

Lesson 1: Problem Finding

Preparation

Purpose

This lesson helps students connect their individual interests with opportunities for solving problems.

Specifically, this lesson requires students to:

- Examine the interconnectivity of topics with their interest topic as a starting point
- Develop a general understanding of where their topic fits within a larger field of knowledge.
- Explore existing problems in an area of interest and identify numerous alternative problems that also need to be solved

Essential Question/s

How are domains of knowledge connected?

What is a problem?

How do you solve problems?

Materials

Computers

Access to the Internet

Paper

Pencil

Large format paper

Markers

Expanding Knowledge handout

Notes for Planning

In searching for a problem, students need to seek out a problem or question that does not have an existing solution or a solution where there is only one right answer or unique solution. Keep in mind that the purpose of pursuing a problem is to bring about change or contribute something new to a domain or field of study. While this curriculum is very process focused, knowledge is foundational to any field, domain, or area of endeavor, therefore students must gain knowledge. As the teacher, it may be challenging to keep up with the many different paths of knowledge students' work to develop, but keep in mind that the student should be constructing their own knowledge through the process and they will need to be able to communicate it in a way that you understand. The caveat here: If they have advanced knowledge in a field and exceeds your capacity to understand (I have encountered this many times!) then it is important that you find a more knowledgeable "other" to support the student's growth and assess the quality and efficacy the student's understanding.

This lesson begins the process of students immersing themselves in a topic of interest. This immersion is one step in students developing the foundational knowledge necessary to meaningfully understand and begin to map the interconnectedness of knowledge while deepening their own understanding of their topic of interest.

Students' level of knowledge about their identified topic of interest will vary significantly, but each student should be able to find a starting point for the process, even if it is only using the key word in their topic of interest. That said, it will be important for students to have ready access to the Internet throughout this exercise, but computers and the Internet should not be the primary focus – the Internet is merely a tool for students to access when needed.

Implementation

Time Needed

2 @ 45 minutes

Notes for Instruction

Part 1:

Using the *Expanding Knowledge* handout have students take their topic or the keyword from their topic and list 5 ideas or concepts that are more general but related to the topic or keyword. These should be listed above the main topic. Then, have students list 5 ideas or concepts that are more detailed or specific. These should actually be subsets or sub domains of the main topic. Five is a minimum, but students can list as many as they would like.

Part 2:

Once students have a list of at least 11 items relevant to their topic, they can begin to search their topic on the Internet. The goal of this search is for students to create a web or map of related topics, concepts, concerns or issues relevant to their topic. We recommend that students start with Wikipedia and utilize the “Contents” box for their search (i.e. the boxed areas that lists the topics and subjects associated with the query). Students should take notes about the related topics to be used to create a map.

Using the large format paper, have students draw the topics, ideas, and concepts they found. Students should also begin to identify the conflicts, challenges, problems, or needs within the field and include these as they develop a mind map to illustrate the connections between and among topics.

Once students complete the large format paper version, they should re-create the same mind map using Prezi (<https://prezi.com/>). Using Prezi allows students to develop technology skills, while supporting them as they formalize their own understanding of the related knowledge in their field or domain of interest. Conflicts, challenges, problems, or

needs within the field should be highlighted. Help students understand that their map represents a portion of a “field of knowledge” and while they may have a lot of information within their map, the map itself does not represent a complete “field”. Hopefully they will begin to identify that there is always more to learn. You might simply close the lesson by asking: Did you find out everything there is to know about your topic? If they were successful in their search, they will begin to recognize that there remains a lot to learn.

Journal:


This lesson is reinforced with a journal entry. Have students consider at least one of the following questions.

Consider your topic search today:

- What problems exist that need to be solved? What ideas do you have that might be useful in solving those problems?
- Is there anything in your field of interest you would like to do? What would you like to do and why is it important?
- Is there anything in your field that you could do better? What could you do better and how would you make it better?
- What ideas do you have for your field? What ideas would you like to get going?
- What would you like to get others to do? What steps might you take to encourage others to act in a positive way?
- What change would you like to see in your field? What steps might you take to begin to make that change happen?

Expanding Knowledge

You have identified a topic that interests you more than all other topics at this time and that you can communicate to others. Make sure that the topic you have identified is one that you can stay interested in for a long time (at least 3 months!). Now that you have identified a topic, you are going to work to find where your topic fits in a field of knowledge.

