Particular

Concepts

Secondary to Adult

Sandbox Particulate Physics Activities

Engineers - Philosophers - Wizards

Intermediate - High School - Adult

Elsie Spry

Contents

Outline of Activities

William J. Spry, PhD.

Overview

The Particular Concepts manual and its accompanying online videos (particularconcepts.com) foster inductive reasoning at all ages. Introducing new, inductively derived principles, the activities extrapolate actual observations and known formulas. These "discoveries" were not deducted from generalized theories. Every activity is tied to ordinary materials, and each activity progressively and inductively takes you from one observable event to the next.

A particulate agglomerate is made up of incompressible particles, which interact only by friction. A particulate becomes a simple machine when piled against a vertical surface: the vertical force of gravity on the particles of the agglomerate is transmitted, by a general wedging action among the particles, to become a combined horizontal force.

William Rankine quantified the Passive Particulate Force, The result is a unique "angle-of-repose". Civil engineers throughout the world use Rankine's formulas to build retaining walls to stabilize the passive force of these materials. The Spry patents extrapolate and apply Rankine's discovery of this internal friction interaction. The "engine", "valve", and "retaining wall" concepts use Rankine's observations to produce these predictable applications. For the bulk of this manual, "Spry" refers to these patented principles: inductive extrapolations of Rankine's well-reasoned revelations. "Particular" is a new term, referring to the properties – or the application of the properties – of Rankine-like particulates.

Particular Concepts stems from a simple *inductive* query: What does an ordinary pile of dry sand reveal through reasonable thought, observation, and manipulation?

Elementary Activities (Sandboxers to Explorers): **Activities 1, 2 and 4** are core to all the other activities (Activity 3 is a miniature gold version of Activity 1). They demonstrate the uniformity of the motive ("Sand Train") and retentive ("Holey Towers") Forces, and are the first introductions to these new physics applications. *It is important to note that both the motive and retentive Force develop uniformly with the depth and mass of the uniform particulate*. **Activity 5** shows how a particulate Force can be precisely directed. **Activity 6** is an up scaling of activities 1, 4, and 5, for older students.

Secondary Activities (Engineers, Philosophers, and Wizards): **Activities 7 through 11** progressively introduce traditional physics principles: coefficient of friction, angle-of-repose, density, the Rankine Passive Force, the Rankine Active Force, center-of-gravity, turning groove, inclined plane, etc. Activity 12 is a rather spectacular application of **Activity 2** as a retaining wall. **Activity 13** is the combination of the traditional principles with the patented principles, culminating in a compound machine that can, for example, move and erect large granite obelisks. **Activity 14** is an opportunity to discuss the nature of discovery, through suggested readings, essays, and journal entries. For further study, a "**Suggested Study List: A Short Time-Line of Inductive Scientists**" is also included at the end of the Secondary - Adult Manual.

Activity 7: The Friction Coefficient

"Sliding Box" 7th-12th

The friction coefficient is a basic and important measurement in physics, and inter-particulate friction is the basis of forming the angle-of-repose in a particulate "pile".

Everyone has at least an intuitive knowledge of what friction does in our every-day world. Unfortunately, it is often presented as a static table of figures. This exercise concretely, actively and *inductively* illustrates what must be overcome in order for **any** object to move.

Activity 7.1: Friction Coefficient

"Ramp Force" 7th-12th

In addition to the friction coefficient, other factors must be overcome to move an object up an inclined plane, or ramp. Again, these are often presented as math-only calculations. This endeavor concretely, actively, and *inductively* illustrates the component parts as a whole which must be overcome.

Activity 8: "Particular" Flow

"Angle-of Repose" 7th-12th

This activity measures the angle-of-repose of different particulates, which is simply an indicator of the internal friction between the particles of each material. By measuring the "flow" of the particulates, Calculators are measuring an important aspect of the motive potential of the material. Both components determine whether the particulate is a good candidate for either Spry* motion, or for Spry** retention:

- The lower the angle-of-repose, the more flow, and the greater the particulate Force per unit of vertical cross section.
- The higher the angle of repose, and the less flow, the easier it is to retain the pile.

Activity 8.1: "Particular" Flow

"Spry Valve Applied" 7th-12th

This direct application of the Spry Valve* incorporates the concept as a working Shear Cell. Scaled up or down, this activity can accommodate any Rankine Particulate, or particulate combinations. Student Engineers will be exasperatingly impressed how easy it is to determine the angle-of-repose with this application of the Spry Valve* in contrast to activity 7.0. Adult engineers having to do this in their profession will also appreciate its utility, as it has not been introduced before!

