



SENATE COMMITTEE ON CURRICULAR AFFAIRS
COURSE SUBMISSION AND CONSULTATION FORM

Principal Faculty Member(s) Proposing Course

Name	User ID	College	Department
RYAN EDWARD RUSSELL	rer190	Arts and Architecture (AA)	Not Available
GARY CHINN	gmc14	Arts and Architecture (AA)	Not Available
HENRY ANDREW PISCIOTTA	hap10	(XX)	Not Available

Academic Home: Arts and Architecture (AA)

Type of Proposal: Add Change Drop

Message for Reviewers:

Course Designation

(GD 115N) Visualizing Information

Course Information

Cross-Listed Courses:

Prerequisites:

Corequisites:

Concurrents:

Recommended Preparations:

Abbreviated Title: Visualizing Info
Discipline: General Education
Course Listing: Inter-Domain

Special categories for Undergraduate (001-499) courses

Foundations

- Writing/Speaking (GWS)
- Quantification (GQ)

Knowledge Domains

- Health & Wellness (GHW)
- Natural Sciences (GN)
- Arts (GA)
- Humanities (GH)
- Social and Behavioral Sciences (GS)

Additional Designations

- Bachelor of Arts
- International Cultures (IL)
- United States Cultures (US)
- Honors Course
- Common course number - x94, x95, x96, x97, x99
- Writing Across the Curriculum

First-Year Engagement Program

First-Year Seminar

Miscellaneous

Common Course

GE Learning Objectives

GenEd Learning Objective: Effective Communication

GenEd Learning Objective: Creative Thinking

GenEd Learning Objective: Crit & Analytical Think

GenEd Learning Objective: Global Learning

GenEd Learning Objective: Integrative Thinking

GenEd Learning Objective: Key Literacies

GenEd Learning Objective: Soc Resp & Ethic Reason

Bulletin Listing

Minimum Credits: 3

Maximum Credits: 3

Repeatable: NO

Department with Curricular Responsibility: Arts And Architecture Administration (UPAA_AAADM)

Effective Semester: FA 2018

Travel Component: NO

Course Outline

A brief outline or overview of the course content:

GD 115N Visualizing Information provides a foundation in the emerging field of data visualization, which is the purposeful and creative process of communicating data by encoding it as visual objects. In this course students will learn how the human visual system processes and perceives images, be introduced to principles and theories of good data visualizations, and gain practical experience building and evaluating visualizations.

A listing of the major topics to be covered with an approximate length of time allotted for their discussion:

Week 1: The Value of Visualization

Assignment: Diagnostic Test (to evaluate familiarity with principals of numerical reasoning)

Readings:

Selected chapters from Visual Display of Quantitative Information

1st chapter of Envisioning Information

Individualized remedial readings based on results of the diagnostic test.

These will be selected chapters from:

Jessica Utts, Seeing Through Statistics, 4th ed., Stamford: Cengage Learning, 2015.

David Hand, Statistics: A Very Short Introduction, New York: Oxford Univ. Press, 2008.

Week 2-3: Visualization Principles & Techniques

Readings:

Chapters 2 through 5 of The Truthful Art

Assignment:

Project Phase 1: Choose and discuss a project article.

Students in small teams will choose from a list of articles that present arguments supported by statistics. They will discuss the article selected and collaboratively answer questions about the article. Questions for Phase 1 will include:

What is the main idea presented?

What is the intended audience for the article?

How were numbers used to support the thesis?

What datasets were employed? How and why were they created?

What were the most convincing and least convincing aspects of the article's use of data?

Do you think that Albert Cairo would call the article "candid?"

Week 4-5: Micro / Macro Readings

Readings:

Chapter 2 in Envisioning Information

Chapters 3 & 4 from Nathan Yau, Data Points: Visualization That Means Something. Indianapolis, Wiley, 2013.

Assignment:

Project Phase 2: Assess the article's employment of visualization types

How might Nathan Yau categorize the type(s) of data used in the article?

Using the Data Viz Project (<http://datavizproject.com/>) what type of graphic(s) most closely resemble the one(s) used in the article?

Was the choice of graphics in the article effective? Could another type of graphic been used? What are the merits of the type chosen and of the alternative you select?

Week 6-7: Layering and Separation

Readings:

Chapter 3 in Envisioning Information

Chapter 6 in The Truthful Art

Assignment:

Project Phase 3: Assessment of reader's ability to explore the data in the article

Does the article permit the reader to engage in both micro and macro readings? Could it? How? What norms are critical for the reader to understand? What candid exceptions help the reader to understand the degree of uncertainty in the analysis?

Does the article employ layering and separation to organize data? Could it? How?

Week 7-9: Color and Information

Readings:

Chapter 5 from Envisioning Information

Assignment:

Project Phase 4: Presentations of design proposals for printed presentation

Proposed revision of the visualizations in the article for peer evaluation

Identify the intended audience for your visualization.

Describe the improvements provided by your design.

Week 10-12: Small Multiples

Readings:

Chapter 4 from Envisioning Information

Article on motion graphics and/or interactive graphics

Week 13-15: Narratives of Space and Time

Readings:

Chapter 6 from Envisioning Information

Assignment:

Project Phase 5: The potential of interactive/motion graphics for the article

Storyboard presentations of potential time-based or interactive data visualizations

Identify the intended audience for your visualization.

Describe the improvements provided by your design.

Course Description:

The world is awash with complex, dynamic information. With the development of powerful technologies capturing vast amounts of data, the art of visually representing information in ways that increase understanding of complex data and models will become a critical skill. Effective representations can communicate information in ways that maximize comprehension, analysis, exploration, and understanding of the underlying data. Knowing how to read and interpret visual data is essential to navigating this ocean of information. Those who know how to present data visually employ a powerful communication tool.