	General / Broad
	List at least 5 ideas, concepts, or topics related to your topic of interest that are more general or broad than your topic. For example: If your topic is “Mars” more general topics might be planets, the solar system, exploration, space, NASA, astronomy, etc.
	Your Topic:
	List at least 5 ideas, concepts, or topics related to your topic of interest that are more general or broad than your topic. For example: If your topic is “Mars” more specific topics might be physical characteristics, regolith, orbit and rotation, moons, habitability, future exploration, surface rovers (Spirit, Opportunity, and Curiosity), etc.
	Specific / Detailed

Expanding Knowledge

Now that you have identified knowledge relevant to your topic of interest, it is time to identify the conflicts, challenges, problems, or needs that exist within your field of interest. List the conflicts, challenges, problems, or needs that definitely exist or that you think might exist. Are there any conflicts, challenges, problems, or needs that you have identified that no one else has identified? Put a star by these.

Conflicts, Challenges, Problems, or Needs

List at least 5 conflicts, challenges, problems, needs, or questions:

Expanding Knowledge

What questions do you still have about your topic of interest? For each question word below, generate at least two questions about your topic that begins with each of the question words. Make sure that the question you pose cannot be answered with a simple Google search. If you need help generating questions, use your question cubes for help!

Who...	
What...	
When...	
Where...	
Why...	
How...	

Expanding Knowledge

You have expanded the breadth of your thinking about your topic. Now it is time to go online and see what else you can learn. This sheet is designed to help you collect information that may be useful to you in the future as you create your map of knowledge related to your topic.

Main Topic:
Sub-Topics:
Why did you choose this topic?
What did you learn by exploring this topic on the Internet?
What new sources did you discover related to your topic?
How do you know the new sources you found were reliable? If you are not sure, what steps can you take to determine the quality and reliability of the sources?
Where will you go to find the answers to the questions you still have?
Are you still interested enough in this topic to explore it for several months? If not, what other topic would you like to consider?

Lesson 2: Topic Evaluation

Preparation

Purpose

Students will use a heuristic to make decisions about which aspect of their primary interest topic holds the most value for their learning.

Specifically, this lesson requires students to:

- Develop a grid to assess the intersection between problems and questions
- Develop a decision grid to assess importance and relevance
- Consider the outcomes and potential consequences of decisions in advance of making the decision

Essential Question/s

How do decisions affect our actions?

How does decision making affect learning?

Materials

Pencil / Pen

Paper

Topic Evaluation Grid handout

Notes for Planning

Decision-making and focusing can be very challenging for students, particularly when they are at the beginning of a research process. Hopefully by now, students have a sense of the topic they are most interested in pursuing for their passion pursuit. Oftentimes, deciding what to actually pursue within a larger topic is where the real challenge begins. This lesson helps students look at the real problems in his or her field of interest and see where the problems of the field intersect with their own personal questions or specific areas of interest.

This is a complex and challenging task. Students may need more than one class period to complete this process, particularly if they have to go back to previous activities to make revisions. ***Revisions are welcome and should be encouraged!*** Students need to understand that processes associated with research, creativity, and productivity are not linear processes, so the more they choose to make changes to past work that enables them to progress in current work, the better.

The goal of this process is to help students start to identify a manageable pursuit. For example, if a student is interested in designing an amphibious vehicle, they may believe that her final product will be a vehicle that she can climb into and drive into the water. In reality, she will need to start with multiple designs and build models to test her results. The final product will not be a full-scale vehicle. And, yeah, that really happened. I had a

group of 8th grade boys who genuinely believed they would build a full-scale car/boat in the nine weeks we had available for the passion pursuit enrichment cluster... Instead, they built 1/4-inch scale model that effectively traveled from the beach into the San Francisco Bay (and back!).

Implementation

Time Needed

45 minutes

Notes for Instruction

Introduce the lesson as an opportunity to narrow the focus of their primary interest topic. You may want to start with a brief discussion (5-7 minutes; 7 minutes maximum) or begin with a brief journal writing exercise. Pose the question:

What are the factors that make a decision difficult?

Provide students with the Topic Evaluation Grid handout and make sure that they understand the directions. Be careful not to over-explain. It is important that students learn to read directions and understand expectations based on those directions, but be available for questions. A sample is provided to help scaffold understanding. You may want to use a document camera for the sample in order to save paper. Students do not need their own copy of the sample.

