



# THE WARRIOR

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*New partnership  
will help military  
amputees increase  
physical capabilities  
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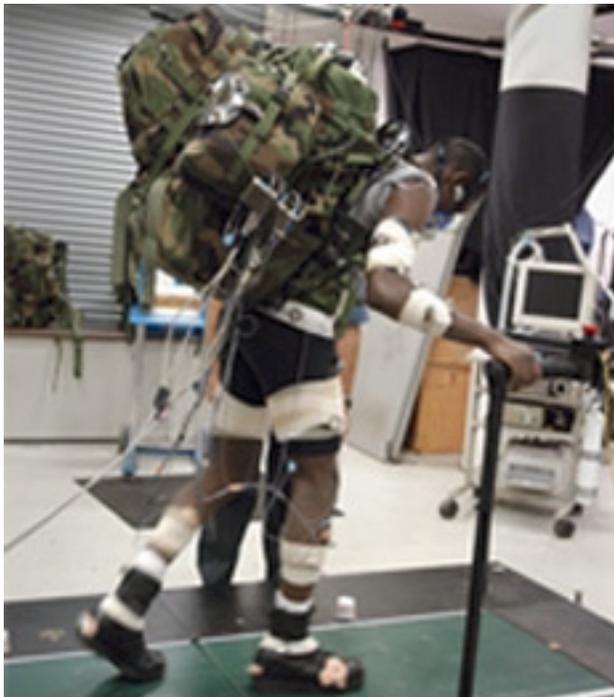
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Warrior/Underhill

Cover photo: A Soldier participates in a study in the Biomechanics Laboratory located at the U.S. Army Soldier Systems Center (SSC). Scientists at the Natick Soldier Center and the U.S. Army Research Institute of Environmental Medicine (USARIEM), which are SSC tenant organizations, are working with scientists at the Walter Reed Army Medical Center's Military Amputee Research Program (MARP) to improve the physical capabilities of military amputees. The Biomechanics Laboratory will play a key role in the research.



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# Prosthetic advances

*New partnership will improve physical capabilities of military amputees*

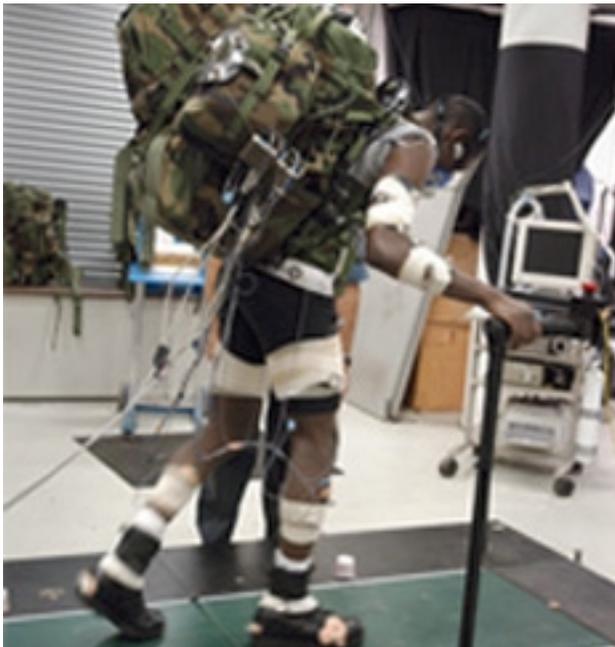
**By Jane Benson**  
Editor

The Natick Soldier Center (NSC), the U.S. Army Research Institute of Environmental Medicine (USARIEM), and the Walter Reed Army Medical Center's Military Amputee Research Program (MARP) have entered into a Memorandum of Understanding (MOU) to improve physical performance of military amputees.

"The goal of the program is to sponsor and conduct research that provides military amputees with the best technology and treatment possible, including rehabilitation," said Dr. John Obusek, Ergonomics Team Leader, NSC. "The objective is to help amputees achieve a level of physical capability that is compatible with continued service on active duty."

Under the MOU, NSC and USARIEM are collaboratively applying their knowledge in Soldier biomechanics and human performance to evaluate the capabilities of the amputee relative to the physical requirements demanded of all Soldiers, according to Obusek.

Scientists at the Biomechanics Lab will study the effect of various forces on human movement. Amputee Soldiers will be studied running, jumping, and using military packs.



