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Using Concept Maps for Formative Assessment

According to Nilson (2010), "Concept maps are quite easy to write instructions for and to assess, which is why they make good gradable assignments and tests" (p. 244).

After explaining to students the purpose of a concept map, share an example of an effective concept map and discuss with students what makes it effective. You might also share a partially completed concept map and have students work in small groups or with the full class to complete it. Be sure students are prepared with enough knowledge on a topic and can understand the connections between its subtopics before asking them to complete a concept map as part of an assessment.

Nilson (2010) provides five evaluative dimensions for assessing concept maps:

- The number of concepts included, unless you provide them
- The number of valid propositions (links between concepts)
- The number of valid levels in the hierarchy
- The number of valid cross-links
- The number of valid examples (p. 244)

You might consider using the following grading system, adapted from Novak and Gowin (1984), to assess students' concept maps.

	Point Value	Number Included	Points Achieved
Concepts	1 pt.		
Propositions	1 pt.		
Hierarchical Levels	5 pts.		
Cross-Links	10 pts.		
Examples	1 pt.		

Scoring Key:
A = 68–75 points
B = 60–67 points
C = 53–59 points
D = 45–52 points
F = 44 points or below

You can also evaluate students' concept maps with a rubric, like this example from the University of Wisconsin–Stout:
https://www2.uwstout.edu/content/profdev/rubrics/inspirationrubric.html

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Using Concept Maps for Exam Prep

You can use a concept map activity to help students prepare for exams. This can help students to see the connections between ideas for a given topic or unit and can allow you to identify and clarify any misconceptions students may have.

1. To begin, put students into groups and provide each group with sticky notes and a list of the top concepts for review.

2. Ask students to write one concept on each sticky note and then work together to create a concept map by arranging the notes in order of importance, labeling them, and indicating the connections between them.

3. After students have completed their concept maps, display the concept map you created to serve as a means of comparison for them. Some connection labels may differ and still be correct, so discuss your map and ask students to share any differences on their maps.

4. Ask students to share verbally or in writing responses to the following questions:
    a. Which concepts do you feel you are most prepared to see on the exam?
    b. Which concepts did you have the most difficulty connecting on your concept map?
    c. What misconceptions or misunderstandings became clearer after discussing differences between your group's map and the instructor's map?
    d. Which concepts or connections are still confusing to you, and how do you plan to address them when studying for the exam?

5. If students provide written responses, collect and review them before the exam. If many students are still having difficulty with a particular concept or connection, you may need to review it with the full class or make additional resources available to students before the exam. You might also consider adjusting the number of questions or point values assigned to concepts that the majority of students find confusing.