In this class, you will become an effective reader and creator of visual representations of data. Through critical assessment of examples, interactions with peers, and the generation of your own projects, you will generate visualizations of data and create works using a common visual language to help people analyze and understand the information at hand. Good visualizations not only present a visual interpretation of data, but also do so by improving comprehension, communication, and decision-making. Effectively functional visualizations can offer insights that reveal evidence and truths that may be difficult to otherwise observe. They can often empower readers to explore both the norms that give meaning to the data and the exceptions that convey its complexity or uncertainty.

Visualized information can assist in revealing:

- Distributions and frequency over time
- Changes and trends
- Relationships and correlations
- Spatial and mapping information

Regardless of your major field of study, the ability to effectively visualize information represents a significant and essential skill for effective communication. Whether you are creating representation of your work for your company's leadership board, a general public audience, or a meeting of your peers, the ability to craft a visual display that offers an accurate and insightful interpretation of data is a key capability in the workplace.

No prior experience in design or statistics is required for success in this course.

The name(s) of the faculty member(s) responsible for the development of the course:

| Name: RYAN EDWARD RUSSELL (rer190)

Title:

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Fax:

Course Justification

Instructional, Educational, and Course Objectives:

This section should define what the student is expected to learn and what skills the student will develop.

This course is designed to provide students with the foundations necessary for understanding and applying principles and theories of good data visualizations.

At the conclusion of the course, students will:

- o Understand the foundations principles, techniques and theory used in data visualization.
- o Understand the variety of existing techniques in information visualization
- o Understand the principles of human perception and cognition in data visualization
- o Be able to critically evaluate, analyze, and build visualizations
- o Be able to read and discuss research papers from visualization literature.
- o Understand basic principles of statistics and an appreciation of statistical reasoning
- o Be able to recognize common areas of misunderstanding about data-based arguments such as biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data
- o Understand the functions that data visualization can perform in the process of creating knowledge with numerical information

Evaluation Methods:

Include a statement that explains how the achievement of the educational objective identified above will be assessed.

The procedures for determining students' grades should be specifically identified.

Students will be expected to research and critically review research papers, case studies, and projects related to data visualization. The procedures for determining the course grade are:

- o Course Forums: Students will be evaluated based on the quality, depth, and productivity of their discussion. (20%)
- o Course Project: A project to design a data visualization will be employed as a critical exercise in understanding and communicating a pre-existing statistical argument. The project will be divided into 5 phases. (5 assignments @ 10% each)
- o Midterm/Final Exam: A midterm and Final exam will be used to assess comprehension of content and progress. (30%)

Relationship/Linkage of Course to Other Courses:

This statement should relate the course to existing or proposed new courses. It should provide a rationale for the level of instruction, for any prerequisites that may be specified, or for the course's role as a prerequisite for other courses.

GD115N will not link or relate with any currently existing courses. The course is not seen as a prerequisite for other courses, and the course does not require prerequisites before enrollment. The course is designed at the 100 level, indicating that it is appropriate for a broad audience of general education students from across disciplines. This is in keeping with the previously stated idea that skills in effective information visualization can provide benefit to any number of academic disciplines.

Relationship of Course to Major, Option, Minor, or General Education:

This statement should explain how the course will contribute to the major, option, or minor and indicate how it may function as a service course for other departments.

This course will not satisfy any requirements in the major or minor in graphic design. However, the course is anticipated to play a role in an eventual undergraduate certificate program in data visualization offered via the Penn State World Campus. In addition, the course is anticipated to be part of an undergraduate World Campus bachelor's degree in data science currently in discussions. While neither of these linkages are to extant programs, the recommendation of the Office for General Education is that these anticipated linkages/relationships be shared to provide context for the course. In addition, data visualization is an emerging interdisciplinary specialty for designers, architects, engineers, social scientists, and other fields. There is growing interest among professionals in those fields to gain expertise in this new specialty. A market scan completed last year by Penn State World Campus indicated that this course would have significant appeal to students in a variety of majors who might be interested in supplementing their major studies with skills related to analyzing, interpreting, and creating visual information.

A description of any special facilities:

GD115N will be offered in a world campus format. Students who participate through the World Campus provide their own computer platforms and Internet connections.

Frequency of Offering and Enrollment:

Initial offering: Fall 2018
Expected enrollment: 35

Alignment with General Education Objectives

EFFECTIVE COMMUNICATION – the ability to exchange information and ideas in oral, written, and visual form in ways that allow for informed and persuasive discourse that builds trust and respect among those engaged in that exchange, and helps create environments where creative ideas and problem-solving flourish.

KEY LITERACIES – the ability to identify, interpret, create, communicate and compute using materials in a variety of media and contexts. Literacy acquired in multiple areas, such as textual, quantitative, information/technology, health, intercultural, historical, aesthetic, linguistic (world languages), and scientific, enables individuals to achieve their goals, to develop their knowledge and potential, to lead healthy and productive lives, and to participate fully in their community and wider society.

CRITICAL AND ANALYTICAL THINKING – the habit of mind characterized by comprehensive exploration of issues,

ideas, artifacts, and events before accepting or formulating a conclusion. It is the intellectually disciplined process of conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

INTEGRATIVE THINKING – the ability to synthesize knowledge across multiple domains, modes of inquiry, historical periods, and perspectives, as well as the ability to identify linkages between existing knowledge and new information. Individuals who engage in integrative thinking are able to transfer knowledge within and beyond their current contexts.

CREATIVE THINKING – the capacity to synthesize existing ideas, images, or expertise in original ways and the experience of performing, making, thinking, or acting in an imaginative way that may be characterized by innovation, divergent thinking, and intellectual risk taking.

GLOBAL LEARNING – the intellectually disciplined abilities to analyze similarities and differences among cultures; evaluate natural, physical, social, cultural, historical, and economic legacies and hierarchies; and engage as community members and leaders who will continue to deal with the intricacies of an ever-changing world. Individuals should acquire the ability to analyze power; identify and critique interdependent global, regional, and local cultures and systems; and evaluate the implications for people's lives.