**Under the agreement, the capabilities of amputees will be evaluated relative to the physical requirements demanded of all Soldiers. This Soldier participates in an unrelated study in NSC's Biomechanics Laboratory.**

***"Advances in both prosthetic technology and treatment that arise from this program will certainly have direct application to civilian amputees as well, as has been the case historically following other major conflicts," said Dr. John Obusek, Ergonomics Team Leader, NSC.***

NSC and USARIEM scientists are specialists in the field of biomechanics. NSC and USARIEM already work together in a joint program focusing on biomechanics studies and investigating ways to avoid injury and improve Soldier performance. NSC is considered the leading expert on the biomechanics of Soldier tasks, including military load carriage.

NSC's Biomechanics Laboratory is a unique facility housing equipment capable of three-dimensional analysis of human movement, measurement of external forces on the body, monitoring of muscle activity, and real-time mapping of pressure patterns associated with wear of clothing and equipment.

According to Obusek, NSC's Biomechanics Laboratory has state-of-the-art motion capture systems and a patented dual force plate treadmill necessary for this type of study.

Walter Reed's Military Amputee Training Center and its U.S. Army Amputee Patient Care Program opened a year ago in November. The center brings together all aspects of amputee patient care and addresses the medical and rehabilitation needs of Soldiers.

The work performed under the new MOU will benefit both Soldiers seeking to return to active duty as well as those who are not.

"All military amputees will benefit from the output of this program, whether it is their intent to remain on active duty or not," said Obusek. "Advances in both prosthetic technology and treatment that arise from this program will certainly have direct application to civilian amputees as well, as has been the case historically following other major conflicts."

# Downsized

*Compressed Meals offer top quality in a smaller package*

**By Curt Biberdorf**  
*Contributing Writer*

In a family of the MRE and MCW/LRP, the FSR and UGR-A, H&S and E, a new tightly-packaged ration developed at the Natick Soldier Center's Combat Feeding Directorate even has a shorter name.

Compressed Meals (CM) are the military's answer to a lighter, leaner individual ration with fresh-food quality for mechanized infantry units now and into the future. "It's filling a niche for the Future Combat Vehicle," said Joel McCassie, project officer. "It provides a compact food source carried inside a vehicle. It looks like it's on track to achieving our goals."

Placed next to a Meal, Ready-to-Eat (MRE), a Compressed Meal is noticeably smaller. It occupies up to one-third less volume and sheds nearly as much weight without sacrificing any of the accessories or calories found in an MRE.

Besides reduced packaging made possible by its less robust storage and handling requirements, weight and volume savings come from dehydrating the main entree using a combination of freeze-drying, air drying and dry blending, according to McCassie.

With freeze-drying, the food is prepared, frozen into a solid block and subjected to an extreme vacuum. Water is extracted through sublimation without damaging the food's characteristics.

Air drying is accomplished by forcing warm air over food in an oven before damage occurs, and dry blending mixes in foods that don't have any water to remove, such as rice and pasta.

What hasn't been compressed is the shelf life, which can extend well beyond the required minimum three years at 80 degrees F or six months at 100 degrees F, McCassie said, and the quality isn't sacrificed either.

Six lunch or dinner menus along with three breakfast menus were created by Combat Feeding Directorate food scientists and manufactured by industry partner Oregon Freeze Dry Inc. in Albany, Ore., leveraging components already found in the MRE and First Strike Ration (FSR), such as crackers and HooAH! bars.

After a full-scale prototype production, an evaluation team from Natick visited a Stryker Brigade at Fort Lewis, Wash., in May 2005 for a focus group to gather comments on the new meals. The Soldiers praised the taste and compactness of the meals while questioning the availability of hot water in the Stryker and time to prepare the ration in a tactical environment, according to McCassie.

Menu variety includes meat and vegetarian selections, as well as egg entrees that never were well regarded in the MRE.



Courtesy photo

**Developed by the Natick Soldier Center's Combat Feeding Directorate, Compressed Meals provide a fresh-food quality, compact food source for mechanized infantry units.**

***“It’s filling a niche for the Future Combat Vehicle,” said Joel McCassie, project officer. “It provides a compact food source carried inside a vehicle. It looks like it’s on track to achieving our goals.”***

“The eggs are awesome,” McCassie said. “The Soldiers were asking for more coffee and caffeinated beverages because they said that’s what kept them alive in Iraq. We’re looking at different options, such as cappuccino and cocoa.”