Topic Evaluation Grid

For this activity you will need your Unanswered Questions sheet and your Conflicts, Challenges, Problems, or Needs sheet from the Expanding Knowledge work.

Expanding Knowledge

Now that you have identified knowledge relevant to your topic of interest, it is time to identify the conflicts, challenges, problems, or needs that exist within your field of interest. List the conflicts, challenges, problems, or needs that definitely exist or that you think might exist. Are there any conflicts, challenges, problems, or needs that you have identified that no one else has identified? Put a star by these.

Conflicts, Challenges, Problems, or Needs

List at least 5 conflicts, challenges, problems, needs, or questions:

Expanding Knowledge

What questions do you still have about your topic of interest? For each question word below, generate at least two questions about your topic that begins with each of the question words. If you need help generating questions, go back to your question cubes for help!

Who...	
What...	
When...	
Where...	
Why...	
How...	

You should have at least 5 conflicts, challenges, problems, or needs (CCPN) and at least 12 unanswered questions (two each for who, what, when, where, why, and how).

In the grid provided below, list your CCPN items in the space provided along the top row and list your unanswered questions on the left side in the remain rows. A sample is provided for you.

Once you have transferred your unanswered questions and CCPNs to the grid, you should have a grid of empty boxes. Compare each CCPN with each unanswered question. For each pair determine if there is a similarity or relationship between the two items. For each pair that has a relationship (even if it is not an obvious relationship) or similarity, put an 'X' in the corresponding box (see the sample below).

For each of the 'X's you placed on the grid, evaluate the pair. Circle all of the 'X's that represent the *most* interesting topic, question, or idea to you.

Topic Evaluation Grid

	CCPN	CCPN	CCPN	CCPN	CCPN
Who...					
Who...					
What...					
What...					
When...					
When...					
Where...					
Where...					
Why...					
Why...					
How...					
How...					

Topic Evaluation Grid

Main Topic:	CCPN	CCPN	CCPN	CCPN	CCPN
Who... <i>Who might be the first person to travel to Mars?</i>	X	X		X	X
Who... <i>Who will solve the engineering problems (fuel, water, radiation) presented by extensive travel in space?</i>	X	X	X	X	X
What... <i>What are the dangers associated with traveling to Mars?</i>	X		X		X
What... <i>What did scientists learn from the rovers that landed on Mars?</i>	X	X			X
When... <i>When is summer on Mars?</i>	X	X			
When... <i>When did the idea of traveling to Mars first appear in literature?</i>					
Where... <i>Where might humans land if they traveled to Mars?</i>	X	X			
Where... <i>Where can humans live on Mars?</i>	X				
Why... <i>Why might humans want to go to Mars?</i>					X
Why... <i>Why didn't humans already land on Mars?</i>			X		X
How... <i>How will we ensure the safety of astronauts who travel to Mars?</i>	X				X
How... <i>How can SpaceX and Blue Origin compete with NASA?</i>			X		X

Lesson 3: Topic Focusing

Preparation

Purpose

Students will use criteria to rank order specific sub-topics within their primary topic of interest to narrow the options for pursuing an investigation.

Specifically, this lesson requires students to:

- Develop criteria for decision making
- Rank Synergy Items based on pre-specified criteria
- Consider the outcomes and potential consequences of decisions in advance of making the decision

Essential Question/s

How are criteria useful?

What are the steps in decision-making?

How do you make defensible decisions?

Materials

Pencil / Pen

Paper

Topic Focusing Grid handout

Notes for Planning

If students have never been introduced to the notion of evaluation criteria before, you will want to plan extra time for introducing this concept. However, the expectation is that students will understand the concept pretty quickly and be able to identify criteria like time, resources, support, value, interest, etc. as fundamental criteria for decision-making.

Once again, decision-making is a complex and challenging task. Students may need more than one class period to complete this process, particularly if they have to go back to previous activities to make revisions. ***Revisions are welcome and should be encouraged!*** Students need to understand that processes associated with research, creativity, and productivity are not linear processes, so the more they choose to make changes to past work that enables them to progress in current work, the better.

The goal of this process is to help students continue to focus on a topic that constitutes a manageable pursuit.

