CHAPTER GRAIN SAFETY

GRAIN SAFETY
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GRAIN SAFETY

Learning Objectives
After completing this station, participants should be able to:
1. Recognize the ways people can become trapped in grain.
2. Understand what can happen once a person is trapped in grain.
3. Identify how to prevent or avoid dangerous situations in grain storage, handling, and transportation.
4. Know how to respond to a grain entrapment emergency.

Safety Requirements
1. Supervise grain demonstrations/activities at all times so that participants are not allowed to play or become entrapped in grain.
2. Never use chemically treated grain in demonstrations/activities.
3. Avoid generating grain dust or keep participants away from grain dust.
4. Have participants use proper lifting techniques (bend knees and keep back straight) when they join in the grain entrapment activity.
5. Be alert about potential allergies to the materials used to fill the container (never use peanuts).

Age-Appropriateness
This lesson is appropriate for participants of all ages. However participants under fourteen should be taught to keep away from grain. They do not need to be taught the warning signs and precautions needed for working with grain that adults and teenagers would need. Younger children may not be familiar with some of the terms and concepts used in the discussion points. Discussion points on avoiding grain dangers are appropriate for all ages. When discussing response to emergencies with younger participants, stress getting help if someone is entrapped. Teenagers and adults should be able to handle the graphic nature of the causes of suffocation whereas 8-year-olds or younger should not have that level of realism. For older participants add the points about turning off equipment and turning on bin aeration fans.

The depth of content and the discussion needs to be tailored to the level of understanding of the group. Refer to the “Teaching Tips” and “Childhood Growth and Development” located in the Teaching Kids section of the manual.

Suggested Instructors
Elevator workers or managers, grain farmers, rural emergency rescue staff, high school science teachers, vocational agriculture instructors, seed/grain distributors, or older FFA members.

Activities/Demonstrations
Choose a Hands-On activity/demonstration listed below or create your own. Develop your discussion points around the Hands-On activity/Demonstration chosen. If time allows, you may choose more than one activity/demo as part of your safety presentation.

1. Breathing Activity – During this activity participants will experience the difficulty in breathing underneath grain by trying to blow out a candle through a tube filled with grain.

2. Grain Bin Model Demonstration – During this activity/demo the participants will view how quickly the action figure gets trapped in a model grain bin and have the opportunity to experiment with the grain bin model by placing the action figure in different locations of the model grain bin.

3. Collapsing Grain Demonstration – During this activity/demo the participants will observe how quickly a person can be trapped in grain when a grain bridge fails and have the opportunity to experiment by placing the action figure in different locations of the collapsing grain
bridge.

4. **Grain Entrapment Demonstration** – During this activity/demo the participants will experience how much force holds people in grain by attempting to pull a disk out of a tank filled with grain.

5. **Gravity Wagon Demonstration** – During this activity/demo the participants will observe the way grain flows in a model gravity wagon, identify safety decals, and experiment with the model gravity wagon by placing the action figure in different locations of the wagon.

6. ** Shrinking Balloon Activity** – During this activity the participants will experience how difficult it is to blow up a balloon that is submerged in grain. This demonstrates how difficult it is to breath in grain.

7. **Vortex Demonstration** – During this demonstration the participants will observe the shape of a vortex that flowing grain forms in a circular bin and how quickly a person can be completely submerged in flowing grain.

**Subject Outline**

**I. Introduction/Capture Their Attention**

A. Introduce yourself and tell about your role in working with grain.

B. Find out about your audience. Ask questions: How many of you help with harvesting grain? How many of you work with the harvested grain? Describe different types of grain (oats, soybeans, corn, etc.) Do any of you know or have heard of someone falling into the grain? What happened?

C. You may want to start with a personal story or a community experience.

**II. Discussion points**

A. Discuss how people can become entrapped in grain:

1. There are four common ways people are caught in grain and those four ways are: being immersed in by flowing grain either in transport vehicles or storage bins, collapse of horizontal bridge of crusted grain that buries a person inside a storage bin, avalanche of a vertical grain wall, and covered by filling or sliding grain.

2. Entrapment in flowing grain is the most common way people get caught in grain. Flowing grain acts like quicksand, it grabs and pulls at the body surfaces. It takes less than five seconds to be rendered helpless and less than 10 seconds to become totally submerged in flowing grain.

