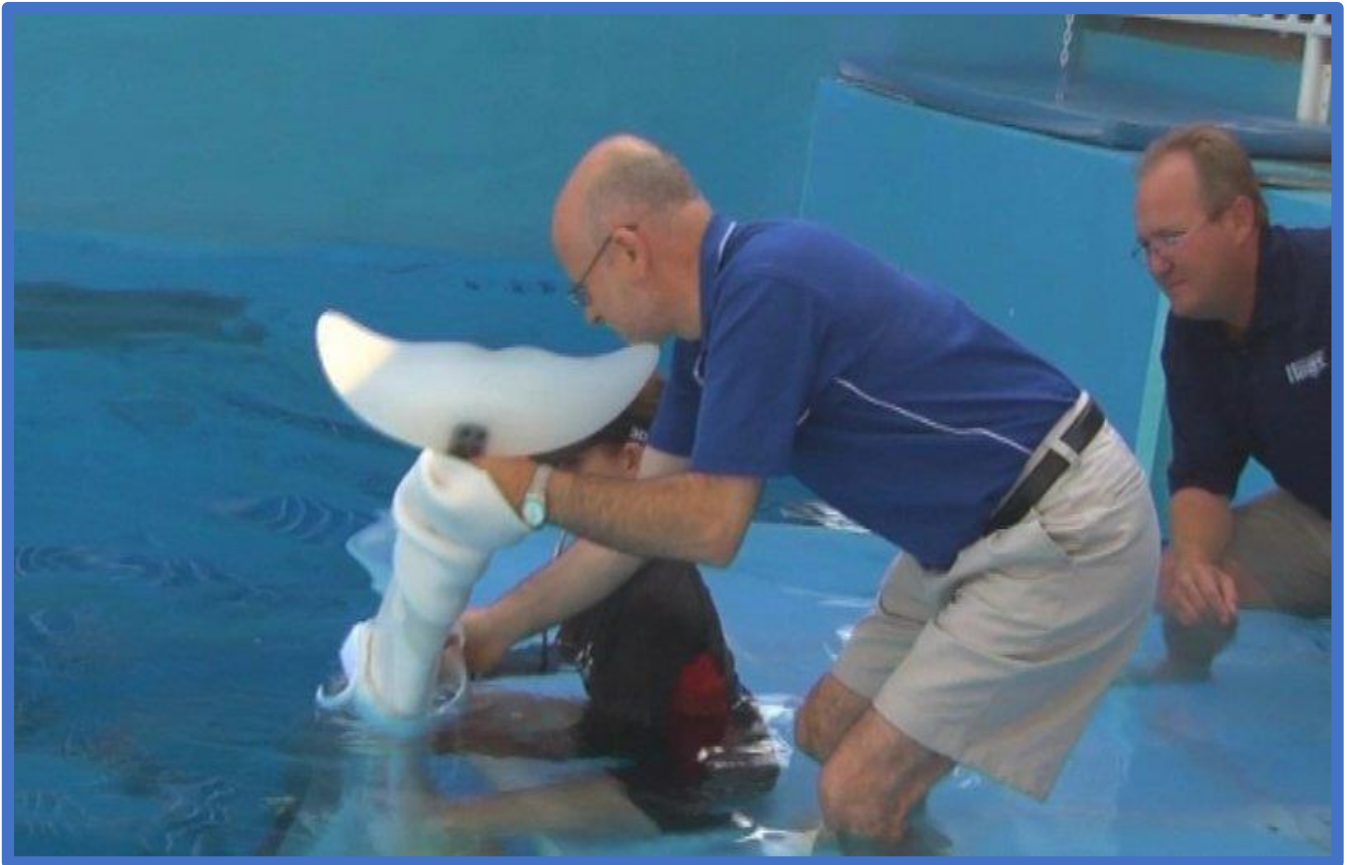


Dolphin Tail Design Project



Introduction – 30 minutes

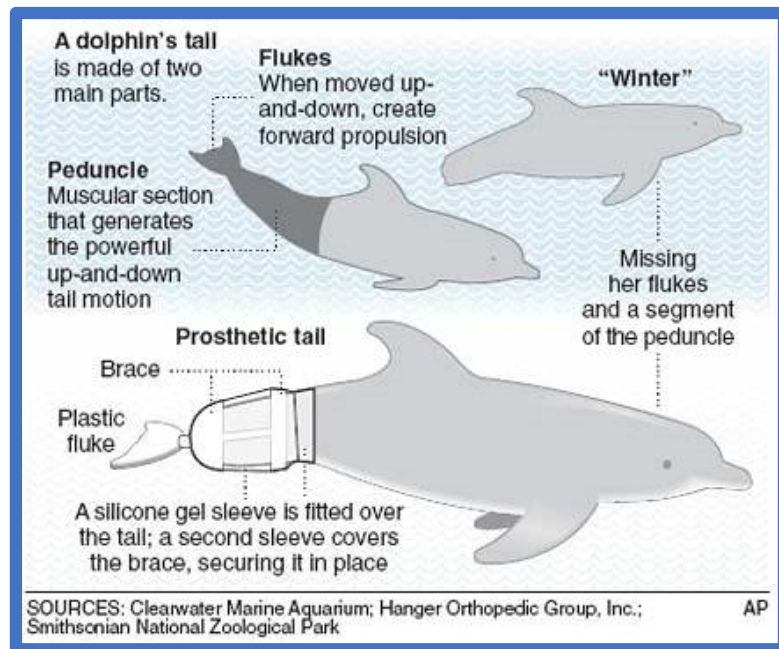
1. Have the girls read the Tale of the Tail: Winter's Story to themselves. **(Handout#1)**
2. Discuss how the design of the prosthetic tail was the product of creativity, ingenuity, teamwork, and the use of scientific methods.



Introduction – 30 minutes (continued)

- Go over the background on what it took to make Winter's prosthetic tail.

It took about 18 months for Kevin Carroll and Dan Strzempka, prosthetists at Hanger Clinic's, Sarasota, Florida to develop the new tail for Winter. It was a more difficult task than Carroll originally anticipated. "When we fit a socket on a person, we have one long, solid bone and the socket isn't moving in every direction. With a dolphin, it needs to move along with her full spine." One of the biggest challenges they faced was figuring out how to keep the tail on and how to propel a 400-pound dolphin 10 feet into the air.



The unique levels of Research & Development (R&D) necessary to fit a prosthetic tail on a dolphin have resulted in the development of a new gel material, WintersGel Prosthetic Liner, which is benefiting human patients.

Winter's new tail sticks to her body using suction, just like a surgical glove grips to a human hand. The gel sleeve created by Hanger Clinic and ALPS to help cling to Winter's tail without irritating her delicate skin has also proven beneficial to humans with limb loss. Carroll is currently researching new materials that will hold up in saltwater.

Introduction – 30 minutes (continued)

