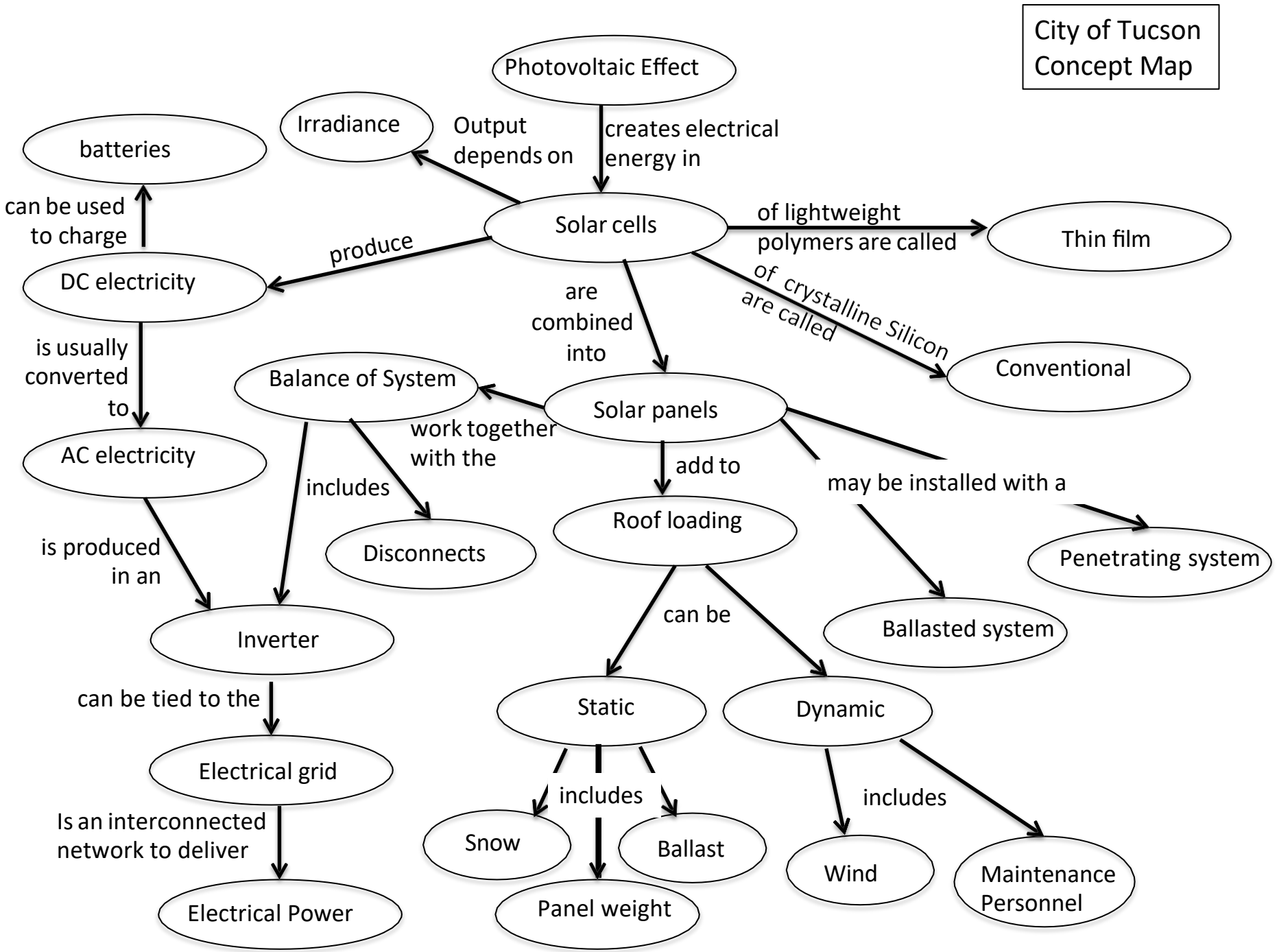
STEM PBL

Assessing Conceptual Knowledge

Conceptual knowledge is assessed through concept mapping, a graphical technique used to assess students' conceptual knowledge. Concept maps can be created using an “open-ended" approach in which students generate and map their own list of concepts related to a particular topic, or using a more structured approach whereby the instructor provides students with a list of concepts to be mapped. In our approach, we provide students with the list of concepts related to a particular PBL challenge in order to limit variability. The concepts we suggest for this challenge are listed below. This document also contains an “expert" concept map for this challenge and a scoring rubric for concept mapping.

