Formative Assessment Exemplar - 8.1.2

Introduction:

The following formative assessment exemplar was created by a team of Utah educators to be used as a resource in the classroom. It was reviewed for appropriateness by a Bias and Sensitivity/Special Education team and by state science leaders. While no assessment is perfect, it is intended to be used as a formative tool that enables teachers to obtain evidence of student learning, identify gaps in that learning, and adjust instruction for all three dimensions (i.e., Science and Engineering Practices, Crosscutting Concepts, Disciplinary Core Ideas) included in a specific Science and Engineering Education (SEEd) Standard.

In order to fully assess students' understanding of all three dimensions of a SEEd standard, the assessment is written in a format called a cluster. Each cluster starts with a phenomenon, provides a task statement, necessary supporting information, and a sequenced list of questions using the gather, reason, and communicate model (Moulding et al., 2021) as a way to scaffold student sensemaking. The phenomenon used in an assessment exemplar is an analogous phenomenon (one that should not have been taught during instruction) to assess how well students can transfer and apply their learning in a novel situation. The cluster provides an example of the expected rigor of student learning for all three dimensions of a specific standard. In order to serve this purpose, this assessment is NOT INTENDED TO BE USED AS A LESSON FOR STUDENTS.

Because this assessment exemplar is a resource, teachers can choose to use it however they want for formative assessment purposes. It can be adjusted and formatted to fit a teacher's instructional needs. For example, teachers can choose to delete questions, add questions, edit questions, or break the tasks into smaller segments to be given to students over multiple days.

General Format:

Each formative assessment exemplar contains the following components:

1. Teacher Facing Information: This provides teachers with the full cluster as well as additional information including the question types, alignment to three dimensions, and answer key. Additionally, an example of a proficient student answer and a proficiency scale for all three dimensions are included to support the evaluation of the last item of the assessment.
2. Students Facing Assessment: This is what the student may see. It is in a form that can be printed or uploaded to a learning platform. (Exception: Questions including simulations will need technology to utilize during assessment.)

Accommodation Considerations:

Teachers should consider possible common ways to provide accommodations for students with disabilities, English language learners, students with diverse needs or students from different cultural backgrounds. For example, these accommodations may include: Providing academic language supports, presenting sentence stems, or reading aloud to students. All students should be allowed access to a dictionary.

References:

Moulding, B., Huff, K., & Van der Veen, W. (2021). *Engaging Students in Science Investigation Using GRC*. Ogden, UT: ELM Tree Publishing.

Teacher Facing Information

Standard: 8.1.2

Assessment Format: Printable or Online Format (Does not require students to have online access)

Phenomenon	
A person is given the choice between two different blankets and wants to choose the blanket that will be the warmest.	Proficient Student Explanation of Phenomenon: Students should be able to use the qualitative and quantitative data provided to draw conclusions about blanket qualities using its properties. The expected explanation is that a student should pick a blanket with a high thread count and a high ratio of air pockets to fiber density, heavier weight. Student final "communication" task: Using data from these activities, write a CER (claim, evidence, reasoning) arguing which type of fabric would be best to use if you want a blanket that will keep you the warmest. Also select ONE other property (researched in these activities) that would create an ideal blanket for you. The CER should include a claim stating which fabric you choose, at least 2 pieces of qualitative data and one piece of quantitative data. You should also provide reasoning of why each piece of evidence supports your claim. *Possible answers for the CER that could be backed up with data from the cluster are wool, cotton, flannel, and fleece supported by certain data.*
Cluster Task Statement	
(Represents the ultimate way the phenomenon will be explained or the design problem will be addressed) In the questions that follow, you will obtain, evaluate, and communicate information regarding properties of different fabrics and their role in determining the fabrics' different uses in society.	
Supporting Information	
Text A: Different fabrics have properties that make them useful in many ways. One is to make blankets for warmth and protection. When a person is covered in a blanket, heat is transferred to the blanket and the environment. The fibers and air pockets of the fabric can insulate and trap the heat keeping the person warm. The greater the ratio of air to the fiber in the structure increases the insulating ability.	