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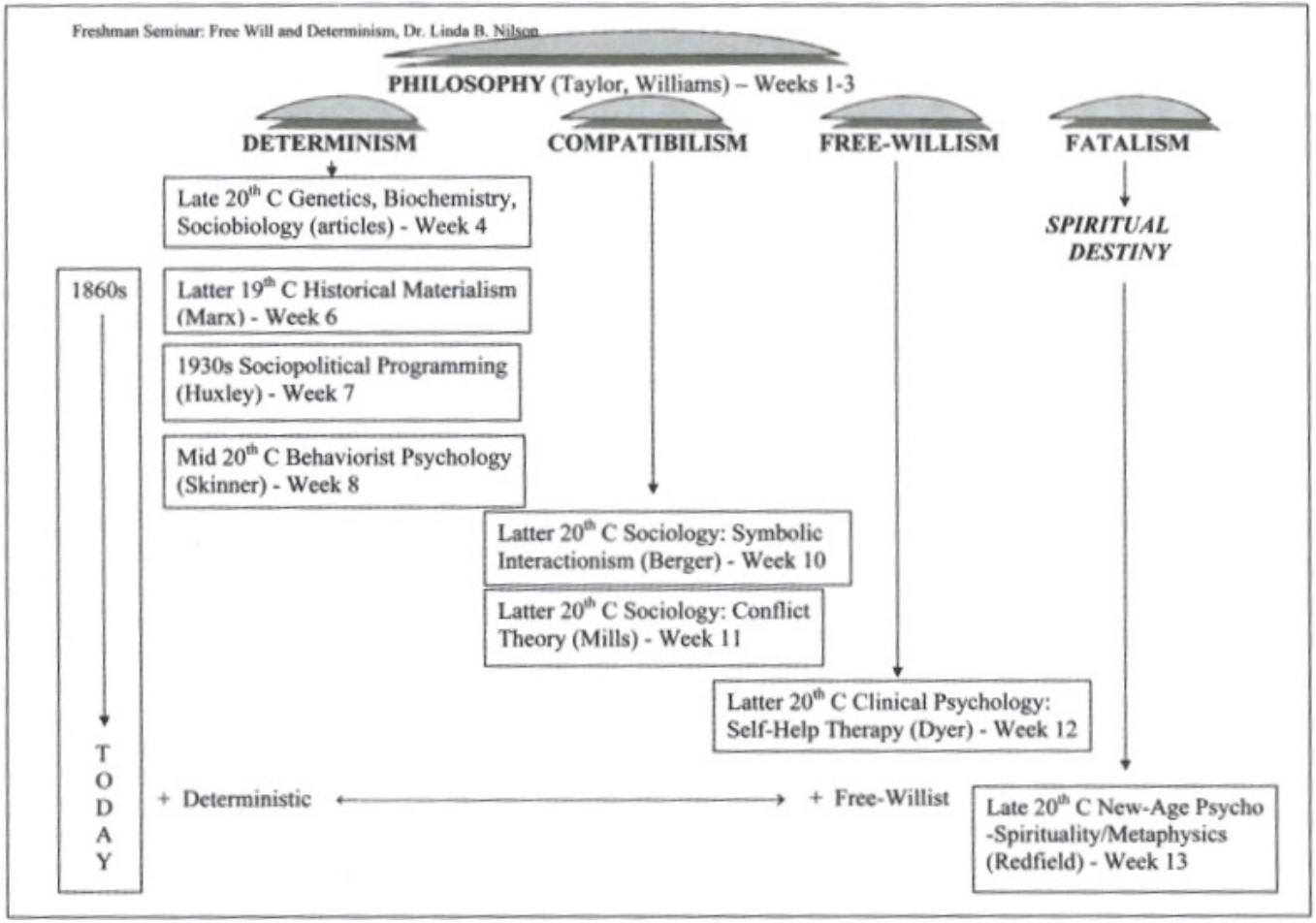
Graphic Syllabus Example

Below is an example of a graphic syllabus from Linda Nilson's "Freshman Seminar: Free Will and Determinism" course, which highlights the chronology/sequence of the topics that will be covered.



Source: Nilson, L. B. (2007). *The graphic syllabus and the outcomes map: Communicating your course.* San Francisco, CA: Jossey-Bass. Reproduced by permission.

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Selecting and Using Visual Tools

Read the following chart to learn about different visual tools and related activities you can assign to students. These activities are intended to help you generate ideas for incorporating visual tools into your own courses, and they can be assigned to students to work individually or in small groups.

Visual Tool	Description	Examples of Student Activities
Concept Map	A diagram showing the relationship between multiple concepts	• In a teacher education course, have students create a concept map to brainstorm ideas before writing their own teaching philosophies. • In a physical therapy course, ask students to create a concept map demonstrating the relationships between concepts and propositions of flexibility. • In a nutrition course, have students create a concept map to show the causes, effects, and prevention methods for childhood obesity. • In a politics course, have students create a concept map to show the uses, risks, events, and media coverage related to nuclear power.
Timeline	A graphic representation of any chronology of events	• In an art history course, have students conduct research and create a timeline of the current events, music, culture, and key people who influenced artists of the time. • In a biology course, ask students to create a timeline of the cardiac cycle, or the sequence of events that take place for one heartbeat to occur. • In a nursing course, ask students to create a timeline to show the chronology of a patient's symptoms and treatments.
Flowchart	A diagram that represents a sequence or process	• In a business ethics course, have students use a flowchart of an ethical decision-making model to answer questions about a specific organization and its practices. • In an electrical engineering course, have students create their own flowchart clearly showing the steps for short circuit troubleshooting. • In a clinical psychology course, ask students to create a flowchart demonstrating the process of diagnosing and treating patients.
Concept Circle	A diagram that shows similarities, differences, and distinguishing qualities of concepts by using distance, overlapping, and circle size to represent relationships.	• In a business course, ask students to create concept circles that show the different stakeholders in an organization, their relative importance, and how they relate to one another. • In a geography course, give students a group of partially completed concept circles representing how different nation groups and states belong to each other and have them fill in the blanks. • In an environmental studies course, ask students to create concept circles that show the relationship between various initiatives to combat climate change.