4. Now have the students at the table choose a **Project Manager**. Tell them that the job of the project manager is to **lead the team** in designing and constructing their own version of Winter's Tail. The Project Manager will also be responsible to **resolve disagreements** among team members and **make all final decisions with input from the team**. The Project Manager will also be responsible to make sure the team understands its **requirements and goals: lowest cost, lightest weight, best technical solution**, and **completed on schedule** (by the end of the day).
5. Then have the Project Manager go over the other 4 roles on the team and select who will be in which role.
 - The **Design Engineer** will be responsible to have everyone on the team draw a tail design; then discuss with the team all of the ideas and choose a design.
 - The **Material Engineer** will be responsible for reviewing the list of materials with the team and their associated cost. The material engineer will also lead the team in deciding which materials they will use to construct their dolphin tail.
 - The **Manufacturing Engineer** will be responsible for leading the team in making the tail after a design is agreed upon and materials have been selected.
 - If there are 5 students in the group, there will be 2 manufacturing engineers.
 - NOTE: All the students on the project team will participate in all phases of the activity.
6. Have the Project Manager work with her team to **name their team**.
7. Once the team roles are established pass out the instructions for **Designing & Building Winter's Tail to the Project Manager**.
8. Have the students follow the instructions to complete their dolphin tail. Note: Your job is to consult and make suggestion if the girls struggle. You can say, have you considered this, etc. Don't do it for them.