SOCIAL RESPONSIBILITY AND ETHICAL REASONING – the ability to assess one's own values within the social context of problems, recognize ethical issues in a variety of settings, describe how different perspectives might be applied to ethical dilemmas, and consider the ramifications of alternative actions. Individuals should acquire the self-knowledge and leadership skills needed to play a role in creating and maintaining healthy, civil, safe, and thriving communities.

What component(s) of the course will help students achieve the General Education Learning Objectives covered in the course? Provide evidence that students in the course have adequate opportunities to achieve the identified learning objectives.

Visualizing information is inherently interdisciplinary; it requires an understanding of basic statistics coupled with an appreciation of visual arts and design principles. The case studies and practice activities in this course invite students to synthesize material from multiple domains and to appreciate the ways in which information literacy, statistical reasoning, and visual design principles work in concert towards reading and making effective visual communications.

COURSE LEARNING OBJECTIVES

Students will have an understanding of the foundations principles, techniques and theory used in data visualization GA4 K2

Students will have an understanding to the variety of existing techniques and systems in information visualization GA3 K3

Students will have an understanding of the principles of human perception and cognition in data visualization GH2 K3

Students will gain practical experience building and evaluating visualization systems GA3 K1, K5

Students will be able to read and discuss research papers from visualization literature GH3, GA1 K2

Students will have an understanding of basic principles of statistics and an appreciation of statistical reasoning GA4 K3

Students will be able to recognize common areas of misunderstanding about data-based arguments such as biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data GH5 K2, K7

Understand the functions that data visualization can perform in the process of creating knowledge with numerical information GA3 K2

How will students be assessed to determine their attainment of the Learning Objective(s) of General Education covered in this course? This assessment must be included as a portion of the student's overall performance in this course.

Visualizing information is inherently interdisciplinary; it requires an understanding of basic statistics coupled with an appreciation of visual arts and design principles. The case studies and practice activities in this course invite students to synthesize material from multiple domains and to appreciate the ways in which information literacy, statistical reasoning, and visual design principles work in concert towards reading and making effective visual communications.

Students in this course will be expected to analyze research papers, case studies, and projects in written assignments in order to synthesize the visual design and information literacy skills, principles, and techniques covered in the units. Students will also be expected create and build sample projects visualizing information, employing the principles and techniques related to statistical reasoning and creating visual objects.

Questions posed in the project phases will test students' understanding of the assigned readings. An initial diagnostic test will ensure that a minimal understanding of statistical reasoning is held by all students. Since the choices made for the project will focus a student on specific, applicable aspects of the course content, a mid-term and final exam will ensure adequate understanding of the full scope of the course content.

General Education Domain Criteria

General Education Designation: Inter-Domain

GA Criteria

Explain the methods of inquiry in arts fields and describe how the contributions of these fields complement inquiry in other areas

Demonstrate an expanded knowledge and comprehension of the role that the arts play in various aspects of human endeavor

Demonstrate competence in the creation of works of art and design

Demonstrate competence in analysis, critical thinking and interpretive reasoning through the exploration of creative works

Identify and explain the aesthetic, historic, social, and cultural significance of important works of art and critically assess creative works, their own or others', through evaluative processes of analysis and interpretation

What components of the course will help students achieve the domain criteria selected above?

Visualizing information is inherently interdisciplinary; it requires an understanding of basic statistics coupled with an appreciation of

visual arts and design principles. The case studies and practice activities in this course invite students to synthesize material from multiple domains and to appreciate the ways in which information literacy, statistical reasoning, and visual design principles work in concert towards reading and making effective visual communications. In this course, students will complete readings, participate in discussions, evaluate examples, and create projects that explore the principles and techniques of visualizing information, developing both aesthetic (color, scale, proportion, etc.) and quantitative literacies.

GH Criteria

- Explain the methods of inquiry in humanities fields and describe how the contributions of these fields complement inquiry in other areas**
- Demonstrate competence in critical thinking about topics and texts in the humanities through clear and well-reasoned responses**
- Critically evaluate texts in the humanities— whether verbal, visual, or digital— and identify and explain moral or ethical dimensions within the disciplines of the humanities**
- Demonstrate knowledge of major cultural currents, issues, and developments through time, including evidence of exposure to unfamiliar material that challenges their curiosity and stretches their intellectual range**
- Become familiar with groups, individuals, ideas, or events that have influenced the experiences and values of different communities**

What components of the course will help students achieve the domain criteria selected above?

In the initial phases of the main project assigned, students will engage in analysis of visual rhetoric. Visual rhetoric as an umbrella term includes visual thinking, visual learning, and visual communication, and focuses on how we interpret and make meaning out of visual information. Essentially, students will be asked to see the use of images as argument. Consideration of arguments presented in news or scholarly texts – looking carefully at both the processes of supporting generalizations (with their elements of subjectivity) and the employment of numbers for support (and its more objective rigor). Throughout the course, but particularly in the later phases of the project, as students seek design solutions, they will need to understand and employ visual languages, to interpret the texts they are studying.

Students will be able to recognize common areas of misunderstanding about data-based arguments such as biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data. Students will be asked to consider the ethical aspects of presenting data, including the choice of data, scales, and associated interpretations.

Integrative Studies

Explain how the intellectual frameworks And methodologies of the two Knowledge Domains will be explicitly addressed in the course and practiced by the students.

The intellectual frameworks and methodologies of graphic design, bounded in arts and design-based thinking and making, and humanities-based approaches to ways of seeing speculating, and representing, will be explicitly outlined and drawn upon within the written course lessons. The GH focus on inquiry, reason, and critical evaluation aligns with an information literacy approach to the course, one that asks students to engage with representations of constructs and adjudicate and evaluate information. In addition, there is an undeniable ethical aspect to the presentation of information that benefits from the probing critical evaluation skills inherent to humanities-based inquiry. The ACRL Information Literacy Competency Standards for Higher Education (ACRL, 2014) are as follows:

- 1 The information literate student determines the nature and extent of the information needed.
- 2 The information literate student accesses needed information effectively and efficiently.
- 3 The information literate student evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system.
- 4 The information literate student, individually or as a member of a group, uses information effectively to accomplish a specific purpose.
- 5 The information literate student understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally.