Concepts for the City of Tucson Solar Challenge

Photovoltaic Effect
Solar Cells
Solar Panels
Irradiance
Thin film Cells
Conventional Cells
Roof loading
Static load
Dynamic load
Snow
Wind
Ballast
Panel weight
Maintenance personnel
AC electricity
DC electricity
Inverter
Batteries
Balance of System
Disconnects
Electrical Grid
Electrical Power
Penetrating system
Ballasted system


City of Tucson
Concept Map
Photovoltaic Effect
creates electrical energy in
Irradiance
Output depends on
batteries
can be used to charge
Solar cells
of lightweight polymers are called
Thin film
produce
DC electricity
are combined into
of crystalline Silicon are called
Conventional
is usually converted to
Balance of System
Solar panels
work together with the
AC electricity
includes
add to
may be installed with a
Disconnects
Roof loading
Penetrating system
is produced in an
Inverter
can be
Ballasted system
can be tied to the
Static
Dynamic
Electrical grid
includes
includes
Is an interconnected network to deliver
Snow
Ballast
Wind
Maintenance Personnel
Electrical Power
Panel weight

PBL Concept Map Scoring Rubric

Assessment Criteria*	Excellent = 4	Good = 3	Fair = 2	Poor = 1	Score
Concept Validity (use only when concepts are not provided to students)	1) Student correctly identifies all relevant concepts and items related to the topic.	2) Student correctly identifies most relevant concepts and items related to the topic	I. Student correctly identifies some relevant concepts and items related to the topic	3) Student correctly identifies few or no relevant concepts and items related to the topic	
Proposition Validity	II. All propositions are complete and valid. III. Linking lines connect related terms and point in correct direction. IV. Linking words accurately describe relationship between concepts. V. Student shows a deep understanding of the relationship between concepts. VI. All or most concepts are linked to more than one related concept.	VII. Most propositions are complete and valid. VIII. Most linking lines connect properly. IX. Most linking words accurately describe the relationship between concepts X. Student shows a good understanding of the relationship between concepts. XI. Most concepts are linked to more than one related concept.	XII. Correct but incomplete propositions. XIII. Linking lines not always pointing in correct direction. XIV. Linking words are absent or don't clarify relationships between concepts. XV. Student shows a partial understanding of the relationship between concepts. XVI. Some concepts are linked to more than one related concept.	XVII. Few or no valid propositions. XVIII. Linking lines do not point in correct direction. XIX. Linking words are absent or incorrectly identify relationships between concepts. XX. Student shows a lack of understanding of the relationship between concepts. XXI. Some concepts are not linked to more than one related concept.	
Presentation	XXII. Concept map is neat, clear, legible, and has easy to follow links. XXIII. No spelling or grammatical errors.	XXIV. Concept map is neat, clear, legible, and has easy to follow links. XXV. Has some spelling or grammatical errors.	XXVI. Concept map is messy and has somewhat difficult to follow links. XXVII. Has many spelling or grammatical errors.	XXVIII. Concept map is sloppy and links are difficult or impossible to understand. XXIX. Has many spelling or grammatical errors.	
Comments:				**Total Score**	

Propositions Generated

1. The photovoltaic effect creates electrical energy in solar cells.
2. Solar cells of lightweight polymers are called thin film.
3. Solar cells of crystalline silicon are called conven8onal.
4. Solar cells output depends on irradiance.
5. Solar cells are combined into solar panels.
6. Solar panels may be installed with a ballasted system.
7. Solar panels may be installed with a penetra8ng system.
8. Solar panels add to roof loading.
9. Roof loading can be static.
10. Static (loading) includes snow, panel weight, ballast.
11. Roof loading can be dynamic.
12. Dynamic (loading) includes wind, maintenance personnel.
13. Solar cells produce DC electricity
14. DC electricity can be used to charge batteries.
15. DC electricity is usually converted to AC electricity.
16. AC electricity is produced in an inverter.
17. (An) inverter can be tied to the electrical grid.
18. (The) electrical grid is an interconnected network to deliver electrical power.
19. Solar panels work together with the balance of system (BOS)
20. (The) balance of system includes inverter, disconnects.