 & 3.12 - Module 12: Section 2.12 <p>Carlton & Adler</p> <ul style="list-style-type: none"> - Ch. 33 AEC - Ch. 31 QM (pg. 468-469) (pg.471-473)(pg.475-476) 	<p>Handouts completed that coordinate with pre-class activities</p> <p>MRO Module 13 quiz (repeatable & graded)</p> <p>Due 11/11</p> <ul style="list-style-type: none"> - Visual inspection - Collimator test
10/21/14	QC cont.		Test at end of class- AEC and QC
10/28/14	X-ray Tube	<p>Johnson & Fauber</p> <ul style="list-style-type: none"> - Ch. 5 X-ray Tube <p>MRO</p> <ul style="list-style-type: none"> - Module 5: Sections 2, 3, 4 & 5 <p>Carlton & Adler (reference)</p> <ul style="list-style-type: none"> - Ch. 6 X-ray Tube 	<p>Handouts completed that coordinate with pre-class activities</p> <p>MRO Module 5 quiz (repeatable & graded)</p>
11/4/14	X-ray Tube cont.		<p>Handouts completed that coordinate with pre-class activities</p> <p>X-ray Circuit & X-ray tube project due 11/11</p> <p>Test at end of class - Ch. 5 X-ray Tube</p>

11/11/14	X-ray Production & Interactions	Johnson & Fauber - Ch. 6 X-ray Production - Ch. 7 X-ray Interactions - Ch. 8 Image Production (pg.72-73) MRO - Module 6: Sections 2, 3 & 4 - Module 7: Section 2 Carlton & Adler (reference) - Ch. 7 X-ray Production - Ch. 12 X-ray Interactions	Handouts completed that coordinate with pre-class activities Due 11/18 - Visual inspection - Collimator test MRO Module 6 quiz (repeatable & graded)
11/18/14	Fluoroscopy	Johnson & Fauber - Ch. 14 Fluoroscopy MRO - Module 14: Sections 2 & 3 Carlton & Adler (reference) - Ch. 36 Fluoroscopy	Test at start of class – Ch. 6 X-ray Production & Ch. 7 X-ray Interactions Handouts completed that coordinate with pre-class activities
11/25/14	Fluoroscopy cont. & QC	Carlton & Adler - Ch.31 QM (pg.473-474)	Handouts completed that coordinate with pre-class activities MRO Module 14 quiz (repeatable & graded)
12/2/14	Fluoro cont. or Catch-up week		Test – Fluoroscopy?
12/9/14	Review		Review packet
12/15/14 – 12/22/14	Final exam		Day and time of final exam to be determined

❖ This timeline may be subject to change. One section may take more or less time than planned. Any changes will be discussed during class time and changed in Blackboard.

Rubric for X-ray room activity

X-ray room design activity

Activity will be graded according to the following rubric. There is a total of 28 possible points.

Points	10	8	0
Content	Content in the writing and diagram is accurate and contains no errors.	Content in the writing and diagram have three or fewer errors.	Content in the writing and diagram has more than three errors.
Presentation	Information is presented accurately and is able to answer questions	Information is presented with a few errors and is able to answer questions	No presentation
Deadline	Project is submitted by deadline	Project is submitted 1 week past deadline	Project submitted after 1 week or not submitted
Resources of information		Site of resources provided	No resources provided

APPENDIX C

Course Outcomes Comparison Assessment (COCA)

Course Name: Imaging Equipment Operation – Fall 2014

Instructor Name: Darcy Willis

1. Competency/ Course Outcome	2. Program Outcome	3. Core Ability	4. Formative Assessment	5. Summative Assessment	6. Comments, Planned Changes or Improvements:
Structure of the atom	Structure of the atom	Critical thinking Science and technology	Draw and label a diagram of an atom	Written exam	To be determined
X-ray circuit	X-ray circuit	Critical thinking Science and technology	X-ray room design activity	Written exam	To be determined
X-ray tube	Diagnostic x-ray tubes	Critical thinking Science and technology	Small group presentation on x-ray tube	Written exam	To be determined
X-ray production	X-ray production	Critical thinking Science and technology	Small group presentation on x-ray production	Written exam	To be determined
X-ray interactions	X-ray interactions	Critical thinking Science and technology	Individuals drawing and explanation of x-ray interactions	Written exam	To be determined

APPENDIX D

Flipped Lesson Plan

Course: Imaging Equipment Operation (3 hour class, one day a week)

Topic for flipping: X-ray circuit

Introduction: The Imaging Equipment Operation is a course for second year radiography students. I have taught the course for the last two years and need to make changes to how the material is delivered. Flipping the classroom will allow more time for in-class activities, question/answer time, and group projects. Before class, you will read the assigned textbook pages, complete MRO modules, review the PowerPoint, and watch assigned videos. Within the Power Point, you will have specified areas to complete and a section to put questions that you want to go over during class. In class, you will work in small groups, drawing the circuit, identifying the components on the drawing, and tracking the flow of electricity throughout the circuit.