3. Collapse of a horizontal bridge is a catastrophic failure of the surface caused by the person standing upon it. The weight of the person on this surface can trigger its collapse. The person becomes trapped beneath the collapsing surface immediately. This hidden grain hazard can only be identified with knowledge about the filling and emptying history of the grain storage structure.

4. The avalanche of a vertical grain wall or being covered by filling or sliding grain is the least common type of grain entrapment. Large grain piles and automatic filling equipment contribute to these entrapments.

B. Dangers of being entrapped in grain

1. The force of grain holding the person can be extremely large. Once entrapped by the grain, the force exerted by the grain prevents people from being freed. Being easily pulled free of grain is impossible. The deeper a person is buried the larger this holding force becomes.

2. Grain is a free flowing material and that means it will fill any open space. Ones’ mouth and nose are two openings that grain will enter. Grain will enter these passageways and block them. This is a serious threat because it severely reduces our body’s ability to get oxygen. How long can you hold your breath? This can lead to
suffocation.

3. Grain pressure restricts your breathing when you are buried. The grain pressure that develops the force that holds people in the grain also produces pressure around your body. When you are buried, your chest and diaphragm are constricted and this can lead to suffocation because you are unable to expand them to pull in oxygen.

4. The grain mass restricts the movement of fresh air. If a person is buried below the surface of the grain then the air around the person becomes polluted after time. As a buried person uses oxygen and exhales carbon dioxide, the air around the person is depleted of oxygen. When the oxygen drops below 19.5 percent, our bodies start experience several side effects.

C. Avoiding grain dangers
   1. Never get into a grain bin, grain wagon, or grain truck.
   2. Apply safety stickers to wagons, truck, and bins to remind yourself and other family members of the dangers present.
   3. If you become entrapped, cover your mouth and nose with your hands to prevent grain from entering.

D. Responding to grain emergencies
   1. Turn off any equipment that is causing the grain to flow or move. This will stop the person from being pulled further beneath the grain.
   2. If you suspect or know someone has become entrapped, get professional help immediately. Professional help understands the dangers and will assure the safety of rescuers and the victim.
   3. Always assume the victim is alive. Turn on bin aeration fans, making certain dryer heat is not turned on. (This has attributed to saving several lives in grain bin rescues.).

Note: This section is for grain but it can be applied to other granular materials such as gravel, coal, salt, pellet feed, and others.
BREATHING ACTIVITY

Learning Objectives
After completing this activity, participants should be able to:
1. Understand how difficult it is to breathe when buried below the grain.
2. Recognize how a person can suffocate in grain.

Safety Requirements
1. Supervise grain demonstrations/activities at all times.
2. Never use chemically treated grains.
3. Avoid generating grain dust or keep participants away from grain dust.
4. Be alert about potential allergies to the materials used to fill the tube (never use peanuts).
5. Only the instructor should light the matches and/or candles. All matches or lighting devices should be in the instructors presence at all times.
6. Do not perform this activity around hay bales or any flammable surface. Have a fire extinguisher present at the session for emergencies.

Age-Appropriateness
This activity is appropriate for participants of all ages. For younger participants, use simplified explanations for talking about breathing. The depth of content and the discussion needs to be tailored to the level of understanding of the group. Refer to the “Teaching Tips” and “Childhood Growth and Development” located in the Teaching Kids section of the manual.

Suggested Instructors
Elevator workers or managers, grain farmers, rural emergency rescue staff, high school science teachers, vocational agriculture instructors, seed/grain distributors, or older FFA members.

Equipment/Supplies Needed
1. Several cardboard tubes such as paper towel tubes. You should have enough tubes for all participants to try or you must use as a demonstration. Cut these tubes to different lengths to provide different experiences.
2. Candles with holders
3. Granular materials (such as rice, unpopped popcorn, soybeans, shelled corn, or other dried beans) to fill cardboard tubes.
4. Two 3-inch (8 cm) squares of fine nylon mesh (such as window screen) for each cardboard tube.
5. Masking tape
6. Matches and a fire extinguisher

Subject Outline
Each participant can join in this activity or have one participant from each group demonstrate the difficulty of breathing beneath grain.