For example, a blanket that is thick and fluffy might be warmer than a thin blanket because of the air spaces trapped between the fibers. The tightness of the fibers or threads (also called thread count) can help to reduce heat loss. This may explain why a heavy thin blanket can keep you warm. Results of studies on fabrics conclude that the thickness and density of the fabric are two of the best qualities of the insulating property of a blanket. In general, the greater the thickness of a blanket, the greater the thermal insulation.

Text B:
A blanket can chase the chill on a spring morning or keep you extra warm on a frosty winter night. Choosing which blanket is the right one for you depends on the warmth, weight and texture you prefer. Thicker blankets, such as wool blankets, cotton fleece blankets, and cashmere blankets, are the warmest. The spaces between the fibers in a fuzzy or napped blanket trap warm air, keeping you warmer. How a fabric holds moisture is as important as the thickness of the fibers:

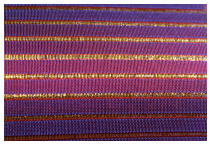
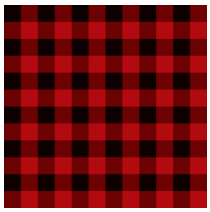
Natural fibers (cotton, linen, wool, silk) are all absorbent.
Synthetic fibers such as polyester, nylon, and acrylic are not.
Absorbent fabrics will tend to keep you quite comfortable, wicking moisture away from the skin and leaving a layer of warm, dry air.

Table 1: Fabric Type With Weight and Texture

Fabric Type	Weight	Texture	Additional Information
Polyester	Lightweight-Midweight	Ultra soft	Some people are allergic to these fibers; not very water absorbent
Linen	Midweight	Soft	becomes softer as you wash it, more expensive, water absorbent
Cotton	Lightweight-Midweight	Can vary from soft to rough	Good for year round use, easy to wash, water absorbent
Silk	Midweight	Soft	Must be dry cleaned, more expensive, not water absorbent
Bamboo	Lightweight	Ultra soft or smooth	Not as durable, highly water absorbent
Wool	Midweight-Heavyweight	Fuzzy, loose fibers	Some people have allergies to these fibers, not water absorbent

Table 1 shows properties of various fabric types

Table 2: Fabric description, usage, and thread count.

Fabric Type	Image of fabric	Thread Count Value: Note: the higher the number, the more tightly woven the material is.	Description and General Usage.
Cotton	 "Brown Cotton Fabric" by shaire productions is licensed under CC BY 2.0	150	Made of organic plant material. Woven into soft, durable, absorbent fabric. It can be produced in mass quantities. Frequently used for t-shirts, jeans, dresses, sweats, etc.
Linen	 "linen fabric" by Mr Thinktank is licensed under CC BY 2.0	80-150	Made of organic plant material. It is lightweight, soft, and absorbent. Frequently used to make tablecloths, upholstery, some clothing, and curtains.
Silk	 "Thai silk Fabric ผ้าไหม Rumtiean Bon Marche'" by Tanu_flickr is licensed under CC BY-NC-SA 2.0	19	Natural fiber produced by an insect (silk worm). Known for shine and softness, strength, and durability. Frequently used for formal attire, accessories, bedding, upholstery and more.
Flannel	 "Flannel plaid background" by Ember Studio is licensed under	82	Medium weight cotton (or wool) that has a fuzzy finish on one or both sides. Frequently used in heavier clothes for colder seasons.

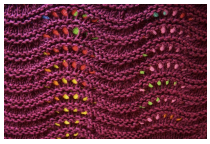
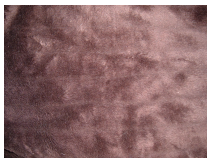
	CC BY 2.0		
Merino Wool	 "Bulky Feather & Fan Shawl: Feather and Fan stitch" by Breibeest is licensed under CC BY 2.0	100-120	Organic material gathered from goats. Can be itchy because of the shape of the fibers. Is odor resistant, moisture wicking, and breathable. Frequently used to make socks and outdoors clothing.
Fleece	 "synthetic fleece" by Mr Thinktank is licensed under CC BY 2.0	1800	Man made from polyester and other synthetic fibers. soft, allows moisture to evaporate. Densely knitted. Frequently used to make blankets, hats, scarves, and sweatpants.