Implementation

Time Needed

45 minutes

Notes for Instruction**Part 1: Establishing Criteria**

Open the lesson by introducing to students to the concept of “criteria”. You can accomplish this by asking “How would you define the word “criteria?” or “How do “criteria” help us make decisions?”. Whatever idea you like for introducing content will certainly work well.

Once students understand the concept of “criteria” put them in pairs or small groups to determine what criteria they would use to make a decision or choice. Explain to them that they are seeking the essential criteria. Allow students to work together to generate a list of 5-10 criteria for decision-making.

After students have developed general criteria, explain to students that they will be making a decision about which topic they to use for the passion pursuit project. Make sure they understand the number of weeks that they will need to stay focused on this topic as this may help them in the next step.

Ask students to individually develop a list of criteria that they could use to make a determination about which topic to select for their passion pursuit project.

Examples of criteria that students might consider:

- I can stay interested in the topic for an extended period of time.
- I will learn something important for pursuing this topic.
- I am most interested in this topic.
- Information about this topic is available to me.
- There is a problem I can solve or a question that I can answer.
- I know a lot about this topic already but I still have more to learn.
- There are other people I could work with on this topic who are equally interested.

This lesson may require two class periods depending on how thoroughly students considered the relationships and similarities between questions and field concerns in the Topic Evaluation Lesson.

Part 2: Narrowing the Focus

Students will need the Topic Focusing Grid for this portion of the assignment. Students should also have a list of criteria they could use to make a decision about their topic selection.

Using the completed Topic Evaluation Grid from Lesson 6.3a – Topic Evaluation, have each student specifically identify the similarities or relationships for each of the

intersections on the Topic Evaluation Grid. Note: These will be the circled 'X's. They will be called "Synergy Items".

Students should list these specific similarities or relationships in the first column of the Topic Focusing Grid handout. The similarities or relationships students have identified (Synergy Items) should constitute a list of very specific topics within the larger field of study and the more general topic that was likely identified in the earlier lessons (e.g. Interest Brackets, Webpage introduction, Journal entries, etc.). If students are not developing more narrowly defined topics and avenues for potential research or productivity with this process, make sure they understand the purpose for these processes before proceeding further.

Have students follow the directions on the Topic Focusing handout. Students should work to narrow their list of topics to three. If there are tied scores, have students first check their addition and then allow them to proceed with more than three topics or Synergy Items to the next lesson.

Topic Focusing Grid

For this activity you will need your completed Topic Evaluation Grid from the last lesson.

Topic Evaluation Grid					
	CCPN	CCPN	CCPN	CCPN	CCPN
Who...					
Who...					
What...					
What...					
When...					
When...					
Where...					
Where...					
Why...					
Why...					
How...					
How...					

For each of the ‘X’s you placed on the grid and circled, specifically identify the relationship or similarity between each item in the pair. You might want to review the pairs and make sure that you circled the right ‘X’s. Remember: The circled ‘X’s represent the *most* interesting topic, question, or idea for you personally. Make a list of the most interesting similarities or relationships. We will call each of these a “Synergy Item”.

After you create your list, transfer the list to the Topic Focusing Grid. List your Synergy Items in the first column. It is okay if you do not have 11 Synergy Items, but you should have at least 5.

In the first row, list the Criteria you will use to narrow the focus of your topic.

Once you have the first column and the first row of the Topic Focusing Grid completed, you will give a score to each item on you list based on the criteria. The range of your score is 0-5. So, if the similarity or relationship you identified meets your criteria to an extreme then you would give it a ‘5’. If the similarity or relationship you identified does not meet the criteria at all, you would give it a ‘0’. So the range of your scores should be “Does not meet the criteria” to “Meets the criteria to the highest degree”. Add the scores for each row and place the total score for each row in the “Row Total” column.

Circle your top three scores. It is okay to have tied scores.

Topic Focusing Grid

	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	
Synergy Item 1						
Synergy Item 2						
Synergy Item 3						
Synergy Item 4						
Synergy Item 5						
Synergy Item 5						
Synergy Item 6						
Synergy Item 7						
Synergy Item 8						
Synergy Item 9						
Synergy Item 10						
Synergy Item 11						
						Row Total

Lesson 4: Topic Selection

Preparation

Purpose

Students will assess the usefulness, viability, and relevance of their Synergy Items to make a final decision about which topic to pursue.

