Mix the Old with the New

Chefs in busy restaurants do a lot of different things. They check the inventory of ingredients used for each popular dish. They may supervise a kitchen staff, making sure their assistants are working well as a team. They may ensure that diners are not waiting too long for their food. They may taste the food before it leaves the kitchen. They do a lot and think about everything that goes into the food and experience their restaurant serves.

But they may not think about how they and their staff change the properties, structure and state of matter of food...but they are doing that with many dishes they serve.

Do you know how to change the properties, structure and state of matter of a substance? If you have made ice before, the answer is yes.

When you put an ice tray filled with water in a freezer, the temperature of the water in that ice tray lowers. The freezer makes a physical change of state to the water by turning it from a liquid to a solid.

When we cook, we change many things about the food we are preparing. These could be any number of properties: size, shape, mass, color or temperature. We can change the physical or chemical nature of the food. We can even change the state of matter the food is currently in to another state of matter.

STATES OF MATTER

There are four common states of matter we see almost every day: solid, liquid, gas and plasma. We can observe all four of them in a kitchen. A solid is as simple as an ice cube, or frozen water. Melt that ice cube, and you produce water, a liquid. Boil that water, and you produce steam, or water vapor. Believe it or not, plasma can be found in kitchens too. It's found in fluorescent lights, neon signs and plasma televisions. Other examples of plasma include the sun and lightning.

CHEMICAL CHANGES

A chemical change produces something from other materials and occurs on the molecular level. Some examples of chemical changes that take place in a kitchen are frying an egg, grilling fish or burning that egg or fish. When you smell onions sautéing in a pan or catch a whiff of the chicken roasting in the oven, the scent coming from the food is also a chemical reaction. Hopefully the scents you smell are only appetizing ones.

There are undesirable chemical changes that occur in the kitchen, too. If you smell the odor of rotting food, you've got a chemical change that needs some addressing! After you wash your metal pots and pans, make sure they dry properly. If they don't dry, the metal could react to the oxygen in the air and rust. Rust is evidence of another chemical change you don't want in your kitchen.

PHYSICAL CHANGES

Physical changes in the kitchen do not produce a new substance. Changes in state or phase are physical changes. For example, cutting vegetables, or even dissolving salt in a hot soup are examples of physical changes. In general, physical changes can be reversed using physical means. In the example of dissolving salt in a hot soup, evaporating the water naturally or applying heat to boil off the water can return the salt to its original state of matter.

When water is boiled, steam is created. That steam is water vapor, or the gas phase of water. That change from a liquid to a gas is an example of a physical change.

Let's say you're making a smoothie with strawberries, bananas, kale and orange juice. When you're cutting the fruits and vegetable into smaller pieces, it's a simple physical change. When you add them to the blender with the orange juice, the physical change that takes place during blending is more complex, and you now have a liquid. You can even go full-circle and turn your liquid smoothie into a solid by turning it into popsicles in the freezer.

A DIFFERENT KIND OF COOKING

There are some chefs in this world who reject or reinterpret traditional cooking techniques and cuisines. They push the boundary of food with new techniques to create entirely new combinations of flavor and texture. They take states of matter, physical changes, and chemical changes of food to a whole different level.

MOLECULAR GASTRONOMY

While some chefs may not actively think about the science behind the food they serve, others are using a modern style and science of cooking called molecular gastronomy. Molecular gastronomy is a scientific discipline that studies the physical and chemical processes that occur while cooking. Chefs who practice molecular gastronomy study and apply scientific principles when cooking and preparing their dishes. Their goal is to use their knowledge to make a tasty and unique dining experience.

They are concerned about *how* to make food delicious as well as *what* makes food delicious. To understand this, they have to consider many factors. Some of these factors include how their ingredients are grown, processed and transported. Where did the seeds used to grow the fruit come from? What kind of dirt and how much water did this vegetable receive? After harvest, was it ever put in a plastic bag? Was it sent by air, truck, and/or boat? What negative effects did transportation have on the produce?

Only after all that is determined do many molecular gastronomy chefs finally get to the cooking part of their craft. They want to understand how ingredients change with different cooking techniques. They want to know how all of a person’s senses, not just taste, play into the enjoyment or dislike of food. They go deeper and learn how the brain interprets the signals our senses send to ultimately determine the flavor tasted. They even experiment with how food is presented, who prepares it, and what mood the diner is in.

Many of these factors are what most chefs consider anyway, but what really differentiates molecular gastronomy chefs is in the preparation and presentation steps. And when it comes down to it, a molecular gastronomy chef is many things at once: a little physicist, a sprinkle of chemist, a dash of agriculturist, a spoonful of biologist, and a heap of psychologist to top it off. That’s a solid list of ingredients that hopefully turns into fun and tasty food.

PREPARATION

Molecular gastronomy chefs look at how ingredients are changed by different cooking methods. These cooking methods affect the eventual flavor and texture of food ingredients.