Table 2 provides characteristics of various fabrics.

Table 3: Weight of Fabric Types

Fabric Type	Weight (per square yard in ounces)
Cotton	4-6
Fleece	10-14
Linen	7
Silk	1
Flannel	12
Wool	11-12

Table 3 provides weights of various fabrics.

Cluster Questions	
Gather: Cluster Question #___1___ Question Type: Highlight Text Addresses: _x_ DCI (PS1.A)	Question 1: Read over the text and highlight the properties (or descriptions) that would make a fabric most suitable for trapping warmth.

_x_ SEP Obtaining, evaluating, and communicating information _x_ CCC structure and function Answer: A blanket can chase the chill on a spring morning or keep you extra warm on a frosty winter night. Choosing which blanket is the right one for you depends on the warmth, weight and texture you prefer.Thicker blankets, such as wool blankets, cotton fleece blankets, and cashmere blankets, are the warmest. The air spaces in a fuzzy or napped blanket trap warm air, keeping you warmer. How a fabric holds moisture is as important as the thickness of the fibers: Natural fibers (cotton, linen, wool, silk) are all absorbent. Synthetic fibers such as polyester, nylon, and acrylic are not. Absorbent fabrics will tend to keep you quite comfortable, wicking moisture away from the skin and leaving a layer of warm, dry air.	A blanket can chase the chill on a spring morning or keep you extra warm on a frosty winter night. Choosing which blanket is the right one for you depends on the warmth, weight and texture you prefer. Thicker blankets, such as wool blankets, cotton fleece blankets, and cashmere blankets, are the warmest. The air spaces in a fuzzy or napped blanket trap warm air, keeping you warmer. How a fabric holds moisture is as important as the thickness of the fibers: Natural fibers (cotton, linen, wool, silk) are all absorbent. Synthetic fibers such as polyester, nylon, and acrylic are not. Absorbent fabrics will tend to keep you quite comfortable, absorbs moisture away from the skin and leaving a layer of warm, dry air.
Gather: Cluster Question #__2___ Question Type: Multiple choice Addresses: _x_ DCI (PS1.A) _x_ SEP Obtaining, evaluating, and communicating information _x_ CCC structure and function Answer: Blanket B	Question 2: According to the text, which blanket description should keep you the warmest? Different fabrics have properties that make them useful in many ways. One is to make blankets for warmth and protection. When a person is covered in a blanket, heat is transferred to the blanket and the environment. The fibers and air pockets of the fabric can insulate and trap the heat keeping the person warm. The greater the ratio of air to the fiber in the structure increases the insulating ability. For example, a blanket that is thick and fluffy might be warmer than a thin blanket because of the air spaces trapped between the fibers. The tightness of the fibers or threads (also called thread count) can help to reduce heat loss. This may explain

<table>
<tr>
<td></td>
<td>why a heavy thin blanket can keep you warm. Results of studies on fabrics conclude that the thickness and density of the fabric are two of the best qualities of the insulating property of a blanket. In general, the greater the thickness of a blanket, the greater the thermal insulation.

A. Blanket A- A thin blanket with a high thread count.
B. Blanket B- A thick and fluffy blanket with a high thread count.
C. Blanket C- A thick and fluffy blanket with a low thread count.
D. Blanket D- A thin blanket with a low thread count.
E. Blanket E- A thick and fluffy blanket with a medium thread count.</td>
</tr>
<tr>
<td>Reason:
Cluster Question #___3___
Question Type: Multiple Choice
Addresses:
_x_ DCI (PS1.A)
_x_ SEP Obtaining, evaluating, and communicating information
_x_ CCC structure and function

Answer:
B: Flannel</td>
<td>Question 3:

Using only Table 2, determine which fabric type you should select if you want a blanket made of only natural fibers, that has the highest possible thread count, and has a soft, fluffy, or fuzzy texture.