I. Introduction/Catch Their Attention
   A. Introduce yourself and tell your experiences working with grain.
   B. Start with a story or personal experience associated with the dangers of working with grain.
C.  Find out about your audience. Ask questions: How many of you help during grain harvest? How many of you work with the harvested grain? Do any of you know or have heard of someone falling into the grain? What happened to them?

II. Activity/Demonstration

A. Tape the nylon mesh to cover one end of the tube then fill the tube with the selected granular material. When filled, tape the other nylon mesh square to the open end of the tube. Make different tube lengths and fill with different grain (The participants could do this or it can be done ahead of time.)

B. Light the candle.

C. Place your mouth to one end of the filled tube and try to blow out the candle.

III. Discussion Points

A. Ask participants what did it feel like to blow through the tube and have them share that experience.

B. Explain what would happen if this was how you had to breath when buried below the grain.

C. Ask participants what would happen with longer or short sections of tubes with grain?

D. Explain to the participants that humans must have at least 19.5 percent oxygen in our air we breathe or specific side-affects occur and eventually death.

E. Discuss with the participants some safety precautions that can be taken with grain:
   1. Always stay out of grain.
   2. Never enter a grain bin, wagon, or truck.
   3. Never walk on stored grain.
   4. Never play in grain.
GRAIN BIN MODEL DEMONSTRATION

Learning Objectives
After watching this demonstration, participants should be able to:
1. Recognize how flowing grain moves in a bin.
2. Understand how a person is entrapped in flowing grain.
3. Understand the speed that a person is entrapped in flowing grain.

Safety Requirements
1. Supervise grain demonstrations/activities at all times.
2. Never use chemically treated grain.
3. Avoid generating grain dust or keep participants away from grain dust.

Age-Appropriateness
This activity is appropriate for participants of all ages. Emphasize seriousness of the activity for younger children who may view covering an action figure as fun.
The depth of content and the discussion needs to be tailored to the level of understanding of the group. Refer to the “Teaching Tips” and “Childhood Growth and Development” located in the Teaching Kids section of the manual.

Suggested Instructors
Elevator workers or managers, grain farmers, rural emergency rescue staff, high school science teachers, vocational agriculture instructors, seed/grain distributors, or older FFA members.

Equipment/Supplies Needed
1. Clear circular model bin.
2. A table to elevate the bin to make it visible for all participants.
3. Catch container underneath the model bin.
5. Grain to fill the model bin.

Subject Outline
I. Introduction/Catch their Attention
   A. Introduce yourself and tell your experiences with working with grain.
   B. Start with a story or personal experience associated with the dangers of working with grain.
   C. Find out about your audience. Ask questions: How many of you help during grain harvest? How many of you work with the harvested grain? Do any of you know or have heard of someone falling into the grain? What happened to them?

II. Activity/Demonstration
   A. Show participants the model bin filled with grain and allow them to see how the grain flows from the bin.
   B. Place the action figure in the center of the bin and open the sliding gate to allow grain to flow from the bottom pulling the action figure under the grain surface.
   C. Let participants experiment with placing the figure at different locations in the bin. They should watch and learn what happens to the action figure.
III. Discussion Points

A. Ask participants if they have watched grain flow from a bin. Ask them to describe what happens.

B. It only takes five seconds to become helpless in flowing grain. Within another 10 seconds a person can become completely submerged.

C. Discuss with the participants some safety precautions that can be taken with flowing grain:
   1. Always stay out of flowing grain.
   2. Never enter a grain bin while the unloading auger or suction tube is operating.
   3. Never walk on stored grain.
   4. Never play in grain bins.
COLLAPSING GRAIN

Learning Objectives
After watching this demonstration, participants should be able to:
1. Recognize how fast a grain bridge can collapse and bury a person.
2. Understand how a person is entrapped in collapsing grain.

Safety Requirements
1. Supervise grain demonstrations/activities at all times.
2. Never use chemically treated grain.
3. Avoid generating grain dust or keep participants away from grain dust.

Age-Appropriateness
This activity is appropriate for participants of all ages. Emphasize seriousness of the activity for younger children who may view covering an action figure as fun.