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Teaching Students How to Create Concept Maps

Since some students may be unfamiliar with concept maps, or many may have seen them but not had experience creating their own, it is important to teach students how to effectively create concept maps. You can do this my following these steps:

1. Model the process by demonstrating the step-by-step process of constructing a simple concept map, discussing the steps as you draw it. Use a simple focal concept that is familiar to all students, such as choosing a restaurant for dinner, in order to help them understand the process as opposed to the content of the map (Newbury, 2010, p. 1).

2. After you have modeled the process, have students create their own simple concept map with a familiar concept, such as applying to college. Give students about 10 minutes to complete the exercise, following these instructions:
    a. Write the main topic, such as applying to college, on an index card.
    b. Identify and write five key actions required to apply to college on separate index cards.
    c. Place the concepts next to one another in order to display their relationships to the main topic and to each other. To do this, the most important or broad concepts should form a line directly under the main topic. Subsets of those topics should be listed under each of the first-line concepts. (Note: Having students place the concepts in a line is just a starting point to provide them with structure. As they become more proficient at developing concept maps, they may use a different approach.)
        i. Label the lines to identify connections.
        ii. Use dotted lines to indicate connections that go across the columns.

3. Circulate around the room as students complete their maps and identify a few maps for students to share with the class. Project these students' maps or have the students recreate them on the board and explain their approach to selecting topics and noting connections.

4. Ask the class questions such as:
    - "Who had the same concepts on their maps?"
    - "What else could be a subconcept in this section?"
    - "Did someone have a different description for this line?"

Once students understand the value of concept maps and the process for creating them, you can have them generate concept maps for other units of study or complex topics in order to help them organize their knowledge and deepen their understanding. This offers students a construct they may use in other courses and in their future careers to organize knowledge and better understand complex topics (Newbury, 2010; Nilson, 2010).

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Visually Demonstrating Your Course Structure

Follow these steps to create a concept map that visually demonstrates the relationships between the learning outcomes or major topics in your course or in a unit of study.

Step 1: Write down the key learning outcomes or topics for the course or unit.

Step 2: Determine a structure for your learning outcomes or topics. Organize the concepts in a nonlinear fashion to allow for a larger variety of concept connections. Do not organize topics chronologically or according to when they are taught unless the concepts lend themselves to a chronological order. For example, a concept map for a course in American History does not need to be structured by year but can be organized around common themes like war, family, or social issues. Begin by writing down the broad topics as you start to sketch your concept map.

Step 3: Once you have the broad topics in place, write down subtopics and begin drawing connections between the concepts you have written. Subtopics might include the central concept of each class period, lecture topics, or key terms from the readings. You might want to review your syllabus, course or unit readings, assignments, activities, and assessments to ensure you are including the most important topics and haven't accidentally forgotten any.

Step 4: Review the concept map as a whole to determine if there are any other connections you want to add. Remember, the links you make are especially important because they allow students to see the interrelatedness of the course topics and provide them with a "big picture" view.