Instructions: Designing & Building Winter's Tail (60 minutes)

Team Name: _____

Description: Using the given materials, you and your teammates will create your own version of Winter's tail. Follow the step-by-step directions below and answer all the questions. **(Note: Minimizing and tracking costs of the project is optional.)**

| | GEL | Tail Fluke | Support |
|------------------|---|---|---|
| Materials | \$1 Plastic Wrap \$3 Nylon (pantyhose) \$4 Rubber gloves \$2 Latex gloves \$2 Plastic Freezer Bags \$3Bubble Wrap | \$4 Poster Board \$6 Aluminum Foil \$7Foam Board \$3 Wire \$3 Wire Clothes Hanger \$2 Plastic Clothes Hanger \$1 Plastic Wrap \$8 Insulated Sheet \$3 Plastic Trash Bags | \$1 Popsicle sticks \$.25 Tooth picks \$.10 Rubber bands \$2 Pipe Cleaners \$1 Tie Wrap \$1 Duck Tape – 12 inch strip \$0 Glue |

Instructions: Designing & Building Winter's Tail - cont

Step 1: The **Project Manager** will remind everyone of their **roles/tasks** and review the project **requirements and goals**.

- Roles/Tasks:
 - The **Design Engineer** will be responsible to have everyone on the team draw a tail design; then discuss with the team all of the ideas and choose a design.
 - The **Material Engineer** will be responsible for reviewing the list of materials with the team and their associated cost (optional). The material engineer will also lead the team in deciding which materials they will use to construct their dolphin tail.
 - The **Manufacturing Engineer** will be responsible for leading the team in making the tail after a design is agreed upon and materials have been selected.
 - If 5 girls are in the group, there will be 2 manufacturing engineers.
- Requirements and Goals:
 - Design and Build a Dolphin Tail with the **best technical performance (strength and comfort)** at the **lowest cost (optional)** and **lightest weight** possible. Also, the tail must be designed and built on **schedule** by the end of the day.
 - The dolphin tail will be **weighed** prior to testing.
 - Also prior to testing, a **peer review** will be performed by another table of students to rate how **comfortable** your tail is.
 - The **strength** of the tail will be measured by how much air you can move when you flap your tail at a candle.
 - Chose another team to present to and exchange for peer review

Step 2: The **Design Engineer** will have each girl on the team draw their idea for the team's dolphin tail design. Then, the Design Engineer will lead the discussion with the team to pick the best design.

Step 3: The **Material Engineer** will discuss with the team all of the materials that they can choose from to make their tail and decide after the discussion which materials they will use. The Material Engineer should lead the team in a discussion about what materials would be best and why.

Note: Mentors remind the girls that Winter's gel has to keep her comfortable and protect her skin. A heavy material may cause friction or trap heat. For your Tail Fluke and Support Materials, try to choose sturdy items to keep the tail functional.

Instructions: Designing & Building Winter's Tail - cont

Step 4: The Material Engineer will list the materials that are chosen and why the team chose that material on [Handout #2 – Dolphin Tail Materials](#).

Step 5: Winter was found on December 10. Choose the team member whose birthday is closest to that day. **Write their name here:** _____
This team member will play the part of Winter so design and build the tail around their forearm, which will represent Winter's tail stump.

Step 6: Winter's tail must be comfortable. Once your tail is complete, switch tails with another table. Explain your tail to the other team. Describe the design and materials and explain why you chose that design and those materials. Tell the students that this is called a **Peer Review**. Have each student at the other table try on the tail and rank it on a scale from 1 to 10 with 1 being least comfortable and 10 being most comfortable. Record their rankings on [Handout #3 – Dolphin Tail Peer Review](#).

Step 7: Have the students at the two tables give their tails back. Have them share their scores and give feedback on the scores. Record the average of the scores you received from the other table on [Handout #4 – Dolphin Tail Results](#).

Step 8: Part of the reason Winter wears her tail is to exercise her muscles for physical therapy. The tail has to be the perfect weight for Winter to be able to move it up and down efficiently. Weigh your tail and record it on [Handout #4 – Dolphin Tail Results](#).