To this end, written assignments—open forums, discussion boards, reflection papers—will include prompts to stimulate integrative thinking. The readings and assignments have been designed to address the “Framework for Information Literacy for Higher Education” developed by the Association of College and Research Libraries, with particular focus on the Framework’s segment on Information Creation as a Process, and with emphasis on data literacy and visual literacy as aspects of information literacy. (<http://www.ala.org/acrl/standards/ilframework>)

Demonstrate that each Of the two domains will receive approximately equal attention, providing evidence from course topics, assignments, or other course components, and that students will integrate material from both domains.

Each of the course lessons will draw upon the curricular materials of both graphic design and information literacy via readings from assigned texts that represent both the craft of display of information (the Tufte textbook) as well as the narrative, critical, and ethical components of presenting data visually (the Cairo textbook). Visual information foundations, techniques, and theory will be contextualized within an information theory framework. The ongoing project for the course requires both an in-depth analysis of published information and creative re-interpretation of that information.

Briefly explain the staffing plan. Given that each Inter-Domain course is approved for two Knowledge Domains, it will be taught by an instructor (or instructional team) with appropriate expertise in both domains.

Faculty in the Graphic Design program within the College of Arts and Architecture and faculty in the College of the Liberal Arts have expressed interest in teaching the course. In addition, faculty from the School of Social Science and Humanities at Penn State Behrend have expressed a willingness to offer the course that that campus. An embedded librarian will be identified to act as a coach on many aspects of the course assignments, including the critical evaluation of information, quantitative skills, and ethics.

Describe the assessments that will be used to determine students' ability to apply integrative thinking.

Students in this course will be expected to analyze research papers, case studies, and projects in written assignments in order to synthesize the visual design and information literacy skills, principles, and techniques covered in the units. Students will also be expected create and build sample projects visualizing information, employing the principles and techniques related to statistical

reasoning and creating visual objects.

Questions posed in the project phases will test students' understanding of the assigned readings. An initial diagnostic test will ensure that a minimal understanding of statistical reasoning is held by all students. Since the choices made for the project will focus a student on specific, applicable aspects of the course content, a mid-term and final exam will ensure adequate understanding of the full scope of the course content.

Campuses That Have Offered () Over The Past 4 Years

semester	AB	AL	BK	BR	BW	CR	DS	ER	FE	GA	GV	HB	HN	HY	LV	MA	NK	PC	SH	SL	UP	WB	WC	WS	XC	XP	XS	YK
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Potential Impact

Pre-Requisites

is *listed as a pre-requisite or concurrent course* for the following courses:

Note: Not all courses may be listed here, due to lionpath requirement incomplection.

No pre-requisites or concurrent courses found

**General Education Assessment
Integrative Studies Course Memo AY 2017-2018**

Course name: Visualizing Information

Course code: GD115

Term: Fall 2018

Faculty name(s): Ryan Russell

Campus: University Park / World Campus

Number students started course/ completed course: (complete when course completed)

Instructions: Complete sections A-E by Fall 2017. Complete sections F-J after your course is completed.

A. Course materials checklist

Item	Included?
Syllabus	Yes
Course materials list (readings, etc.)	Yes
Lecture notes	Yes
In-class course activity descriptions	Yes
Assignment prompts including scoring schemes (e.g. rubrics)	Yes
Quiz, exam questions	Yes

B. Curriculum rationale:

Main purpose:

What is the significant topic, issue, or product to be approached in interdisciplinary fashion?

This course is designed to provide students with the foundations necessary for understanding and applying principles and theories of good data visualizations.

Reason for interdisciplinary approach:

Why is an interdisciplinary approach valuable or necessary for this issue(s) or topic?

Visualizing information is inherently interdisciplinary; it requires an understanding of basic statistics coupled with an appreciation of visual arts and design principles. The case studies and practice activities in this course invite students to synthesize material from multiple domains and to appreciate the ways in which information literacy, statistical reasoning, and visual design principles work in concert towards reading and making effective visual communications.

Integrative objects for student work:

What is aim of taking integrative approach? What are students expected to produce?

At the conclusion of the course, students will have gained

- An understanding of the foundations principles, techniques and theory used in data visualization.
- Understand the variety of existing techniques in information visualization

- Understand the principles of human perception and cognition in data visualization
- Be able to critically evaluate, analyze, and build visualizations
- Be able to read and discuss research papers from visualization literature.
- Understand basic principles of statistics and an appreciation of statistical reasoning
- Be able to recognize common areas of misunderstanding about data-based arguments such as biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data
- Understand the functions that data visualization can perform in the process of creating knowledge with numerical information

Interdisciplinary tasks:

What sort of interdisciplinary tasks will students need to make to produce the integrative objects?

Students in this course will be expected to analyze research papers, case studies, and projects in written assignments in order to synthesize the visual design and information literacy skills, principles, and techniques covered in the units. Students will also be expected create and build sample projects visualizing information, employing the principles and techniques related to statistical reasoning and creating visual objects.

Questions posed in the project phases will test students' understanding of the assigned readings. An initial diagnostic test will ensure that a minimal understanding of statistical reasoning is held by all students. Since the choices made for the project will focus a student on specific, applicable aspects of the course content, a mid-term and final exam will ensure adequate understanding of the full scope of the course content.

Disciplines to be integrated:

Why is it important for interdisciplinary work on this issue?

Data visualization is an emerging interdisciplinary specialty for designers, architects, engineers, social scientists, and other fields. There is growing interest among professionals in those fields to gain expertise in this new specialty.

What substantial contribution does each discipline make?