Specifically, this lesson requires students to:

- List the top ranked topics for exploration
- Specifically identify the question to answer or problem to be solved
- Identify the purpose or usefulness of pursuing solution to the problem or answer to the question
- Identify a potential audience that can evaluate a product in the domain
- Identify who might benefit from a solution or answer
- Identify potential outcomes

Essential Question/s

What makes a problem real?

Who benefits when problems are solved or questions are answered?

What is expertise?

Materials

Computer

Access to the Internet

Pencil / Pen

Paper

Topic Selection handout

Notes for Planning

This process should be fairly straight forward for students, however, they may have lost sight of the fact that they are supposed to be identifying a big question (i.e. one that cannot be answered with a Google search, one that will require an experiment or in-depth research) or solving a problem. This lesson has them re-focus on the goals of the passion pursuit and lays the foundation for the submission of a proposal.

The most important aspect of the work students will do in this lesson is to determine authentic audiences for their work. As a teacher, you recognize that it would be easier if you just gave them a rubric and identified the student's classmates as the "authentic audience" but you know as well as anyone that the teacher and classmates do not constitute an authentic audience. Moreover, the quality of students' work is exponentially increased when the audience has the knowledge and expertise to assess the quality of students' work. Finally, given the amount of time that students will be and have already

invested in this process, it is only fair that the work they do receive the level of evaluation that is commensurate with the effort.

If a student already has a high level of interest in a particular topic, they may already have mentors or more knowledgeable others who can help them continue to grow and develop in their field of interest. For other students, however, this may be the first time they have ever delved deeply into this specific topic or they may have reached a level of knowledge that requires more advanced expertise. To support students in finding experts in their field of interest, you can start by sending a survey home to parents within the school community. Ask questions like:

- What is your area of expertise?
- What do you do for work?
- What hobbies do you have?
- Would you be willing to serve in a mentor capacity for students in your class?

Typically adults are excited by the prospect of sharing their expertise and appreciate when students are pursuing knowledge in a related area.

The next level of searching for experts will be to contact a professor at your local or state university. This is a great way to introduce students to the idea that there is learning beyond the preK-12 setting. If there is no university nearby, consider contacting a teacher at the high school level who may have advanced knowledge in the area of students' interest.

Don't forget the power of the Internet! As the teacher, you should be the one to reach out to experts on the Internet on behalf of students. The Internet is powerful, but we still need to keep students safe. If an expert is only available via the Internet, we recommend that you become the liaison for student and oversee all communications that occur between the expert and the student.

Implementation

Time Needed

45 minutes

Notes for Instruction

Have students read the instructions for the topic selection handout. Once they have read and understand the instructions, have them complete the table. They should not have more than 5 Synergy Items, but there may be multiple problems or questions for any one of the Synergy Items. Students need to have a minimum of 3 Synergy Items identified. They will select one for their proposal and the remaining items will serve as contingency plans. See lesson 7.1 – *Finalize the Plan* for more details.

Topic Selection

For this activity you will need your completed Topic Focusing Grid from the last lesson.

Topic Focusing Grid						
	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	
Synergy Item 1						Row Total
Synergy Item 2						
Synergy Item 3						
Synergy Item 4						
Synergy Item 5						
Synergy Item 6						
Synergy Item 7						
Synergy Item 8						
Synergy Item 9						
Synergy Item 10						
Synergy Item 11						

You should have your top three scores circled. If there is a tie, you may have more than three items but you should not exceed five items and you should not have all of your Synergy Items in the top.

For each of your top Synergy Items, you will be identifying the problem or questions, the purpose, the audience, the outcome, an expert evaluator. Each of these items is explained further below:

- **Problem or Question:** You may have lost track of the purpose of your passion pursuit as you went through the process of narrowing your topic. Here, you will once again identify a question that needs to be answered (remember, the answer cannot be found with a Google search) or a problem that needs to be solved for each of your top scoring Synergy Items.
- **Purpose:** This answers the question: “So what?” Why is your topic important to pursue? What value is there in solving the problem or answering the question?
- **Audience:** Who will benefit from the solution to your problem or the answer to your question?
- **Outcome:** What will be the product that results from your efforts? What format will you use to communicate a solution or answer to your audience?
- **Expert:** Who has the expertise or knowledge to support you as you pursue the answer to your question or solution to the problem? Who has the requisite knowledge to judge the quality of your outcomes? Keep in mind that this will likely not be your teacher or classmates. It will have to be someone outside the school.