German Young Physicists' Tournament

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1 Invent Yourself: Paper Boomerang

Make a returning boomerang from a sheet of paper by folding and/or cutting. Investigate how its motion depends on relevant parameters.

2 Air Muscle

Place a balloon inside a cylindrical net (as is sometimes used to wrap garlic) and inflate it. The net will expand and shorten. Investigate the properties of such a "muscle".

3 Lato Lato

Attach a ball to each end of a string and connect the center of the string to a pivot. When the pivot oscillates along the vertical direction, the balls start to collide and oscillate with increasing amplitude. Investigate the phenomenon.

4 Climbing Magnets

Attach a rod assembled from cylindrical neodymium magnets horizontally to a vertical ferromagnetic rod. Limit the motion of the magnets to the vertical direction. When the ferromagnetic rod is spun around its axis of symmetry, the magnetic rod begins to climb up. Explain this phenomenon and investigate how the rate of climbing depends on relevant parameters.

5 Dancing Slinky

Twist a slinky several times and keep its bottom fixed. After releasing the top, the slinky starts to "dance" – wave-like phenomenon can be observed from the side-view. Explain the phenomenon and investigate the parameters affecting the slinky's motion.

6 Dripping Faucet

A leaky faucet develops interesting dripping patterns, where the time between drops depends on the water flowrate. Investigate this phenomenon and study how it depends on relevant parameters.

7 Ruler Cannon

Two rulers are tightly held against each other. A round projectile (e.g. a plastic bottle cap or a ball) is inserted between them close to one of their ends. When extra force is exerted on the surface of the rulers, the projectile is ejected at a high speed. Investigate this effect and the parameters that affect ejection speed.

8 Levitating Fluid

When a container partially filled with liquid is oscillated vertically and air is injected at the bottom of the container, the fluid can "levitate". Investigate the phenomenon.

9 Magnetic Assist

Attach one or two magnets to a non-magnetic and non- conductive base such that they attract a magnet suspended from a string. Investigate how the motion of the moving magnet depends on relevant parameters.

10 Rayleigh–Bénard convection

Uniformly and gently heat the bottom of a container containing a suspension of powder in oil (e.g. mica powder in silicon oil), cell-like structures may form. Explain and investigate this phenomenon.

11 Spring Hysteresis

Connect two identical linear springs symmetrically to a mass in a "V" shape, and apply an adjustable force to the mass. When this force is varied, the resulting motion of the mass depends on the history of changes in the applied force under certain conditions. Investigate this phenomenon.

12 Sound Versus Fire

A small flame can be put out by sound. Investigate the parameters of the flame and characteristics of the sound that determine whether the flame will be extinguished.

13 Spaghetti Accelerator

When a piece of spaghetti is pushed into a bent tube, small debris of spaghetti may be ejected from the other end of the tube at a surprisingly high speed. Investigate this phenomenon.

14 Water Bottle Rocket

Pump air into a plastic water bottle partially filled with water. Under certain conditions, the bottle is launched and flies into the air. Investigate how the acceleration during lift-off depends on relevant parameters.

15 Wailing Bowl

When you strike the side of a metal bowl containing some water, you can hear a characteristic sound. The sound changes when the water in the bowl is moving. Explain and investigate the phenomenon.

16 Wirtz Pump

A Wirtz Pump is a hollow spiral, mounted vertically. It is arranged such that one end dips below water once per revolution, while the other end (at the center of the spiral) is connected to a vertical tube. When rotated, it can be used to pump water to a great height. Explain this phenomenon and investigate how relevant parameters affect the pumping height.

17 Quantum Fingerprint

Shine laser light onto an organic polymer (eg. styrofoam). The scattered light may have a higher or lower wavelength than the incident light. Explain the phenomenon and determine what can be concluded about the molecular structure of the material from the wavelength shift.