Competencies: The competencies are outlined according to the Wisconsin Technical College System (WTCS).

Summarize the purpose and function of x-ray circuitry

You will demonstrate your competence:

2.a. in an oral, written, or graphic summary

Your performance will be successful when:

2.a. summary describes the function of x-ray circuitry

2.b. summary identifies the key features and components of x-ray circuitry

2.c. summary specifies the relationship between circuitry components

2.d. summary relates the function of components to producing x-rays

2.e. summary specifies appropriate safety procedures

2.f. summary describes common malfunctions and their corrective measures

Out of class activities: The following lists of activities are to be completed prior to class. The PowerPoint will be checked for notes prior to the start of class. If the activities are not completed, you will have to use one of the computers in the student work area and complete the assigned activities before doing the individual or group activities. The times provided are only approximate and may vary for each student.

Required activity #1: Selected readings from *Essentials of Radiographic Physics and Imaging*

- Read chapter 4, pages 34- 42 (General X-ray Circuit)

Time: approximately 30 minutes

Required activity #2: *MRO (Mosby's Radiographic Online), Essentials of Radiographic Physics and Imaging*

- Module 4 – Section 8: General X-ray Circuit

- Module 4 Media – Section 9: Principles of Circuit Operation
Time: approximately 30 minutes

Required activity #3: Watch ASRT video clip – X-ray Circuit

The video clip can be found on the ASRT student CD. Time: approximately 10 minutes.

Required activity #4: While completing activities #1, #2 and #3, take notes in specified slides of the PowerPoint. This activity will be checked for completion in the beginning of class. No point value is attached to this activity.

Optional activity #1: Selected readings from *Principles of Radiographic Imaging, 5th Edition*

- Read chapter 4, pages 76-87 (Controlling Electrical Current & Rectification).
Time: approximately 30 minutes
- Read chapter 5, pages 96-99 (Basic X-ray Circuit)
Time: approximately 10 minutes

This book is an additional resource. These readings are optional as this book includes helpful information but most students find the description of the content confusing.

Optional activity #2: *MRO (Mosby's Radiographic Online), Essentials of Radiographic Physics and Imaging.*

- Module 4 activities
- Module 4 quizzes (These quizzes are repeatable and have no point value attached.)
Time: approximately 30 minute

Within the MRO, there are activities and quizzes you can complete. The quizzes are usually pretty short, consisting of approximately five to ten questions. Sometimes the quizzes will be used as a graded activity but most of the time they are an extra study tool.

In class activities: As mentioned earlier, the Power Point notes will be checked for completion at the start of class. Before the activities begin, questions that came up during the out of class activities will be reviewed. Approximately 20 minutes will be set aside for questions, but this time can be adjusted depending on the number of questions that needs to be addressed. Some of the questions may be better suited to answer as a whole class versus individual groups. See activity #1 below as it will be used during the question session. The remaining activities will be completed in small groups during the remaining three hour class time.

Activity #1: As you enter the classroom, turn in your laminated “windshield”. It is a picture of a windshield broken down into three sections:

CLEAR = I get it!

BUGS = I get it for the most part, but some things are still unclear.

MUD = I still don't get it!

While completing the outside activities, put a brief description for each section of the windshield. As you are handing in the windshields, I will take a quick look to see if there are specific areas that a large portion of the class does not understand. This will allow the instructor to focus the initial question session on these main parts. This might help some of you who are afraid of speaking up during class.

Activity #2: In small groups, you will complete an x-ray circuit diagram. You will start off by labeling the main sections: primary circuit, secondary circuit, and filament circuit. The next step will be to label the components of each circuit. After labeling the components of each circuit, describe the function of each component. The final part of this activity will be “walking” the instructor through the circuit, explaining the entire x-ray circuit and its components. Time: approximately 1 hour will set aside for this activity.

Break: A short break (approximately 15 minutes) will be given after activity #1 is completed.

Activity #2: As a whole class, we will do some type of review game of the material from activity #1. Time: approximately 20 minutes will be set aside for this activity.

Activity #3: The remaining portion of the class will be used for you to work on an individual project. Each of you will complete a project of designing an x-ray room. The projects consists of three parts. Time: approximately 45 minutes.

Part 1: During class time, you will make a list of everything you think is needed to build an x-ray room. Make a list of questions to ask the managers at your clinical sites about other things that are necessary to think about when designing an x-ray room.

Part 2: Ask the manager the questions when you go to clinical. This portion of the activity will have to be completed outside of class.

Part 3: Put all of the information together in a drawing and include a written description.

These projects will be presented in class the following week.
I allowed 10 extra minutes for a little leeway time.