The depth of content and the discussion needs to be tailored to the level of understanding of the group. Refer to the “Teaching Tips” and “Childhood Growth and Development” located in the Teaching Kids section of the manual.

Suggested Instructors
Elevator workers or managers, grain farmers, rural emergency rescue staff, high school science teachers, vocational agriculture instructors, seed/grain distributors, or older FFA members.

Equipment/Supplies Needed
1. A 5-gallon (19 L) container (bucket or even model grain bin can be used)
2. A table to elevate the bin to make it visible for all participants
3. An inflated balloon that would fit the container
4. Pin or pointed long wire
5. Action figure for use in the demonstration
6. Grain to fill the container.

Subject Outline
I. Introduction/Catch Their Attention
   A. Introduce yourself and tell your experiences with working with grain.
   B. Start with a story or personal experience associated with the dangers of working with grain.
   C. Find out about your audience. Ask questions: how many of you help during grain harvest? How many of you work with the harvested grain? Do any of you know or have heard of someone falling into the grain? What happened?

II. Activity/Demonstration
   A. Place the inflated balloon in the bottom of the 5-gallon container and fill with grain to the top.
   B. Place the action figure in the center of the container.
   C. Use the long pointed wire or pin to pop the balloon and watch as the action figure disappears beneath the grain.
   D. Let participants experiment with placing the figure at different locations in the container. They should watch and learn what happens to the action figure.
III. Discussion Points

A. Ask participants if they have ever known a person that was trapped by a collapsing grain bridge. Ask them to describe what happened.

B. It only takes a second to become helpless below the grain when there is a catastrophic failure that occurs with a grain bridge.

C. Discuss with the participants some safety precautions that can be taken with grain:
   1. Never enter a grain bin.
   2. Never walk on stored grain.
   3. Never play in or on grain.
GRAIN ENTRAPMENT

Learning Objectives
After completing this activity, participants should be able to:
1. Understand the magnitude of the force that holds a person in grain.
2. Know how to help a person trapped in grain.

Safety Requirements
1. Supervise grain demonstrations/activities at all times.
2. Never use chemically treated grain.
3. Avoid generating grain dust or keep participants away from grain dust.
4. Have participants use proper lifting techniques (bend knees and keep back straight) when they join in the grain entrapment activity.

Age-Appropriateness
This activity is appropriate for participants of all ages. The depth of content and the discussion needs to be tailored to the level of understanding of the group. Refer to the “Teaching Tips” and “Childhood Growth and Development” located in the Teaching Kids section of the manual.

Suggested Instructors
Elevator workers or managers, grain farmers, rural emergency rescue staff, high school science teachers, vocational agriculture instructors, seed/grain distributors, or older FFA members.

Equipment/Supplies Needed
1. A container that could be a stock tank or 55-gallon (208 L) drum
2. Two 8’ (2.4 m) lengths of 5/8-inch (16 mm) ropes
3. Two 3/4-inch (2 cm) plywood disks (2" [5 cm] smaller than the diameter of the tank or drum identified in point 1 or maximum of 24" [61 cm] diameter). Attach the 5/8-inch (16 mm) rope to each plywood disk (knot one end and then run through hole in disk). Place one disk on bottom of container. The other disk and rope is used to show participants what is buried in the grain.
4. Grain to fill the container. Fill container to a depth of at least 30 inches (76 cm) with grain.
5. Tug-of-War with grain display can be used. (Optional see resource section for purchasing or renting information.)

Subject Outline
I. Introduction/Capture Their Attention
   A. Introduce yourself and tell your experiences with working with grain.
   B. Start with a story or personal experience associated with the dangers of working with grain.
   C. Find out about your audience. Ask questions: How many of you help during grain harvest? How many of you work with the harvested grain? Do any of you know or have heard of someone falling into the grain? What happened?

II. Activity/Demonstration
   A. Show participants the grain tank and rope and explain that the rope is attached to a disk of plywood (show them the second disk and rope as an example).
   B. Let the participants lift the rope and plywood disk prior to trying to pull out the submerged one in the grain. That way they will be able to see for themselves how light the
rope and plywood disk is without grain on it.