He added that they also liked the ease of preparation and the scrambled egg breakfast menus unavailable in the MRE.

Preparing an entrée takes seven steps: cutting open the pouch, breaking apart large clumps, adding 12 ounces of boiling water, stirring thoroughly, folding the pouch top to retain heat, waiting 10 minutes, and finally stirring and serving.

The Crew Sustainment for Future Combat Systems project involving several military organizations may solve the hot water shortage and also provide cool water for beverages using a lightweight thermoelectric device as an alternative to the heavier Mounted Water Ration Heater. Part of the vision is to collect potable water from combusted diesel fuel for Compressed Meals and beverages, McCassie said.

Dehydration technology for the meals is applicable to the continuous product improvement of the Meal, Cold Weather/Long Range Patrol (MCW/LRP) and in bulk compressed entrees packed in cans or pouches for Unitized Group Ration (UGR), Navy submarines or as stockpiled Homeland Defense emergency supplies, according to McCassie. Meals also could be made for home, office or outdoor enthusiasts with the same technology.



Courtesy photo

**Soldiers praised the taste and compactness of the meals during an evaluation at Fort Lewis, Wash.**

He said focus groups at Fort Lewis affirmed that the project was progressing well. The next step will be to assemble a larger quantity to conduct a field evaluation as early as next year. Initial fielding could begin late in 2007.

# Mission: Augmented Cognition

## Augmented cognition technology will help warfighters handle information overload

**By Jane Benson**  
Editor

Scientists at the Natick Soldier Center (NSC), the Defense Advanced Research Projects Agency (DARPA), and Honeywell Corporation are developing augmented cognition technology to solve the modern warfighter's new and overwhelming problem: information overload.

According to Henry Girolamo, the NSC DARPA agent for the Army's Augmented Cognition Program, "Augmented cognition is a very important program for the Army because it will increase survivability and effectiveness. The technology we are developing will ultimately help warfighters when they are faced with information overload, especially under stress, and will significantly improve mission performance."

Girolamo stated that DARPA and NSC are managing a research team led by Honeywell Laboratories that will foster the development of prototype systems that can detect and measure a combatant's cognitive state. The technology will assess the warfighter's cognitive state and then influence the way information is sent to the warfighter. This capability will be integrated into communications, computer, and intelligence systems currently under development in the U.S. Army's Future Force Warrior (FFW) program and other transformational warfighter systems.

Augmented cognition systems are expected to reduce warfighter stress by adjusting information management to the combatant based on his cognitive, physical, and emotional states as well as environmental conditions. The augmenting system features neuro-physiological sensors that assess the warfighter's focus of attention. The sensors measure and record brain activity as well as physical responses, such as heart rate.

Augmented cognition technology will help enhance the warfighter's decision-making capabilities by helping the warfighter determine which information available to him is most important and to help him decide the best course of action in varying environments.

The system will be designed to adapt to the individual's preferred learning style, such as whether the individual warfighter responds best to audio, visual, or tactile cues and instructions.

Augmented cognition technology may be designed to respond to the context in which the warfighter is operating. For example, if Soldiers are moving in a tactical line formation, the system could use this information along with brain signals to better determine the Soldier's state of attention and readiness for receiving information and in the modality most useful to him or her.

***According to Dr. James Sampson, Human Factors Engineering Consultant, "Augmented cognition technology is the result of advances in neuroscience, computer technology, and neuro-psychology. Much research and engineering still needs to be done, but there is considerable promise in this technology for the military." Furthermore, "in the future, it will be possible that this same technology will be used by the public at-large to manage information for a wide range of applications."***

The wireless system will primarily be a closed-loop system (i.e., internally self adaptive), which means the system will interpret the warfighter's cognitive, emotional, and physical state and then prioritize information through the system for the warfighter.

The system may also be designed to be an open-loop system. Open-loop systems funnel information from the operator to someplace or someone else. This type of system provides decision-making tools to a commander or a medic, for example, to assist them in directing or helping the warfighter during mission execution. Open-loop technology is easier to design and can also allow the Soldier to obtain information, for example, from remote sensors on equipment so he or she will be aware if the equipment is functioning properly.

