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FOOD SCIENCE

1. **DESCRIPTION**: Teams will study the science behind milk products and experiment with ingredients and other variables to produce and analyze results to produce the best dairy products below.

   A TEAM OF UP TO: 2 **EYE PROTECTION**: **C** **IMPOUND**: Yes **APPROX. TIME**: 50 min.

2. **EVENT PARAMETERS**:
   a. **Students:** Each team must bring safety equipment, a writing implement, a calculator and the materials listed below needed to prepare ice cream and perform the protein/fat analysis and/or the curd analysis. Each team may bring 5 pages (both sides) containing information in any form from any source (sheet protectors are permitted). Teams must bring only plastic bags, cups, spoons, graduated cylinders, 500-600 mL plastic container with lids, cheesecloth, beakers, pH paper, paper towels, gloves, and a towel. Glove types must be of competitor's choice.
   b. **Supervisors:** will provide necessary milk products (any type of milk may be provided including powdered), salts, lemon juice, vinegar, ice (if necessary), thermometers, or other reagents or equipment to complete the experimental activities. The provided quantity of milk product will be between 125 and 150 ml depending on which Lab is being used. The amounts provided shall be the same for each student.
   c. **Safety Requirements:** Students must wear goggles, an apron or a lab coat, gloves (for ice cream Lab only), and have skin covered from the neck down to the wrist and toes. Long hair, shoulder length or longer, must be tied back. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in an unsafe manner will be disqualified from the event.

3. **THE COMPETITION**:
   a. **NOTEBOOK:** Prior to the tournament, teams must perform 3 or more experiments for each of the three Lab Tasks below. These experiments must be recorded on the **Food Science Experiment Form (**see on www.soinc.org) and must be placed together in the Notebook. Students are encouraged to do more than nine experiments, but only the first 3 for each task will be graded. Each experiment will constitute one entry in the Notebook and each must have only one Independent Variable. The Notebook will be impounded prior to the start of the tournament for grading.
   b. **LAB TASKS:** At the tournament, teams will use the provided food materials to perform the tasks below. At Regional teams will only perform one of the tasks. At State Tournaments students will be asked to complete one or two of the tasks. At Nationals, students will be asked to perform two or three.
      i. **Ice Cream Formation:** Teams will be provided the same amount of an unknown liquid milk product to prepare ice cream based on the provided materials and form the ice cream on a surface to obtain a height measurement by the Event Supervisor. Teams may use any amount of the provided ingredients. The ice cream formation must self-stand for 5 seconds before the measurement is taken. Students may hand shape the ice cream.
         1) Combine up to 125 mL of milk, cream or half and half with up to 15 mL of sugar and add up to 1.2 mL of vanilla if desired.
         2) Fill a 1-gallon Ziploc bag half-full with ice and add up to 90 mL of salt. Seal the bag and shake to mix the ice and salt.
         3) In a 1 pint sized Ziploc bag place the ice cream mixture and seal the bag.
         4) Place the smaller sealed bag in the large bag and mix and shake vigorously so that the ice cream mixture is cooled and mixed well.
         5) After about 5-10 minutes, the ice cream can be removed from the smaller plastic bag.
      ii. **Determine Curd Mass:** Teams will be provided the same amount of an unknown liquid milk product to prepare curds and determine the mass of curd formation, which will be compared to the Event Supervisor's mass of curd formation using the same materials and similar procedures.
         1) Measure 120 mL of milk in the beaker.
         2) The temperature of the milk should be close to room temperature.

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3) Add drops of vinegar or lemon juice to the milk and gently swirl (or stir) for 30 seconds, then allow the milk to sit for approximately 5 minutes.
4) Drain the mixture through cheesecloth fastened over the top of a beaker collecting the curds in the cheesecloth and let drain for 15 minutes.
5) Determine the mass of the curds.

iii. **Determine Milk Fat Mass from Cream:** Teams will be provided the same amount of cream to prepare butter and determine the mass of butter formation, which will be compared to the Event Supervisor's mass of butter formation using the same materials and similar procedures.
1) Transfer 150 mL of the heavy cream into a plastic 500-600 mL container.
2) The temperature of the cream should be approximately 13°C.
3) Cap the bottle carefully and shake until a distinct separation of butter particles occurs.
4) Drain off liquid portion and discard it.
5) Determine the mass of the butter.

c. **TEST TOPICS:** Teams will take a written exam that covers only dairy food science topics such as: the role of lipids, carbohydrates and proteins typically found in dairy foods; standard labeling regulations; basic organic reactions such as esterification, fat bonding; saturated and unsaturated fats; chemical structure of sugars, starches, fats, and proteins; essential fats, vitamins, proteins; how cooking changes dairy foods chemically; allergens in dairy foods; dairy food preservation; RDA (recommended daily allowance) of essential minerals and vitamins in dairy foods and the consequences of not having them; freezing point depression; non-dairy 'milk' products; lactose free milk; health benefits of dairy foods; low fat, fat free milk; lactose intolerance; emulsification; pasteurization; organic dairy products; casein and whey proteins; probiotics.

d. **SAMPLE TEST QUESTIONS**
i. What is the protein that is most common to cow's milk?
ii. Does table salt or rock salt produce a greater freezing point depression?
iii. What are the chemical compositions and nutritional values of 2% milk, skim milk, half-half, cream and whole milk?
iv. What are the chemical structures and names of the common fats in dairy products?
v. How does soy milk compare and contrast with cow's milk?

4. **SCORING**: High score wins. Final Score = Notebook Score + Lab Task(s) Score + Test Score - Penalties.
a. Notebook Score = Complete experiments receive up to 2 points each. Incomplete experiments receive fewer points (maximum 18 points).
b. Lab Tasks Score = Total of score(s) of required Lab(s)
i. Ice Cream Score = 0.1 pts for each mm (rounded off) of height (e.g., Team gets 125 mm x 0.1=12.5)
ii. Curd Mass and the Milk Fat Mass Scores = Team mass/Supervisor mass x 10 (e.g., Team get 2.4g Supervisor gets 2.5g = 0.96x10 = 9.6) (maximum 10 points each).
c. Test Score = Percentage correct/2 (maximum 50 points)
d. Penalties: Up to 10% of total possible score may be subtracted for failure to clean up as instructed.
e. Tie Breaker: Preselected questions on Test
f. Scoring Example: Notebook Score was 18, Ice Cream Score 12.5, Curd Mass Score was 9.6, Test Score was 90%, No Penalties. Final Score = 18 + 12.5 + 9.6 + 90/2 = 85.1

Recommended Resources: All reference and training resources including the **Chem/Phy Sci CD (CPCD)** are available on the Official Science Olympiad Store or Website at www.soinc.org or http://www.ift.org/Knowledge-Center/Learn-About-Food-Science/K12-Outreach/Food-Science-Experiments/Food-Chemistry-Experiments.aspx