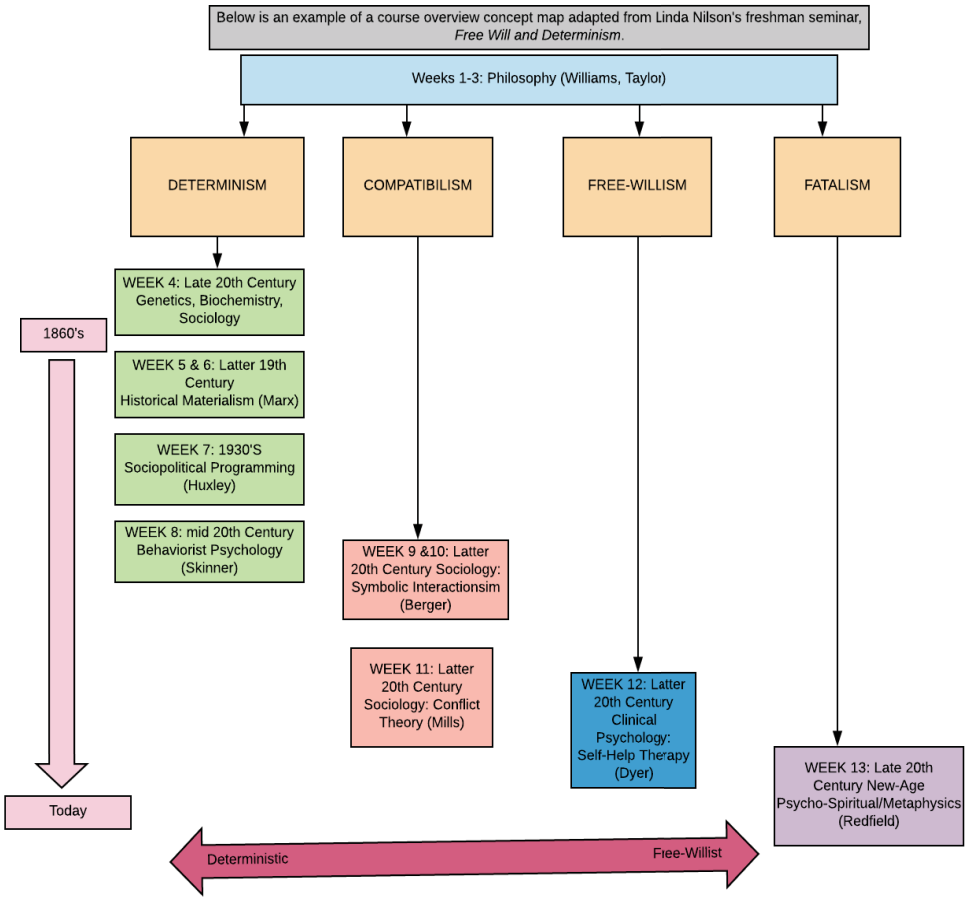
Step 5: Now that you have a sketch of the concept map, decide if you want to share your hand-drawn version with students or if you'd like to use a tool like Prezi to recreate it. A Prezi is especially good for a complicated course concept map because it allows you to place all of the central concepts on a main page and zoom into each major concept to see the additional levels associated with it (Ortega & Brame, 2015).

If your concept map includes topics for the full course, share your concept map with students at the start of the semester and post it to your course site. Return to the concept map periodically to connect students' knowledge from previous topics or units to the new knowledge they are gaining as they progress through the course.

Develop Course Overview Concept Maps

Posting a course overview concept map to the home page of your course helps students better understand how the topics addressed in the course fit together. You can also create a concept map for individual modules to help students visualize how the module concepts fit together and connect to the overall course objectives. Another type of concept map that helps students understand how the coursework is structured to meet learning objectives is an overview map that illustrates the various assignments, assessments, and requirements for the course.