Related studies performed by the U.S. Army Research Institute of Environmental Medicine (USARIEM) have shown that sleep deprivation, exertion, hunger, and exposure to temperature extremes can reduce the warfighter's ability to focus his attention and process information, which can lead to poor decision making. NSC has also been exploring how humans process information while on the move and how this influences decisions and mission performance.

According to Dr. James Sampson, Human Factors Engineering Consultant, "Augmented cognition technology is the result of advances in neuroscience, computer technology, and neuro-psychology. Much research and engineering still needs to be done, but there is considerable promise in this technology for the military." Furthermore, "in the future, it will be possible that this same technology will be used by the public at-large to manage information for a wide range of applications."

For example, drivers may have such systems to help them be much more situationally aware as they attempt to negotiate unfamiliar and complex networks of highways.

The goal is to incorporate the technology into Future Force Warrior by 2007.

***According to Henry Girolamo, the NSC DARPA agent for the Army's Augmented Cognition Program, "Augmented cognition is a very important program for the Army because it will increase survivability and effectiveness. The technology we are developing will ultimately help warfighters when they are faced with information overload, especially under stress, and will significantly improve mission performance."***



**Augmented Cognition Technology will be integrated into communications, computer, and intelligence systems currently under development in the U.S. Army's Future Force Warrior (FFW) program and other transformational warfighter systems.**

# Dried and tried

*Meal Cold Weather/Long Range Patrol menu revised to improve quality*

**By Curt Biberdorf**  
*Contributing Writer*

Nearly five years after the Meal, Cold Weather (MCW) and Food Packet, Long Range Patrol (LRP) merged into a single product, the subsequent 12 menus are now being revised.

Food technologists at the Natick Soldier Center's Combat Feeding Directorate held their first field evaluation in a decade of current and new menu items under consideration with Soldiers from the 51<sup>st</sup> Infantry in Darmstadt, Germany.

More than 80 Long Range Surveillance troops from Company E agreed to evaluate the LRP during training in Grafenwohr, Germany, in June 2005. They tried all of the items as part of a recently-funded program by the military to improve assault/special-purpose rations, said Vicki Loveridge, a senior food technologist on the Individual Combat Ration Team.

"We're trying to get some variety and take out products that are not doing well," Loveridge said. "We really didn't know the current relative acceptability of the menu items except for some of the components used in other rations."

She said many of the Soldiers were experienced and familiar with the rations, which brought a seasoned perspective, but it's taken a while for most troops to realize these types of rations are available. Orders increased during the second procurement of the Meal, Cold Weather/Long Range Patrol (MCW/LRP) from Soldiers and Marines serving in Afghanistan and Iraq.

"Anyone with a short-term, high-intensity mission where weight is critical or anyone who has a cold weather mission can order these for their use," Loveridge said. The MCW/LRP is procured as a single ration for ease of supply but each has a different purpose.

The Ration, Cold Weather was redesigned five years ago into the MCW. Contained in white packaging, the MCW is substituted for the Meal, Ready-to-Eat (MRE) that in the past leaked after freezing and thawing, and contributed to hypothermia and dehydration in cold weather climates.

Freeze-dried entrees joined other dried foods for 1,540 calories per package, issued at three packages per day to provide 4,620 calories of nutrition. Warfighters would have to consume four MREs to get an equivalent amount of calories. A full day's ration is 1.5 pounds lighter than the MRE.

The MCW differs from the LRP in that sodium and protein content are controlled to decrease the need for water.

***"Anyone with a short-term, high-intensity mission where weight is critical or anyone who has a cold weather mission can order these for their use," said Vicki Loveridge, a senior food technologist on the Individual Combat Ration Team.***



Courtesy photo

**This Soldier enjoys a taste test of new and existing meal offerings of Meal Cold Weather/Long Range Patrol during an evaluation in Darmstadt, Germany.**



**Food Packet, Long Range Patrol and Meal, Cold Weather were merged into a single product five years ago. The subsequent 12 menus are now being revised to improve Soldier satisfaction.** Courtesy photo

Loveridge said the merger of the two rations rescued the LRP from discontinuation. Wrapped in tan packaging, the LRP has only about a fifth of the production quantity of the MCW, but since they're mostly the same, the costs are low enough to remain in production.