A. Cotton
B. Flannel
C. Wool
D. Fleece</td>
</tr>
<tr>
<td>Reason:
Cluster Question #___4___
Question Type: Table Sort
Addresses:
_x_ DCI (PS1.A)
_x_ SEP Obtaining, evaluating, and communicating information
_x_ CCC structure and function

Answer:
<table>
<tr><td>Fabric</td><td>Answer</td></tr>
<tr><td>A</td><td>Cotton</td></tr>
<tr><td>B</td><td>Fleece</td></tr>
<tr><td>C</td><td>Wool</td></tr>
</table>
</td>
<td>Question 4:
Using the information from Data Tables A, B and C with the information about the 3 unknown fabrics to identify the unknown fabrics.

Fabric A- Has a weight of 5 ounces per square yard, is made from organic material, and is often used to make t-shirts, jeans, sweatshirts and sweatpants.

Fabric B- Has a weight of 10 ounces per square yard, is made from synthetic fibers, and is often used to make sweats, blankets, gloves, hats, and other outerwear.

Fabric C- Has a weight of 12 ounces, is made from organic material and is often used to make outdoor clothing and socks.</td>
</tr>
</table>

	<table><tr><th>Fabric</th><th>Answer</th></tr><tr><td>A</td><td></td></tr><tr><td>B</td><td></td></tr><tr><td>C</td><td></td></tr></table>
Cluster Question #___5___ Question Type: Multi-Select Addresses: _x_ DCI (PS1.A) _x_ SEP Obtaining, evaluating, and communicating information _x_ CCC structure and function Answer: Students should choose: Texture, Durability, Weight, Absorbency (with water)	Question 5: A blanket's warmth is an important property to consider, but there are other properties that people desire when shopping for blankets, such as the color. Below is a list of properties that may or may not be useful in designing blankets. **Using the supporting information only**, select 4 other properties that could be incorporated in a blanket's design. Explain how and why each property would be useful. **Note: Some of the properties below may be great for determining the right material for your blanket, but they are not found in the Supporting Information above.** Answer Options: A) Texture B) Durability C) Weight D) Boiling Point E) Melting Point F) Conductivity G) Flexibility H) Color I) Flammability J) Reactivity with Oxygen K) Absorbency (with water)
Communicate: Cluster Question #___6__ Question Type: Long Answer Argument Addresses: _x_ DCI (PS1.A) _x_ SEP Obtaining, evaluating, and communicating information _x_ CCC structure and function Answer:	Question 6: A. Using data from these activities, write a CER (claim, evidence, reasoning) arguing which type of blanket fabric would be best to use if you want a blanket that will keep you the warmest. B. Then, choose ONE other property that would create the ideal blanket for you, and explain why this would be the ideal blanket for you?

Possible answers for the CER that could be backed up with data from the cluster are wool, cotton, flannel, and fleece are options supported by certain data.	Your CER should include a claim stating which fabric you choose, At least 2 pieces of qualitative data and one piece of quantitative data. You should also support each piece of evidence with reasoning of why that evidence supports your claim.

Proficiency Scale

Proficient Student Explanation:
Students should be able to use the qualitative and quantitative data provided to draw conclusions about blanket qualities using its properties. The expected explanation is that a student should pick a blanket with a high thread count and a high ratio of air pockets to fiber density, heavier weight.

The student's CER should include a claim stating which fabric they chose, At least 2 pieces of qualitative data and one piece of quantitative data. They should also support each piece of evidence with reasoning of why that evidence supports your claim.
Possible answers for the CER that could be backed up with data from the cluster are wool, cotton, flannel, and fleece are options supported by certain data.

Level 1 - Emerging	Level 2 - Partially Proficient	Level 3 - Proficient	Level 4 - Extending
SEP: Does not meet the minimum standard to receive a 2.	**SEP:** Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices. Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the	**SEP:** Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings Communicate scientific and/or technical	**SEP:** Extends beyond proficient in any way.

	engagement in other scientific and/or engineering practices. Communicate scientific and/or technical information in written formats.	information (e.g. about a proposed object, tool, process, system) in writing.	
CCC: Does not meet the minimum standard to receive a 2.	**CCC:** Observes different materials have different substructures. Identifies substructures have shapes and parts that serve functions.	**CCC:** Designs structures to serve particular functions by taking into account properties of different materials, and understands how materials can be shaped and used.	**CCC:** Extends beyond proficient in any way.
DCI: Does not meet the minimum standard to receive a 2.	**DCI:** Measurements of a variety of properties can be used to identify materials.	**DCI:** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.	**DCI:** Extends beyond proficient in any way.