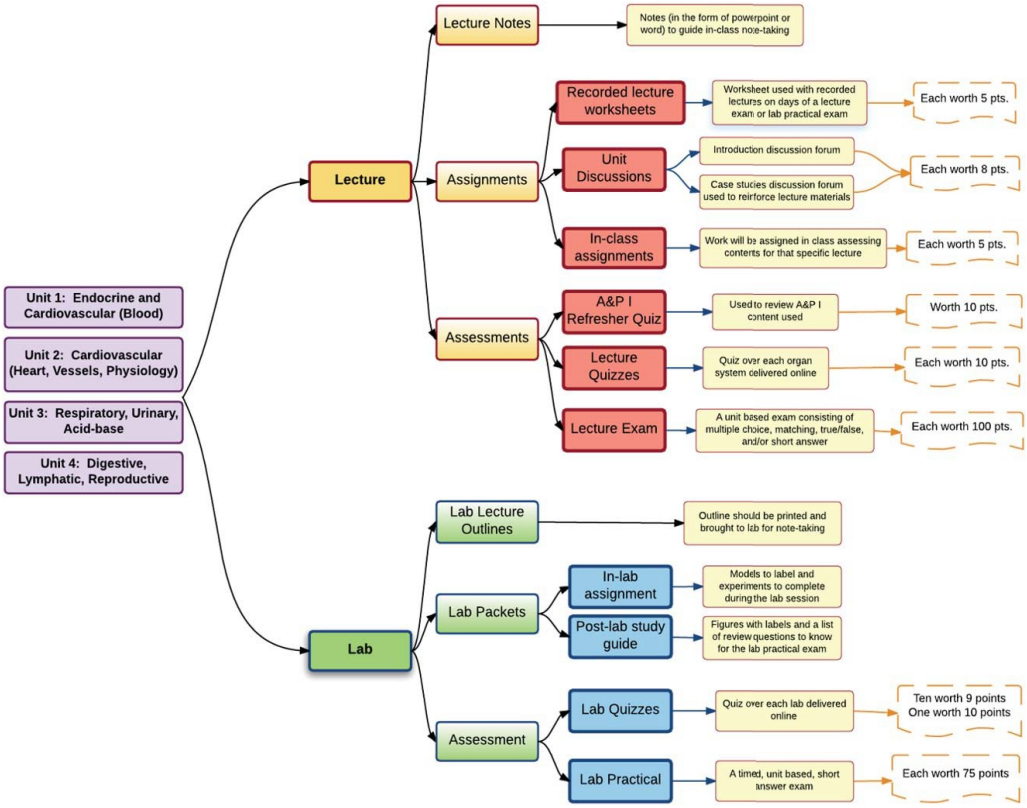
Lucidchart, a free online software program, offers hundreds of customizable templates and icons to enhance the visual effectiveness of your concept maps.



Example of concept map illustrating how course concepts fit together.

Source: Nilson, L. B. (2007). *The graphic syllabus and the outcomes map: Communicating your course*. San Francisco, CA: Jossey-Bass. Reproduced by permission.

Example of course overview of assignments, assessments, and requirements. Graphic courtesy of Randyl Rohm, M.S. Supervisor, Office of Instructional Technology, Purdue University Northwest



Deepen Learning Through Timeline Assignments

Using a free timeline software, such as Timeline JS, instructors can create timeline-based assignments designed to meet a variety of learning objectives including the analysis or comparison of different time periods, developing historical contexts, illustrating complex processes, etc. (Picard & Bruff, 2016). As an individual or group assignment, students can search for, upload, or link to appropriate multimedia resources including videos, images, graphics, research articles, blogs, etc. to demonstrate understanding.

Interactive timeline assignments can be used for a variety of assignments and assessments in any discipline. For example:

Type of Activity	Example
Individual or group research project	*In a physics course, have students create an interactive timeline of a fundamental physics discovery of the early 20th century (1900-1950) that leads to modern day breakthroughs, discoveries, or inventions.*
Summarizing course content as a study tool for final exam	*In a public policy course, to help students prepare for a final exam, have students create an interactive timeline of US immigration policy in the 20th century with links to data sources that provide an analysis of public sentiment and cultural context at each relevant point in the timeline.*
Interactive class activity to deepen understanding of course concepts	*In a literature course, have students create an interactive timeline about the book* Cutting for Stone *by Abraham Vergheses, plotting the socio-political events that take place in the book.*

Grading Interactive Timeline Assignments

The grading schema you choose will depend on the type of assignment and the weight that it carries.

For low-weight assignments, such as summarizing course content to use as a study guide, specify the minimum number of timeline entries each student is expected to contribute. Also, provide a list of the components they should include (e.g., title, description, link, citation, etc.).

For assignments with a heavier weight, such as projects, provide a detailed rubric that outlines your expectations.

Example Interactive Timeline Assignment Rubric

Dimension	Exceeds	Meets	Approaches
Number of entries on timeline	Includes at least 15 entries on timeline	Includes 10-14 entries on timeline	Includes fewer than 10 entries on timeline
Research-based description and/or analysis of timeline entry	All entries include 50-word minimum description and/or analysis with properly cited (APA) resources.	Eight or more entries include 50-word minimum description and/or analysis with properly cited (APA) resources.	Fewer than eight entries include 50-word minimum description and/or analysis with properly cited (APA) resources.
Variety of multimedia resources	Timeline entries include all of the following: video clips, digital images, and descriptive graphics.	Timeline entries include two of the following: video clips, digital images, and descriptive graphics.	Timeline entries include one of the following: video clips, digital images, and descriptive graphics.