LRP rations go back to the 1960s, where they were popular among troops serving in Vietnam. They're designed for troops during an initial assault, conducting special operations or on long-range reconnaissance patrol, and are without re-supply for up to 10 days. Issued at one package per day, the ration weighs a half pound less than the MRE and has enough extra calories to give them what is needed to survive.

Soldiers have said that at least once a day they feel full, filling up on the entree containing 500-600 calories.

"At a focus group at the end of evaluation, Soldiers were saying that the entree was too big," said Loveridge. "I'd never heard that before."

Unheated water can be poured into the pouch holding the entree, which can slow hydration, and consequently, the acceptability of rice entrees, she said. Heated or unheated, water requirements don't change with dried foods.

"There's a misconception that you need extra water for dehydrated rations," Loveridge said. "You need a given amount of water per day depending on activity and temperature. Whether some of that comes in the food or is consumed separately, the water requirement is the same."

The current or "control" menu for the evaluation was modified in 2003. Cereal bars, granola bars and peanut brittle were pulled because they didn't meet minimum shelf life requirement of 80 degrees F for three years. Cappuccino, starch jellies, Combos, peanut butter M&Ms, chocolate sports bar, raisin nut mix, chocolate-covered cookie and fig bar were added to the menus.

This year's test menu brought new entrees of freeze-dried chicken teriyaki, Mexican rice and chicken, sea-food chowder and chili macaroni with beef.

Trail mix, and peanut butter and banana walnut dessert bars were taken from the developmental First Strike Ration. Chocolate peanut butter, pizza cheese spread, smoked almonds, dried-fruit cranberries, brown sugar toaster pastry and granola were adopted from the MRE. Corn nuts, Walnettos, granola cereal with blueberries, cran-raspberry HooAH! bars and a freeze-dried ice cream sandwich are commercial items new to any individual ration.

A strawberry dairy shake, and fruit, lemon-lime and orange-flavored sports drinks are the remaining changes. All drink mixes in the MCW/LRP will be packed in the new zippered drink pouch for easier consumption.

At the focus group, Loveridge introduced candy-coated chocolate-covered coffee beans, honey gel pouches and energy fruit chews to gauge their level of interest. She said the coffee beans went fast and likely will be offered in the next evaluation.

As for the overall evaluation, Loveridge said the egg entrees and granola cereal were especially popular. Pending results from the evaluation and decisions from the Joint Operational Rations Forum, an updated list of menus is expected by next year.

**Editor's Note: The MCW/LRP can be ordered by military supply units through the Defense Supply Center-Philadelphia. The NSN is 8970-01-467-1753 for the MCW and 8970-01-467-1749 for the LRP.**

# Portable Chemical Sterilization

***New Portable Chemical Sterilizer provides sterilized surgical instruments anywhere, anytime***

***By Kenneth Kustin, Christopher Doona,  
Florence Feeherry, and David Baer  
Contributing Writers***

To meet the needs of Army medics in difficult situations, a team of expert research scientists have developed an apparatus to conveniently sterilize contaminated medical equipment in the absence of electricity.

Christopher Doona of the Research, Development and Engineering Command (RDECOM) Natick Soldier Center (NSC)-Combat Feeding Directorate in Natick, Mass., and Dave Baer of the U.S. Army Medical Research and Materiel Command (MRMC) Institute of Surgical Research (ISR) in Fort Sam Houston, Texas, assembled a team of research scientists and engineers including Florence Feeherry (NSC), former Senior Scientists Irwin Taub (NSC) and Al McManus (ISR), and professors Ken Kustin (Brandeis University), Maria Curtin (Stonehill College), and Satish Kandlikar (Rochester Institute of Technology).

The dedicated work of the NSC-ISR team of chemists, microbiologists, physiologists, and engineers in developing a Portable Chemical Sterilizer (PCS) has paid off. In the past year, they designed and tested three different prototype versions, submitted two patent applications to the U.S. Patent and Trademark Office (USPTO), and were selected for a 2005 Department of the Army Research and Development Achievement Award for their outstanding scientific and technical excellence.