C. Invite participants to attempt to pull the disk out. Use proper lifting techniques (bent knees and straight back).

D. Dismantle the display at the end of each activity or at the end of the day – remove the grain to free the disc and show participants that the activity is not rigged.

III. Discussion Points

A. Ask participants if they have ever tried to pull a bucket free that was buried in grain. Ask them if it was difficult to do.

B. Discuss the difficulty of trying to free a person trapped in grain.

C. Discuss some procedures to use when helping a person trapped in grain. Remind participant that they should not endanger themselves while attempting to rescue someone else.
   1. Always assume trapped victim is alive.
   2. Call for help – tell emergency dispatcher what is wrong so they can send the right equipment.
   3. Never start an unloading auger or open a gravity flow gate – victim can be drawn into auger, become wedged in opening, or will be pulled deeper in the grain.
   4. Have someone help you turn on bin aeration fans (making certain the dryer heat is not turned on) to provide as much air as possible to the victim.
GRAVITY WAGON

Learning Objectives
After watching this demonstration, participants should be able to:
1. Recognize how flowing grain moves in a gravity wagon.
2. Understand how a person is entrapped in flowing grain.
3. Understand the speed that a person is entrapped in flowing grain.

Safety Requirements
1. Supervise grain demonstrations/activities at all times.
2. Never use chemically treated grain.
3. Avoid generating grain dust or keep participants away from grain dust.

Age-Appropriateness
This activity is appropriate for participants of all ages. Emphasize seriousness of the activity for younger children who may view covering an action figure as fun. The depth of content and the discussion needs to be tailored to the level of understanding of the group. Refer to the “Teaching Tips” and “Childhood Growth and Development” located in the Teaching Kids section of the manual.

Suggested Instructors
Elevator workers or managers, grain farmers, rural emergency rescue staff, high school science teachers, vocational agriculture instructors, seed/grain distributors, or older FFA members.

Equipment/Supplies Needed
1. A scale model of a gravity wagon (see resource section for purchasing and renting information)
2. A table to elevate the gravity wagon to make it visible for all participants
3. Catch container underneath the model gravity wagon
4. Grain to fill the model gravity wagon
5. Action figures for use in the demonstration

Subject Outline
I. Introduction/Capture Their Attention
   A. Introduce yourself and tell your experiences with working with grain.
   B. Start with a story or personal experience associated with the dangers of working with grain.
   C. Find out about your audience. Ask questions: How many of you help during grain harvest? How many of you work with the harvested grain? Do any of you know or have heard of someone falling into the grain? What happened? Ask participants how many of them know of someone who has been entrapped in a gravity grain wagon?
   D. Tell the participants about an actual grain entrapment victim who was about their age.

II. Activity/Demonstration
   A. Demonstrate the way grain will flow in a model gravity wagon.
   B. Place the action figure in the front center of the gravity wagon (above the sliding gate) and open the sliding gate to allow grain to flow from the bottom pulling the action figure under the grain surface.
   C. Let participants experiment with placing the figure at different locations in the wagon.
They should watch and learn what happens to the action figure.

III. Discussion Points

A. Ask participants if they have watched grain flow from a gravity wagon. Ask them to describe what happens and if there is any difference from a grain bin.

B. It only takes five seconds to become helpless in flowing grain. Within another 10 seconds a person can become completely submerged.

C. Show safety decals and explain where they are to be placed.

D. Discuss with the participants some safety precautions that can be taken with grain:
   1. Always stay out of flowing grain.
   2. Never walk on stored grain.
   3. Never play in gravity wagons.
SHRINKING BALLOON ACTIVITY

Learning Objectives
After completing this activity, participants should be able to:
1. Understand how difficult it is to breath when buried below the grain.
2. Recognize how much energy it takes to expand your lungs to breathe.

Safety Requirements
1. Supervise grain demonstrations/activities at all times.
2. Never use chemically treated grains.
3. Avoid generating grain dust or keep participants away from grain dust.
4. Be alert about potential allergies to the materials used to fill the container (never use peanuts).
5. Make certain that the balloons used in this demonstration do not become a choking hazard.

Age-Appropriateness
This activity is appropriate for participants of all ages. For younger participants, use simplified explanations for talking about breathing.
The depth of content and the discussion needs to be tailored to the level of understanding of the group.
Refer to the “Teaching Tips” and “Childhood Growth and Development” located in the Teaching Kids section of the manual.