Integrate Visual Tools Into Your Online Presentations

Engaging visuals help students understand complex relationships or patterns connected to key course concepts, principles, and/or ideas. Internet resources and software applications provide a multitude of options for instructors to integrate engaging visuals into their online presentations. Below are practices for integrating visual tools into your online presentations.

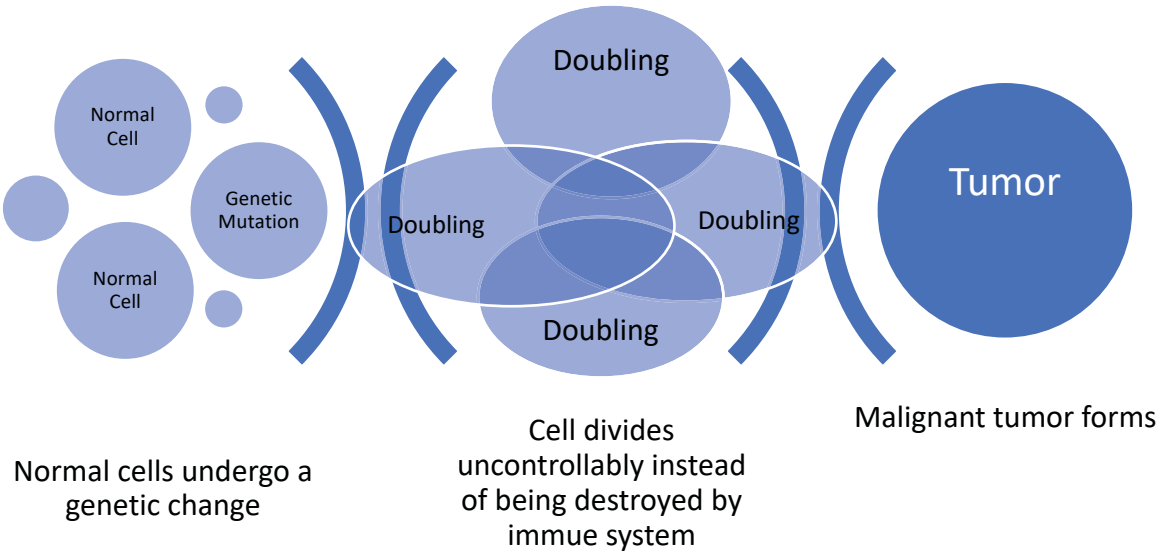
Visual Images

Visual images not only make the presentation visually engaging, they can also enhance learning and retention (Nilson, 2010). Check with your educational technology department and library to find out if your school has a subscription to any digital image collections. You can also find free image collections online such as

- EveryStockPhoto: http://www.everystockphoto.com/
- Artstor's Public Collections: http://library.artstor.org/
- Flickr Creative Commons: https://www.flickr.com/creativecommons/
- Public Domain Pictures: https://www.publicdomainpictures.net/en/

Create Engaging Concept Maps With SmartArt

SmartArt, a tool integrated into PowerPoint, offers several customizable templates for visually demonstrating relationships between concepts, illustrating complex processes, or providing an overview of how topics or concepts fit together. Below is an example of a concept map made with SmartArt illustrating the process of cancer cell development.



Click here to watch a YouTube video demonstrating how to create a concept map using SmartArt. Below are additional practices for using SmartArt to create concept maps.

Animate graphics for emphasis. Add animation to emphasize ideas or show information in phases as you offer explanations, which can help students more easily process information. Click here for information on animating a SmartArt graphic.

Integrate engaging pictures. Use photos to illustrate the relationship between concepts. SmartArt allows you to insert pictures with accompanying text.

Provide a note-taking activity. Copy your SmartArt concept map into a Word document to create a note-taking activity to accompany your microlecture. Leave the key points blank and ask students to fill in the information as they watch the video. This activity helps student process new content and improves learning.