Architecture, engineering, and social science research targets interdisciplinary problems. The Integration of data from a broad array of sources can highlight and clarify important relationships across results.

How does each present a clearly distinct perspective, mode of knowing and inquiry?

As scientists, engineers, architectures, and other disciplines acquire large amounts of data comes discussion around ethics, teaching and understanding. The necessity of furthering understanding about behaviors, actions and correlations make it necessary for graphic designers to utilize specific principles, methods, and tools to successfully communicate that information to broad audiences.

What would be missing if this discipline were not represented?

The application of graphic design principles to the visualization of data creates a common visual language to help people analyze and understand information at hand. Good visualizations not only present a visual interpretation of data, but also do so by improving comprehension, communication, and decision-making.

Course structure:

Does the syllabus serve as a map of, or orientation, to the course? Do tools, readings, message for each week reinforce each other and take students on a developmental path toward integrative thinking?

The syllabus serves as a guide for the course objectives, grading expectations, required readings, and necessary resources to complete all work within the semester. The course objectives in particular are key to highlighting that visualizing information is inherently interdisciplinary; it requires an understanding of basic statistics coupled with an appreciation of visual arts and design principles.

C. Integrative Studies Courses must address TWO Knowledge Domains. In the table below, mark the domains addressed in your course:

Knowledge Domain	Mark X for two domains:
GA	X
GH	X
GHW	
GN	
GS	

D. List course learning objectives. Mark the Gen Ed Knowledge Domain and Key Learning Objectives addressed by each course objective (at least 3 out of 5 objectives for each Domain must be addressed; at least 2 out of 7 objectives for each Key objective including Integrative Thinking Key objective). See appendix for list of Knowledge Domain and Key Learning Objectives at end of document. (BY FALL 2017)

COURSE LEARNING OBJECTIVE	Gen Ed Knowledge Domain Objective Addressed	Gen Ed Key Learning Objective Addressed
Students will have an understanding of the foundations principles, techniques and theory used in data visualization	GA4	K2
Students will have an understanding to the variety of existing techniques and systems in information visualization	GA2, GA3	K3
Students will have an understanding of the principles of human perception and cognition in data visualization	GH2	K3
Students will gain practical experience building and evaluating visualization systems	GA3, GA5	K1, K5
Students will be able to read and discuss research papers from visualization literature	GH3, GA1	K2
Students will have an understanding of basic principles of statistics and an appreciation of statistical reasoning	GA4	K3
Students will be able to recognize common areas of misunderstanding about data-based arguments such as biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data	GH5	K2, K7

E. For each course objective listed in D, list in-class course activities to develop each course objective. Also note how you will assess each course objective. Attach course activity descriptions, assignment prompts and any related assessment documents (e.g. rubrics, exam questions).

COURSE LEARNING OBJECTIVE	Course activity and purpose	Course assessment
Students will have an understanding of the foundations principles, techniques and theory used in data visualization	Class lectures and discussions focused on gestalt theory.	Assessment 1: Individual student assignment: Design is everywhere. 3 found examples and a 300-word summary of selections. Submissions and designs statements scored using rubric.
Students will have an understanding of the principles of human perception and cognition in data visualization	Weekly lectures and class discussions, includes both in-class lectures as well as participation in the discussion on Canvas.	Assessment 2: Class discussions about weekly lectures. All students are required to post at least 1 substantive discussion reply pertaining to each weekly lecture. Participation scored using rubric.
Students will gain practical experience building and evaluating visualization systems	Weekly assignments covering vizualization techniques, including: <ul style="list-style-type: none"> • Micro / Macro Readings • Layering and Separation • Small Multiples • Color and Information • Narratives of Time and Space 	Assessment 3: Students will create visualizations for covering various techniques outlined in weekly course content (and provide a rigorous rationale for her/his design choices).
Students will be able to read and discuss research papers from visualization literature	Papers and Casestudies presented as part of weekly course readings.	Assessment 4: All students are required to post at least 1 substantive discussion reply pertaining to each weekly lecture. Participation scored using rubric. All case studies and course readings are also included on the midterm and final exam. Scored using rubric.
Students will have an understanding of	Class lectures and	Assessment 5: All

<p>basic principles of statistics and an appreciation of statistical reasoning</p>	<p>discussions focused on statistical reasoning.</p>	<p>students are required to post at least 1 substantive discussion reply pertaining to each weekly lecture. Participation scored using rubric.</p>
<p>Students will be able to recognize common areas of misunderstanding about data-based arguments such as biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data</p>	<p>Course readings, case studies and discussions focused on biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data.</p>	<p>Assessment 6: All students are required to post at least 1 substantive discussion reply pertaining to each weekly lecture. Participation scored using rubric.</p> <p>All case studies and course readings are also included on the midterm and final exam. Scored using rubric.</p>

F. For each course assessment listed in E, note how students performed.

Student Assessment	Student Performance
Assessment 1: 500 word essay uses literary analysis method. Essay scored using rubric.	Students scored as follows for each rubric element (5 point scale): a- Use literary analysis conventions: 80% scored 4 or above b- Develop argument: 70% scored 3 or above c- Grammar

- G. Did students have expected prior knowledge and skills to commence study in your course? If not, how did you address lack of expected knowledge/skills?
- H. Discuss student reaction to course activities with particular attention to grasp of each Knowledge Domain’s modes of inquiry, and integrative thinking ability development. Did student reaction to course activities meet your expectations? If not, will you improve any course activities in the next course offering?
- I. Discuss student performance on assessments with particular attention to grasp of each Knowledge Domain’s modes of inquiry, and integrative thinking ability development. Did student performance for each assessment meet your expectations? If students did not meet your performance expectations, what will change in the next course offering to improve student performance?
- J. Reflect as Knowledge Domain expert(s) on teaching an interdisciplinary course. Did you teach the course alone or as a faculty team? What did you learn about interdisciplinary course teaching? Were you able to sufficiently grasp modes of inquiry in each Knowledge Domain in order to lead integrative course activities and assess student integrative thinking? What do you plan to improve as a teacher to ensure course success the next time you teach the course?