Activity 9: "Particular" Density (Uniform and Composite)

“Density” 7th-12th

This activity introduces the final component needed to quantify the particulate forces inherent within a particulate pile. With the angle-of-repose, and the density or unit mass, all the particulate forces of a particulate pile can be calculated in the following activity.

Activity 10: Applied Rankine Forces
"Rankine Unchained" 7th-12th

This activity instructs the student in using independently published density and angle-of-repose charts. This provides for the determination of the motive and retentive forces of various particulates that meet Rankine's conditions. These tables are used by Civil Engineers to determine the Rankine Passive Force to construct retaining walls that stabilize soil. This activity also calculates the Rankine Active Force of the particulate such as dry sand, whose particles are held together solely by internal friction. Both calculations are used for the patented Spry applications of both forces.

Activity 11: Applied Rankine Forces
"'Particular' Tower" 7th-12th

Engineers compare traditional retaining wall construction to variations on the Spry Retaining Wall*. A rather explosive demonstration, it continues the concept introduced in Activity 2 (Elementary Manual) with the "Holey Towers". The less material used for the retaining wall, and the more the retentive force (and weight) of a particulate are incorporated in the configured Spry Valve "holes" of a wall, the stronger the wall is.

Activity 12: Center of Gravity Plus!
"In the Groove" 7th-12th

Through model construction of a modified "Holey Tower" (Activity 2), students determine and take advantage of an object's **center of gravity**, and combine that principle with a steep **incline plane**, a **turning groove,** and the properties of particulates to erect several objects (including an obelisk) into a vertical position. This is an important part of the culminating compound machine that incorporates the Rankine Active and Retentive Forces to produce controlled rotation as the incline of the particulate surface is altered, using the Spry valve as the control.

Activity 13: Inductive and Deductive Thought
"Science Discovery?" 11th-Adult

Discovery can be defined in several ways:

Scientific discovery happens through the use of inductive reason, within a specific definition of reality. Scientific reality is defined as an event or object that has been observed at
separate times, separate locations in space, and by separate, independent observers. Inductive reason starts with this set of recognized events, and uses existing mathematical or physical principles to hypothesize an extended reality. An essential part of inductive reason is extrapolating a further conclusion. This extended conclusion -- if repeatable at independent time/space/location/observer -- becomes a principle in itself.

Deductive reason is now used to apply the new "principles", again within the repeatable at independent time/space/location/observer set of recognized events. This deductive reasoning further tests the new "principle". If the new "principle" is achieved, the process is stopped, and the new "principles" can then become theory; but if the new "principle" is achieved by the failure of an expected deductive result, the process must be repeated again from inductive to deductive.

This final activity opens discussion to compare the two integral arms of "scientific" reasoning: inductive and deductive. The discussion can go wherever it will lead, but one discussion may be how our view of science may be truncated if just one line of reasoning is recognized as "science", and not the other; and what those consequences can be. Bruno, Da Vinci, Darwin, and others have all been affected by such consequences, and a list of readings covering their discoveries and biographies are included in the final pages of the Particular concepts manual.

Scope of Activity 14: "Particular" Compound Machine
"Ancient Mystery"

This activity combines the "Particular" Motive Force with an inclined plane, producing a compound machine that elevates an obelisk prior to rotating it to its final vertical position (as covered in Activity 10). A compound machine consists of two or more simple machines put together. This activity shows how an object can be directed with great precision, through the actual flow of a particulate when combined with other simple machine.

This culminating activity requires full knowledge of all the preceding activities, as well as the ability to quantify the force needed to move an object of mass -- such as a granite obelisk -- up an inclined plane, then rotating it to its final position.

"SECRET" NOTE:

To raise the obelisk, participants must figure out the final part of the riddle inductively: the taper of the obelisk, in combination with the angle of the inclined plane, is a necessary part of presenting a perpendicular surface to the" Particular" Motive Force. (The importance of the taper -- and the taper similarities shared between all known large ancient obelisks, and how they relate to the angle-of-repose for particular sand --is outlined in ERIC Article #: ED438175.)

Scope of the Suggested Study List
"A Short Inductive Timeline"

For further independent study, this is a short listing of inductive scientists throughout human recorded history. Humans are first and foremost observers: it is a gift we often squander for what the "consensus" dictates.