

ONPAR Paper Task: Cool Clothes

Scoring Rubric

Item	Description	0 points	1 point	2 points	3 points
1 - 2	<i>Identify a target user and name two important design constraints</i>	Does not name an appropriate user and does not choose important constraints.	Names an appropriate user AND identifies one important constraint. Or identifies 2 constraints but does not identify an appropriate user.	Names an appropriate user AND identifies two important constraints.	
3	<i>Create a model of the design that shows how thermal energy moves in the system</i>	Model contains 1 or none of the elements listed for 1 point	Model includes 2 of the 4 elements listed for full credit	Model includes 3 of the 4 elements listed for full credit	Model includes all 4 of these elements: - A person with a vest that has at least 4 pockets - arrows pointing from the surroundings to the pockets - arrows pointing from the person to the pockets - labels identifying arrows as thermal energy
4	<i>Annotate the table to find products that meet chosen criteria and constraints</i>	Annotation missing or incorrectly identifies D as a possible solution.	Annotation correctly identifies criteria by crossing off C, D, and E, but may miss some constraints.	Annotation correctly identifies options meeting all criteria and constraints: - Crosses off C, D and E that do not meet the temperature criteria. - Student annotates using stars, circles or another method items that meet their constraints	
5	<i>Explain and support your optimal solution with data.</i>	The design uses a process that does not meet the temperature criteria.	Student chooses C or E and writes a logical explanation to support their choice OR The design uses a process that meets the temperature criteria (A or B) AND includes 1 of the following elements shown in columns to the right.	The design uses a process that meets the temperature criteria (A or B) AND includes 2 of the 3 elements listed for full credit	The design uses a process that meets the temperature criteria (A or B) AND includes the following 3 elements: - Supports their choice by describing how the solution meets the criteria - Fits at least one of their constraints. - Student references data in their explanation
6	<i>Describe the chemistry of your optimal solution</i>	Selects 1 or zero descriptors that match the optimal solution	Selects 2 descriptors that match the optimal solution	Selects 3 descriptors that match the optimal solution: A, B, & E = <i>endo</i> , <i>absorbs</i> , <i>not a chem rxn</i> . C = <i>endo</i> , <i>absorbs</i> , <i>chem rxn</i> D = <i>exo</i> , <i>releases</i> , <i>chem rxn</i>	

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Some people who work in hot conditions, like road construction, warehouses, or outdoor athletes, wear “cooling vests” to help them avoid heat stress at work. A basic design is a vest with pockets inside to hold instant cooling packs. Create a prototype of a cooling vest that **will cool to a temperature between 50°F – 60°F**.

Engineers need to think about *who* will use their design solutions.

1. Identify one specific user for your vest: many correct answers
2. Circle the **two** most important constraints, or limitations, for your design. You may use the blank spaces to add your own ideas based on your ideal user:

Easy to wear

Low-cost

Easy to change cooling packs

Light weight

Sustainable materials

Can also be used with hot packs

Trendy

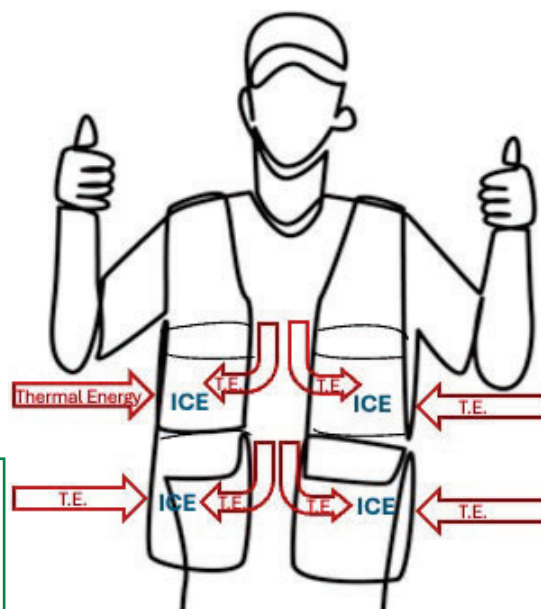
Easy to clean

many correct answers,
but must match the
needs of their target user

your idea #1 (optional)

your idea #2 (optional)

3. Use words and pictures to create a model of your user wearing a vest with at least four pockets for placing cold packs. Use arrows to show how thermal energy moves in the system.



Focus on SEPs: Designing Solutions

Look to see that student choices throughout the task align to the user they selected above. The constraints, model design, and tradeoffs should match the design criteria and be coherent for their chosen user

Focus on CCCs: Energy & Matter

Look to see that students accurately represent the flow of energy with the arrows on their model, and correctly check "endothermic" & "absorbs energy" on the next page (or "exothermic" & "releases" if they chose D)

Your class collaborated to research some substances for creating cold packs. Each experiment started at 70°F. The information is summarized in the table below:

	Starting Substances	Product	Price per pound	Ending Temperature	Mass per cold pack
A	Ammonium nitrate + water	Mixture	\$13.99	53°F	60g
B	Potassium chloride + water	Mixture	\$10.99	57°F	12 g
C	Sodium bicarbonate + citric acid	New substances	\$11.99	39°F	40 g
D	Iron + oxygen (with water)	New substances	\$13.25	120°F	65g
E	Sodium bicarbonate + water	Mixture	\$1.79	64°F	12g

4. **Annotate the table** using the criteria and constraints.

Criteria: cools to 50°F - 60°F

Cross off any options that do not fit the criteria

Constraint #1: _____
From the front page

Star any options that fit

Students should cross off C, D, E because they do not fit the criteria. Other annotations will vary, but should be logical to match their constraints

Constraint #2: _____
From the front page

Circle any options that fit

5. **Explain your Optimal Solution.** Support your explanation with data using some of the terms from the word bank.

better than	worse than	even though	trade-off
meets the criteria		fits/does not fit the constraint	

My design will use A or B. It is optimal because _____
A / B / C / D / E

Answers will vary, but student explanations should

- describe how their solution meets criteria
- fit at least one constraint
- reference data

6. **Describe** your optimal solution. Check all that apply:

☒ Endothermic

☐ Exothermic

☐ Releases energy (energy exits)

☒ Absorbs energy (energy enters)

☐ Chemical reaction

☒ **Not** a chemical reaction

This is the correct answer if a student chooses A, B or E above.
If C: endo, absorbs, chemical rxn
If D: exo, releases, chemical rxn