- If your tail weighs 1-10 grams, you can fan it up and down once every second.
- If you tail weighs 11-20 grams, you can move it up and down once every 2 seconds.



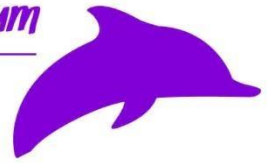
Instructions: Designing & Building Winter's Tail - cont

Step 9: Lastly, you will test the strength of your tail. The test will imitate the amount of water your tail design would move as Winter moves her tail up and down. In this case, the force of Winter's tail will be tested by seeing how much air it can move. You will measure the force by attempting to extinguish a candle.

- Place the tail onto Winter's tail stump, your teammates arm.
- Place a candle on a table or desk.
- Have the team member with the tail on their arm stand two feet from the candle.
- The mentor will light the candle.
- Use Winter's tail to fan the flame either once every second or once every two seconds depending on the answer in **Step 7**.
- If the movement of the tail extinguishes the flame, the mentor will move the candle back an additional foot and relight it.
- Continue moving and relighting the candle until the movement of the tail no longer has an effect on the flame.

On **Handout #4 – Dolphin Tail Results**, record how many feet away the candle was when it was last extinguished and how many feet away the candle was when it last flickered.





The Tale of the Tail: Winter's Story

On the calm waters of Mosquito Lagoon one December morning, a crab trap buoy floated gently on the surface of the water. Beneath the buoy was a long rope and tied to the long rope was a crab trap. To a young dolphin calf, it looked like the perfect toy! The dolphin calf grabbed the rope in her mouth and began to play. She swam back and forth, up and down, twisting and turning around the rope. Suddenly, she realized that the rope was tangled all around her body. It was twisted around her fin on top, called a dorsal fin. It was twisted around her fins on the side, called pectoral fins. Most tightly, it was twisted around her tail, called her flukes. The young dolphin needed help and quick!

Luckily, a fisherman nearby saw the crab trap buoy bouncing around on the top of the water. He directed his boat closer and saw the little dolphin all wrapped up in the line of the crab trap. He called for help and waited until a rescue team arrived. The rescue team saw that the little dolphin would need the care of an animal doctor, called a veterinarian, and took her all the way across the state of Florida to Clearwater Marine Aquarium.

Once she was at Clearwater Marine Aquarium, the young dolphin was named Winter after the season in which she was found. The veterinarian and the animal care team at the aquarium realized that Winter's tail was very damaged from her experience with the crab trap – so damaged that she would never be able to use it again. Sure enough, her tail slowly began to fall off until it was completely gone. Winter didn't let her missing tail slow her down. She learned how to swim side-to-side, like a fish swims. But the animal care team at CMA knew that swimming like that could hurt Winter's back – a dolphin's tail is supposed to move up and down! They worked with a group of people from Hanger Prosthetics, a company that makes artificial legs and arms for people. The doctors at Hanger designed a new tail for Winter. When Winter wears it, she can swim like a normal dolphin does – up and down!

Handout #2 – Dolphin Tail Materials

Team Name: _____

| Material | Why was material chosen? | Cost (Optional) |
|--------------------|---------------------------------|----------------------------|
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| Total Cost: | | |

Handout #3 – Peer Review

Team Name: _____

| Student | Rating: 1 – Least comfortable 10 – Most Comfortable | Notes |
|----------------------------|--|-------|
| | 1 2 3 4 5 6 7 8 9 10 | |
| | 1 2 3 4 5 6 7 8 9 10 | |
| | 1 2 3 4 5 6 7 8 9 10 | |
| | 1 2 3 4 5 6 7 8 9 10 | |
| | 1 2 3 4 5 6 7 8 9 10 | |
| Average Rating: | | |

Handout #4 – Dolphin Tail Results

Team Name: _____

Material Cost Total (Optional): _____

Peer Review – Average Comfort Rating: _____

Weight: _____

- If 1-10 grams, you can move your tail up and down once every second.
- If 11-20 grams, you can move your tail up and down once every 2 seconds.

Strength Test:

- How many feet away was the candle when it was last extinguished? _____
- How many feet away was the candle when it last flickered?
