Bionics in the ZOO
Workbook

Name: ____________________________
Class: ____________________________
Date: ____________________________
General Information:

Group-work:

• You are working in groups of 3 or 4.

Stations:

• Every station takes 15-25 minutes.

Working at the stations:

• Leave the stations as you found them.
These symbols help you:

- Write something.
- Look.
- Read.
- Experiment.
- Arrange something.
- Calculation
- Draw.
1a. What is BIONICS?

1. Read the information sheet: What is BIONICS?

2. Note two pioneers of bionics and what they did:

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1. You play cards.

Arrange the text sections on the Poster each with 2 pictures. At one picture you can see the natural model and at the other picture the technical application.

2. Answer wrong or right:
Mark the right answer with a cross.
If the answer should be wrong, notice the correct answer.

a. The gecko-adhere principle works with the special structure of the geckos legs.

   ( ) right
   ( ) wrong

b. The idea of the Velcro closure came up on a walk with the inventors dog.

   ( ) right
   ( ) wrong

c. The flow resistance is getting bigger when the wings spread apart.

   ( ) right
   ( ) wrong

d. The honey-comb is 5-squared.

   ( ) right
   ( ) wrong

e. All plants have a self-cleaning effect.

   ( ) right
   ( ) wrong
Experiment: Which form dive deepest?

Different wax forms should be tested about the ability for swimming.
The water filled cylinder is the racetrack.
The start position is marked.
The different forms are fixed on a hook, which are put on a string and after all could fall in the water.

1. Put the forms consecutively on the string.
2. The figures should not have an oscillation.
3. An other participant take a pen.
4. The participant, who held the string, let the string go and the figure falls into water.
5. The distance of dunking is measured with a ruler.
6. Every figure is used three times.
7. Result of the experiment should be: which form is dunking deepest and have so the lowest resistance?

Before you start the experiment, venture a guess which figure is the best:
Conduct the experiment and note the observation.

<table>
<thead>
<tr>
<th>Figure</th>
<th>1. distance</th>
<th>2. distance</th>
<th>3. distance</th>
<th>Positioning: Which form dove deepest?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Bowl</td>
<td></td>
<td></td>
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<tr>
<td>Egg-form</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Spindle, hook on top</td>
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<td></td>
<td></td>
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<tr>
<td>Spindle, hook not on top</td>
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<td></td>
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<tr>
<td>plate</td>
<td></td>
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</tbody>
</table>

**Interpretation**

Notice the properties of a good diving form.

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2b.: Swimming adaption

The streamline shape is the ideal drop form of an object, which has a low resistance adverse the circulate medium around the object.

1. Which animal is the fastest swimmer?

2. Which animal is the slowest swimmer?

3. Because of what fact do the different animals swim different fast?
   Tip: Look at the form of the animals.

4. Do you know a technical application for the bionics phenomena of the streamline shape?
   Notice!
1. Look at the Dolphins in the Aquaria.

2. Try to draw the form of the dolphins head.

3. Look at the picture of the tanker and compare it with the dolphins snout. Do you recognise likeness? If you do, notice.

4. Read the information text “Dolphin snout” and answer the following questions:
   a. What is the name of the dolphin snout?

   b. Describe, why the composition of the dolphin snout and the fore of the tanker are formed in that way.
1. Compare the animals in the aquaria with the figure underneath.

2. Did the animals in the aquaria have the same fin arrangement? If not, notice the differences.

   - **Dolphin**: 
   - **Manatee**: 
   - **Sea lion**: 
   - **Fish**: 

3. Dolphins, Manatees and sea lions are mammals as well as human. Because of this they have an other fin structure as fishes.

   Do you remember something when you look at the figure of the dolphin fin?

   Tip: Look at your left hand and draw it next to the dolphin fin.
1. Look at the information sheet and explain in one sentence what you understand at the term fin ray-effect.

2. Now you can look at the fin ray-effect at different models. There are three different models of fins.
   a. Look at the different fin models.
   b. Try to push against the model. (The finger imitates the water flow)
   c. What happen with the model?

3. The technical application of the fin ray-effect can be found in robotics. The adaptive form is used to lift sensitive objects like eggs or bulbs. In the grasping model you can try to lift the ping-pong with the help of the fin ray-effect models.
   a. Could you lift the ping-pong?
   b. If you were a technican, what would you do to improve the system?
1. Try to connect the animals with the right communication system.

<table>
<thead>
<tr>
<th>Fish</th>
<th>Ears</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dolphin</td>
<td>Lateral line organ</td>
</tr>
<tr>
<td>Manatee</td>
<td>Vibrissae</td>
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<tr>
<td>Sea lion</td>
<td>Sonar</td>
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</tbody>
</table>

2. Dolphin- communication

a.) Read the text of the dolphin snout.
b.) You could listen to the voices of the dolphins.

Explain the communication in one sentence.

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3. Application of the dolphin communication: Tsunami-pre-warning system

Look at the poster, it shows the tsunami pre-warning system. On the poster are numbers, where small texts belonging. Arrange the small texts to the right number and also note the number in your workbook.

Nummer:

\[\text{-------} \]

Pressure sensors register transformations on the sea ground. The sensors send these information with dolphin technology to buoys, which swim on the water surface.

\[\text{-------} \]

A satellite send the information from the buoys to the control centre.

\[\text{-------} \]

When two earth plates converge, so that one of it move under the other a earthquake is generated on the sea ground. This generates a movement of water, which leads to big waves. This big waves can be very huge and hit the land, so called tsunamis.

\[\text{-------} \]

The warning centre send out a tsunami warning for human and evacuate the affected areas.

\[\text{-------} \]

Buoys send signals from the sea ground and a GPS-signal to the satellite.
5.: skin adaption

1. Poster with different skin adaption's
   
a. Arrange the animal drawings to the right object on the poster.

   • Slime
   • Sand paper
   • Feather

b. How should the surface of the skin be, so that the animals are fast in the water?
   Venture your guess and delete the inapt property.

   oily    damp    slimy    sparkling    orange
   hairy   waterproof    smooth    rough    dry

   e. Read the information sheet “Bionics of shark-skin” and answer the questions:

   How is the shark-skin built-on?

   Which technical implication has the shark skin?
# Bionics- docket

<table>
<thead>
<tr>
<th>Station</th>
<th>Done?</th>
<th>School grade</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a. What is bionics?</td>
<td></td>
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<tr>
<td>1b. Bionics examples</td>
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<tr>
<td>2a. Streamline shape</td>
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<tr>
<td>2b. Swimming adaption</td>
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<tr>
<td>2c. Dolphin snout</td>
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<tr>
<td>3a. Fin is not fin</td>
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<tr>
<td>3b. Fin Ray - Effekt</td>
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<tr>
<td>4. Communication under water</td>
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<tr>
<td>5. Skin adaption</td>
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