Appendix: General Education Objectives: Knowledge Domain, Key and Integrative Thinking (with number codes)

Knowledge Domain

RECOMMENDED Bloom's taxonomy level	GA
EXPLAIN	GA1. Explain the methods of inquiry in arts fields and describe how the contributions of these fields complement inquiry in other areas
DEFINE, COMPREHEND	GA2. Demonstrate an expanded knowledge and comprehension of the role that the arts play in various aspects of human endeavor
CREATE	GA3. Demonstrate competence in the creation of works of art and design
ANALYZE, CRITICAL THINK	GA4. Demonstrate competence in analysis, critical thinking and interpretive reasoning through the exploration of creative works
IDENTIFY, EXPLAIN	GA5. Identify and explain the aesthetic, historic, social, and cultural significance of important works of art and critically assess creative works, their own or others', through evaluative processes of analysis and interpretation
	GH
EXPLAIN	GH1. Explain the methods of inquiry in humanities fields and describe how the contributions of these fields complement inquiry in other areas
CRITICAL THINK	GH2. Demonstrate competence in critical thinking about topics and texts in the humanities through clear and well-reasoned responses
CRITICAL THINK, EVALUATE	GH3. Critically evaluate texts in the humanities– whether verbal, visual, or digital– and identify and explain moral or ethical dimensions within the disciplines of the humanities
DEFINE	GH4. Demonstrate knowledge of major cultural currents, issues, and developments through time, including evidence of exposure to unfamiliar material that challenges their curiosity and stretches their intellectual range
DEFINE	GH5. Become familiar with groups, individuals, ideas, or events that have influenced the experiences and values of different communities
	GHW
EXPLAIN	GHW1. Explain the methods of inquiry in Health and Wellness fields and describe how the contributions of these fields complement inquiry in other areas
DESCRIBE	GHW2. Describe multiple perceptions and dimensions of health and wellness (emotional, spiritual, environmental, physical, social, intellectual, and occupational)
IDENTIFY, EXPLAIN	GHW3. Identify and explain ways individuals and/or communities can achieve and maintain health and wellness
DESCRIBE, EXPLAIN	GHW4. Describe health-related risk factors and explain changes in knowledge, attitudes, behaviors, activities or skills that have the potential of improving health and wellness
DISSEMINATE KNOWLEDGE, DEMONSTRATE BEHAVIOR	GHW5. Disseminate knowledge about health and wellness and demonstrate behavioral practices needed to engage in healthy living across the life span.
	GN
EXPLAIN, DESCRIBE	GN1. Explain the methods of inquiry in the natural science fields and describe how the contributions of these fields complement inquiry in other areas

EXPLAIN	GN2. Construct evidence-based explanations of natural phenomena
COMPREHEND	GN3. Demonstrate informed understandings of scientific claims and their applications
EVALUATE	GN4. Evaluate the quality of the data, methods, and inferences used to generate scientific knowledge
IDENTIFY	GN5. Identify societal or philosophical implications of discoveries in the natural sciences, as well as their potential to address contemporary problems
	GS
EXPLAIN	GS1. Explain the various methods of inquiry used in the social and behavioral sciences and describe how the contributions of these fields complement inquiry in other areas
IDENTIFY, EXPLAIN	GS2. Identify and explain major foundational theories and bodies of work in a particular area of social and behavioral sciences
DESCRIBE	GS3. Describe the ways in which many different factors may interact to influence behaviors and/or institutions in historical or contemporary settings
EXPLAIN	GS4. Explain how social and behavioral science researchers use concepts, theoretical models and data to better understand and address world problems
RECOGNIZE	GS5. Recognize social, cultural, political and/or ethical implications of work in the social and behavioral sciences.

Key Objectives

K1. EFFECTIVE COMMUNICATION – the ability to exchange information and ideas in oral, written, and visual form in ways that allow for informed and persuasive discourse that builds trust and respect among those engaged in that exchange, and helps create environments where creative ideas and problem-solving flourish.
K2. KEY LITERACIES – the ability to identify, interpret, create, communicate and compute using materials in a variety of media and contexts. Literacy acquired in multiple areas, such as textual, quantitative, information/technology, health, intercultural, historical, aesthetic, linguistic (world languages), and scientific, enables individuals to achieve their goals, to develop their knowledge and potential, to lead healthy and productive lives, and to participate fully in their community and wider society.
K3. CRITICAL AND ANALYTICAL THINKING – the habit of mind characterized by comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating a conclusion. It is the intellectually disciplined process of conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.
K5. CREATIVE THINKING – the capacity to synthesize existing ideas, images, or expertise in original ways and the experience of performing, making, thinking, or acting in an imaginative way that may be characterized by innovation, divergent thinking, and intellectual risk taking.
K6. GLOBAL LEARNING – the intellectually disciplined abilities to analyze similarities and differences among cultures; evaluate natural, physical, social, cultural, historical, and economic legacies and hierarchies; and engage as community members and leaders who will continue to deal with the intricacies of an ever-changing world. Individuals should acquire the ability to analyze power; identify and critique interdependent global, regional, and local cultures and systems; and evaluate the implications for people’s lives.
K7. SOCIAL RESPONSIBILITY AND ETHICAL REASONING – the ability to assess one’s own values within the social context of problems, recognize ethical issues in a variety of settings,

describe how different perspectives might be applied to ethical dilemmas, and consider the ramifications of alternative actions. Individuals should acquire the self- knowledge and leadership skills needed to play a role in creating and maintaining healthy, civil, safe, and thriving communities.

Integrative Thinking Objectives

K4. INTEGRATIVE THINKING – the ability to synthesize knowledge across multiple domains, modes of inquiry, historical periods, and perspectives, as well as the ability to identify linkages between existing knowledge and new information. Individuals who engage in integrative thinking are able to transfer knowledge within and beyond their current contexts.