One method is called direct spherification. This is the process of turning a liquid into little caviar-like balls. Employing gelling solutions like sodium alginate, liquids like fruit and vegetable juices, and even milk, are dropped into calcium chloride and water to form a thin shell around the liquid. This jelly membrane creates the ball that pops with the liquid's intense flavor when eaten. The spheres are fragile and are usually served immediately.

Another method is a variation on the existing technique of using foams. Well-known foams include whipped cream and mousse, and also involve the use of air or another gas to create a lighter texture and feel when eaten. A variation on the foaming technique is to make foam that is made of mainly air. You can make foams out of almost anything. It can have so much air that it resembles big soap bubbles. This changes the texture into something lighter while allowing the flavor to remain. Steak bubbles, anyone?

A recipe that combines the foam and spherification techniques is Apple Caviar with Banana Foam served on a spoon. Combining apple juice in the form of spheres and banana foam whisked with heavy cream, milk, sugar and gelatin, this spoonful is not your typical dessert!

Some molecular gastronomy cooking methods involve temperature regulation. One method is called sous-vide and entails cooking food, like meats, in airtight plastic bags in a water bath. This ensures the entire piece of meat is cooked evenly and also retains its juices. Cooking times when using the sous-vide method don't have to, but can increase dramatically. Some chefs choose to tenderize tough meats like beef brisket with a sous-vide water bath that lasts for two to three days.

Although it may seem like weird science or just plain ridiculous, molecular gastronomy chefs want to explore new possibilities in the kitchen. Combining new and old cooking techniques, new equipment and technologies, and various sciences, these chefs may be inventing the food of the future. Whether they are successful or not, they are definitely making things fun.

GOOD FOOD IS GOOD FOOD

Whether a chef uses traditional or new cooking methods, the fundamentals of cooking are the same. Both traditional and molecular gastronomy chefs change the properties of the food they serve. They change the states of matter, properties and structure of food to, hopefully, serve a great meal.

Name: _______________________________________ Date: _________________________

1. What do chefs change with many dishes they serve?

- **A** the properties, structure, and state of matter of food
- **B** the bulbs in fluorescent lights and neon signs
- **C** the chemical composition of sodium alginate and calcium chloride
- **D** the amount of time they allow their pots and pans to dry after washing them

2. What does the passage describe?

- **A** The passage describes how to cook beef brisket and fried eggs.
- **B** The passage describes molecular gastronomy and changes in food.
- **C** The passage describes the average day of someone who works for a chef.
- **D** The passage describes what molecular gastronomy chefs like to eat.

3. A change in the state of matter of something is an example of a physical change. Solid, liquid, gas, and plasma are states of matter.

What can be concluded from this information?

- **A** Changing water from liquid to solid is an example of a physical change.
- **B** Changing water from liquid to solid is an example of a chemical change.
- **C** Frying an egg and grilling a fish are both examples of physical changes.
- **D** Changing water from liquid to gas is an example of both a physical change and a chemical change.

4. What kind of changes do chefs make to food?

- **A** Chefs make chemical changes only.
- **B** Chefs make physical changes only.
- **C** Chefs make chemical and physical changes.
- **D** Chefs never make any changes to food.

5. What is this passage mostly about?

- **A** the chemical change that occurs when dishes do not dry
- **B** the physical change that occurs when water is boiled
- **C** a cooking method called sous-vide
- **D** chefs, cooking, and changes in food

6. Read these sentences: “When you put an ice tray filled with water in a freezer, the temperature of the water in that ice tray lowers. The freezer makes a physical change of state to the water by turning it from a **liquid** to a solid.”

What does the word “**liquid**” mean above?

A a large amount of money
B a loud explosion that causes a lot of damage
C a fluid, or something that flows
D a gas, or something that floats in the air

7. Choose the answer that best completes the sentence below.

Chopping up a fish is an example of a physical change; _______, grilling a fish is an example of a chemical change.

A as a result
B for instance
C including
D on the other hand

8. What is molecular gastronomy?

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9. Describe a cooking method used by molecular gastronomy chefs.

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10. Is knowing about the physical and chemical changes of food important for a molecular gastronomy chef? Explain why or why not, using evidence from the passage.

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Teacher Guide & Answers

Passage Reading Level: Lexile 1050

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8. What is molecular gastronomy?

Suggested answer: Students may quote or paraphrase the definition given in the passage: "Molecular gastronomy is a scientific discipline that studies the physical and chemical processes that occur while cooking."

9. Describe a cooking method used by molecular gastronomy chefs.

Suggested answer: Answers may vary, as long as they come from the passage. For example, students may describe the use of foams. This cooking method involves using air or another gas to give a lighter texture to solid food, while allowing the flavor to remain.

10. Is knowing about the physical and chemical changes of food important for a molecular gastronomy chef? Explain why or why not, using evidence from the passage.

Suggested answer: Answers may vary, though all should acknowledge that it is important for a molecular gastronomy chef to know about the physical and chemical changes of food. Such chefs use their knowledge of these changes to make new types of food, such as airy foams and gelatinous spheres full of liquid.