(Student Facing Format on following page)

Name: _____ Date: _____

Stimulus

A person is given the choice between two different blankets and wants to choose the blanket that will be the warmest.

Text A:

Different fabrics have properties that make them useful in many ways. One is to make blankets for warmth and protection. When a person is covered in a blanket, heat is transferred to the blanket and the environment. The fibers and air pockets of the fabric can insulate and trap the heat keeping the person warm. The greater the ratio of air to the fiber in the structure increases the insulating ability. For example, a blanket that is thick and fluffy might be warmer than a thin blanket because of the air spaces trapped between the fibers. The tightness of the fibers or threads (also called thread count) can help to reduce heat loss. This may explain why a heavy thin blanket can keep you warm. Results of studies on fabrics conclude that the thickness and density of the fabric are two of the best qualities of the insulating property of a blanket. In general, the greater the thickness of a blanket, the greater the thermal insulation.

Text B:

A blanket can chase the chill on a spring morning or keep you extra warm on a frosty winter night. Choosing which blanket is the right one for you depends on the warmth, weight and texture you prefer. Thicker blankets, such as wool blankets, cotton fleece blankets, and cashmere blankets, are the warmest. The spaces between the fibers in a fuzzy or napped blanket trap warm air, keeping you warmer. How a fabric holds moisture is as important as the thickness of the fibers:

Natural fibers (cotton, linen, wool, silk) are all absorbent.
Synthetic fibers such as polyester, nylon, and acrylic are not.
Absorbent fabrics will tend to keep you quite comfortable, wicking moisture away from the skin and leaving a layer of warm, dry air.

Table 1: Fabric Type With Weight and Texture

Fabric Type	Weight	Texture	Additional Information
Polyester	Lightweight-Midweight	Ultra soft	Some people are allergic to these fibers; not very water absorbent
Linen	Midweight	Soft	becomes softer as you wash it, more expensive, water absorbent
Cotton	Lightweight-Midweight	Can vary from soft to rough	Good for year round use, easy to wash, water absorbent
Silk	Midweight	Soft	Must be dry cleaned, more expensive, not water absorbent
Bamboo	Lightweight	Ultra soft or smooth	Not as durable, highly water absorbent
Wool	Midweight-Heavyweight	Fuzzy, loose fibers	Some people have allergies to these fibers, not water absorbent

Table 1 shows properties of various fabric types

Table 2: Fabric description, usage, and thread count.

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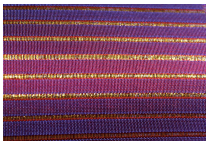
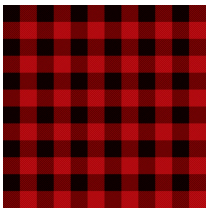
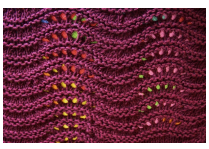
Silk	 "Thai silk Fabric ผ้าไหม Rumtiean Bon Marche'" by Tanu_flickr is licensed under CC BY-NC-SA 2.0	19	Natural fiber produced by an insect (silk worm). Known for shine and softness, strength, and durability. Frequently used for formal attire, accessories, bedding, upholstery and more.
Flannel	 "Flannel plaid background" by Ember Studio is licensed under CC BY 2.0	82	Medium weight cotton (or wool) that has a fuzzy finish on one or both sides. Frequently used in heavier clothes for colder seasons.
Merino Wool		100-120	Organic material gathered from goats. Can be itchy because of the shape of the fibers. Is odor resistant, moisture wicking, and breathable. Frequently used to make socks

	"Bulky Feather & Fan Shawl: Feather and Fan stitch" by Breibeest is licensed under CC BY 2.0		and outdoors clothing.
Fleece	 "synthetic fleece" by Mr Thinktank is licensed under CC BY 2.0	1800	Man made from polyester and other synthetic fibers. soft, allows moisture to evaporate. Densely knitted. Frequently used to make blankets, hats, scarves, and sweatpants.

Table 2 provides characteristics of various fabrics.