Disciplinary grounding
IT1. Define/ recognize/ apply disciplinary theories, findings, examples, methods, validation criteria, genres, communication forms
Advancement through integration
IT2. Use integrative structures such as conceptual frameworks, graphic representations, models, metaphors, explanations, solutions that result in more complex, effective, empirically grounded or comprehensive accounts or products than would have been possible under single disciplinary framework.
Critical awareness
IT3. Frame problems or solutions in ways that show reflection on choices, opportunities, compromises by taking interdisciplinary approach
IT4. Exhibit awareness of of disciplinary contributions, how disciplines are integrated, limitations of integration
IT5. Recognize personal and disciplinary bias and the role such bias may play in framing of issues, events, ideas or works as well as the development of ideas or solutions (optional).

Syllabus – GD115: Visualizing Information

Course Description

The world is awash with complex, dynamic information. The successful visualization of data creates a common visual language to help people analyze and understand information at hand. Good visualizations not only present a visual interpretation of data, but also do so by improving comprehension, communication, and decision-making.

In this course students will learn how the human visual system processes and perceives images, good design practices for visualization and students will be introduced to principles and theories of good data visualizations.

Course Objectives

General Education courses will work to help you achieve these key learning objectives:

EFFECTIVE COMMUNICATION – the ability to exchange information and ideas in oral, written, and visual form in ways that allow for informed and persuasive discourse that builds trust and respect among those engaged in that exchange, and helps create environments where creative ideas and problem-solving flourish.

KEY LITERACIES – the ability to identify, interpret, create, communicate and compute using materials in a variety of media and contexts. Literacy acquired in multiple areas, such as textual, quantitative, information/technology, health, intercultural, historical, aesthetic, linguistic (world languages), and scientific, enables individuals to achieve their goals, to develop their knowledge and potential, to lead healthy and productive lives, and to participate fully in their community and wider society.

CRITICAL AND ANALYTICAL THINKING – the habit of mind characterized by comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating a conclusion. It is the intellectually disciplined process of conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

INTEGRATIVE THINKING – the ability to synthesize knowledge across multiple domains, modes of inquiry, historical periods, and perspectives, as well as the ability to identify linkages between existing knowledge and new information. Individuals who engage in integrative thinking are able to transfer knowledge within and beyond their current contexts.

COURSE LEARNING OBJECTIVE	Gen Ed Knowledge Domain Objective Addressed
Students will have an understanding of the foundations principles, techniques and theory used in data visualization	GA4
Students will have an understanding to the variety of existing techniques and systems in information visualization	GA2, GA3
Students will have an understanding of the principles of human perception and cognition in data visualization	GH2

Students will gain practical experience building and evaluating visualization systems	GA3, GA5
Students will be able to read and discuss research papers from visualization literature	GH3, GA1
Students will have an understanding of basic principles of statistics and an appreciation of statistical reasoning	GA4
Students will be able to recognize common areas of misunderstanding about data-based arguments such as biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data	GH5

GA
GA1. Explain the methods of inquiry in arts fields and describe how the contributions of these fields complement inquiry in other areas
GA2. Demonstrate an expanded knowledge and comprehension of the role that the arts play in various aspects of human endeavor
GA3. Demonstrate competence in the creation of works of art and design
GA4. Demonstrate competence in analysis, critical thinking and interpretive reasoning through the exploration of creative works
GA5. Identify and explain the aesthetic, historic, social, and cultural significance of important works of art and critically assess creative works, their own or others', through evaluative processes of analysis and interpretation
GH
GH1. Explain the methods of inquiry in humanities fields and describe how the contributions of these fields complement inquiry in other areas
GH2. Demonstrate competence in critical thinking about topics and texts in the humanities through clear and well-reasoned responses
GH3. Critically evaluate texts in the humanities– whether verbal, visual, or digital– and identify and explain moral or ethical dimensions within the disciplines of the humanities
GH4. Demonstrate knowledge of major cultural currents, issues, and developments through time, including evidence of exposure to unfamiliar material that challenges their curiosity and stretches their intellectual range
GH5. Become familiar with groups, individuals, ideas, or events that have influenced the experiences and values of different communities

This course is designed to provide students with the foundations necessary for understanding and applying principles and theories of good data visualizations.

At the conclusion of the course, students will:

- Understand the foundations principles, techniques and theory used in data visualization.
- Understand the variety of existing techniques in information visualization
- Understand the principles of human perception and cognition in data visualization
- Be able to critically evaluate, analyze, and build visualizations
- Understand basic principles of statistics and an appreciation of statistical reasoning

- Be able to recognize common areas of misunderstanding about data-based arguments such as biased data, inadequate sampling, misinterpreted correlations, confounding variables, and incomplete reporting of important data
- Understand the functions that data visualization can perform in the process of creating knowledge with numerical information

Textbooks

Edward Tufte, *The Visual Display of Quantitative Information* (2nd Edition) Cheshire: Graphics Press, 2001.

Edward Tufte, *Envisioning Information*, Cheshire: Graphics Press, 1990.

Alberto Cairo, *The Truthful Art: Data, Charts, and Maps for Communication*, San Francisco: Riders, 2016. [selected chapters provided via electronic course reserves]

Grading and Evaluation

Students will be expected to research and critically review research papers, case studies, and projects related to data visualization. The procedures for determining the course grade are:

- **Course Forums:** Students will be evaluated based on the quality, depth, and productivity of their discussion. (20%)
- **Course Project:** A project to design a data visualization will be employed as a critical exercise in understanding and communicating a pre-existing statistical argument. The project will be divided into 5 phases. (5 assignments @ 10% each)
- **Midterm/Final Exam:** A midterm and Final exam will be used to assess comprehension of content and progress. (30%)

Course Calendar

Week 1: The Value of Visualization

Assignment:

Diagnostic Test (to evaluate familiarity with principals of numerical reasoning)

Readings:

Selected chapters from *Visual Display of Quantitative Information*

1st chapter of *Envisioning Information*

Individualized remedial readings based on results of the diagnostic test.