U.S. Army medics treating wounds in far-forward field stations face many challenges. Power generators are often not only unavailable, but their use is undesirable due to the noise and heat they emit. With an ample supply of sterile medical equipment, the surgeon can patch wounds and save limbs and lives, even in such a remote location. However, once a doctor's supply of clean, germ-free surgical instruments is used up, all surgery must stop. Medics can use only sterile instruments. Contaminated instruments risk spreading life-threatening infections and are useless for saving lives even in the hands of the most skilled surgeon.

Medics need a lightweight, durable, and reusable apparatus that can easily be transported and used in remote locations to conveniently sterilize contaminated medical equipment in the absence of electricity. This device must be truly portable: it should weigh 15-20 pounds, and have the size and dimensions adapted for easy carrying. And the doctor doesn't want to wait for hours for fresh, sterile instruments; the sterilization process should be completed within 15-30 minutes.

***With this truly portable, rapid-acting field sterilizer at the ready, far-forward teams will be better able to maintain their supply of fresh, sterilized instruments, and the highly skilled Army doctors will be better prepared to react to medical emergencies and protect the health and lives of today's warfighter confronting a hostile combat environment.***

The team considered the commercially available sterilization methods such as steam-autoclaving, irradiating, or fumigating, and found that each method failed to fulfill the three requirements of sterilizing contaminated medical instruments: power-free, portable, and fast-acting. The team worked together and forged an innovative new solution: a novel chemical combination activated by small quantities of water in a specially designed lightweight plastic carry-case with sufficient capacity to sterilize an entire tray of used surgical instruments.

To operate the Portable Chemical Sterilizer (PCS), packets of safe chemical reagents are mixed in water to generate large amounts of germ-destroying chlorine dioxide. Chlorine dioxide is the lethal chemical agent that was used to decontaminate the Hart Senate Office Building and the Brentwood postal facility during the anthrax (bacterial spore-former *Bacillus anthracis*) attacks. In alternative treatments, chlorine dioxide could be used to decontaminate military field equipment, sanitize field-feeding equipment, or to eliminate harmful pathogens or spoilage organisms from the surfaces of fresh fruits and vegetables.

The NSC-ISR team also developed a special aluminum pressure vessel for use in more severe environments such as high altitudes or freezing temperatures, and the chemical combination is augmented with the familiar MRE heater to generate chlorine dioxide and high temperatures. Gas scrubbers remove any excess gas so the device can be safely operated indoors while ensuring operator safety.

The environment will not be harmed, because the chemical end-products are harmless salts that can be dissolved in water and easily disposed.

While developing the concept of a PCS prototype was truly an innovative scientific achievement, moving this invention from the laboratory bench-top to an actual field setting requires validation testing to ensure its effectiveness on killing common infectious bacteria, such as *Staphylococcus aureus*, *Escherichia coli*, *Listeria monocytogenes* and *Bacillus*-type spores.

Doona was eager to demonstrate that practical results could readily be achieved with the lightweight plastic carry-case.

"I was delighted that tests in the carry-case model with exposure times as short as 15 minutes left the microbiologist searching in vain for any signs of live bacteria," said Doona. "It was one time when a negative result was purely positive."

The Army and regulatory agencies demand nothing less than 100 percent killing of these harmful pathogenic bacteria, and the PCS satisfies this demand.

Currently further tests and evaluations of all aspects of this apparatus are underway to determine its optimal design for commercialization.

With this truly portable, rapid-acting field sterilizer at the ready, far-forward teams will be better able to maintain their supply of fresh, sterilized instruments, and the highly skilled Army doctors will be better prepared to react to medical emergencies and protect the health and lives of today's warfighter confronting a hostile combat environment.



**Step 1. Add reagents and water**



**Step 2. Generate ClO<sub>2</sub> (chlorine dioxide sterilant)**



**Step 3. Sterilization is complete--surgical instruments are ready for use.**

**Portable Chemical Sterilizer prototype for electricity-free sterilization is based on a modified Pelican case. It is easy-to-carry, affords lightweight transportation, and its compact design makes it stackable and easy to store. Sterilization of an entire tray of surgical instruments takes place in as little as 15 minutes by 1) combining dry reagents in an interior vessel, 2) closing the case while the chemical reaction occurs--expelling warmed gases and controllably generating chlorine dioxide sterilant, and 3) removing the chlorine dioxide to reveal bright and shiny, freshly sterilized instruments.**



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