Table 3: Weight of Fabric Types

Fabric Type	Weight (per square yard in ounces)
Cotton	4-6
Fleece	10-14
Linen	7
Silk	1
Flannel	12
Wool	11-12

Table 3 provides weights of various fabrics.

Your Task

In the questions that follow, you will obtain, evaluate, and communicate information regarding properties of different fabrics and their role in determining the fabrics' different uses in society.

Question 1

Read over the text and highlight the properties (or descriptions) that would make a fabric most suitable for trapping warmth.

A blanket can chase the chill on a spring morning or keep you extra warm on a frosty winter night. Choosing which blanket is the right one for you depends on the warmth, weight and texture you prefer. Thicker blankets, such as wool blankets, cotton fleece blankets, and cashmere blankets, are the warmest. The air spaces in a fuzzy or napped blanket trap warm air, keeping you warmer. How a fabric holds moisture is as important as the thickness of the fibers:

Natural fibers (cotton, linen, wool, silk) are all absorbent.
Synthetic fibers such as polyester, nylon, and acrylic are not.
Absorbent fabrics will tend to keep you quite comfortable, absorbs moisture away from the skin and leaving a layer of warm, dry air.

Question 2

According to the text, which blanket description should keep you the warmest?

Different fabrics have properties that make them useful in many ways. One is to make blankets for warmth and protection. When a person is covered in a blanket, heat is transferred to the blanket and the environment. The fibers and air pockets of the fabric can insulate and trap the heat keeping the person warm. The greater the ratio of air to the fiber in the structure increases the insulating ability. For example, a blanket that is thick and fluffy might be warmer than a thin blanket because of the air spaces trapped between the fibers. The tightness of the fibers or threads (also called thread count) can help to reduce heat loss. This may explain why a heavy thin blanket can keep you warm. Results of studies on fabrics conclude that the thickness and density of the fabric are two of the best qualities of the insulating property of a blanket. In general, the greater the thickness of a blanket, the greater the thermal insulation.

A. Blanket A- A thin blanket with a high thread count.
B. Blanket B- A thick and fluffy blanket with a high thread count.
C. Blanket C- A thick and fluffy blanket with a low thread count.
D. Blanket D- A thin blanket with a low thread count.
E. Blanket E- A thick and fluffy blanket with a medium thread count.

Question 3

Using only Table 2, determine which fabric type you should select if you want a blanket made of only natural fibers, that has the highest possible thread count, and has a soft, fluffy, or fuzzy texture.

A. Cotton
B. Flannel
C. Wool
D. Fleece

Question 4

Using the information from Data Tables 1, 2 and 3 with the information about the 3 unknown fabrics to identify the unknown fabrics.

Fabric A- Has a weight of 5 ounces per square yard, is made from organic material, and is often used to make t-shirts, jeans, sweatshirts and sweatpants.

Fabric B- Has a weight of 10 ounces per square yard, is made from synthetic fibers, and is often used to make sweats, blankets, gloves, hats, and other outerwear.

Fabric C- Has a weight of 12 ounces, is made from organic material and is often used to make outdoor clothing and socks.

Fabric	Answer
A	
B	
C	

Question 5

A blanket's warmth is an important property to consider, but there are other properties that people desire when shopping for blankets, such as the color. Below is a list of properties that may or may not be useful in designing blankets. **Using the supporting information only**, select 4 other properties that could be incorporated in a blanket's design. Explain how and why each property would be useful.

Note: Some of the properties below may be great for determining the right material for your blanket, but they are not found in the Information above.

Answer Options:

A) Texture
B) Durability
C) Weight
D) Boiling Point
E) Melting Point
F) Conductivity
G) Flexibility
H) Color
I) Flammability
J) Reactivity with Oxygen
K) Absorbency (with water)

_____

_____

Question 6

A. Using data from these activities, write a CER (claim, evidence, reasoning) arguing which type of blanket fabric would be best to use if you want a blanket that will keep you the warmest.

B. Then, choose ONE other property that would create the ideal blanket for you, and explain why this would be the ideal blanket for you?

Your CER should include a claim stating which fabric you choose, At least 2 pieces of qualitative data and one piece of quantitative data. You should also support each piece of evidence with reasoning of why that evidence supports your claim.

_____

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