Suggested Instructors
Elevator workers or managers, grain farmers, rural emergency rescue staff, high school science teachers, vocational agriculture instructors, seed/grain distributors, or older FFA members.

Equipment/Supplies Needed
1. A 5-gallon (19 L) container with rough inside walls
2. Balloon
3. Granular materials (such as rice, unpopped popcorn, soybeans, shelled corn, or other dried beans) to fill the container
4. Several plastic straws
5. Masking tape

Subject Outline
Each participant can join in this activity or have one participant from each group demonstrate the difficulty of breathing beneath grain.

I. Introduction/Capture Their Attention
   A. Introduce yourself and tell about your experiences working with grain.
   B. Start with a story or personal experience associated with the dangers of working with grain.
   C. Find out about your audience. Ask questions: How many of you help during grain harvest? How many of you work with the harvested grain? Do any of you know or have heard of someone falling into the grain? What happened to them?

II. Activity/Demonstration
   A. Tape the straws together and fasten one end of the straw inside the neck of the balloon. Place the inflated balloon with straw in the bottom of the 5-gallon container and fill with grain. Make sure you are holding air in the balloon by pinching the straw end closed.
B. Have the participants watch as 3/4 of the air from the balloon let out. Now let the participants try to re-inflate the balloon. The pressure in a large bin will be more than the smaller container and will change the success rate.

III. Discussion Points
   A. Ask participants what did it feel like to try and re-inflate the balloon buried below the grain? Have them share that experience.
   B. Explain what would happen if this was how you had to breath when buried below the grain.
   C. Ask participants if they noticed what happen when the air was let out of the balloon?
   D. Explain to the participants that humans must have at least 19.5 percent oxygen in the air we breathe or specific side-affects occur and eventually death.
   E. Discuss with the participants some safety precautions that can be taken with grain:
      1. Always stay out of grain.
      2. Never enter a grain bin, wagon, or truck.
      3. Never walk on stored grain.
      4. Never play in grain.
VORTEX DEMONSTRATION

Learning Objectives

After watching this demonstration, participants should be able to:
1. Recognize the funnel shape flowing grain makes in a circular bin.
2. Understand how a person is pulled down into the grain.

Safety Requirements

Supervise grain demonstrations/activities at all times.

Age-Appropriateness

This activity is appropriate for participants of all ages. The depth of content and the discussion needs to be tailored to the level of understanding of the group. Refer to the “Teaching Tips” and “Childhood Growth and Development” located in the Teaching Kids section of the manual.

Suggested Instructors

Elevator workers or managers, grain farmers, rural emergency rescue staff, high school science teachers, vocational agriculture instructors, seed/grain distributors, or older FFA members.

Equipment/Supplies Needed

1. Two 2-liter soda pop bottles
2. A tornado tube (see resource section for purchasing information) to join the two 2-liter soda pop bottles
3. Water to fill one 2-liter bottle

Subject Outline

I. Introductions/Catch Their Attention
   A. Introduce yourself and tell your experiences working with grain.
   B. Start with a story associated with dangers of working with grain.
   C. Find out about your audience. Ask questions: How many of you work/play around harvested grain? Does anyone know of someone who was entrapped in grain? What happened to that person?

II. Activity/Demonstration

   Demonstrate the shape of a vortex that flowing grain will form in a circular bin. Swirl the bottles in a circular motion and invert so the full bottle is on top.

III. Discussion Points

   A. Ask participants to explain what a vortex or “tornado” shape looks like.
   B. Ask participants if they have watched grain flow from a bin. Ask them to describe what happens.
   C. Explain to the participants that a similar shape occurs in flowing grain and it will cause a person to be pulled under the surface of the grain.
   D. It only takes five seconds to become helpless in flowing grain. Within another 10 seconds a person can become completely submerged.
   E. Discuss with the participants some safety precautions that can be taken with flowing grain:
      1. Always stay out of flowing grain.
      2. Never enter a grain bin while the unloading auger or suction tube is operating.
      3. Never walk on stored grain.
      4. Never play in grain bins.
Additional Notes:

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Chapter – Grain