These will be selected chapters from:

Jessica Utts, *Seeing Through Statistics*, 4th ed., Stamford: Cengage Learning, 2015.

David Hand, *Statistics: A Very Short Introduction*, New York: Oxford Univ. Press, 2008.

Week 2-3: Visualization Principles & Techniques

Readings:

Chapter 1 of *Infographics: The Power of Visual Storytelling*

Chapters 2 through 5 of *The Truthful Art*

Assignment:

Project Phase 1: Choose and discuss a project article.

Students in small teams will choose from a list of articles that present arguments supported by statistics. They will discuss the article selected and collaboratively answer questions about the article. Questions for Phase 1 will include:

What is the main idea presented?

What is the intended audience for the article?

How were numbers used to support the thesis?

What datasets were employed? How and why were they created?

What were the most convincing and least convincing aspects of the article's use of data?

Do you think that Albert Cairo would call the article “candid?”

Week 4-5: Micro / Macro Readings

Readings:

Chapter 2 in *Envisioning Information*

Chapters 3 & 4 from Nathan Yau, *Data Points: Visualization That Means Something*. Indianapolis, Wiley, 2013.

Assignment:

Project Phase 2: Assess the article’s employment of visualization types

How might Nathan Yau categorize the type(s) of data used in the article?

Using the *Data Viz Project* (<http://datavizproject.com/>) what type of graphic(s) most closely resemble the one(s) used in the article?

Was the choice of graphics in the article effective? Could another type of graphic been used? What are the merits of the type chosen and of the alternative you select?

Week 6-7: Layering and Separation

Readings:

Chapter 3 in *Envisioning Information*

Chapter 6 in *The Truthful Art*

Assignment:

Project Phase 3: Assessment of reader’s ability to explore the data in the article

Does the article permit the reader to engage in both micro and macro readings? Could it? How? What norms are critical for the reader to understand? What candid exceptions help the reader to understand the degree of uncertainty in the analysis?

Does the article employ layering and separation to organize data? Could it? How?

Week 7-9: Color and Information

Readings:

Chapter 5 from *Envisioning Information*

Assignment:

Project Phase 4: Presentations of design proposals for printed presentation

Proposed revision of the visualizations in the article for peer evaluation

Identify the intended audience for your visualization.

Describe the improvements provided by your design.

Week 10-12: Small Multiples

Readings:

Chapter 4 from *Envisioning Information*

'Motion Graphics' from *Infographics: The Power of Visual Storytelling*, Pg. 74-87

Week 13-15: Narratives of Space and Time

Readings:

Chapter 6 from *Envisioning Information*

Assignment:

Project Phase 5: The potential of interactive/motion graphics for the article

Storyboard presentations of potential time-based or interactive data visualizations

Identify the intended audience for your visualization.

Describe the improvements provided by your design.

Resource List

Data Sets

- [30 Places to Find Open Data on the Web](https://visual.ly/blog/data-sources/) (https://visual.ly/blog/data-sources/)
- [World Bank Data Catalog](https://data.world/data4democracy) (https://data.world/data4democracy)
- [Office for National Statistics \(UK\)](https://www.ons.gov.uk/) (https://www.ons.gov.uk/)

Visualization Resources & Blogs

- [Data Viz Project](http://datavizproject.com/) (http://datavizproject.com/)
- [Visual Complexity](http://www.visualcomplexity.com/vc/) (http://www.visualcomplexity.com/vc/)
- [Information is Beautiful](http://www.informationisbeautiful.net/) (http://www.informationisbeautiful.net/)
- [Information Aesthetics](http://infosthetics.com/) (http://infosthetics.com/)

Note to students with disabilities

Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for modifications or reasonable accommodations in this course, contact the Office for Disability Services, ODS, located at 116 Boucke Building at 814-863-1807(V/TTY). For further information regarding ODS please visit their web site at www.equity.psu.edu/ods. Instructors should be notified as early in the semester as possible regarding the need for modification or reasonable accommodations. Since many students have disabilities not readily noticeable this announcement or statement encourages students to identify their needs early in the semester so timely adaptations can be made.

Academic Integrity

Any instance of academic dishonesty, which, according to the faculty handbook, includes cheating, plagiarism, fabricating or falsifying information or citations, facilitating acts of academic dishonesty by others having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students, will result in a failing grade for the assignment. There will be no opportunity given to recover lost points for assignments that you fail due to academic dishonesty. Repeated dishonesty will result in a failing grade for the course and a consultation with the department head.

Syllabus Statement Regarding Copyright

All course materials students receive or to which students have online access are protected by copyright laws. Students may use course materials and make copies for their own use as needed, but unauthorized distribution and/or uploading of materials without the instructor's express permission is strictly prohibited. University Policy AD 40, Recording of Classroom Activities and Note Taking Services, addresses this issue. Students who engage in the unauthorized distribution of copyrighted materials may be held in violation of the University's Code of Conduct and/or liable under Federal and State laws. Many students at Penn State

Counseling And Psychological Services

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis

intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

Counseling and Psychological Services at University Park (CAPS)

(<http://studentaffairs.psu.edu/counseling/>): 814-863-0395

Counseling and Psychological Services at Commonwealth Campuses

(<http://senate.psu.edu/faculty/counseling-services-at-commonwealth-campuses/>)

Penn State Crisis Line (24 hours/7 days/week): 877-229-6400

Educational Equity/Report Bias

Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

Consistent with University Policy AD29, students who believe they have experienced or observed a hate crime, an act of intolerance, discrimination, or harassment that occurs at Penn State are urged to report these incidents as outlined on the University's Report Bias webpage (<http://equity.psu.edu/reportbias/>)